Umatilla/Willow Subbasin Plan Appendices

Table of Contents

Appendix A - Wildlife Species in the Umatilla/Willow Subbasin

Wildlife species occurring in the Umatilla/Willow subbasin (generated using ICBEMP species range maps, the IBIS database, and verified by local biologists).

Common Name	Scientific Name
Amphibians	
bullfrog	*Rana catesbeiana*
Columbia spotted frog	*Rana luteiventris*
Great Basin spadefoot	*Spea intermontana*
long-toed salamander	*Ambystoma macrodactylum*
northern leopard frog	*Rana pipiens*
pacific tree frog	*Pseudacris regilla*
tailed frog	*Ascaphus truei*
tiger salamander	*Ambystoma tigrinum*
western toad	*Bufo boreas*
Woodhouse's toad	*Bufo woodhousii*
Birds[1]	
American Avocet	*Recurvirostra americana*
American Bittern	*Botaurus lentiginosus*
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Dipper	*Cinclus mexicanus*
American Goldfinch	*Carduelis tristis*
American Kestrel	*Falco sparverius*
American Pipit	*Anthus rubescens*
American Golden-plover[3]	*Pluvialis dominica*
American Redstart[2]	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
American Tree Sparrow	*Spizella arborea*
American White Pelican	*Pelecanus erythrorhynchos*
American Widgeon	*Anas americana*
Ash-throated Flycatcher [2]	*Myiarchus cinerascens*
Baird's Sandpiper	*Calidris bairdii*
Bald Eagle	*Haliaeetus leucocephalus*
Band-tailed Pigeon[3]	*Patagioenas fasciata*
Bank Swallow	*Riparia riparia*
Barn Owl	*Tyto alba*
Barn Swallow	*Hirundo rustica*
Barred Owl[2]	*Strix varia*
Barrow's Goldeneye	*Bucephala islandica*
Belted Kingfisher	*Ceryle alcyon*
Bewick's Wren	*Thryomanes bewickii*
Black Scoter[3]	*Melanitta nigra*
Black Swift[2]	*Cypseloides niger*
Black Tern	*Chlidonias niger*
Black-and-white Warbler[3]	*Mniotilta varia*

Black-backed Woodpecker	*Picoides arcticus*
Black-bellied Plover	*Pluvialis squatarola*
Black-billed Magpie	*Pica pica*
Black-capped Chickadee	*Parus atricapillus*
Black-chinned Hummingbird	*Archilochus alexandri*
Black-crowned Night Heron	*Nycticorax nycticorax*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Black-necked Stilt	*Himantopus mexicanus*
Black-throated Gray Warbler[2]	*Dendroica nigrescens*
Black-throated Sparrow	*Amphispiza bilineata*
Blue Grouse	*Dendragapus obscurus*
Blue Jay [2]	*Cyanocitta cristata*
Blue-winged Teal	*Anas discors*
Bohemian Waxwing	*Bombycilla garrulous*
Bonaparte's Gull	*Larus philadelphia*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brewer's Sparrow	*Spizella breweri*
Broad-tailed Hummingbird [2]	*Selasphorus platycercus*
Brown Creeper	*Certhia americana*
Brown-headed Cowbird	*Molothrus ater*
Bufflehead	*Bucephala albeola*
Bullock’s Oriole	*Icterus bullockii*
Burrowing Owl	*Athene cunicularia*
Bushtit	*Psaltriparus minimus*
California Gull	*Larus californicus*
California Quail	*Callipepla californica*
Calliope Hummingbird	*Stellula calliope*
Canada Goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Canyon Wren	*Catherpes mexicanus*
Caspian Tern	*Sterna caspia*
Cassin’s Finch	*Carpodacus cassinii*
Cassin's Vireo	*Vireo cassinii*
Cattle Egret[2]	*Bubulcus ibis*
Cedar Waxwing	*Bombycilla cedrorum*
Chestnut-backed Chickadee	*Parus rufescens*
Chipping Sparrow	*Spizella passerine*
Chukar	*Alectoris chukar*
Cinnamon Teal	*Anas cyanoptera*
Clark's Grebe[2]	*Aechmophorus clarkii*
Clark's Nutcracker	*Nucifraga columbiana*
Cliff Swallow	*Hirundo pyrrhonota*
Common Goldeneye	*Bucephala clangula*
Common Loon	*Gavia immer*
Common Merganser	*Mergus merganser*
Common Nighthawk	*Chordeiles minor*
Common Poorwill	*Phalaenoptilus nuttallii*
Common Raven	*Corvus corax*
Common Redpoll	*Carduelis flammea*
Common Tern	*Sterna hirundo*

Common Yellowthroat [3]	*Geothlypis trichas*
Cooper's Hawk	*Accipiter cooperii*
Cordilleran Flycatcher	*Empidonax occidentalis*
Dark-eyed Junco	*Junco hyemalis*
Double-crested Cormorant	*Phalacrocorax auritus*
Downy Woodpecker	*Picoides pubescens*
Dunlin	*Calidris alpine*
Dusky Flycatcher	*Empidonax oberholseri*
Eared Grebe	*Podiceps nigricollis*
Eastern Kingbird	*Tyrannus tyrannus*
Eurasian Widgeon	*Anas penelope*
European Starling	*Sturnus vulgaris*
Evening Grosbeak	*Coccothraustes vespertinus*
Ferruginous Hawk	*Buteo regalis*
Flammulated Owl	*Otus flammeolus*
Forster's Tern	*Sterna forsteri*
Fox Sparrow	*Passerella iliaca*
Franklin's Gull	*Larus pipixcan*
Gadwall	*Anas strepera*
Glaucous Gull[2]	*Larus hyperboreus*
Glaucous-winged Gull	*Larus glaucescens*
Golden Eagle	*Aquila chrysaetos*
Golden-crowned Kinglet	*Regulus satrapa*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Grasshopper Sparrow	*Ammodramus savannarum*
Gray Catbird	*Dumetella carolinensis*
Gray Flycatcher	*Empidonax wrightii*
Gray Jay	*Perisoreus canadensis*
Gray Partridge	*Perdix perdix*
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*
Great Blue Heron	*Ardea herodias*
Great Egret	*Casmerodius albus*
Great Gray Owl	*Strix nebulosa*
Great Horned Owl	*Bubo virginianus*
Greater Scaup	*Aythya marila*
Greater White-fronted Goose	*Anser albifrons*
Great-tailed Grackle[3]	*Quiscalus mexicanus*
Greater Yellowlegs	*Tringa melanoleuca*
Green Heron [2]	*Butorides striatus*
Green-tailed Towhee[2]	*Pipilo chlorurus*
Green-winged Teal	*Anas crecca*
Gyrfalcon	*Falco rusticolis*
Hairy Woodpecker	*Picoides villosus*
Hammond's Flycatcher	*Empidonax hammondii*
Harlequin Duck[3]	*Histrionicus histrionicus*
Harris' Sparrow	*Zonotrichia querula*
Hermit Thrush	*Catharus guttatus*
Herring Gull	*Larus argentatus*
Hooded Merganser	*Lophodytes cucullatus*
Hooded Warbler[3]	*Wilsonia citrina*

Horned Grebe	*Podiceps auritus*
Horned Lark	*Eremophila alpestris*
House Finch	*Carpodacus mexicanus*
House Sparrow	*Passer domesticus*
House Wren	*Troglodytes aedon*
Killdeer	*Charadrius vociferous*
Indigo Bunting [3]	*Passerina cyanea*
Lapland Longspur[2]	*Calcarius lapponicus*
Lark Sparrow	*Chondestes grammacus*
Lazuli Bunting	*Passerina amoena*
Least Flycatcher[2]	*Empidonax minimus*
Least Sandpiper	*Calidris minutilla*
Lesser Goldfinch[2]	*Carduelis psaltria*
Lesser Scaup	*Aythya affinis*
Lesser Yellowlegs	*Tringa flavipes*
Lewis' Woodpecker	*Melanerpes lewis*
Lincoln's Sparrow	*Melospiza lincolnii*
Loggerhead Shrike	*Lanius ludovicianus*
Long-billed Curlew	*Numenius americanus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Long-eared Owl	*Asio otus*
Long-tailed Duck	*Clangula hyemalis*
MacGillivray's Warbler	*Oporornis tolmiei*
Mallard	*Anas platyrhynchos*
Magnolia Warbler[3]	*Dendroica magnolia*
Marbled Godwit[2]	*Limosa fedoa*
Marsh Wren	*Cistothorus palustris*
Merlin	*Falco columbarius*
Mew Gull	*Larus canus*
Mountain Bluebird	*Sialia currucoides*
Mountain Chickadee	*Parus gambeli*
Mountain Quail	*Oreortyx pictus*
Mourning Dove	*Zenaida macroura*
Nashville Warbler	*Vermivora ruficapilla*
Northern Bobwhite*	*Colinus virginianus*
Northern Flicker	*Colaptes auratus*
Northern Goshawk	*Accipiter gentiles*
Northern Harrier	*Circus cyaneus*
Northern Mockingbird[2]	*Mimus polyglottos*
Northern Pintail	*Anas acuta*
Northern Pygmy-owl	*Glaucidium gnoma*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Northern Saw-whet Owl	*Aegolius acadicus*
Northern Shoveler	*Anas clypeata*
Northern Shrike	*Lanius excubitor*
Northern Waterthrush[2]	*Seiurus noveboracensis*
Olive-sided Flycatcher	*Contopus borealis*
Orange-crowned Warbler	*Vermivora celata*
Osprey	*Pandion haliaetus*
Pacific Golden-plover[2]	*Pluvialis fulva*

Pacific Loon	*Gavia pacifica*
Palm Warbler[3]	*Dendroica palmarum*
Parasitic Jaeger[3]	*Stercorarius parasiticus*
Pectoral Sandpiper	*Calidris melanotos*
Peregrine Falcon	*Falco peregrinus*
Pied-billed Grebe	*Podilymbus podiceps*
Pileated Woodpecker	*Dryocopus pileatus*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Carduelis pinus*
Pomarine Jaeger	*Stercorarius pomarinus*
Prairie Falcon	*Falco mexicanus*
Purple Finch[2]	*Carpodacus purpureus*
Pygmy Nuthatch	*Sitta pygmaea*
Red Crossbill	*Loxia curvirostra*
Red Phalarope[3]	*Phalaropus fulicarius*
Red-breasted Merganser[2]	*Mergus serrator*
Red-breasted Nuthatch	*Sitta canadensis*
Red-eyed Vireo	*Vireo olivaceus*
Redhead	*Aythya americana*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Red-necked Grebe	*Podiceps grisegena*
Red-necked Phalarope	*Phalaropus lobatus*
Red-tailed Hawk	*Buteo jamaicensis*
Red-throated Loon[2]	*Gavia stellata*
Red-winged Blackbird	*Agelaius phoeniceus*
Ring-billed Gull	*Larus delawarensis*
Ring-necked Duck	*Aythya collaris*
Ring-necked Pheasant	*Phasianus colchicus*
Rock Pigeon	*Columba livia*
Rock Wren	*Salpinctes obsoletus*
Ross' Goose [2]	*Chen rossii*
Rough-legged Hawk	*Buteo lagopus*
Ruby-crowned Kinglet	*Regulus calendula*
Ruddy Duck	*Oxyura jamaicensis*
Ruddy Turnstone[2]	*Arenaria interpres*
Ruffed Grouse	*Bonasa umbellus*
Rufous Hummingbird	*Selasphorus rufus*
Rusty Blackbird[3]	*Euphagus carolinus*
Sabine's Gull[3]	*Xema sabini*
Sage Sparrow	*Amphispiza nevadensis*
Sage Thrasher	*Oreoscoptes montanus*
Sanderling	*Calidris alba*
Sandhill Crane	*Grus canadensis*
Savannah Sparrow	*Passerculus sandwichensis*
Say's Phoebe	*Sayornis saya*
Semipalmated Plover	*Charadrius semipalmatus*
Semipalmated Sandpiper	*Calidris pusilla*
Sharp-shinned Hawk	*Accipiter striatus*
Short-billed Dowitcher	*Limnodromus griseus*
Short-eared Owl	*Asio flammeus*

Snow Bunting	*Plectrophenax nivalis*
Snow Goose	*Chen caerulescens*
Snowy Egret[2]	*Egretta thula*
Snowy Owl	*Nyctea scandiaca*
Solitary Sandpiper	*Tringa solitaria*
Song Sparrow	*Melospiza melodia*
Sora	*Porzana carolina*
Spotted Sandpiper	*Actitis macularia*
Spotted Towhee	*Pipilio maculatus*
Steller's Jay	*Cyanocitta stelleri*
Stilt Sandpiper[2]	*Calidris himantopus*
Surf Scoter	*Melanitta perspicillata*
Swainson's Hawk	*Buteo swainsoni*
Swainson's Thrush	*Catharus ustulatus*
Swamp Sparrow[2]	*Melospiza georgiana*
Thayer's Gull	*Larus thayeri*
Three-toed Woodpecker	*Picoides tridactylus*
Townsend's Solitaire	*Myadestes townsendi*
Townsend's Warbler	*Dendroica townsendi*
Tree Swallow	*Tachycineta bicolor*
Tricolored Blackbird	*Agelaius tricolor*
Trumpeter Swan	*Cygnus buccinator*
Tundra Swan	*Cygnus columbianus*
Turkey Vulture	*Cathartes aura*
Varied Thrush	*Ixoreus naevius*
Upland Sandpiper[3]	*Bartramia longicauda*
Vaux's Swift	*Chaetura vauxi*
Veery	*Catharus fuscescens*
Vesper Sparrow	*Pooecetes gramineus*
Violet-green Swallow	*Tachycineta thalassina*
Virginia Rail	*Rallus limicola*
Warbling Vireo	*Vireo gilvus*
Western Bluebird	*Sialia mexicana*
Western Grebe	*Aechmophorus occidentalis*
Western Gull[2]	*Larus occidentalis*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
Western Sandpiper	*Calidris mauri*
Western Screech Owl	*Otus kennicottii*
Western Scrub-jay[2]	*Aphelocoma californica*
Western Tanager	*Piranga ludoviciana*
Western Wood-pewee	*Contopus sordidulus*
White-breasted Nuthatch	*Sitta carolinensis*
White-crowned Sparrow	*Zonotrichia leucophrys*
White-faced Ibis[2]	*Plegadis chihi*
White-headed Woodpecker	*Picoides albolarvatus*
White-throated Sparrow	*Zonotrichia albicollis*
White-throated Swift	*Aeronautes saxatalis*
White-winged Crossbill[2]	*Loxia leucoptera*
White-winged Scoter[2]	*Melanitta fusca*

Wild Turkey	*Meleagris gallopavo*
Willet	*Catoptrophorus semipalmatus*
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Willow Flycatcher	*Empidonax traillii adastus*
Wilson's Phalarope	*Phalaropus tricolor*
Wilson’s Snipe	*Gallinago delicata*
Wilson's Warbler	*Wilsonia pusilla*
Winter Wren	*Troglodytes troglodytes*
Wood Duck	*Aix sponsa*
Yellow Warbler	*Dendroica petechia*
Yellow-billed Cuckoo [2]	*Coccyzus americanus*
Yellow-breasted Chat	*Icteria virens*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Yellow-rumped Warbler	*Dendroica coronata*

Mammals

American badger	*Taxidea taxus*
American beaver	*Castor canadensis*
American marten	*Martes americana*
Belding's ground squirrel	*Spermophilus beldingi*
big brown bat	*Eptesicus fuscus*
black bear	*Ursus americanus*
black-tailed jackrabbit	*Lepus californicus*
bobcat	*Lynx rufus*
bushy-tailed woodrat	*Neotoma cinerea*
California myotis	*Myotis californicus*
Canada lynx	*Lynx canadensis*
coast mole	*Scapanus orarius*
Columbian ground squirrel	*Spermophilus columbianus*
common porcupine	*Erethizon dorsatum*
coyote	*Canis latrans*
deer mouse	*Peromyscus maniculatus*
eastern fox squirrel	*Sciurus niger*
ermine	*Mustela erminea*
fringed myotis	*Myotis thysanodes*
golden-mantled ground squirrel	*Spermophilus lateralis*
Great Basin pocket mouse	*Perognathus parvus*
heather vole	*Phenacomys intermedius*
hoary bat	*Lasiurus cinereus*
house mouse	*Mus musculus*
least chipmunk	*Tamias minimus*
little brown myotis	*Myotis lucifugus*
long-eared myotis	*Myotis evotis*
long-legged myotis	*Myotis volans*
long-tailed vole	*Microtus longicaudus*
long-tailed weasel	*Mustela frenata*
Merriam's shrew	*Sorex merriami*
mink	*Mustela vison*
montane vole	*Microtus montanus*
mountain cottontail	*Sylvilagus nuttallii*

mountain lion	*Felis concolor*
mule deer	*Odocoileus hemionus*
muskrat	*Ondatra zibethicus*
northern flying squirrel	*Glaucomys sabrinus*
northern grasshopper mouse	*Onychomys leucogaster*
northern pocket gopher	*Thomomys talpoides*
northern raccoon	*Procyon lotor*
northern river otter	*Lutra canadensis*
Norway rat	*Rattus norvegicus*
Ord's kangaroo rat	*Dipodomys ordii*
pallid bat	*Antrozous pallidus*
Preble's shrew	*Sorex preblei*
pronghorn	*Antilocapra americana*
red fox	*Vulpes vulpes*
red squirrel	*Tamiasciurus hudsonicus*
Rocky Mountain elk	*Cervus elaphus nelsoni*
sagebrush vole	*Lemmiscus curtatus*
silver-haired bat	*Lasionycteris noctivagans*
snowshoe hare	*Lepus americanus*
southern red-backed vole	*Clethrionomys gapperi*
striped skunk	*Mephitis mephitis*
Townsend's big eared bat	*Corynorhinus townsendii*
vagrant shrew	*Sorex vagrans*
Virginia opossum	*Didelphis virginiana*
Washington ground squirrel	*Spermophilus washingtoni*
water shrew	*Sorex palustris*
water vole	*Microtus richardsoni*
western harvest mouse	*Reithrodontomys megalotis*
western jumping mouse	*Zapus princeps*
western pipistrelle	*Pipistrellus hesperus*
western small-footed myotis	*Myotis ciliolabrum*
western spotted skunk	*Spilogale gracilis*
white-tailed deer	*Odocoileus virginianus*
white-tailed jackrabbit	*Lepus townsendii*
wolverine	*Gulo gulo*
yellow-bellied marmot	*Marmota flaviventris*
yellow-pine chipmunk	*Tamias amoenus*
Yuma myotis	*Myotis yumanensis*
Reptiles	
common garter snake	*Thamnophis sirtalis*
gopher snake	*Pituophis catenifer*
longnose leopard lizard	*Gambelia wislizenii*
night snake	*Hypsiglena torquata*
northern sagebrush lizard	*Sceloporus graciosus graciosus*
painted turtle	*Chrysemys picta belli*
racer	*Coluber constrictor*
rubber boa	*Charina bottae*
short-horned lizard	*Phrynosoma douglassii*
side-blotched lizard	*Uta stansburiana*
striped whipsnake	*Masticophis taeniatus*

western fence lizard	*Sceloporus occidentalis*
western rattlesnake	*Crotalus viridis*
western skink	*Eumeces skiltonianus*
western terrestrial garter snake	*Thamnophis elegans*

[1] A special thanks to Aaron Skirvin, Dave Herr, Craig Corder, Mike Denny, Karen Kronner, and June Whitten of the Pendleton Bird Club for providing their expertise on birds in the Umatilla subbasin; Russ Morgan also provided valuable information on bird species found in the Willow subbasin.
[2] Status of species is uncertain; these may be regularly observed at low numbers or infrequent breeders.
[3] Very infrequent observations (usually less than one observation every 5 years); includes vagrants. These species are not included in the IBIS database or used in assessment analyses (e.g., functional redundancy) because they are not common enough to be considered to be part of the functioning ecosystem.
* The Northern Bobwhite was introduced into the subbasin and was once common in the Hermiston area; however, there is currently not a naturally reproducing population, and recent sightings are probably birds that have escaped or are being used for dog training (personal communication: A. Skirvin, April 2004).
**Two records of the Upland Sandpiper are recorded for the Boardman Bombing range in the Willow Creek subbasin; this species is believed to be declining throughout the state.

Appendix B. Data on Aquatic Focal Species: Adult returns to TMFD, Disposition, Escapement, Artificial Production, and Harvest

Table 1. Summer steelhead adult returns, disposition, harvest, and escapement for the Umatilla River 1987-2002. Table from Kissner (2003).

RUN YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Summer Steelhead (STS) Enumerated at TMD	2480	2474	1667	1111	2769	1914	1290	1531	2081	2477	1765	1886	2892	3662	5520
Natural STS Enumerated at Three Mile Dam (TMD)	2315	2104	1422	724	2247	1298	945	875	1296	1014	862	1135	2160	2596	3562
Hatchery STS Enumerated at TMD	165	370	245	387	522	616	345	656	785	1463	903	751	732	1066	1958
Hatchery STS Harvested below TMD						15	14	40	35	67	89	54	74	87	147
Estimated # of nonendemic STS strays to TMD						187	35	121	120	174	177	49	60		
Harvest or straying to other areas															
TMD+sport below TMD+other areas-%strays															
Natural Female STS Enumerated at TMD						942	688	645	922	742	593	774	1355	1776	2180
Hatchery Female STS Enumerated at TMD						364	251	342	447	720	529	478	377	643	965
Natural Male STS Enumerated at TMD						356	257	230	374	272	269	361	805	797	1382
Hatchery Male STS Enumerated at TMD						252	94	314	338	743	374	273	355	446	993
Natural STS Sacrificed or Mortalities at TMD	20	12	25	2	3	0	0	0	8	5	2	1	0	2	1
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	70	51	33	73	95	70	75	42	97	49
Natural STS Taken for Brood Stock	151	160	106	99	237	125	92	86	105	97	86	111	115	106	100
Natural STS Spawned	62	84	53	85	172	95	79	59	63	75	68	76			
Hatchery STS Taken for Brood Stock	0	0	0	103	95	91	42	68	26	10	30	15	15	10	10
Hatchery STS Spawned	0	0	0	42	0	3	17	22	21	3	21	4		7	
Natural Females Released above TMD	1436	1232			1193	878	641	602	863	687	549	718	1317	1721	2129
Natural Males Released above TMD	708	702			814	292	211	187	323	222	225	306	728	744	1332
Natural STS Released above TMD	2144	1934	1290	623	2007	1170	852	789	1186	909	774	1024	2045	2465	3461
Hatchery Females Released above TMD	114	216			161	266	183	289	376	669	475	427	351	583	939

Table 1. Continued

RUN YEAR	**1987** **1988**	**1988** **1989**	**1989** **1990**	**1990** **1991**	**1991** **1992**	**1992** **1993**	**1993** **1994**	**1994** **1995**	**1995** **1996**	**1996** **1997**	**1997** **1998**	**1998** **1999**	**1999** **2000**	**2000** **2001**	**2001** **2002**
Hatchery Males Released above TMD	46	137			154	188	69	266	305	689	328	234	324	399	960
Hatchery STS Released above TMD	160	353	102	234	315	454	252	555	681	1358	803	661	675	982	1899
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5	0	0	*
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39	99	84	*
Natural STS Harvested above TMD-ODFW								0	0	0	0	0		0	0
Hatchery STS Harvested above TMD-ODFW						22	5	21	25	24	12	47	4	3	57
Natural Female STS Potentially Available to Spawn	1436*	1232*			1193*	875	638	599	863	687	547	715	1317	1721	2129
Hatchery Female STS Potentially Available to Spawn	114*	216*			161*	242	170	268	344	640	453	384	301	539	911
Total Female STS Potentially Available to Spawn	1550*	1448*			1354*	1117	808	862	1207	1327	1000	1099	1618	2260	3040
Natural Male STS Potentially Available to Spawn	708*	702*			814*	290	209	185	323	222	222	304	728	744	1332
Hatchery Male STS Potentially Available to Spawn	46*	137*			154*	165	57	246	273	661	306	191	273	356	931
Total Male STS Potentially Available to Spawn	754*														2263
Natural STS Potentially Available to Spawn	2144	1934	1290	623	2007	1165	847	784	1186	909	769	1019	2045	2465	3461
Hatchery STS Potentially Available to Spawn	160	353	102	234	315	407	227	514	617	1301	758	575	574	895	1842
Total STS Available to Spawn	2304	2287	1392	857	2322	1572	1074	1298	1803	2210	1527	1594	2619	3360	5303
STS Redds Observed in Index Reaches	138	77	HW	HW	135	HW	64	74	119	138	126	218	238	383	347
Total STS Redds Observed	275	128	HW	HW	300	HW	224	126	150	149	217	293	523	n/a	n/a
Index Reaches Miles Surveyed	18.5	20	HW	HW	21.4	HW	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	19.4
Total Redds Per Mile in Index Reaches	7.5	3.9	HW	HW	6.3	HW	3.0	3.5	5.6	6.4	5.9	10.2	11.1	17.9	17.9
Total Miles Surveyed in Umatilla River	61.0	50.2	HW	HW	67.2	HW	65.8	35.0	34.4	24.6	38.0	37.2	47.6	n/a	n/a
Redds Per Mile in all Areas Surveyed	4.5	2.5	HW	HW	4.5	HW	3.4	3.6	4.4	6.1	5.7	7.9	11.0	n/a	n/a

Notes: Index reaches are in Squaw, N. F. Meacham, Buckaroo, Camp, and Boston Canyon Creeks and the S. F. Umatilla River.
Notes: We assumed that harvest was 50% females and 50% males. No adjustments made for hook and release mortality

Table 2 Spring Chinook salmon adult return, disposition, and escapement to the Umatilla River Subbasin, 1989-2002. Table from Kissner (2003).

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Hatchery adults enumerated at TMFD	68	2158	1294	461	1202	261	388	2075	2033	343	1742	3863	4164	4785
Estimated natural adults enumerated at TMFD [1]								77	161	66	22	348	212	276
Total adults enumerated at TMFD	68	2158	1294	461	1202	261	388	2152	2194	409	1764	4211	4376	5061
Hatchery jacks enumerated at TMFD													161	112
Estimated natural jacks enumerated at TMFD [1]													28	70
Total jacks enumerated at TMFD	96	32	36	3	19	10	108	121	4	20	210	124	189	182
Sacrificed or mortalities at TMFD	36	25	234	200	165	31	56	57	58	11	79	27	41	25
Taken for brood stock	0	200	0	0	0	0	0	0	600	202	631	617	677	588
Adults released above TMFD	64	1949	1085	263	1050	235	378	2132	1537	207	1138	3562	3720	4322
Jacks released above TMFD	64	16	11	1	6	5	62	80	3	9	126	97	129	137
Adipose clipped CHS released above TMFD	3	685	479	135	603	133	162	572	400	38	327	1281	739	
Harvested above TMFD- CTUIR	0	0*	82	0	176	0	0	167	187	0	110 [2]	695 [3]	247 *	245*
Harvested above TMFD- ODFW	0	20	23	0	18	0	0	206	31	0	11	143	80	110
Adults potentially available to spawn	64	1929	980	263	856	235	378	1759	1319	207	1020	2724	3393	3967
Adults sampled on spawning grounds	6	272	228	78	471	112	194	715	667	89	539	1388	986	1269
Jacks sampled on spawning grounds			2	1	3	1	22	24	1	2	40	32	13	30
Adult percent recovered (after harvest)	4.7	13.8	23.3	29.7	55.0	47.7	51.3	40.6	50.6	43.0	52.8	51.0	29.1	32.0
Number of ad clips sampled	0	83	136	39	356	50	78	166	182	17	137	394	135	263
Percent recovered (ad clips)	0	12.1	28.4	28.9	59	37.6	48.1	29	45.5	44.7	41.9	30.8	18.3	58.1
Prespawning mortalities sampled (adults)			88	22	124	19	60	256	230	28	157	227	460	372
Prespawning mortalities sampled (jacks)			1	1	1	1	10	5	0	0	13	7	3	13
Spawned adults sampled			130	48	336	93	126	440	401	61	361	1102	501	772
Spawned jacks sampled			1		2	0	11	19	1	1	27	20	10	15
Redds observed	14	289	144	59	224	74	90	347	288	60	292	721	626	828
Spawned females sampled			81	37	205	56	73	267	244	41	228	689	335	513

Notes:
1) The estimated escapement of natural spring Chinook salmon adults was determined by scale analysis (circuli counts) of a sample of the unmarked adults returning to Three Mile Falls Dam.
2) Harvest includes 8 gaff mortalities sampled and 4 seriously injured fish that would not survive to spawn
3) Harvest includes 17 gaff mortalities sampled after fishery
* Complete creel not conducted, minimum estimate of harvest
Jack=<450 mm MEPH length

Table 3. Fall Chinook (CHF) salmon adult returns, deposition, and escapement to the Umatilla River, 1988-2001. Table from Kissner (2003).

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Adult CHF enumerated at TMD	91	271	329	522	225	368	692	595	646	354	286	737	643	1146
Jack CHF enumerated at TMD	195	267	113	468	79	29	230	291	80	207	154	137	437	1158
Sub jack CHF enumerated at TMD	1268	65	618	273	0	15	367	343	606	189	230	152	4948	970
CHF sacrificed or mortalities at TMD	921	333	192	731	6	8	166	195	95	159	78	67	409	2/92/10
CHF taken for brood stock	0	0	0	348	211	385	0	0	576	300	201	465	603	462/24
Adult female CHF released above TMD	?	?	?	57	7	6	305	213	9	30	5	133	59	81
Adult male CHF released above TMD	?	?	?	112	29	27	288	302	79	12	84	147	10	601
Total adult CHF released above TMD	58	192	168	169	36	33	593	515	88	42	89	280	69	682
Jack CHF released above TMD	138	78	89	18	51	7	213	255	53	131	114	99	298	1042
Sub jack CHF released above TMD	0	0	611	0	0	12	317	264	520	118	188	115	4647	960
Adult female CHF outplanted in Umatilla	0	0	0	0	0	0	0	0	423	483	74	433	245	465
Maturing male CHF outplanted in Umatilla	0	0	0	0	0	0	0	0	285	457	126	458	226	478
Total female CHF released - TMD+outplant	?	?	?	57	7	6	305	213	432	513	79	566	304	546
Total male CHF released -TMD+outplant	?	?	?	130	80	46	818	821	937	718	512	819	5181	2603
CHF redds observed		0	0	0	0	0	82	9	170	301	6	89	0	0
Unidentified redds observed		92	50	18	0	0	7	1	1	22	24	25	165	0

Table 4. Disposition of coho salmon returning to the Umatilla River (1988-2003). Table from CTUIR, DNR, Fisheries Program.

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Coho Salmon																
Adults enumerated at TMD	936	4154	409	1732	356	1533	984	947	618	670	3081	3702	4654	22792	3820	8319
Jacks enumerated at TMD	746	479	515	189	173	16	62	52	24	137	191	205	1276	80	971	667
Sacrificed or mortalities at TMD	0	4001	110	445	0	79	113	0	20	42	222	236	219/96	279/4	172	126
Adults taken for brood stock	0	0	0	0	0	580	0	860	0	0	0	0	0	0	0	0
Adult females released above TMD				387	141	395	398	29	293	337	1464	1595	2235	9568	1923	3571
Adult males released above TMD				612	201	486	481	76	305	301	1406	1873	2185	12945	1713	4642
Total adults released above TMD	936	580	364	999*	342	881	879	105	598	638	2870	3468	4435	22513	3636	8213
Jacks released above TMD	746	52	450	91	168	13	54	34	24	127	180	196	1180	76	914	647
Coho redds observed	NA	0	0	0	12	44	24	1	18	51	90	42	0	10	NA	NA
Unidentified redds observed	NA	92	50	18	0	0	7	1	1	22	24	25	165	0	NA	NA

*In 1991 an additional 208 female and 178 male coho were recycled from TMD to the mouth for potential harvest

Table 5. Hatchery releases of summer steelhead in the Umatilla River Basin. Data from CTUIR Umatilla Hatchery Satellite Facilities Operation and Maintenance Project.

Year of Release	Hatchery	No. Released	No./lb.	Stock
1967	Gnat Creek	109,805	75.0	Skamania
1967	Oak Springs	238,020	117.0	Idaho (Oxbow)
1967	Wallowa	142,240	240.0	Idaho (Oxbow)
1968	Gnat Creek	23,100	66.0	Skamania
1968	Gnat Creek	150,000	Eggs	Skamania
1969	Carson	174,341	145.0	Skamania
1970	Wizard Falls	39,489	8.0-9.0	Skamania
1975	Oak Springs	11,094	9.0	Umatilla River
1981	Oak Springs	17,558	6.0-9.0	Umatilla River
1981	Oak Springs	9,400	145.0	Umatilla River
1982	Oak Springs	59,494	7.0-8.0	Umatilla River
1982	Oak Springs	67,940	124.0	Umatilla River
1983	Oak Springs	60,500	11.0	Umatilla River
1983	Oak Springs	52,700	62.0	Umatilla River
1984	Oak Springs	57,939	6.5	Umatilla River
1984	Oak Springs	22,000	135.0	Umatilla River
1985	Oak Springs	39,134	150.0	Umatilla River
1986	Oak Springs	54,137	8.4	Umatilla River
1987	Oak Springs	1,485	5.5	Umatilla River
1988	Oak Springs	95,290	6.5-10.3	Umatilla River
1988	Oak Springs	10,033	57.5	Umatilla River
1988	Irrigon	24,618	3200.0	Umatilla River
1989	Oak Springs	81,712	5.5-6.6	Umatilla River
1990	Oak Springs	89,193	5.5-7.7	Umatilla River
1991	Oak Springs	71,935	6.2-8.7	Umatilla River
1991	Oak Springs	3,998	12.5	Umatilla River
1992	Umatilla	19,977	5.8	Umatilla River
1992	Umatilla	47,458	5.8	Umatilla River
1992	Umatilla	64,550	5.0	Umatilla River
1992	Umatilla	67,419	5.5	Umatilla River
1992	Umatilla	5,443	5.8	Umatilla River
1993	Umatilla	44,824	4.5	Umatilla River
1993	Umatilla	47,979	5.6	Umatilla River
1993	Umatilla	65,465	6.1	Umatilla River
1994	Umatilla	51,403	4.9	Umatilla River
1994	Umatilla	49,598	5.1	Umatilla River
1994	Umatilla	52,097	5.2	Umatilla River
1994	Umatilla	1,732	5.7	Umatilla River
1995	Umatilla	48,539	5.6	Umatilla River
1995	Umatilla	49,983	4.7	Umatilla River
1995	Umatilla	47,941	5.5	Umatilla River
1996	Umatilla	47,543	5.1	Umatilla River

Table 1 continued

Year of Release	Hatchery	No. Released	No./lb.	Stock
1996	Umatilla	49,377	5.3	Umatilla River
1996	Umatilla	49,783	5.1	Umatilla River
1997	Umatilla	46,788	4.6	Umatilla River
1997	Umatilla	41,555	5.4	Umatilla River
1997	Umatilla	48,944	4.9	Umatilla River
1998	Umatilla	49,084	4.7	Umatilla River
1998	Umatilla	41,088	5.9	Umatilla River
1998	Umatilla	47,313	5.5	Umatilla River
1999	Umatilla	41,843	4.9	Umatilla River
1999	Umatilla	44,226	5.5	Umatilla River
1999	Umatilla	35,564	5.9	Umatilla River
1999	Umatilla	9,878	43.9	Umatilla River
2000	Umatilla	51,659	4.8	Umatilla River
2000	Umatilla	52,736	4.7	Umatilla River
2000	Umatilla	49,343	6.4	Umatilla River
2001	Umatilla	50,829	4.8	Umatilla River
2001	Umatilla	48,291	5.4	Umatilla River
2001	Umatilla	41,403	4.7	Umatilla River
2002	Umatilla	54,917	5.1	Umatilla River
2002	Umatilla	54,366	4.2	Umatilla River
2002	Umatilla	47,521	4.5	Umatilla River
2002	Umatilla	1,826	3.6-4.2	Umatilla River
2003	Umatilla	41,369	4.8	Umatilla River
2003	Umatilla	42,805	4.0	Umatilla River
2003	Umatilla	42,783	4.4	Umatilla River

Table 6. Juvenile summer steelhead and coho releases in the Umatilla River Basin (1981-2003). Data from CTUIR Umatilla Hatchery Satellite Facilities Operation and Maintenance Project.

Year	Summer Steelhead					Coho			
	Lower Umatilla	Upper Umatilla	Minthorn	Bonifer	Thornhollow & Pendleton	Lower Umatilla	Upper Umatilla	Minthorn	Pendleton
1981		17,558 (y) 9,400 (sy)							
1982		59,494 (y) 67,940 (sy)							
1983		60,500 (y) 52,700 (sy)							
1984				57,939 (y) 22,000 (sy)					
1985				53,850 (y) 39,134 (sy)					
1986				54,137 (y)					
1987		1,485 (y) (2)				786,660 (y) (6)			
1988	33,984 (y) (3)	40,790 (4 & 5)	30,549 (y)			996,433 (y) (3)			
1989		29,586 (y)	29,852 (y)	22,274 (y)			829,607 (y)	161,889 (y)	
1990		29,446 (y)		59,747 (y)		202,315 (y) (6)	654,209 (y)	157,299 (y)	
1991	3,998 (y) (7)	29325 (y)		42,610 (y)			802,655 (y)	132,404 (y)	
1992	5,443 (y) (7)	131,969 (y)	47,458 (y)	19,977 (y)			961,386 (y)	152,974 (y)	
1993			47,979 (y)	110,289 (y)		437,884 (y) (8)	454,794 (y)		
1994	1,732 (y) (7)		49,598 (y)	103,500 (y)		418,222 (y) (8)	465,883 (y)		
1995			49,983 (y)	96,480 (y)		824,963 (y) (8)	689,303 (y)		
1996			47,543 (y)	49,377 (y)	49,783 (y)	977,378 (y) (8)	500,005 (y)		
1997			46,788 (y)	90,499 (y)		1,400,939 (y) (8)			
1998			49,084 (y)	88,401 (y)	54,974 (y)		1,606,786 (y)		
1999	9,878 (sy)		41,843 (y)	79,790 (y)			1,475,922 (y)		
2000			104,395 (y)	49,343 (y)					1,561,290 (y)
2001			92,232 (y)	48,291 (y)					1,474,559 (y)
2002			47,521 (y)	54,917 (y)	54,366 (y)				1,621,857 (y)
2003			42,805 (y)	41,369 (y)	42,783 (y)				1,546,167 (y)

/1 y = yearling releases; sy = subyearling releases; upper Umatilla River includes Meacham Creek

/2 Small release due to IHNV & IPN problems in eggs
/3 Fish released below Westland Dam
/4 Includes both experimental control group and gradeouts from 88 brood year
/5 Does not include unfed fry
/6 Released at RM 23
/7 Passage evaluation releases
/8 Released at RM 42.5

Table 7. Rainbow trout stocked in the Umatilla River and McKay Creek from 1991 to 1999 (no fish were stocked after 1999) Data from ODFW.

Year	Stream	Location	Number
1991	Umatilla River	Forks Area	8,004
1992	Umatilla River	Forks Area	7,802
1993	Umatilla River	Forks Area	7,814
1994	Umatilla River	Pendleton Area	7,820
1995	Umatilla River McKay Creek	Pendleton Area Below Reservoir	3,401 2,000
1996	Umatilla River	Pendleton Area	4,991
1997	Umatilla River	Pendleton Area	5,008
1998	Umatilla River	Pendleton Area	4,597
1999	Umatilla River	Pendleton Area	3,800

Table 8. Rainbow trout stocked in Willow Creek subbasin streams from 1991 to 2003. Data from ODFW.

Year	Stream	Location	Number
1991	Willow Creek	Above Reservoir	4,000
1992	Willow Creek	Above Reservoir	4,000
1993	Willow Creek	Above Reservoir	4,000
1994	Willow Creek	Below Reservoir	2,000
1995	Willow Creek	Below Reservoir	2,000
1996	Willow Creek	Below Reservoir	2,000
1997	Willow Creek	Below Reservoir	2,000
1998	Willow Creek	Below Reservoir	2,000
1999	Willow Creek	Below Reservoir	2,000
2000	Willow Creek	Below Reservoir	2,000
2001	Willow Creek	Below Reservoir	2,000
2002	Willow Creek	Below Reservoir	2,000
2003	Willow Creek	Below Reservoir	2,000

Table 9. Hatchery releases of spring Chinook in the Umatilla River Basin. Data from CTUIR Umatilla Hatchery Satellite Facilities Operation and Maintenance Project.

Year of Release	Hatchery	No. Released	No./lb.	Stock
1986	Carson	99,970	22.8	Carson
1986	Irrigon	300,438	87.0	Carson
1986	Irrigon	75,000	15.0	Carson
1987	Carson	99,897	10.4	Carson
1987	Oxbow	169,100	199.0	Carson
1988	Bonneville	1,196	21.4	Carson /a
1988	Carson	99,895	20.6	Carson
1988	Bonneville	297,377	8.3-10.3	Carson /a
1988	Bonneville	75,767	11.1	Carson /a
1989	Bonneville	325,520	10.6-12.0	Carson /a
1990	Carson	99,775	18.6	Carson
1990	Bonneville	390,208	9.0-13.4	Carson /a
1991	Carson	96,733	16.9-20.6	Carson
1991	Bonneville	196,657	10.1-11.8	Carson /a
1991	Bonneville	159,624	16.5-16.8	Carson /b
1992	Carson	90,982	18.7	Carson
1992	Carson	5,272	18.7	Carson
1992	Bonneville	208,029	8.5-9.2	Carson /a
1992	Umatilla	955,752	35.4	Carson
1992	Irrigon	294,458	32.5	Carson
1992	Bonneville	132,929	11.3	Carson
1992	Umatilla	101,416	19.4	Carson
1993	Bonneville	186,948	14.5	Carson
1993	Umatilla	208,782	8.3	Carson
1993	Carson	85,134	20.3	Carson
1993	Carson	10,952	20.0-20.5	Carson
1993	Umatilla	667,367	27.6	Carson
1993	Umatilla	460,809	19.9	Carson
1994	Umatilla	205,143	8.4	Carson
1994	Bonneville	152,854	11.5	Carson
1994	Bonneville	252,248	12.3	Carson
1994	Umatilla	8,890	8.1-8.3	Carson
1994	Umatilla	839,377	30.4	Carson
1994	Umatilla	378,225	8.7	Carson
1995	Bonneville	247,871	10.3	Carson
1995	Umatilla	275,804	7.9	Carson
1995	Bonneville	74,735	14.4	Carson
1995	Bonneville	74,921	11.4	Carson
1996	Umatilla	378,561	8.9	Carson /c
1997	Umatilla	225,883	9.1	Carson /d
1998	Umatilla	382,714	11.6	Carson /e
1998	Umatilla	114,370	18.1	Carson /f
1998	Little White Salmon	172,999	15.6	Carson /e
1998	Little White Salmon	172,258	11.6	Carson /e
1998	Carson	99,641	16.3	Carson
1999	Umatilla	253,831	13.7	Carson /f

Table 9 continued

Year of Release	Hatchery	No. Released	No./lb.	Stock
1999	Little White Salmon	302,015	12.7-16.1	Carson /f
1999	Carson	103,761	13.2	Carson
2000	Umatilla	254,101	13.3	Carson /g
2000	Umatilla	103,621	12.2	Carson /g
2000	Little White Salmon	173,545	13.1	Carson /h
2000	Little White Salmon	185,069	11.1	Carson /h
2000	Carson	99,848	14.4	Carson
2001	Umatilla	91,727	14.8	Carson /f
2001	Umatilla	244,794	10.4	Carson /f
2001	Little White Salmon	165,310	13.0	Carson /f
2001	Little White Salmon	180,919	11.3	Carson /f
2001	CNFH	99,983	13.9	Carson
2002	Umatilla	107,717	13.8	Carson /f
2002	Umatilla	104,089	12.0	Carson /f
2002	Umatilla	148,048	13.7	Carson /f
2002	Umatilla	152,026	12.3	Carson /f
2002	Willard NFH	143,516	17.0	Carson /f
2002	Willard NFH	220,725	14.9	Carson /f
2003	Umatilla	104,679	13.0	Carson /f
2003	Umatilla	102,217	12.1	Carson /f
2003	Umatilla	148,748	12.2	Carson /f
2003	Umatilla	103,656	11.6	Carson /f
2003	Little White Salmon	322,806	16.9	Carson /f

/a Carson via Lookingglass broodstock
/b Carson via Lookingglass, Umatilla River and Big Canyon broodstock
/c Carson via Lookingglass (Wallowa H.) and Ringold (Lyons Ferry H.) broodstock
/d Carson via Ringold (Lyons Ferry H.) and Little White Salmon broodstock
/e Carson via Little White Salmon broodstock
/f Carson via Umatilla River broodstock
/g Carson via Ringold (Lyons Ferry H.) and Umatilla River broodstock
/h Carson via Ringold (Little White Salmon H.) broodstock

Table 10. Juvenile fall and spring Chinook salmon releases in the Umatilla River Basin (1982-2003). Data from CTUIR Umatilla Hatchery Satellite Facilities Operation and Maintenance Project.

Year	Fall Chinook							Spring Chinook			
	Lower Umatilla	Upper Umatilla	Bonifer	Minthorn	Thornhollow	Imeques	Pendleton	Lower Umatilla	Upper Umatilla	Bonifer	Imeques
1982	3,807,171 (sy) (b)										
1983		80,564 (y)	20,000 (y)								
1984	966,250 (sy)	175,104 (y)	53,308 (y)								
1985	3,223,172 (sy)	60,507 (y)	137,655 (y) 51,000 (f)								
1986	2,029,602 (sy)		115,779 (y)	91,036 (y) 35,574 (f)					300,438 (sy)	99,970 (y) 75,000 (f)	
1987	1,476,830 (sy)		102,363 (y)	111,143 (y & sy)					169,100 (sy)	99,897 (y)	
1988	3,316,007 (sy)	79,681 (f)	99,550 (y)	115,199 (y & f)				156,312 (y)	210,496 (y & f)	107,427 (y & f)	
1989	2,393,710 (sy)	295,575 (y & f)		78,825 (f)					164,786 (y & f)	160,734 (y & f)	
1990		255,614 (y) 3,132,127 (sy & f)		71,864 (f)				99,775 (y)	195,425 (y & f)	194,783 (y & f)	
1991	10,462 (sy) (c)	194,847 (y) 3,166,079 (sy)		79,672 (sy)				5,937 (y) (c)	265,428 (y & f)	181,649 (y & f)	
1992	7,837 (sy) (c)	220,440 (y) 3,182,712 (sy)						5,272 (y) (c)	189,910 (y) 1,484,555 (sy & f)	109,101 (y)	
1993	29,681 (sy) (c)	2,629,917 (sy) 134,837 (y)						10,952 (y) (c)	480,864 (y) 1,128,176 (sy & f)		
1994	22,174 (sy) (c)	2,843,212 (sy) 283,453 (y)						8,890 (y) (c)	610,245 (y)		1,217,602 (sy & f)
1995					227,088 (y) 561,423 (sy)	1,904,875 (sy)					673,331 (y)
1996					204,022 (y) 853,598 (sy)	360,381 (y) 2,106,815 (sy)					378,561 (y)
1997					433,347 (y) 788,310 (sy)	86,574 (y) 1,792,523 (sy)					225,883 (y)
1998					436,010 (y) 1,010,140 (sy)	1,767,302 (sy)					827,612 (y) 114,370 (f)

Table 10 continued.

Year	Fall Chinook							Spring Chinook			
	Lower Umatilla	Upper Umatilla	Bonifer	Minthorn	Thornhollow	Imeques	Pendleton	Lower Umatilla	Upper Umatilla	Bonifer	Imeques
1999					449,568 (y)	1,842,666 (sy)					659,607 (y)
2000					469,756 (y) 975,871 (sy)		2,044,648 (sy)				816,184 (y)
2001	322,283 (y)				400,761 (y) 324,713 (sy)						782,733 (y)
2002	312,869 (sy)				520,564 (y) 307,194 (sy)						876,121 (y)
2003	311,406 (sy)				509,135 (y) 313.383 (sy)						782,106 (y)

/a y = yearling releases; sy = subyearling releases; f = fall releases; upper Umatilla River includes Meacham Creek
/b Releases in 1982 were Tule stock; all other releases have been upriver brights
/c Passage evaluation releases

Table 11. Hatchery releases of fall Chinook in the Umatilla River Basin. Data from CTUIR Umatilla Hatchery Satellite Facilities Operation and Maintenance Project.

Year of Release	Hatchery	No. Released	No. lb.	Stock
1982	Bonneville/SCNFH	3,807,171	79.0-92.0	Tule
1983	Bonneville	100,564	5.9	Bonneville URB
1984	Bonneville	228,412	8.6	Bonneville URB
1984	Bonneville	966,250	85.1	Bonneville URB
1985	Bonneville	3,223,172	92.3	Bonneville URB
1985	Bonneville	198,162	7.8	Bonneville URB
1985	Bonneville	51,000	16.2	Bonneville URB
1986	Irrigon	206,815	4.7-5.0	Bonneville URB
1986	Irrigon	2,029,602	86.0	Bonneville URB
1986	Irrigon	35,574	11.6	Bonneville URB
1987	Irrigon	1,476,830	60.4	Priest Rapids URB
1987	Bonneville	211,506	8.1-8.6	Bonneville URB
1987	Irrigon	2,000	20.0	Priest Rapids URB
1988	Irrigon	1,886,757	68.3	Priest Rapids URB
1988	Irrigon	1,429,250	93.1	Bonneville URB
1988	Irrigon	94,089	8.6-9.8	Priest Rapids URB
1988	Bonneville	200,341	8.8-10.2	Bonneville URB
1989	Bonneville	217,443	8.6	Bonneville URB
1989	Irrigon	2,393,710	66.6	Priest Rapids URB
1989	Irrigon	156,957	10.9-11.1	Priest Rapids URB
1990	Bonneville	255,614	8.2	Bonneville URB
1990	Irrigon	2,425,681	87.5	Bonneville URB
1990	Irrigon	629,800	82.4	Priest Rapids URB
1990	Irrigon	148,510	8.8-9.2	Bonneville URB
1991	Bonneville	194,847	7.8	Bonneville URB
1991	Irrigon	10,462	80.0-194.0	Bonneville URB
1991	Irrigon	3,245,751	80.5-86.0	Bonneville URB
1992	Bonneville	220,440	7.6-7.7	Bonneville URB
1992	Umatilla	2,678,343	62.2	Bonneville URB
1992	Irrigon	504,369	53.4	Umatilla River
1992	Irrigon	5,167	62.8	Umatilla River
1992	Umatilla	2,670	112.0	Bonneville URB
1993	Bonneville	134,837	9.1	Bonneville URB
1993	Umatilla	2,629,917	62.7	Upriver Brights /a
1993	Umatilla	29,681	95.5-142.0	Upriver Brights /a
1994	Bonneville	283,453	8.5-10.4	Bonneville URB
1994	Umatilla	2,843,212	65.2	Upriver Brights /b
1994	Umatilla	22,174	85.0-171.0	Upriver Brights /b
1995	Bonneville	227,088	8.0	Bonneville URB
1995	Umatilla	2,466,298	63.1-64.7	Priest Rapids URB
1996	Bonneville	421,316	7.0-7.1	Bonneville URB
1996	Umatilla	143,087	5.1	Priest Rapids URB
1996	Umatilla	2,960,413	63.9-71.0	Priest Rapids URB
1997	Umatilla	258,953	7.6-8.1	Priest Rapids URB
1997	Willard	260,968	13.6	Upriver Brights /c
1997	Umatilla	2,580,833	66.0-67.3	Upriver Brights /b

Table 11 continued.

Year of Release	Hatchery	No. Released	No. lb.	Stock
1998	Bonneville	256,910	10.8	Bonneville URB
1998	Willard	179,100	7.8	Upriver Brights /c
1998	Umatilla	2,777,442	64.9-67.7	Priest Rapids URB
1999	Bonneville	449,568	9.0-9.4	Umatilla River
1999	Umatilla	1,842,666	55.9	Upriver Brights /d
2000	Bonneville	235,246	10.9	Umatilla River
2000	Bonneville	234,510	10.1	Umatilla River
2000	Umatilla	975,871	49.0	Priest Rapids URB
2000	Umatilla	2,044,648	48.3	Priest Rapids URB
2001	Bonneville	213,499	9.7	Umatilla River
2001	Bonneville	187,262	9.2	Umatilla River
2001	Umatilla	324,713	45.3	Umatilla River
2001	Umatilla	322,283	33.6	Umatilla River
2002	Bonneville	259,607	9.0	Umatilla River
2002	Bonneville	260,957	8.7	Umatilla River
2002	Umatilla	307,194	40.6	Umatilla River
2002	Umatilla	312,869	39.0	Umatilla River
2003	Bonneville	261,065	13.1	Umatilla River
2003	Bonneville	248,070	10.5	Umatilla River
2003	Umatilla	313,383	54.6	Umatilla River
2003	Umatilla	311,406	56.2	Umatilla River

/a Bonneville, Little White Salmon and Umatilla River broodstock
/b Priest Rapids and Umatilla River broodstock
/c Little White Salmon broodstock
/d Priest Rapids and Little White Salmon broodstock

Table 12. Hatchery releases of coho salmon in the Umatilla River Basin. Data from CTUIR Umatilla Hatchery Satellite Facilities Operation and Maintenance Project.

Year of Release	Hatchery	No. Released	No./lb.	Stock
1966	Little White Salmon	500,000	1312.0	Little White Salmon
1967	Little White Salmon	200,000	1087.0	Little White Salmon
1967	Cascade	500,000	Eggs	Tanner Creek
1968	Little White Salmon	750,000	Eggs	Little White Salmon
1969	Carson	200,040	23.0	Little White Salmon
1987	Cascade	948,549	13.5-14.0	Tanner Creek
1988	Cascade	996,433	16.6	Tanner Creek
1989	Cascade	986,906	15.3-18.2	Tanner Creek
1990	Cascade	988,928	11.2-14.7	Tanner Creek
1991	Cascade	955,629	15.4-17.1	Tanner Creek
1992	Cascade	489,165	15.7	Tanner Creek
1992	Cascade	472,221	15.5	Tanner Creek
1993	Cascade	437,884	17.5	Tanner Creek
1993	Cascade	454,794	17.6	Tanner Creek
1994	Cascade	465,883	17.1	Tanner Creek
1994	Cascade	418,222	18.1	Tanner Creek
1995	Cascade	502,105	14.7	Tanner Cr. & Umatilla R
1995	Cascade	497,449	14.5	Tanner Cr. & Umatilla R
1995	Sandy	191,854	13.9	Tanner Creek
1995	Lower Herman Cr.	322,858	20.3	Tanner Creek
1996	Lower Herman Cr.	465,769	17.9	Tanner Creek
1996	Cascade	500,005	18.0	Tanner Creek
1996	Cascade	511,609	18.6	Tanner Creek
1997	Klaskanine	81,445	18.1	Tanner Creek
1997	Gnat Creek	881,341	15.3	Tanner Cr. & Sandy R.
1997	Lower Herman Cr.	438,153	16.0	Umatilla River
1998	Cascade	1,078,436	16.8	Tanner Creek
1998	Lower Herman Cr.	528,350	16.3	Tanner Creek
1999	Cascade	1,010,608	17.9	Tanner Creek
1999	Lower Herman Cr.	465,314	15.8	Tanner Creek
2000	Cascade	249,792	16.8	Tanner Creek
2000	Cascade	798,210	15.2	Tanner Creek
2000	Lower Herman Cr.	513,288	16.8	Tanner Creek
2001	Cascade	745,497	13.7	Tanner Creek
2001	Cascade	250,323	17.5	Tanner Creek
2001	Lower Herman Cr.	478,739	17.5	Tanner Creek
2002	Cascade	249,684	14.7	Tanner Creek
2002	Cascade	185,018	14.0	Tanner Creek
2002	Cascade	644,680	14.2	Tanner Creek
2002	Lower Herman Cr.	542,475	15.6	Tanner Creek
2003	Cascade	249,988	16.3	Tanner Creek
2003	Cascade	591,349	15.0	Tanner Creek
2003	Cascade	188,971	15.4	Tanner Creek
2003	Lower Herman Cr.	515,859	15.8	Tanner Creek

Table 13. Dates, sites and number of adult lamprey released in the Umatilla River and Meacham Creek. Data from A. Jackson, CTUIR, unpublished.

Date	Site Name	RM	# of adults released
2000-5-08	Umatilla R.-Thornhollow	118.4	150
2000-5-08	Umatilla R.-Bear Cr. confluence	139.9	300
2000-5-08	Meacham Cr. @ Camp Cr. confluence	17.5	150
2001-5-02	Umatilla R.-Thornhollow	118.4	82
2001-5-02	Umatilla R.-Bear Cr. confluence	139.9	81
2001-5-02	Meacham Cr. @ Camp Cr. confluence	17.5	81
2002-4-25	Umatilla R.-Mission	98.8	150
2002-4-29	Umatilla R.-Thornhollow	118.4	100
2002-4-29	Umatilla R.-Bear Cr. confluence	139.9	141
2002-4-29	Meacham Cr. @ Camp Cr. confluence	17.5	100
2003-5-06	Umatilla R.-Thornhollow	118.4	90
2003-5-06	Umatilla R.-Bear Cr. confluence	139.9	110
2003-5-07	Meacham Creek	10	115
2003-5-07	Meacham Cr. @ Camp Cr. confluence	17.5	115
2003-5-09	Iskuulpa Creek	4.8	25
2003-5-09	Iskuulpa Creek	5.0	29

Table 14. Synopsis of non-tribal steelhead angling regulations implemented by ODFW on the Umatilla River 1984-2004.

Year	Season Length	Wild or Hatchery Harvest	Bag Limit Daily/Annual
84-85	Dec 1 – March 31	Wild/Hatchery	2/10
85-86	Dec 1 – March 31	Wild/Hatchery	2/10
86-87	Dec 1 – March 31	Wild/Hatchery	2/10
87-88	Dec 1 – March 31	Wild/Hatchery	2/10
88-89	Dec 1 – March 31	Wild/Hatchery	2/10
89-90	Dec 1 – March 31	Wild/Hatchery	2/10
90-91	Dec 1 – March 31	Wild/Hatchery	2/10
91-92	Dec 1 – March 31	Wild/Hatchery	2/10
92-93	Sept 1 – April 15	Hatchery	2/40
93-94	Sept 1 – April 15	Hatchery	2/40
94-95	Sept 1 – April 15	Hatchery	2/40
95-96	Sept 1 – April 15	Hatchery	2/40
96-97	Sept 1 – April 15	Hatchery	2/20
97-98	Sept 1 – April 15	Hatchery	2/20
98-99	Sept 1 – April 15	Hatchery	2/20
99-00	Sept 1 – April 15	Hatchery	2/20
00-01	Sept 1 – April 15	Hatchery	3/20
01-02	Sept 1 – April 15	Hatchery	3/no limit
02-03	Sept 1 – April 15	Hatchery	3/no limit
03-04	Sept 1 – April 15	Hatchery	3/no limit

Table 15. Summary of steelhead catch statistics, 1992-2001 run years. Data is from creel surveys conducted from the Umatilla River mouth to the western boundary of the Confederated Tribes of the Umatilla Indian reservation near Highway 11. Table from Chess et al. (2003).

Year	No. anglers	Hours fished	No. hatchery steelhead harvested	No. hatchery steelhead released	No. natural steelhead released	Catch rate (fish/h)
1992-93	543	5,293	37	NA	140[a]	0.040
1993-94	577	4,504	19	7	37	0.014
1994-95	1,070	6,172	61	24	172	0.042
1995-96	880	4,560	60	10	162	0.051
1996-97	1,409	6,916	90	25	169	0.048
1997-98	898	6,676	101	43	238	0.057
1998-99	1,179	9,097	101	31	272	0.044
1999-00	1,154	8,545	78	22	454	0.065
2000-01	1,455	7,283	90	24	181	0.041
2001-02	1,624	12,057	204	56	733	0.082

[a] *Includes an undetermined number of hatchery steelhead released.*

Table 16. Summer Steelhead catch statistics from punch cards from 1970-71 through 1991-92. ODFW data.

Run Year	Catch	Run Year	Catch
1970-71	1307	1981-82	630
1971-72	735	1983-84	495
1972-73	1913	1984-85	175
1973-74	326	1985-86	196
1974-75	338	1986-87	133
1975-76	379	1987-88	76
1976-77	116	1988-89	219
1977-78	866	1989-90	400
1978-79	280	1990-91	206
1979-80	878	1991-92	418

Table 17. Tribal harvest of naturally produced or wild steelhead and hatchery produced steelhead in the Umatilla River. Data from Kissner (2003).

Run Year	Wild Catch	Hatchery Catch
1992-93	5	25
1993-94	5	20
1994-95	5	20
1995-96	0	39
1996-97	0	33
1997-98	5	33
1998-99	5	39
1999-00	0	99
2000-01	0	84

Table 18. Statistical summary of spring Chinook salmon sport fishery in the Umatilla River, 1990-2002. There was no sport fishery during years not listed. From Chess et al. (2003).

Year	Survey area[a]	Open Area	Angling Days	Number Anglers	Hours fished	Number Harvested	Number released	Catch rate (fish/h)
1990	Ryan Creek to Forks	Ryan Creek to Forks	12	80	1,248	20	0	0.016
1991	Ryan Creek to Forks	Ryan Creek to Forks	12	235	1,544	23	0	0.015
1993	Yoakum Bridge to wCTUIR	Yoakum Bridge to wCTUIR and	16	39	317	0	0	0.000
	Ryan Creek to Forks	Ryan Creekto forks	16	145	1,211	18	0	0.015
1996	Rieth Bridge to wCTUIR	Rieth Bridge to wCTUIR and	20	428	2,471	205	0	0.083
	Ryan Creek to Forks	Ryan Creek to Forks	20	67	429	1	0	0.002
1997	TMFD to Yoakam Bridge	TMFD to wCTUIR	23	58	812	19	0	0.023
	Yoakam Bridge to wCTUIR		23	337	2,529	12	0	0.005
1999	TMFD to Yoakam Bridge	TMFD to wCTUIR	23	18	21	0	0	0.000
	Yoakam Bridge to wCTUIR		23	222	531	4	2	0.011
2000	Mouth to TMFD	Mouth to wCTUIR	76	1,103	9,198	443	82	0.057
	Yoakum Bridge to wCTUIR		76	214	4,274	141[b]	9	0.035
2001	Mouth to TMFD	Mouth to wCTUIR	76	1,404	10,872	463	13	0.043
	Yoakum Bridge to wCTUIR		76	324	4,053	80	2	0.020
2002	Mouth to TMFD	Mouth to wCTUIR	40	924	10,326	645	11	0.064
	Yoakum Bridge to wCTUIR		53	222	7,227	110	6	0.016

[a] *wCTUIR = west boundary of Confederated Tribes of the Umatilla Indian Reservation (RM); Forks = confluence of Umatilla River north and south forks (river mile 89.5); TMFD = Three Mile Falls Dam (river mile 3.7).*
[b] *Includes an estimated 57 fish caught prior to the initiation of creel surveys.*

Table 19. Spring Chinook harvest estimates for the tribal fishery in the Umatilla River, 1990-2002. Data provided by the CTUIR Natural Production M&E Project. Fishing effort was not estimated.

Year	Number Harvested	Year	Number Harvested
1990	No Surveys	1997	187
1991	82	1998	No fishery
1992	No Fishery	1999	110
1993	176	2000	695
1994	No fishery	2001	247
1995	No fishery	2002	245
1996	167		

Table 20. Synopsis of non-tribal coho (Co) and fall Chinook (ChF) angling regulations implemented by ODFW on the Umatilla River 1989-2004.

Year	Season Length	Open Area	Daily Bag		Season Bag
			Jacks	Adults	
1989	Oct 1 – Nov 30	Below TMFD	10 Co/ChF	2 coho, No ChF	40 adult coho
1990	Oct 1 – Nov 30	Below TMFD	10 Co/ChF	2 coho, No ChF	40 adult coho
1991	Oct 1 – Nov 30	Below TMFD	10 Co/ChF	2 coho, No ChF	40 adult coho
1992	Oct 1 – Nov 30	Below Stanfield Dam	10 Co/ChF	2 coho, No ChF	40 adult coho
1993	Oct 1 – Nov 30	Below Stanfield Dam	10 Co/ChF	2 coho, No ChF	40 adult coho
1994	Oct 1 – Nov 30	Below Stanfield Dam	10 Co/ChF	2 coho, No ChF	40 adult coho
1995	Oct 1 – Nov 30	Below Stanfield Dam	10 Co/ChF	2 coho, No ChF	40 adult coho
1996	Oct 1 – Nov 30	Below Stanfield Dam	10 Co/ChF	2 coho, No ChF	40 adult coho
1997	Oct 1 – Nov 30	Below Stanfield Dam	10 Co/ChF	2 coho, No ChF	20 adult coho
1998	Oct 1 – Nov 30	Below Stanfield Dam	5 Co/ChF	2 coho, No ChF	20 adult coho
1999	Oct 1 – Nov 30	Below Stanfield Dam	5 Co/ChF	2 coho, No ChF	20 adult coho
2000	Sept 1 – Nov 30	Mouth to CTUIR Boundary	5 Co/ChF	2 coho, No ChF	20 adult coho
2001	Sept 1 – Nov 30	Mouth to CTUIR Boundary	5 Co/ChF	2 coho, No ChF	20 adult coho
2002	Sept 1 – Nov 30	Mouth to CTUIR Boundary	5 Co/ChF	2 coho, No ChF	Fin clipped Coho – no limit Non-clipped Coho - 20
2003	Sept 1 – Nov 30	Mouth to CTUIR Boundary	5 Co/ChF	2 coho, No ChF	Fin clipped Coho – no limit Non-clipped Coho - 20

Table 21. Catch and harvest of adult (Ad), jack (Jk), and subjack (SJ) fall chinook and adult and jack coho salmon relative to run size in the Umatilla River, 1992-2001. From Chess et al. (2004).

Run	Number caught			Number harvested			Percent of run caught			Percent of catch harvested		
year	Ad	Jk	SJ	Ad	Jk	SJ	Ad	Jk	SJ	Ad	Jk	SJ
						Fall Chinook						
1992	12	67	71	2	16	22	5.0	NA	NA	16.7	23.9	31.0
1993	13	1	1	9	1	1	3.4	3.6	6.3	69.2	100.0	100.0
1994	18	61	173	10	17	48	2.6	24.1	41.6	55.6	27.9	27.7
1995	34	12	76	5	10	31	5.6	4.0	20.6	14.7	83.3	40.8
1996	63	0	227	15	0	163	9.5	0.0	29.5	23.8		71.8
1997	53	105	130	11	83	95	14.5	36.2	45.8	20.8	79.0	73.1
1998	46	26	95	3	17	67	15.9	15.2	32.0	6.5	65.4	70.5
1999	51	21	92	4	8	44	6.9	14.5	46.9	7.8	38.1	47.8
2000	60	35	739	18	27	543	9.1	7.5	13.5	30.0	77.1	73.5
2001	153	69	138	8	53	103	13.3	5.7	12.9	5.2	76.8	74.6
Mean	**50**	**40**	**174**	**9**	**23**	**112**	**8.6**	**12.3**	**27.7**	**25.0**	**63.5**	**61.1**
						Coho						
1992	44	88		35	70		11.3	36.2		79.5	79.5	
1993	49	4		49	4		3.1	18.2		100.0	100.0	
1994	44	31		21	12		4.4	41.9		47.7	38.7	
1995	30	25		23	25		3.1	32.1		76.7	100.0	
1996	44	51		44	51		6.6	68.0		100.0	100.0	
1997	37	158		37	134		5.2	58.3		100.0	84.8	
1998	56	37		56	33		1.8	16.4		100.0	89.2	
1999	234	70		184	56		7.2	26.8		78.6	80.0	
2000	129	133		79	112		2.7	9.6		61.2	84.2	
2001	1,736	23		455	7		7.5	26.4		26.2	30.4	
Mean	**240**	**62**		**98**	**50**		**5.3**	**33.5**		**77.0**	**78.7**	

Appendix C: Terrestrial Focal Species Accounts

Species accounts for the 10 terrestrial focal species selected for the Umatilla/Willow subbasin are given below. These species accounts were provided to subbasin planners at the Council website http://www.nwppc.org/fw/subbasinplanning/admin/species/Default.asp#null. The authors of each species account are listed, although some selections have been edited.

PILEATED WOODPECKER
Dryocopus pileatus

Species Account Author: Charles Gobar, United States Forest Service

LIFE HISTORY, KEY ENVIRONMENTAL CORRELATES, AND HABITAT REQUIREMENTS
Migration Status: Permanent resident

Breeding Habitat: Woodland

Nest Type: Cavity

Clutch Size: 3-5

Length of Incubation: 15-18 days

Days to Fledge: 26-28

Number of Broods: 1

Diet

Feeds extensively on carpenter ants (*Camponotus* spp.) and beetle larvae obtained by chiseling into standing trees, stumps, and logs; also digs into anthills on ground and eats other insects, fruits, and seeds (Hoyt 1957). In Wisconsin, Nicholls (1994) found the cerambycid wood borer, *Trigonarthris*, to be the major prey of pileated woodpeckers feeding at dead American elms (*Ulmus americana*). The preference of the birds for feeding at larger trees seemed related to the requirement of the beetles for larger trees as their habitat. There tends to be seasonal variation in the diet and foraging strategy to take advantage of available foods. More fruit and seeds are taken in late summer and fall (Conner 1979, Hoyt 1948, Sprunt and Chamberlain 1970); more excavation for arthropods is done in winter (Conner 1979, Hoyt 1948, Pfitzenmeyer 1956, Tanner 1942). Quantitative studies of diet include stomach content and scat analysis. In a range-wide, year-round study, Beal (1911) found 80 stomachs to include 22% beetles (*Cerambycidae, Buprestidae, Elateridae, Lucanidae, Scarabaeidae, Carabidae*), 40% ants (*Camponotus sp., Crematogaster sp.*), 11% other insects, and 27% vegetable (numerous fruits, see Bull and Jackson 1995). Analyses of 330 scats in Oregon revealed 68% carpenter ants, 29% thatching ants (*Formica*), 0.4% beetles, and 2% other. The species is opportunistic, known to take advantage of insect outbreaks (e.g., western spruce budworm (*Choristoneura occidentalis*) Bull and Jackson 1995), the progression of fruiting trees in an area (Stoddard 1978), and to visit suet feeders in many areas of eastern North America (Connecticut, Hardy 1958; Mississippi, Jackson, pers. obs.; Tennessee, Spofford 1947; Georgia, Stoddard 1978; Minnesota, Tusler 1958).

Logs and stumps are important foraging substrates in many areas (e.g., Mannan 1984, Renken and Wiggers 1989, Schardien and Jackson 1978), but Aubry and Raley (1992) rarely observed foraging on logs in closed canopy forests of western Washington. Mannan (1984) found the pileated to forage on dead wood substrates 96% of the time.

Reproduction

Pairs share a territory year round (Bull and Jackson 1995). On warm days of February and early March in the southeastern U.S. and March through early April in northern areas there is an increase in vocalizations and drumming associated with pair formation and increased territoriality. Vocalizations and drumming take place with greatest frequency in early morning and late afternoon (Hoyt 1941). Courtship behavior is described in detail by Kilham (1979, 1983), with additional details and circumstances by Arthur (1934), Hoyt (1944), and Oberman (1989). Nest construction, egg-laying, hatching, and fledging are also progressively later from south to north (Bull and Jackson 1995) and likely from lower to higher altitudes (at least in California, Harris 1982).

Early egg dates in the southern U.S. are in early March; late egg dates, from northern areas, are in mid-June. Similarly, nestlings have been found from mid-May in the southeast to mid-July in the north (Bull and Jackson 1995, Peterjohn 1989). Young remain with adults at least through late summer or early fall. Clutch size is usually 3-4 throughout the range (Bent 1939, Christy 1939); a clutch of 6 was reported by Audubon and Chevalier (1842). Incubation takes 15-19 days (Bendire 1895, Hoyt 1944, Kilham 1979), by both sexes. Young are tended by both parents, leave nest at 22-26 days (Hoyt 1944, Bull and Jackson 1995).

Longevity records thus far include several birds surviving for 9 years (Bull and Jackson 1995, Bull and Meslow 1988, Hoyt and Hoyt 1951, Hoyt 1952). However, through 1981, there had only been 15 recoveries from a total of 670 banded (Clapp et al. 1983), thus it is quite possible that this species could live much longer.

Migration

Although generally considered to be a resident species, there is evidence of some migratory movement in the northern part of its range. Hall (1983) reported a small southward movement of pileated woodpeckers in fall along the Allegheny Front of West Virginia. Sutton (1930) also noted gradual southward movement in fall through New York State. In British Columbia, the paucity of winter records in the northern half of the province indicates that many breeding individuals there move considerable distances to the south (Campbell et al. 1990).

Threats

Major threats are (from greatest to least): (1) conversion of forest habitats to non-forest habitats, (2) short rotation, even-age forestry, (3) monoculture forestry, (4) forest fragmentation, (5) removal of logging residue, downed wood, and pine straw that would ultimately put nutrients back into the ecosystem and provide foraging substrate, (6) lightning striking cavity/roost trees because they are the oldest, tallest trees around as a result of cutting priorities, (7) deliberate killing by humans, and (8) toxic chemicals. The first four threats are ones that have been a major concern for some time.

As an example of habitat losses, nonfederal forested wetlands decreased by 5 million acres in the continental U.S. between 1982 and 1987 (Cubbage and Flather 1992). Forest fragmentation has been recognized as a major problem for many wildlife species (e.g., Wilcove 1990), but it results in habitat changes within as well as between fragments. In the southeast, smaller fragments tend to become drier (hence less conducive to conditions favorable to the pileated) and also change in plant species composition and tend towards younger successional stages (Rudis 1992). Removal of logging residue, downed wood, and pine straw from forested areas is becoming increasingly common. Considerable research directed at finding ways to maximize economic returns from the forest through such actions is being conducted by the U.S. Forest Service and others (e.g., Howard and Setzer 1989) and pine straw is currently sold on some southern forests. Removing these materials not only removes the nutrients they contain and foraging substrates for pileated woodpeckers and others, but also changes the water balance of the forest floor, making the forest a drier environment less suitable for the arthropod fauna the woodpecker is dependent on.

Shooting by humans was a serious problem in the past (e.g., Sclater 1912, Stoddard 1947) and continues in some areas (Jackson, pers.obs.). The birds are an impressive and easy target and in some quarters are considered to harm trees. Becker (1942) offered one of the most detailed accounts of the disappearance of the species. Toxic chemicals can affect woodpeckers in two ways: (1) by direct poisoning and (2) by killing their arthropod prey. Careless use of agricultural chemicals and widespread control programs such as have been conducted in the past against the imported fire ant can have both affects. In addition, when woodpeckers nest in chemically treated utility poles, embryos or chicks can be killed by the fumes (Rumsey 1970).

In the eastern U.S., rat snakes (*Elaphe obsoleta*) have been reported as nestling predators (Gress and Wiens 1983, Kilham 1959, Moore 1984). Both sharp-shinned (*Accipiter striatus*; Smith 1983) and Cooper's (*A. cooperi*; Michael 1921) hawks are known as potential predators on pileated woodpeckers. Erdman (pers. comm.) has found remains of adults and juveniles at goshawk (*A. gentilis*) nests in Wisconsin. The sharp-shinned hawk is certainly more of a threat to fledglings than to adults. Todd (1944) reported predation by a gray fox (*Urocyon cinereoargenteus*) on a ground-feeding pileated in Tennessee. Because they feed extensively on the ground, woodpeckers are vulnerable to being killed by vehicles as they approach or leave feeding sites (e.g., Eifrig 1944), an argument for keeping downed wood away from highway rights-of-ways.

Habitat Requirements (Nesting, Breeding, Non-breeding)

General

Dense deciduous (favored in southeast), coniferous (favored in north, northwest and west), or mixed forest, open woodland, second growth, and (locally) parks and wooded residential areas of towns. Prefers woods with a tall closed canopy and a high basal area. Most often in areas of extensive forest or minimal isolation from extensive forest. Uses a minimum of 4 cavities per year (only one for raising brood).

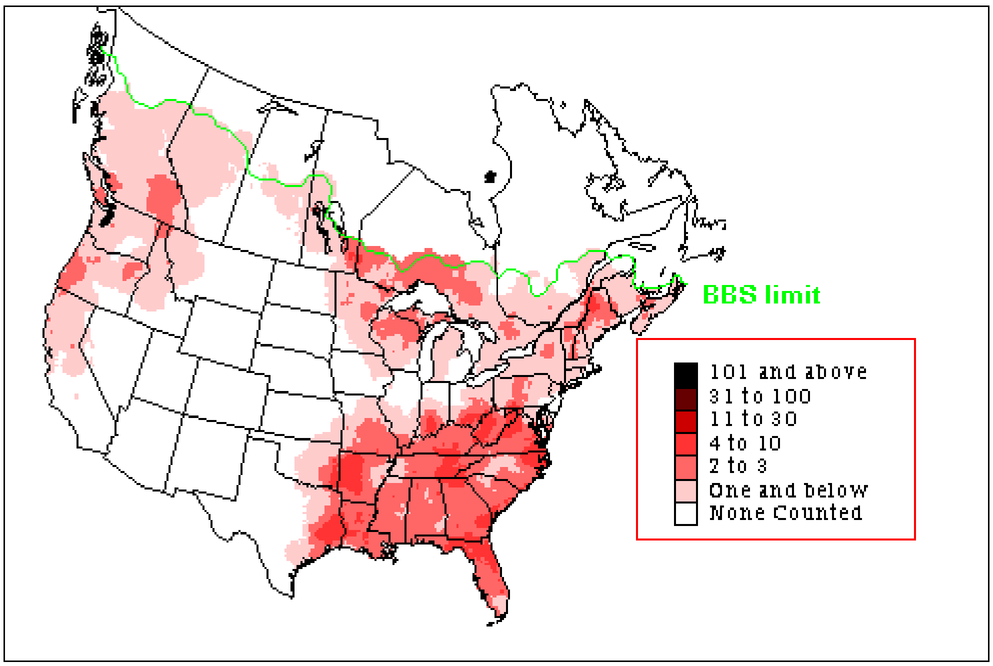
Nesting

Nests are in cavities excavated by both sexes usually in dead stubs in shaded places; cavity entrance averages about 14 m above ground (see photos and descriptions in Harrison 1975, 1979). Usually digs a new hole for each year's brood, but the same cavity may be used for several years. Nest tree species and size varies among regions and even within regions depending on site and availability. In southern British Columbia, preferred nest sites were in live aspen with heartwood decay, in trees larger than 40 cm dbh (Harestad and Keisker 1989). In northwest

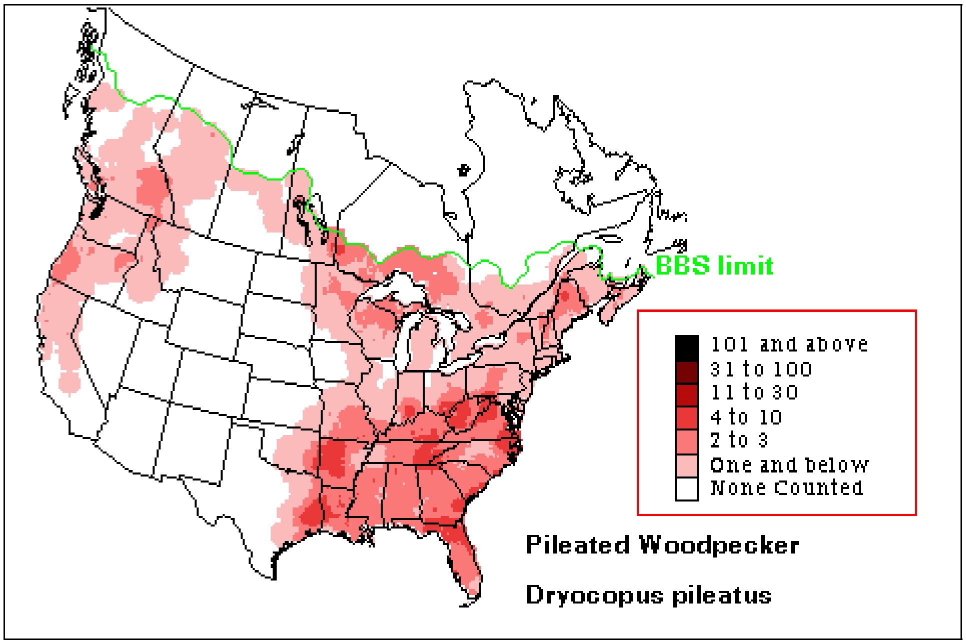
Montana, most of 54 nest trees were large western larch (*Larix occidentalis*) and nest trees averaged 74.9 cm dbh (McClelland 1979). In northeast Oregon, 75% of nest trees were ponderosa pine (*Pinus ponderosa*) and mean dbh of nest trees was 84 cm (Bull 1987). In western Oregon, 73% of nest trees were Douglas-fir (*Pseudotsuga menziesii*) and nest trees averaged 69 cm dbh (Mellen 1987). In Virginia, 28% of nest trees were hickory (*Carya spp*.), 22% red oak (*Quercus rubra*), 17% chestnut oak (*Q. prinus*) and nest trees averaged 54.6 cm dbh (Conner et al. 1975). Most studies report nests 5-17 m above ground in wood softened by fungal rot, in trees usually 100-180 years old, over 51 cm DBH, 12-21 m tall, and often near permanent water (Bushman and Therres 1988).

Population and Distribution (historic and current)

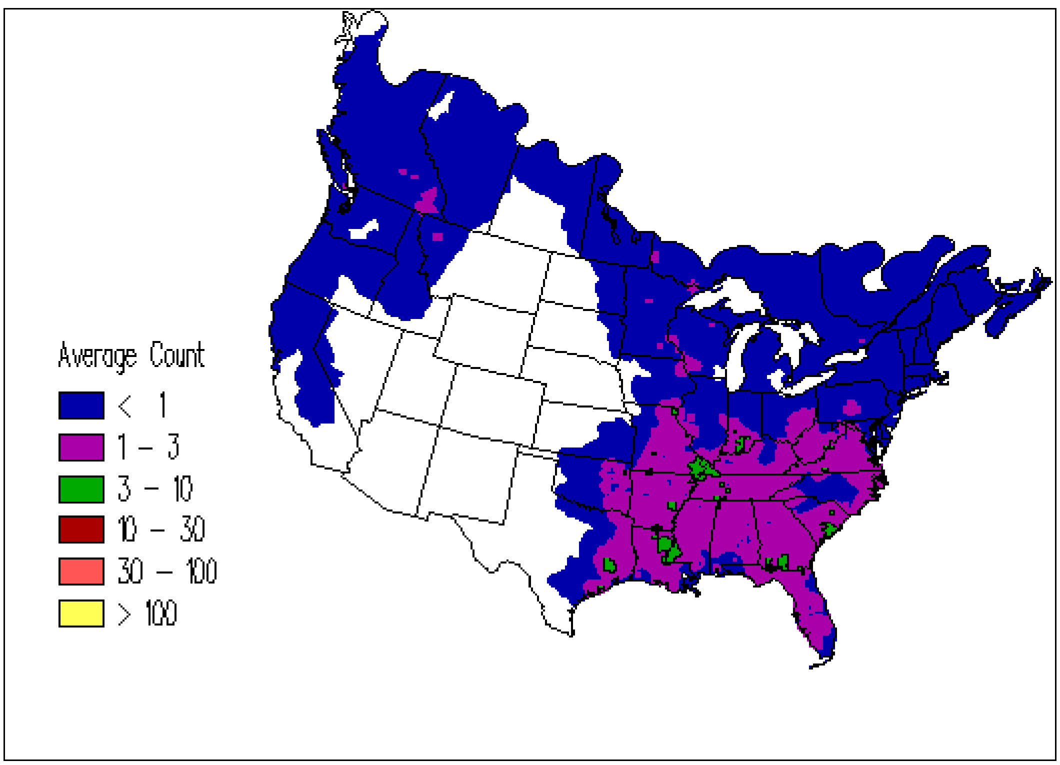
Current Summer Distribution Map and Abundance (from CBC data) (Sauer et al. 2003

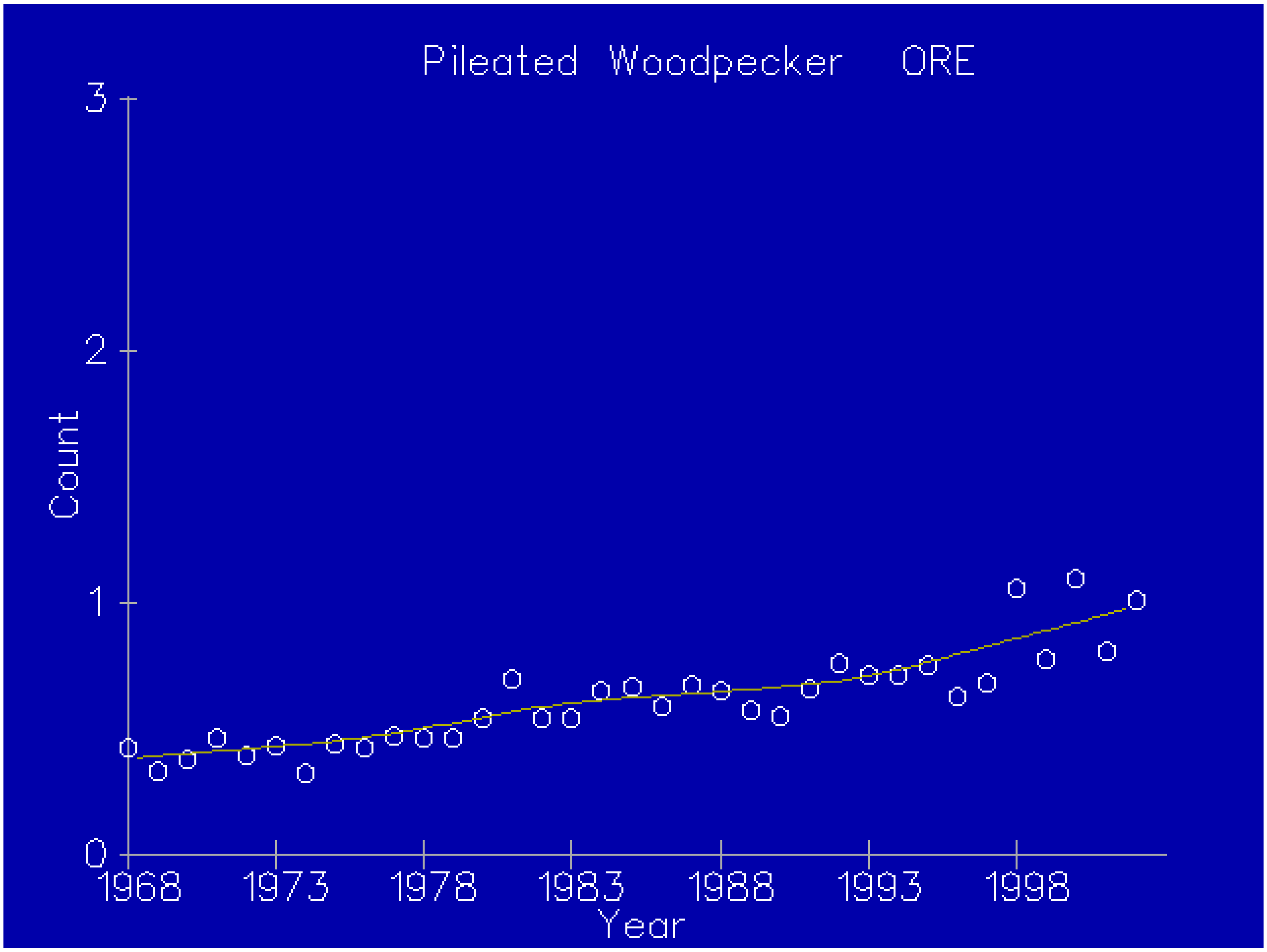


Current Breeding Distribution and Abundance (from CBC data) (Sauer et al. 2003)



Current Winter distribution from CBC





Pileated Woodpecker Population Trend Data, Oregon (From BBS)

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WHITE-HEADED WOODPECKER
Picoides albolarvatus

Original Species Account Authors: Paul Ashley and Stacy Stoval, as appeared in the Southeast Washington Ecoregional Assessment, January 2004

Introduction

The white-headed woodpecker (*Picoides albolarvatus*) is a year round resident in the Ponderosa pine (*Pinus ponderosa*) forests found at the lower elevations (generally below 950m). White-headed woodpeckers are particularly vulnerable due to their highly specialized winter diet of ponderosa pine seeds and the lack of alternate, large cone producing, pine species.

Nesting and foraging requirements are the two critical habitat attributes limiting the population growth of this species of woodpecker. Both of these limiting factors are very closely linked to the habitat attributes contained within mature open stands of Ponderosa pine. Past land use practices, including logging and fire suppression, have resulted in significant changes to the forest structure within the Ponderosa pine ecosystem.

White-headed Woodpecker Life History, Key Environmental Correlates, and Habitat Requirements

Life History

Diet

White-headed woodpeckers feed primarily on the seeds of large Ponderosa pines. This is makes the white-headed woodpecker quite different from other species of woodpeckers who feed primarily on wood boring insects (Blood 1997; Cannings 1987 and 1995). The existence of only one suitable large pine (ponderosa pine) is likely the key limiting factor to the white-headed woodpecker's distribution and abundance.

Other food sources include insects (on the ground as well as hawking), mullein seeds and suet feeders (Blood 1997; Joe *et al.* 1995). These secondary food sources are used throughout the spring and summer. By late summer, white-headed woodpeckers shift to their exclusive winter diet of ponderosa pine seeds.

Reproduction

White-headed woodpeckers are monogamous and may remain associated with their mate throughout the year. They build their nests in old trees, snags or fallen logs but always in dead wood. Every year the pair bond constructs a new nest. This may take three to four weeks. The nests are, on average 3m off the ground. The old nests are used for overnight roosting by the birds.

The woodpeckers fledge about 3-5 birds every year. During the breeding season (May to July) the male roosts in the cavity with the young until they are fledged. The incubation period usually lasts for 14 days and the young leave the nest after about 26 days. White-headed woodpeckers have one brood per breeding season and there is no replacement brood if the first brood is lost. The woodpeckers are not very territorial except during the breeding season. They are not especially social birds outside of family groups and pair bonds and generally do not have very dense populations (about 1 pair bond per 8 ha).

Nesting
Generally large ponderosa pine snags consisting of hard outer wood with soft heartwood are preferred by nesting white-headed woodpeckers. In British Columbia 80 percent of reported nests have been in ponderosa pine snags, while the remaining 20 percent have been recorded in Douglas-fir snags. Excavation activities have also been recorded in Trembling Aspen, live Ponderosa pine trees and fence posts (Cannings *et al.* 1987).

In general, nesting locations in the South Okanagan, British Columbia have ranged between 450 - 600m (Blood 1997), with large diameter snags being the preferred nesting tree. Their nesting cavities range from 2.4 to 9 m above ground, with the average being about 5m. New nests are excavated each year and only rarely are previous cavities re-used (Garrett *et al.* 1996).

Migration
The white-headed woodpecker is a non-migratory bird.

Habitat Requirements
Breeding
White-headed woodpeckers live in montane, coniferous forests from British Columbia to California and seem to prefer a forest with a relatively open canopy (50-70 percent cover) and an availability of snags (a partially collapsed, dead tree) and stumps for nesting. The birds prefer to build nests in trees with large diameters with preference increasing with diameter. The understory vegetation is usually very sparse within the preferred habitat and local populations are abundant in burned or cut forest where residual large diameter live and dead trees are present.

Highest abundances of white-headed woodpeckers occur in old-growth stands, particularly ones with a mix of two or more pine species. They are uncommon or absent in monospecific ponderosa pine forests and stands dominated by small-coned or closed-cone conifers (e.g., lodgepole pine or knobcone pine).

Where food availability is at a maximum such as in the Sierra Nevadas, breeding territories may be as low as 10 ha (Milne and Hejl 1989). Breeding territories in Oregon are 104 ha in continuous forest and 321 ha in fragmented forests (Dixon 1995b). In general, open Ponderosa pine stands with canopy closures between 30-50% are preferred. The openness however, is not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989). In the South Okanagan, British Columbia, Ponderosa pine stands in age classes 8 -9 are considered optimal for white-headed woodpeckers (Haney 1997). Milne and Hejl (1989) found 68 percent of nest trees to be on southern aspects, this may be true in the South Okanagan as well, especially, towards the upper elevational limits of Ponderosa pine (800 - 1000m).

White-headed Woodpecker Population and Distribution
Population
Historic
No data are available.

Current
No data are available.

Distribution

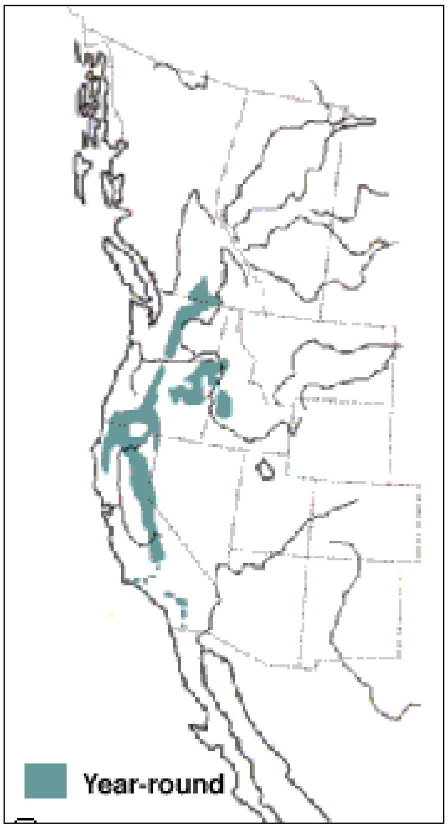
Historic

No data are available.

Current

These woodpeckers live in montane, coniferous forests from southern British Columbia in Canada, to eastern Washington, southern California and Nevada and Northern Idaho in the United States. The exact population of the white-headed woodpecker is unknown but there are thought to be less than 100 of the birds in British Columbia.

Woodpecker abundance appears to decrease north of California. They are uncommon in Washington and Idaho and rare in British Columbia. However, they are still common in most of their original range in the Sierra Nevada and mountains of southern California. The birds are non-migratory but do wander out of their range sometimes in search of food.



White-headed Woodpecker Status and Abundance Trends

Status

Although populations appear to be stable at present, this species is of moderate conservation importance because of its relatively small and patchy year-round range and its dependence on mature, montane coniferous forests in the West. Knowledge of this woodpecker's tolerance of forest fragmentation and silvicultural practices will be important in conserving future populations.

Trends

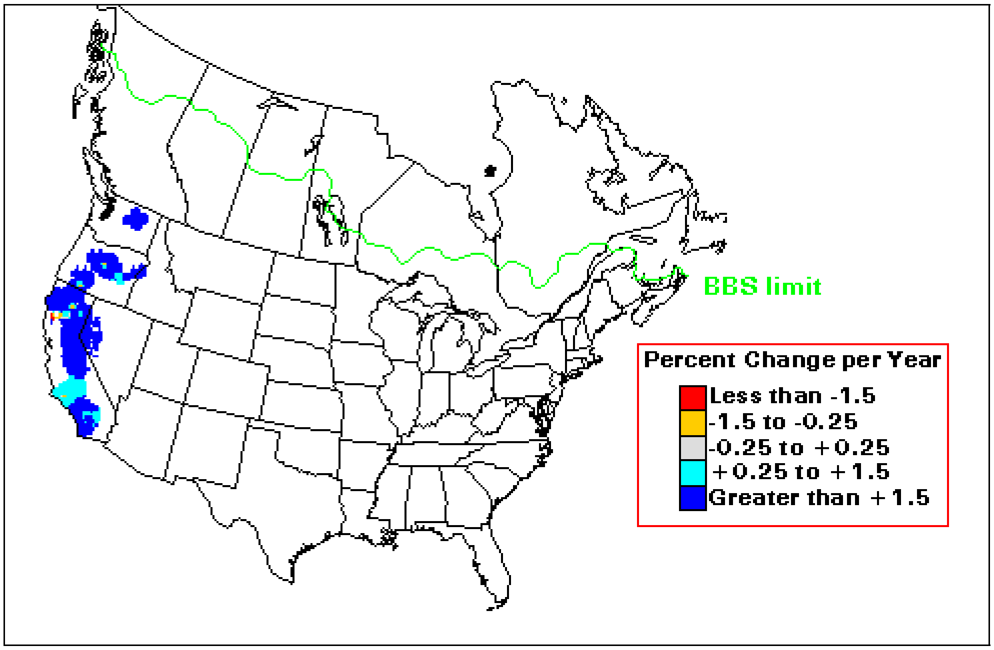


Figure 1. White-headed woodpecker Breeding Bird Survey (BBS) population trend: 1966-1996 (Sauer *et al.* 2003).

Factors Affecting White-headed Woodpecker Population Status
Key Factors Inhibiting Populations and Ecological Processes
Logging

Logging has removed much of the old cone producing pines throughout the South Okanagan. Approximately 27, 500 ha of ponderosa pine forest remain in the South Okanagan and 34.5 percent of this is classed as old growth forest (Ministry of Environment Lands and Parks 1998). This is a significant reduction from the estimated 75 percent in the mid 1800s (Cannings 2000). The 34.5 percent old growth estimate may in fact be even less since some of the forest cover information is incomplete and needs to be ground truthed to verify the age classes present. The impact from the decrease in old cone producing ponderosa pines is even more exaggerated in the South Okanagan because there are no alternate pine species for the white-headed woodpecker to utilize. This is especially true over the winter when other major food sources such as insects are not available. Suitable snags (DBH>60cm) are in short supply in the South Okanagan.

Fire Suppression

Fire suppression has altered the stand structure in many of the forests in the South Okanagan. Lack of fire has allowed dense stands of immature ponderosa pine as well as the more shade tolerant Douglas-fir to establish. This has led to increased fuel loads resulting in more severe stand replacing fires where both the mature cone producing trees and the large suitable snags are destroyed. These dense stands of immature trees has also led to increased competition for nutrients as well as a slow change from a Ponderosa pine climax forest to a Douglas-fir dominated climax forest.

Predation

There are a few threats to white-headed woodpeckers such as predation and the destruction of its habitat. Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers.

There is also predation by the great horned owl on adult white-headed woodpeckers. However, predation does not appreciably affect the woodpecker population.

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RED-NAPED SAPSUCKER
Sphyrapicus nuchalis

Original Species Account Author: Charles Gobar, United States Forest Service

Introduction
The red-naped sapsucker (*Sphyrapicus nuchalis*) occurs in the inland West, inhabiting montane coniferous forests mixed with deciduous groves of aspen (*Populus spp*.), cottonwood (*Populus spp.*), and willow (*Salix spp*.). The sapsucker creates nest cavities and sap wells that are used by other birds, mammals and insects. Considered a double key stone species as its nest cavities are sued by secondary cavity-nesters and its sp wells provide food for a variety of other animal, from insects to other birds to squirrels (Daily et al. 1993). Locally common, populations are generally stable to increasing, but there is concern over loss of aspen and cottonwood nesting habitat and large snags for nest cavities.

Life History, Key Environmental Correlates, and Habitat Requirements
Life History
Diet
In general, the sapsucker diet includes sap, cambium and soft parts beneath the bark. Neat rows of holes are drilled in the bark or the bark may be removed in strips to collect the oozing sap and insects attracted to it (Marshall et al. Eds. 2003). Rows of small holes are drilled in conifer and broad-leaved trees and the sapsucker. The amount of sap taken and tree species used vary seasonally (Scott et al. 1977). Sap is most important in seasons when insects are not abundant. The sapsucker also feeds on insects caught in the sap. Other foods items the bird feeds on include tree cambium, ants, larvae, beetles, wasps, caterpillars, and small amounts of fruit and berries (Scott et al. 1977, Marshall et al. Eds. 2003). [NatureServe 2003]

Reproduction
Courtship and territorial displays may involve drumming and posturing and calling during the breeding season. Territories for red-naped sapsucker range from 1.6 to > 14.6 acres (Marshall et al. Eds. 2003). In the Pacific Northwest, territory size reported to be about 10 acres (Bull 1978 *in* NatureServe 2003) in size. In California, defends territories 0.6 to 6.0 hectares in size (USDA Forest Service 1994 *in* NatureServe 2003). Both sexes begin excavating a nest cavity before copulating. Three to seven eggs are laid and young are in the nest cavity from mid-May to late July (Gabrielson and Jewett 1970, and Anderson 1988e, Anderson 1989d, and Spencer 2000b *in* Marshall et al. Eds. 2003)

The red-naped sapsucker is known to hybridize with red-breasted sapsucker (*Sphyrapicus ruber*) and yellow-bellied sapsucker (*Sphyrapicus varius*) where distributions overlap. The outcome may produce viable hybrid offspring; hybrid and backcross mating (Scott et al. 1976, Johnson and Johnson 1985 *in* NatureServe 2003).

Nesting
Typically, four to five eggs are laid and incubated by both female and male sapsuckers. Eggs are incubated 12-13 days and fledging occurs in 25-26 day; both sexes attend young (Ehrlich et al. 1988 *in* NatureServe 2003). In Colorado, nests with eggs were recorded throughout June. Nestlings were noted from late June to mid-July in Montana and Wyoming (Johnsgard 1986 *in* NatureServe 2003). In central Arizona, 100 percent of 18 nests monitored successfully fledged

young (Li and Martin 1991 *in* NatureServe 2003). Re-use of same nest tree, but with a new cavity, each year suggests strong site fidelity (USDA Forest Service 1994 *in* NatureServe 2003).

Migration
The red-naped sapsucker is a local migrant and a long distance migrant. Arrives in northern Rocky Mountains mainly April-May, with peak arrival from late April to early May. Fall migration occurs from mid August o mid October (Gabrielson and Jewett 1970). The red-naped woodpecker is a transient and winter visitor in northwestern Mexico from late September to mid-April (Howell and Webb 1995 in NatureServe 2003).

Mortality
No information is available on survival rates.

Harvest
Not applicable.

Historic
Not applicable.

Current
Not applicable.

Habitat Requirements
The red-naped sapsucker responds to habitat mosaic that includes broad-leaved trees (e.g. aspen, birch, and cottonwood) for nesting and adjacent coniferous forest and/or willows for foraging (Ehrlich and Daily 1988 *in* NatureServe 2003, Tobalske 1992). Typically found in riparian habitats especially aspen, as well as cottonwoods, alders, and pine forest, and less frequently in mixed conifer forests (Marshall et al. Eds. 2003). Known to use natural edges of mature conifer and deciduous hardwood habitats. Gabrielson and Jewett (1970) and Browning (1973b *in* Marshall et al. Eds. 2003) found sapsucker nests more abundant between 6,000 and 7,000 feet in the Blue Mountains. Numerous nests were found in two area of south-central Oregon, at elevations from 5,200-6,600 feet and 6,650-7,550 feet (Dobkin et al. 1995 and Trombino 1998 *in* Marshall et al. Eds. 2003).

In a Colorado study, abundance did not vary with differences in understory (herbaceous, short shrub, tall shrub) of mature aspen stands (Finch and Reynolds 1987 *in* NatureServe 2003). In a study of Idaho cottonwoods gallery forest, there appeared to be no significant sensitivity to patch size, although birds were more often detected in large patches (more than 25-495 ac. 0.21 birds per point count visit) than in small patches (less than 2-7 acres; 0.12 birds per point count visit; Saab 1998).

Will use forest edges and logged forests, but extensive clearcuts or the removal of snags and preferred tree species would be detrimental. Also will use burns, partially cut forests and small clearcuts where snags and live hardwood trees remain and adjacent forest is available for foraging (Bock and Lynch 1970,and Tobalske 1992 *in* NatureServe 2003).

Nesting
A primary cavity nester, excavates a nest hole in a snag or a living tree with a dead or rotten interior, and shows a strong preference for aspen (Johnsgard 1986, Li and Martin 1991, and

Daily et al. 1993 *in* NatureServe 2003). The red-naped sapsucker will also use cottonwood (*Populus spp.*), alder (*Alnus spp.*), western larch (*Larix occidentalis*), ponderosa pine, lodgepole pine ((*Pinus contorta*); USDA 1991. Aspen nest trees often have heartwood decay brought about by shelf fungus (*Fomes igniarius var. populinus*), a heart rot that infects roots and dead branch stubs and spreads from the base of trees upward, but leaves the sapwood intact (Kilham 1971, Crockett and Hadow 1975, Daily et al. 1993, and Dobkin et al. 1995 *in* NatureServe 2003). Seventy-two percent of live aspen with woodpecker-excavated cavities at Hart Mountain had visible fungi. Of the 25 nests in riparian and snowpocket aspen woodlands on Hart Mountain, 92-100 percent were in aspens. Dead trees (8%) and live trees (92%) were used in proportion to availability (Dobkin et al. 1995).

In a Colorado study; sapsuckers placed the first nest cavity close to ground and then excavated progressively higher cavities in subsequent years. Nest cavities were usually freshly excavated during the season of use and most nests were in trees bearing nest cavities excavated during previous years. Nest height averaged 8.8 feet in trees with no other cavities and 19.7 feet in trees with more than one cavity (Daily et al. 1993). In a study in Colorado and Wyoming, sapsuckers used both healthy aspen and aspen infected by shelf fungus, nested in trees 6.7 to 16.5 inches dbh (mean 12.2 inches dbh) and used cavities that were 3.3 to 36 feet high (mean 16.4 feet; Crockett and Hadow 1975).

In the Hart Mountain study (Dobkin et al. 1995 *in* NatureServe 2003) mean diameter at breast height was 10.8 inches, tree height was 47.9 feet, cavity height was 13.8 feet and entrance diameter was 1.7 inches. Less than 4 percent of all aspens were greater than 33 feet in height and greater than 9 inches in diameter at breast height, yet were preferred as nest trees. No nests were located along the riparian woodland edge nor were any oriented in that direction. Nest trees on average were located 65.6 feet from edges, and the mean canopy cover was 76 percent (Dobkin et al. 1995 *in* Marshall et al. Eds. 2003).

In Oregon and Washington, the red-naped was reported to nest in snags greater than or equal to 10 inches diameter breast height and nest heights at least 15 feet in height (Thomas et al. 1979). In the Blue Mountains of northeast Oregon, of eight nests, seven (88%) were within 330 feet of open water. Nests were in western larch, lodgepole pine, Douglas-fir, grand fir, and ponderosa pine; two were in live trees. Trees retained 70-100 percent of original bark and were likely dead less than 10 years. Mean diameter at breast height was 20 inches, trees height was 66 feet, and cavity height was 30 feet (Bull 1980 *in* Marshall et al. Eds. 2003). In western larch/Douglas-fir (*Pseudotsuga menziesii*) forests of northwestern Montana, red-naped sapsuckers nested in both small and large trees, ranging from 22 to 46.8 inches diameter at breast height and averaging 22.8 inches diameter at breast height (McClelland et al. 1979 *in* NatureServe 2003).

In mixed coniferous forest in northeast Oregon, densities per 100 acres were 0-0.5 in old growth (Mannan 1982 *in* Marshall et al. Eds. 2003). In mixed coniferous and aspen forest (six sights ranging from 1-98 percent aspen) at 9,000 feet on the west slope of the Rocky Mountains, in Colorado densities ranged 0-3 birds per 100 acres (Scott and Crouch *in* Marshall et al. Eds. 2003).

Breeding

The red-naped sapsucker primarily breeds in coniferous forests that include aspen and other hardwoods vegetation types. In the Northern Rockies, most abundant in cottonwood and aspen forests, also observed in other riparian cover types and in harvested conifer forests. Of harvest types, most observations were in patch cuts, seed-tree cuts, clearcuts and older clearcuts. Birds in harvested stands and in drier conifer forests were probably associated with patches of deciduous trees (Hutto and Young 1999 *in* NatureServe 2003). In the Centennial Mountains, Idaho, the sapsucker uses xeric tall willow (*Salix spp*.) communities (Douglas et al. 1992). In Wyoming and Colorado, closely associated with aspen and mixed habitats (Finch and Reynolds 1988 *in* NatureServe 2003). In Colorado subalpine forests, significantly associated with habitats where aspen occurs near (less than 164 feet) willow, and used the willow for foraging (Ehrlich and Daily 1988, Daily et al. 1993). In the Pacific Northwest, typically breeds in aspen, riparian cottonwood, ponderosa pine, mixed conifer, and white fir (*Abies concolor*) forests (Bull 1978 *in* NatureServe 2003).

Foraging
The sapsucker drills for sap in conifer (e.g., western larch, pine) and deciduous trees (e.g. aspen, willow, cottonwood and birch (*Betula spp*.). In Oregon, aspen, willow, elm, apple, and ornamental pine trees are used often for foraging. In California, the red-naped drilled in and around pitchy bole wounds on ponderosa pine that were the result of earlier overstory removal and porcupine feeding (Oliver 1970 *in* NatureServe 2003). Sap well attract insects and are used for drinking sap.

Non-breeding
During migration and winter the sapsucker tends to use various forest and open woodland habitats, parks, orchards, and gardens (AOU 1998). In northwestern Mexico found in forests and edge feeding at mid- to upper levels; may overlap with wintering yellow-bellied sapsuckers in north-central Mexico and red-breasted sapsuckers in northern Baja California (Howell and Webb 1995 in NatureServe 2003). In western Mexico, Hutto (1992 in NatureServe 2003) found red-naped sapsucker only in pine-oak-fir forests.

Management
Sustaining populations of red-naped sapsuckers requires maintaining, enhancing, and restoring snags, riparian woodlands, and hardwood stands of aspen or cottonwood adjacent to coniferous forest. Both snags and live trees retained for the species should include a mix of hardwood and conifer species, particularly near riparian areas and mesic sites (USDA Forest Service 1994 *in* NatureServe 2003). Aspen and other trees with shelf fungus (*Fomes ignlarius populinus*) should be retained to provide optimal conditions for nest cavities. Access to conifer sap in adjacent forest is also important in the early spring, and to birches and aspens after bud-break (Tobalske 1992).

Partners in Flight have established biological objectives for this species in riparian woodland habitat for the Northern Rocky Mountains of Eastern Oregon and Washington (Altman 2000). These include providing and maintaining habitats that meet the following definition: large trees and snags, especially aspen and cottonwood, with adequate representation of younger seral stages for replacement (i.e., greater than 10 percent cover of sapling in the understory); greater than 1.5 trees (live) per acre and greater than 1.5 snags per acre, greater than 39 feet in height and 10 inches in diameter at breast height; and mean canopy cover between 30 to 70 percent, either clumped with patches and openings or relatively evenly distributed (Altman 2000). In addition, were ecologically appropriate, initiate actions in aspen habitat to provide areas with natural (e.g., fire) or mechanical disturbance to provide successional development in the stand (Altman 2000). Sustaining populations requires maintaining, enhancing, and restoring snags, riparian woodland, and hardwood stands of aspen, birch, and cottonwood adjacent to coniferous forest.

Population and Distribution
Population
Historic
Historic population data was not available for this species.

Current
The red-naped populations appear to be stable to increasing overall, with areas of local declines, perhaps related to loss of cottonwood, and aspen nesting habitats. However, North American Breeding Bird Surveys (BBS) trend estimates confounded because of changes in sapsucker taxonomy splitting red-naped from yellow-bellied sapsucker (*Sphyrapicus varius*) and BBS sampling and sample size are minimal for analysis for most states and physiographic regions. The BBS data indicates a nonsignificant population increase in North America Between 1966 and 1996 (1.3 percent average increase per year), and a steep and significant increase between 1980 and 1996 (4.5 percent average increase per year (Sauer et al. 2003).

Most likely including yellow-bellied sapsucker data (vs. only red-naped data), Thomas, et al (1979) estimated that 150 snags per 100 acres, greater than or equal to 10 diameter at breast height were necessary to support the "maximum population" in Blue Mountain forests of Oregon and southeast Washington.

Captive Breeding Programs, Transplants, Introductions
Not applicable for this species.

Historic
Not applicable for this species.

Current
Not applicable for this species.

Distribution
Historic
Historic distribution data was not available or extremely limited for this species. The species is noted in Gabrielson and Jewett (1970) as regular but not a common resident and breeding bird of eastern slope of Cascades, Blue Mountains and timbered parts of isolated ranges of eastern Oregon.

Current
The red-naped sapsucker breeds in the Rock Mountain region from southwest Canada, west and central Montana, and southwest South Dakota south, east of the Cascades and Sierra Nevada, to east-central California, southern Nevada, central Arizona, southern New Mexico, and extreme western Texas ((AOU 1983 *in* NatureServe and *in* Marshall et al. Eds. 2003). The current distribution of red-naped sapsucker is shown in **Figure 1.**

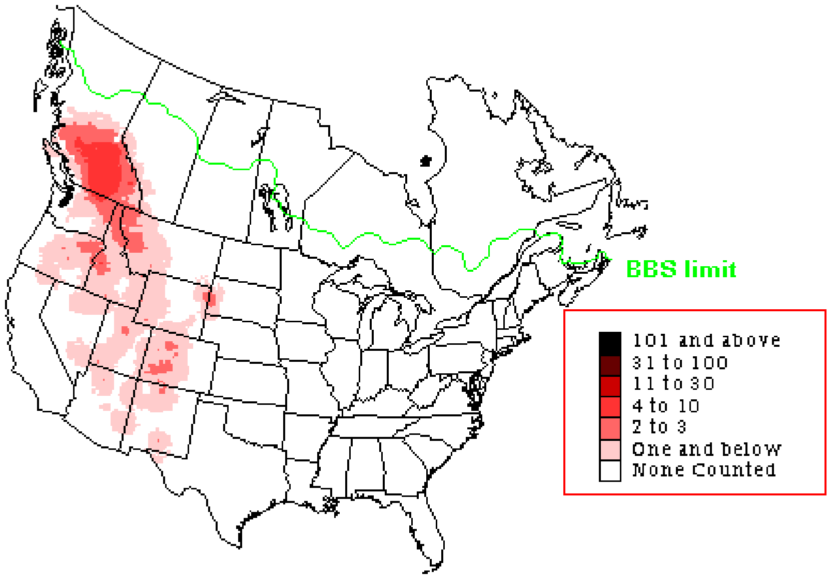

Figure 1: Red-naped sapsucker summer distribution based on Breeding Bird Surveys (Sauer et al. 2003).

Breeding
In Oregon, the sapsucker is a common summer resident throughout the eastern slope of the Cascades eastward throughout the Blue Mts., Wallowa Mtn., and lesser mountains, such as Mahogany Mtn. (Malheur Co.), Steens Mtn. (Harney Co.), and Hart Mtn. (Lake Co.) (Gilligan et al. 1994).

Non-Breeding
Winters in southern California (casually in Oregon, southern Nevada, central Arizona, and central New Mexico south to southern Baja California, and northwest and north-central Mexico, including Jalisco, Durango, Coahuila and Nuevo Leon ((AOU 1983) *in* NatureServe and *in* Marshall et al. Eds. 2003).

A common spring and fall transient through the mountains of eastern Oregon, and at lower elevations along rivers, in town, and at desert oases. Occurs rarely in winter along the east slope of the Cascades and very rare elsewhere east of the Cascades.

Red-naped Sapsucker Status and Abundance Trends
Status
Red-naped sapsuckers are demonstrably secure globally. In Oregon the species in not identified as threatened, endangered, or sensitive species (ODFW 1997). Within the state of Oregon, red-naped sapsuckers are apparently secure and are not of conservation concern (Altman 2000).

Trends
Trend estimates for other states and physiographic regions for these periods showed not statistically significant change. Mapped trends for 1966-1996 show population declines in parts of British Columbia and Alberta, central Oregon, and the central Rockies (eastern Idaho to Utah and n. Colorado), and marked increases in the Northern Rockies, southern Colorado, and northern New Mexico (Sauer et al. 2003 *in* NatureServe 2003). BBS data for Oregon showed a

non-significant increase of 0.5 percent increase per year, in the population from 1966-2000 (Sauer et al. 2003).

Factors Affecting Red-naped Sapsucker Population Status
Key Factors Inhibiting Populations and Ecological Processes

- Threats are largely unknown, but sapsuckers dependency on aspen and mature riparian woodland is cause for concern because of impacts on these habitats by land management activities throughout its range (NatureServe 2003).

- Loss of aspen stands and a decline in aspen regeneration has occurred throughout the mountain west due to fire suppression, conifer invasion, cutting, and development. For example aspen has declined 100 percent (about 1,800 acres) when comparing historical and current conditions in the Umatilla sub basin (NHI 2004). In addition, many of the aspen forest in the Blue Mountains are over 100 years old and decadent or declining in vigor. Lack of tree regeneration may lead to inevitable loss of large tees, which could result in significant declines in cavity –nesting (Dobkin et al. 1995) and affect the species in the long term.

- Grazing can have detrimental effects where the health and regeneration of aspen, cottonwood, and other preferred species is compromised. Studies of grazing impacts show mixed effects in the short term. In an Idaho cottonwood gallery forest where moderate to heavy grazing reduced understory shrub cover, Saab (1998) found no significant difference between grazed and unmanaged sites, although sapsucker abundances were slightly higher in unmanaged forest. On the other hand, in western Montana cottonwood/ponderosa pine riparian habitat, were significantly more abundant on lightly grazed sites than on heavily grazed sites, where ground cover, bush cover, mid-canopy cover, and number of small trees (less than 10 centimeter dbh) were significantly reduced in the heavily grazed sites (Mosconi and Hutto 1982 *in* NatureServe 2003). In California/Nevada aspen habitat, Page et al. (1978, cited in Saab et al. 1995) also observed a negative response to grazing.

Out-of-Subbasin Effects and Assumptions

No data could be found on the migration and wintering grounds of the red-naped sapsucker. It is a long distance migrant and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions could be occurring along its entire migration route and winter range.

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FERRUGINOUS HAWK
Buteo regalis

Original Species Account: obtained from NatureServe Explorer website at http://natureserve.org/explorer with supplements provided by Russ Morgan, Oregon Department of Fish and Wildlife.

Distribution
The species is found in U.S. States (AZ, CA, CO, ID, KS, MN, MT, ND, NE, NM, NN, NV, OK, OR, SD, TX, UT, WA, WY) and Canadian Provinces (AB, BC, MB, SK). In some jurisdictions, the statuses for common species have not been assessed. A species is not referenced in a jurisdiction if it is not known to breed in the jurisdiction or if it occurs only accidentally or casually in the jurisdiction. Thus, the species may occur in a jurisdiction as a seasonal non-breeding resident or as a migratory transient.

Global breeding ranges include eastern Washington, southern Alberta, southern Saskatchewan, extreme southwestern Manitoba (Bechard and Schmutz 1995), south to eastern Oregon, Nevada, northern Arizona, northern New Mexico, Texas panhandle, extreme western Oklahoma, and western Kansas. Recently discovered breeding in California (Small 1994). Historic breeding range in the southwestern U.S. apparently was much greater than at present (Hall et al. 1988). Two subpopulations are recognized (Bechard and Schmutz 1995); one to the east and another to the west of the Rocky Mountains.

Non-breeding ranges occur primarily in southwestern and south-central U.S. south to Baja California and central mainland of Mexico. In the U.S., in largest numbers occur in western Texas, eastern New Mexico, and western Oklahoma (Root 1988). The species winters locally in some more northerly breeding areas (Bechard and Schmutz 1995).

Between 1991 and 1993 a total of 28 active ferruginous hawk nests were known within the Umatilla subbasin (ODFW unpubl. data). These known nest sites were distributed into two distinct population areas; higher elevation grasslands/foothill canyonlands – 15 nests (where most nests were located in rock outcroppings and cliffs), and low elevation shrubsteppe/juniper savannah areas – 13 nests (juniper tree nests). While it is unknown the status of these historical nest sites today, it is known that a number of those "active" nest trees in the lower elevation portion of the basin have been lost by fire and human removal within the past 10 years (Russ Morgan personal communication).

Habitat
According to the ICBEMP terrestrial vertebrate habitat analyses, historical source habitats for ferruginous hawk occurred throughout all three ERUs within our planning unit (Wisdom et al. in press). Within this core of historical habitat, declines in source habitats were most evident for the Columbia Plateau; over 72% of the watersheds had moderate or strongly declining trends, and source habitat has been reduced from historical levels by 53%. Relatively stable trends are apparent for source habitats in the Great Basin and Owyhee Uplands (4% and 8% declines, respectively). Within the entire Interior Columbia Basin, over 54% of the watersheds show moderate or strongly declining trends in source habitats (Wisdom et al. in press).

Low elevation shrub-steppe and grasslands with scattered juniper trees are the habitat most threatened in the Umatilla/Willow subbasin. Conversion to agriculture, habitat loss from overgrazing, conversion of juniper savannah through fire suppression, and loss of isolated mature juniper trees by fire, cutting and trampling of roots by cattle seeking shade are four primary sources of loss (Altman and Holmes, 2000). Remaining core habitat strongholds within the subbasin are the Boardman Bombing Range (US Navy), Boardman Conservation Area (The Nature Conservancy and private), and the Horn Butte and Willow Creek area (BLM and private).

Palustrine habitat is riparian. Terrestrial habitat is cliff, desert, grassland/herbaceous and savanna. Open country, primarily prairies, plains and badlands; sagebrush, saltbush-greasewood shrubland, periphery of pinyon-juniper and other woodland, desert. In the southern Great Plains, common at black-tailed prairie dog colonies in winter (Schmutz and Fyfe 1987). They nest in tall trees or willows along streams or on steep slopes, in junipers (Utah), on cliff ledges, on river-cut banks, on hillsides, on power line towers, and sometimes on sloped ground on the plains or on mounds in open desert. Generally they avoid areas of intensive agriculture or human activity.

Hawks prefer open grasslands and shrub-steppe communities, using native and tame grasslands, pastures, hayland, cropland, and shrub-steppe (Stewart 1975, Woffinden 1975, Powers and Craig 1976, Fitzner et al. 1977, Blair 1978, Wakeley 1978, Lardy 1980, Schmidt 1981, Gilmer and Stewart 1983, Green and Morrison 1983, Konrad and Gilmer 1986, MacLaren et al. 1988, Palmer 1988, Roth and Marzluff 1989, Bechard et al. 1990, Black 1992, Niemuth 1992, Bechard and Schmutz 1995, Faanes and Lingle 1995, Houston 1995, Zelenak and Rotella 1997, Leary et al. 1998). Usually occupy rolling or rugged terrain (Blair 1978, Palmer 1988, Black 1992). High elevations, forest interiors, narrow canyons, and cliff areas are avoided (Janes 1985, Palmer 1988, Black 1992), as is parkland habitat in Canada (Schmutz 1991a).

Landscapes with moderate coverage (less than 50 percent) of cropland and hayland are used for nesting and foraging (Blair 1978; Wakeley 1978; Gilmer and Stewart 1983; Konrad and Gilmer 1986; Schmutz 1989, 1991a; Bechard et al. 1990; Faanes and Lingle 1995; Leary et al. 1998). In North Dakota, hayfields and native pastures were the habitats most often used by both fledglings and adults, whereas cultivated fields rarely were used (Konrad and Gilmer 1986). Fledglings in South Dakota hunted in an area where native hay recently had been cut (Blair 1978). When prey densities were low in big sagebrush (*Artemisia tridentata*)/grassland habitat, agricultural fields served as important foraging areas (Leary et al. 1998). Foraged extensively in alfalfa (*Medicago sativa*) and irrigated potato fields in Washington and in alfalfa fields in Idaho during the breeding season presumably because of high prey densities (Wakeley 1978, Leary et al. 1998).

Breeding

Home ranges are variable, ranging from about 0.5 to about 90 square kilometers; the latter figure refers to nests where birds commuted some distance to feeding grounds. A number of studies give mean home ranges on the order of 7 square kilometers, which equates to a circle with a diameter of about 3 kilometers; three times that home range gives a separation distance of about 10 kilometers. Home ranges: Ferruginous Hawk, mean 5.9 square kilometers in Utah (Smith and Murphy 1973); range 2.4 to 21.7 square kilometers, mean 7.0 square kilometers in Idaho (Olendorff 1993); mean 7.6 square kilometers in Idaho (McAnnis 1990); mean 90 square kilometers in Washington (Leary et al. 1998); Red-tailed Hawk, most forage within 3 kilometers of nest (Kochert 1986); mean spring and summer male home ranges 148 hectares (Petersen 1979); Hawaiian Hawk, 48 to 608 hectares (n = 16; Clarkson and Laniawe 2000); Zone-tailed Hawk, little information, apparent home range 1-2 kilometers/pair in west Texas (Johnson et al.

2000); White tailed Kite, rarely hunts more than 0.8 kilometers from nest (Hawbecker 1942); Prairie Falcon, 26 square kilometers in Wyoming (Craighead and Craighead 1956), 59 to 314 square kilometers (reported by Steenhof 1998); Aplomado Falcon, 2.6 to 9.0 square kilometers (n = 5, Hector 1988), 3.3 to 21.4 square kilometers (n = 10, Montoya et al. 1997).

Nest site fidelity is high in Zone-tailed Hawk; all seven west Texas nesting territories occupied in 1975 were reused in 1976 (Matteson and Riley 1981). Ferruginous Hawk: In California, dispersal distances from natal sites to subsequent breeding sites ranged from 0 to 18 kilometers, mean 8.8 kilometers (Woodbridge et al. 1995); in contrast, none of 697 nestlings in Saskatchewan returned to the study area; three were found 190 200 and 310 kilometers away (Houston and Schmutz 1995).

In nonbreeding class, evidence of recurring presence of wintering birds (including historical); and potential recurring presence at a given location, usually minimally a reliable observation of five birds (this can be reduced to one individual for rarer species). Occurrences should be locations where the species is resident for some time during the appropriate season; it is preferable to have observations documenting presence over at least 20 days annually. Be cautious about creating EOs for observations that may represent single events.
Separation distance is somewhat arbitrary; 10 kilometers can be used to define occurrences of manageable size for conservation purposes. However, occurrences defined primarily on the basis of areas supporting concentrations of foraging birds, rather than on the basis of distinct populations.

Nests

Nest site selection depends upon available substrates and surrounding land use. Ground nests typically are located far from human activities and on elevated landforms in large grassland areas (Lokemoen and Duebbert 1976, Blair 1978, Blair and Schitoskey 1982, Gilmer and Stewart 1983, Atkinson 1992, Black 1992). Lone or peripheral trees are preferred over densely wooded areas when trees are selected as the nesting substrate (Weston 1968, Lokemoen and Duebbert 1976, Gilmer and Stewart 1983, Woffinden and Murphy 1983, Palmer 1988, Bechard et al. 1990). Tree-nesting hawks seem to be less sensitive to surrounding land use, but they still avoid areas of intensive agriculture or high human disturbance (Gilmer and Stewart 1983; Schmutz 1984, 1987, 1991a; Bechard et al. 1990).

Foothill and canyon grasslands with rock outcroppings are, by their very nature, a more stable nesting habitat and exhibit little change in nest availability from year to year. Observations of old nest structures on rock outcroppings indicate that ferruginous hawks may use and maintain a number of different nest structures over time within a territory – often rotating the actual nesting site from year to year. Virtually all of this habitat type within the subbasin is privately owned and is used for cattle ranching and, to a lesser extent, farming. Clearly the largest threats to ferruginous hawks in this habitat are human disturbance to highly visible nest sites and grassland quality as it relates to prey availability. In 1993, a number of easily visible nests were destroyed by illegal killing of nesting adult birds in the Little Butter Creek area. In addition, grazing practices which remove most or all of the native bunchgrass cover (especially during drought years) can negatively affect nest success. Even so, from 1990 to 2004, the number of active nests in this habitat type appears to be relatively stable (Russ Morgan personal communication).

In eastern Colorado, nested more frequently in grassland areas than in cultivated areas (Olendorff 1973). In North Dakota, preferred to nest in areas dominated by pasture and hayland (Gilmer and

Stewart 1983, Gaines 1985). In southwestern Montana, sagebrush (*Artemisia*) and grasslands predominated within 100 meters of nests (Atkinson 1992). Ground nests in northern Montana were located in grass-dominated, rolling (more than 10 percent slope) rangeland; in general, cropland and areas with dense (more than 30 percent cover), tall (more than 15.24 centimeters) sagebrush were avoided (Black 1992). In western Kansas, most nests were surrounded by more than 50 percent rangeland and 25-50 percent cropland, although one pair incorporated more than 75 percent cropland in its territory (Roth and Marzluff 1989). The majority of nests (86 of 99) were not in direct view of black-tailed prairie dog (*Cynomys ludovicianus*) towns, although most nest sites were within 8 kilometers of towns (Roth and Marzluff 1989). In Utah, Idaho, Oregon, and California, preferred native grassland and shrubland habitats over cropland, and preferred areas with no perches (Janes 1985). In Washington, some nests occurred in agricultural fields, but most nests were in areas with higher percentages of grassland, shrubland, and western juniper (*Juniperus occidentalis*) (Bechard et al. 1990). Nest productivity in Idaho was greater in territories with higher amounts of crested wheatgrass (*Agropyron cristatum*) fields interspersed with desert shrub than in territories with monotypic stands of crested wheatgrass or shrubland, or with greater amounts of Utah juniper (*Juniperus osteosperma*), alfalfa, and cropland (Howard 1975).

In Alberta, however, cultivated areas (11-30 percent of 4,100 hectare plots) had higher nesting densities than grassland areas with 0-11 percent cultivation (Schmutz 1989). In cultivated areas (20 percent) in northcentral Montana, nests closer to cultivated fields and roads were more successful, presumably because of higher prey densities associated with edge habitats (Zelenak and Rotella 1997). The numbers of fledglings produced in unfragmented rangeland versus a mixture of rangeland and cropland were not significantly different in Nebraska (Podany 1996).

The slope, height, and exposure of nests were mostly similar across the species' range. The mean height of ground nests (on buttes or hills) above the surrounding prairie in South Dakota was less than 10 meters, and nests were oriented toward the south and west, providing access to prevailing winds from the south and west (Blair 1978). Lokemoen and Duebbert (1976) found ground nests in South Dakota were all oriented toward the west. Nests in southwestern Montana were significantly oriented toward the south (Atkinson 1992). Nests on rock outcrops in Montana were built on slopes averaging 62.8 percent and were found on the upper 35 percent of the slope (Atkinson 1992). Ground nests in northern Montana were located either on the top of a small rise or on slopes ranging from 10 to 50 percent (Black 1992). Average height of ground nests below the highest surrounding topographic feature was 10 meters, whereas average height of ground nest sites above the valley floor was 10.4 meters, indicating that nests were placed at mid-elevation sites within the immediate topography (Black 1992). Nests in Wyoming were built on a mean slope of 14.26 degrees, and the mean height of nests was 4.55 meters (MacLaren et al. 1988).

In southeastern Washington, 86 percent of nests on outcrops and in western junipers were located less than 10 meters from the ground and had southern or western exposures (Bechard et al. 1990). In Oregon shrub-steppe, nests were in relatively short western juniper trees, were less than 10 meters from the ground, and had large support branches (Green and Morrison 1983). In Washington, Idaho, and Utah, the majority of nests also were less than 10 meters from the ground in western juniper and Utah juniper trees (Woffinden 1975, Fitzner et al. 1977, Woffinden and Murphy 1983). Howard (1975) and Howard and Wolfe (1976) also found Utah juniper trees were important nest substrates in southern Idaho and northern Utah. In Utah, nests were built 2-3 meters from the ground, were most commonly located on the sides or summits of hills, and often had southern or eastern exposures (Weston 1968). Woffinden (1975) found that the majority of nests in Utah were on slopes ranging from 15 to 80 degrees with a mean of 42.5 degrees.

Habitat Loss

Some habitat has been lost due to agricultural development. Schmutz and Schmutz (1980) reported that habitat in the breeding range in Canada has been severely depleted by agriculture, disturbance, and forest invasion (see also Jensen 1995), though recent trends suggest relative stability (Schmutz 1995). Loss of grassland is not regarded as an immediate threat (USFWS 1992), but is likely a long-term threat (Olendorff 1993). Ability of native grasslands and shrublands to support viable populations may be compromised by the invasion of exotic annuals, especially cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola iberica*). However, conversion of large areas of dense shrublands to grasslands may locally benefit Ferruginous Hawks.

Ferruginous Hawks are easily disturbed by humans during the breeding season (Olendorff 1973, Gilmer and Stewart 1983, Schmutz 1984, White and Thurow 1985, Bechard et al. 1990). Abandonment of nests occurs particularly in the early stages of nesting (Davy 1930, Weston 1968, Fitzner et al. 1977, Gilmer and Stewart 1983, White and Thurow 1985). In eastern Colorado, nests in remote locations had greater productivity compared to more accessible nests (Olendorff 1973). In South Dakota, the probability of fledging young was 11.4 percent greater in more remote nests than in nests within 2.47 kilometers of occupied buildings (Blair 1978). In North Dakota, avoided cropland and nesting within 0.7 kilometers of occupied buildings (Gaines 1985). In Alberta, rarely nested within 0.5 kilometers of farmyards (Schmutz 1984). In other instances, more tolerant of human disturbance. Nesting has occurred near active railroads and gravel roads (Rolfe 1896, Gilmer and Stewart 1983, MacLaren et al. 1988). Sensitivity to disturbance may be heightened in years of low prey abundance (White and Thurow 1985). Shooting may also be a threat, especially on the wintering grounds (Harmata 1981, Gilmer et al. 1985). Poisoning of prey species may be a threat both directly to hawks eating poisoned animals and indirectly through reduction of prey base, especially at prey concentration areas such as prairie dog colonies.

Diet

Both the immature and adult hawks are carnivorous. Mammals are the primary prey during the breeding season, although birds, amphibians, reptiles, and insects also are taken (Weston 1968, Howard 1975, Fitzner et al. 1977, Blair 1978, Smith and Murphy 1978, Gilmer and Stewart 1983, Palmer 1988, De Smet and Conrad 1991, Atkinson 1992). Primary prey in central grasslands are ground squirrels (*Spermophilus spp*.), followed by pocket gophers (*Thomomys spp*.) and white-tailed jackrabbits (*Lepus townsendii*) (Bechard and Schmutz 1995). Primary prey in western shrub-steppe are jackrabbits (*Lepus spp*.), followed by ground squirrels and pocket gophers (Smith and Murphy 1978, Bechard and Schmutz 1995). White-tailed (*Cynomys leucurus*) and black-tailed prairie dogs(*Cynomys ludovicianus*)also serve as prey items (Powers and Craig 1976, MacLaren et al. 1988). In Oregon, Janes (1985) found that the highest abundance of major prey species (white-tailed jackrabbits, Townsend's ground squirrels [*Spermophilus townsendii*], and northern pocket gophers [*Thomomys talpoides*]) occurred in native grasslands. Foraging range is variable, with three kilometers the mean diameter in several species. Hunting occurs most frequently near sunrise and sunset (Evans 1982).

Vulnerability of prey also is an important factor in habitat suitability, such that Ferruginous Hawks avoid dense vegetation that reduces their ability to see prey (Howard and Wolfe 1976, Wakeley 1978, Schmutz 1987). Prey vulnerability decreases where taller small-grain crops replace shorter grasses (Houston and Bechard 1984). Intensive agricultural practices, such as annual plowing and biennial fallowing, exclude many prey species (Wakeley 1978, Houston and Bechard 1984). In Alberta, prey abundance increases as the area of cultivation increases up to 30 percent, but abundance is reduced where agriculture is extensive, e.g., more than 30 percent (Schmutz 1989).

Global Short Term Trend

Most recent global population estimate is 5,842-11,330 compiled by Olendorff (1993). However, Schmutz et al. (1992) estimated 14,000 for the Great Plains alone. Estimated population in Canada in the early 1990s was 2000-4000 breeding pairs (Schmutz, 1994 COSEWIC report, cited by Jensen 1995). Between year movements of population centers and individuals makes estimation of actual abundance difficult.

Local declines have been noted (e.g., Woffinden and Murphy 1989), but a widespread decline was not evident as of the early-1990s (USFWS 1992, Olendorff 1993). North American Breeding Bird Survey (BBS) data for the U.S. and Canada indicate a 13.5 percent increase from 1988 to 1989 and an average annual 0.5 percent increase for 1966-1989 (Droege and Sauer 1990). Wintering data from Christmas Bird Counts also indicate an increase in numbers from 1952-1984 (USFWS 1992). Schmutz (1995) reported that the range in Canada has been reduced by half, and that habitat within the range has been severely depleted and total numbers reduced by about 95 percent. Kirk et al. (1995) indicated that populations in Canada apparently are stable in available habitat. Jensen (1995) reported a recent range re-expansion in south-central Canada. Historically, very abundant in eastern Montana but numbers were lowered by the early 1900's (Allen 1874, Cameron 1914).

Global Protection

There is one protected at Kevin Rim by BLM as an ACEC (Area of Critical Environmental Concern). Eight Key Raptor Areas are managed by BLM in Montana (Centennial Valley, Lima Foothills, Madison River, Sweetwater Breaks, Kevin Rim, Rocky Mountain East Front, Rock Creek-Thoeny Area, and Lone Tree Management Area).

Global protection needs cover extensive areas of suitable habitat throughout the breeding and wintering range, including the concentrated prey sources such as prairie dog towns.

Economic Attributes
Management Summary
Stewardship Overview

Conversion of grasslands to intensive cultivation has reduced the amount of preferred habitat that is available and has been implicated in the population decline of the species in some areas (Schmutz 1984, Faanes and Lingle 1995). Agricultural development has restricted the species to areas of greater topographic relief or other areas unsuitable for agriculture (Stewart 1975). Keys to management are providing suitable nest sites, protecting active nest areas from disturbance, and improving habitat for prey. Isolated trees and stringers should be protected from livestock in nesting habitat. Prescribed burning may increase habitat suitability in shrub-dominated areas. Practices that increase exotic plant species number or dominance should be discouraged.

Artificial nests have been used to increase number of nesting pairs in areas where suitable sites are scarce (Schmutz 1984).

Preserve Selection & Design Considerations
Land Protection
Maintain ownership of public lands that have substantial numbers of hawks (Olendorff 1993). Protect large tracts of native prairie from conversion to monotypic stands of grass or other types of agriculture (Howard and Wolfe 1976, Lardy 1980, Schmutz 1991a, Bechard and Schmutz 1995). Avoid seeding of exotic grasses and cultivating of habitat, where possible (Janes 1985). Leave scattered islands of shrubby vegetation in crested wheatgrass fields so that the islands make up a minimum of 20 percent of the total area (Howard and Wolfe 1976).

Management Requirements
Prey Consideration
Increase grassland area to increase Richardson's ground squirrel (*Spermophilus richardsonii*) abundance in Canada (Houston and Bechard 1984). Improve prey habitat by providing native shrub vegetation and increasing edge (Howard and Wolfe 1976, Bechard and Schmutz 1995). If brush is chained, windrow it to provide cover for prey (Olendorff 1993). When converting land from sagebrush steppe to herbaceous grassland (e.g., to crested wheatgrass), create a mosaic of treated (chained or disced) and untreated areas (Howard and Wolfe 1976). To attract small rodents, maintain or restore sagebrush-grass rangeland, removing pinyon pine (*Pinus edulus*)/Utah juniper stands (Howard and Wolfe 1976). If it is necessary to control lagomorph or rodent populations, try to lower the peaks of cyclic highs rather than completely exterminating them (Olendorff 1993).

Reduce Disturbance
Do not disturb nest sites from 15 March to 15 July (Howard and Wolfe 1976, Bechard and Schmutz 1995). Close public areas near nest sites to recreation during the breeding season (Lardy 1980) and close public land to firearms where dense populations of Ferruginous Hawks are particularly susceptible to shooting (Olendorff 1993). Establish buffer zones around nest sites and delay energy development until 45 days after fledging (Konrad and Gilmer 1986). White and Thurow (1985) recommended creating a buffer zone of 0.25 kilometers around nest sites. Atkinson (1992) suggested that a minimum distance of 0.45 kilometers be maintained from the nest. Olendorff (1993) suggested buffer zones of 0.25 kilometers for brief disturbances, 0.5 kilometers for intermittent activities, 0.8 kilometers for prolonged activities, and more than 1.0 kilometer for construction or similar activities. Provide information to ranchers, seismic crews, prospectors, and others to avoid disturbance to the nest (Atkinson 1992). Conduct treatments, e.g., chaining, discing, plowing, or burning, during the non-nesting season to avoid direct impacts to the hawks and their prey species during the reproductive season (Olendorff 1993). Generally, avoid treatments between 1 March and 1 August each year, especially during the incubation period when hawks are more prone to abandon nests if disturbed. Mitigate development impacts from mining, pipeline construction, and urbanization (Bechard and Schmutz 1995). Encourage rest-rotation or deferred-rotation grazing systems (Olendorff 1993). Delay grazing to allow for the completion of incubation (Atkinson 1992).

Nest Structures
Enhance, protect, and create nest substrates through fencing of nest trees, supporting heavy tree nests that are at risk of toppling, and building artificial nesting structures where nest sites are otherwise lacking (Olendorff 1973, Smith and Murphy 1978, Houston 1985, Bechard and

Schmutz 1995, Leary et al. 1998). Other successful nest structure management techniques are to remove some of the previous year's nesting material to reduce the chance of toppling, realign the nest over a vertical axis, widen the base of the nest, reinforce the base of the nest using wire netting or other materials, move the nest to a safer location, or provide protection from predators by nailing tin sheathing around the tree base (Craig and Anderson 1979). In converting tree communities to grassland, provide nest sites by leaving individual trees, a mosaic of stands of trees, or a thin scattering of trees (Olendorff 1993). Leave poles and cross-arms of unused electrical lines for hunting perches (Olendorff 1993).

Grazing provides benefits by reducing vegetative cover and making prey more visible (Wakeley 1978, Konrad and Gilmer 1986). Kantrud and Kologiski (1982) found highest densities of Ferruginous Hawks in heavily grazed areas in the northern Great Plains. These areas provided a combination of grazing and soil type (typic borolls) that resulted in abundant prey populations (Kantrud and Kologiski 1982). In South Dakota, preferentially placed ground nests in lightly grazed pasture or idle areas (Lokemoen and Duebbert 1976, Blair 1978, Blair and Schitoskey 1982). In Saskatchewan, preferred grassland habitat exists in large blocks of government pastures located along the Montana and Alberta borders (Houston and Bechard 1984). These blocks of habitat are the only remaining areas with stable populations in Saskatchewan (Houston and Bechard 1984). Livestock, however, can weaken nest trees by excessive rubbing or trampling (Houston 1982, Olendorff 1993). Bock et al. (1993) suggested negative response to grazing in shrub-steppe habitats, based on the ground cover requirements of their prey.

Biological Research Needs

Understanding of the wintering ecology, dispersal, site fidelity (breeding and winter), and possible differences between subpopulations east and west of the Rocky Mountains is needed for conservation planning. Other research needs include basic biology, color polymorphism, nomadism, and relationship between populations of hawks and prey, especially cyclic species. The effects of management actions and strategies on Ferruginous hawks is also poorly known (Bechard and Schmutz 1995).

Reproduction Comments: Occur on breeding areas from late February through early October (Weston 1968, Olendorff 1973, Maher 1974, Blair 1978, Smith and Murphy 1978, Gilmer and Stewart 1983, Schmutz and Fyfe 1987, Palmer 1988, Bechard and Schmutz 1995). See Palmer (1988) and Hall et al. (1988) for egg dates in different areas. Clutch size usually is two to four. Incubation lasts about 32-33 days, mostly by female; male provides food. Young fledge in 35-50 days (males before females), depend on parents for several weeks more. No evidence that yearlings breed. Renesting within the same year is rare (Woffinden 1975, Palmer 1988) even when clutch is lost. Territory and nest site reoccupancy is common and one of several nests within a territory may be used in alternate years (Davy 1930, Weston 1968, Olendorff 1973, Blair 1978, Smith and Murphy 1978, Palmer 1988, Roth and Marzluff 1989, Schmutz 1991b, Atkinson 1992, Houston 1995). Mate fidelity also is common. (Schmutz 1991b). Clutch size, fledging rate, and/or breeding density tend to vary with prey (especially jackrabbit [*Lepus spp*.] or ground squirrel [*Spermophilus spp*.]) availability.

Ecology Comments

Density and productivity are closely associated with cycles of prey abundance (Woffinden 1975; Powers and Craig 1976; Smith and Murphy 1978, Smith et al. 1981; Gilmer and Stewart 1983; Houston and Bechard 1984; White and Thurow 1985; Palmer 1988; Schmutz 1989, 1991a; Schmutz and Hungle 1989; Bechard and Schmutz 1995). Estimates of home range size vary from

3.14 to 8.09 square kilometers in the Columbia River Basin and Great Basin regions of the western U.S. (Janes 1985). The average home range was 90.3 square kilometers in Washington, and the variability in home range was significantly related to distance from the nest to the nearest irrigated agricultural field (Leary et al. 1998). One male that nested closest to the surrounding agricultural fields had the smallest home range, whereas another male nesting farthest from the agricultural fields had the largest home range. In Utah, mean home range recorded of 5.9 square kilometers (Smith and Murphy 1973). An area of up to 21.7 square kilometers may be required by one pair for hunting in Idaho (Wakeley 1978). Up to 8-10 nests per 100 square kilomters if local conditions are favorable (see Palmer [1988] for density data in several areas). In 11 study areas, mean nearest neighbor distance was 3.4 kilometers (range 0.8-7.2); in six study areas the mean home range size was 7.0 square kilometers (range 3.4-21.7) (Olendorff 1993). Recent studies in Idaho (McAnnis 1990) and Washington (Leary 1996) found average home ranges of 7.6 square kilometers (minimum convex polygon)/19.4 square kilometers (95 percent harmonic mean) and 70 square kilometers (95 percent minimum convex polygon)/31 square kilometers (85 percent adaptive kernel), respectively.

Mobility and Migration

Hawks arrive in northern breeding range (South Dakota) by March-early April, in Utah and Colorado mostly in late February-early March; yearlings arrive later. Adults depart northern end of breeding range by late October; young depart in August. Wintering areas of grassland and desert shrub breeders are mainly separate. (Schmutz and Fyfe 1987). Alberta populations winter mainly in Texas. In southern breeding range, may be short-distance migrant or possibly sedentary (Palmer 1988).

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GRASSHOPPER SPARROW
Ammodramus savannarum perpallidus

Original Species Account Authors: Paul Ashley and Stacy Stoval, as appeared in the Southeast Washington Ecoregional Assessment, January 2004

Introduction
Grassland ecosystems that were prominent in the Columbia Basin have suffered the greatest losses of any habitats in the Columbia Plateau (Kagan et al.1999). The Palouse Prairie has been identified as the most endangered ecosystem in the United States (Noss *et al.* 1995). Land conversion and livestock grazing coupled with the rapid spread of cheatgrass (*Bromus tectorum*) and a resulting change in the natural fire regime has effectively altered much of the grassland habitats to the effect that it is difficult to find stands which are still in relatively natural condition (Altman and Holmes 2000).

As a result, many of these steppe, grassland, species are declining in our area. BBS data (Robbins et al. 1986) have shown a decreasing long term trend for the grasshopper sparrow (1966-1998) (Sauer *et al.* 1999). Throughout the U.S., this sparrow has experienced population declines throughout most of its breeding range (Brauning 1992, Brewer *et al.* 1991, Garrett and Dunn 1981). In 1996, Vickery (1996) reported that grasshopper sparrow populations have declined by 69% across the U.S. since the late 1960s. In Washington, the grasshopper sparrow is considered a State Candidate species (http://wdfw.wa.gov/wlm/diversity/soc/candidat.htm). In Oregon it is considered as a naturally rare, vulnerable species, and a state Heritage program status as imperiled.

Focal Species Life History, Key Environmental Correlates, and Habitat Requirements
Life History
Diet
Grasshopper sparrows are active ground or low shrub searchers. Vickery (1996) states that exposed bare ground is the critical microhabitat type for effective foraging. Bent (1968) observed that grasshopper sparrows search for prey on the ground, in low foliage within relatively dense grasslands, and sometimes scratch in the litter.

They eat mostly insects, primarily grasshoppers, but also other invertebrates and seeds. In one study, grasshoppers formed 23% of the grasshopper sparrows' diet during 8 months of the year; 60% of their diet in Jan., and 37% from May to Aug. From Feb. to Oct., 63% of food taken was animals, 37% vegetable. Insects comprised 57% total food; spiders, myriapods, snails and earthworms made up 6%. Of the insects, "harmful" beetles (click beetles (*Clateridae*), weevils (Sitones *et. al*), and smaller leaf beetles (*Systens spp.*) made up 8%, caterpillars (cutworms) made up 14%. Vegetable matter eaten included waste grain, grass, weed and sedge seeds (Smith 1968, Terres 1980).

Their diet varies by season. Spring diet 60% invertebrates, 40% seeds (n=28); summer diet 61% invertebrates, 39% seeds (n=100); fall diet 29% invertebrates, 71% seeds (n=17), and no data for winter (Martin *et al.* 1951 in Vickery 1996).

Reproduction
Grasshopper sparrows are monogamous throughout the breeding season (Ehrlich 1988).

Grasshopper sparrows nest in semi-colonial groups of 3-12 pairs (Ehrlich 1988). Smith (1963) recorded breeding densities that ranged from 0.12 to 0.74 males per hectare in Pennsylvania and Collier (1994) observed breeding densities of 0.55 males per hectare in California.
Clutch size ranges from 2 to 6, with 4 most frequently (Smith 1963). The female alone has a brood patch and incubates eggs (Smith 1963, Ehrlich 1988, Harrison 1975). During incubation, the male defends the pair's territory (Smith 1963).

Incubation period is from 11 to 13 days (Smith 1963, Ehrlich 1988, Harrison 1975), with a nestling period of 6 to 9 days after hatching (Harrison 1975, Hill 1976, Kaspari and O'Leary 1988). Hatchlings are blind and covered with grayish-brown down (Smith 1968).

Throughout most of their range, grasshopper sparrows can produce two broods, one in late May and a second in early July (George 1952, Smith 1968, Vickery 1996). However, in the northern part of its range, one brood is probably most common (Vickery et al. 1992, Wiens 1969). grasshopper sparrows frequently renest after nest failure, and if unsuccessful in previous attempts, may renest 3-4 times during the breeding season (Vickery 1996).

After the young hatch, both parents share the responsibilities of tending the hatchlings and seem more concerned over human intrusion into their territory than before (Smith 1963). Kaspari and O'Leary (1988) observed cooperative breeding by non-parental attendants ("defined as birds bringing food to the nest"). Unrelated juveniles and adults from adjacent territories made 9-50% of the provisioning visits to four of twenty-three nests. Parents facilitated visits from non-parental attendants by moving off the nest yet unrelated birds that did not bring food to the nest were vigorously chased away. Kaspari and O'Leary (1988) suggested that non-parental attendants, rare among the population observed, are likely cases of "misdirected parental care".

Nesting
Grasshopper sparrows arrive on the breeding grounds in mid-April and depart for the wintering grounds in mid-September (George 1952, Bent 1968, Smith 1968, Harrison 1975, Stewart 1975, Laubach 1984, Vickery 1996). In Saskatchewan and Manitoba, they arrive later (mid-May) and leave earlier (August) (Knapton 1979). Grasshopper sparrows may be site faithful (Skipper 1998).

With few exceptions, nests are built on the ground, near a clump of grass or base of a shrub, "domed" with overhanging vegetation (Vickery 1996). Female grasshopper sparrows build a cup nest in two or three days time. Domed with overhanging grasses and accessed from one side, the rim of the nest is flush with the ground; the slight depression inside fashioned such that the female's back is nearly flush with the ground while brooding (Dixon 1916, Pemberton 1917, Harrison 1975, Ehrlich 1988, and Vickery 1996).

Male grasshopper sparrows establish territories promptly upon arrival to the breeding grounds and rigidly maintain them until the young hatch. Territorial defense then declines and considerable movement across territory boundaries may occur. It appears that fledglings frequently flutter into adjoining territories and the parent birds follow in answer to the feeding call. A sharp increase in territorial behavior is exhibited during the two or three days prior to re-nesting (Smith 1963). Collier (1994 in Vickery 1996) observed grasshopper sparrow territory sizes of 0.37 0.16 (SD) ha (n=41) in southern California. In other states, territories have been observed to range in size from 1.4 ha (n=6) in Michigan (Kendeigh 1941) to 0.19 0.13 (SD) ha (n=20: Piehler 1987) in western Pennsylvania.

Although average territory size for grasshopper sparrows is small (<2 ha) (George 1952, Wiens 1969, 1970, Ducey and Miller 1980, Laubach 1984, Delisle 1995), grasshopper sparrows are area sensitive, preferring large grassland areas over small areas (Herkert 1994a,b, Vickery et al. 1994, Helzer 1996). In Illinois, the minimum area on which grasshopper sparrows were found was 10-30 ha (Herkert 1991), and the minimum area needed to support a breeding population may be >30 ha (Herkert 1994b). In Nebraska, the minimum area in which grasshopper sparrows were found was 8-12 ha, with a perimeter-area ratio of 0.018 (Helzer 1996, Helzer and Jelinski 1999). Occurrence of grasshopper sparrows was positively correlated with patch area and inversely correlated with perimeter-area ratio (Helzer and Jelinski 1999).

Migration

In spring, the grasshopper sparrow is a notably late migrant, arriving in southern B.C. in early to late May (Vickery 1996). Grasshopper sparrows arrive in Colorado in mid May and remain through September. They initiate nesting in early June, and most young fledge by the end of July. They winter across the southern tier of states, south into Central America.

This species generally migrates at night, sometimes continuing into morning. Mechanisms surrounding migration are not known but probably involve similar mechanisms as in savannah Sparrow, which include magnetic, stellar, and solar compasses (Moore 1980, Able and Able 1990a, b). While in migration the grasshopper sparrow does not form large conspecific flocks; individuals are found in mixed-species flocks with other sparrows and appear to migrate in small numbers, traveling more as individuals (Vickery 1996).

Data regarding the movements of grasshopper sparrows outside of the breeding season is scarce due to their normally secretive nature (Zeiner et al.1990). Although diurnally active, grasshopper sparrows are easily overlooked as "they seldom fly, preferring to run along the ground between and beneath tufts of grass" (Pemberton 1917). Because of their secretive nature the northern limits of their winter range is poorly known. Migratory individuals have been recorded casually south to w. Panama (Ridgely and Gwynne 1989) and (in winter) north to Maine (PDV), New Brunswick, Minnesota (Eckert 1990), and w. Oregon (Vickery 1996).

Mortality

Nest predators cited include: Raccoons (*Procyon lotor*), Red Fox (*Vulpes vulpes*), Northern Black Racers (*Coluber constrictor constrictor*), Blue Jays (*Cyanocitta cristata*), and Common Crows (*Corvus brachyrhynchos*) (Johnson and Temple 1990, Wray et. al 1982). Loggerhead Shrikes (*Lanius ludovicianus*) commonly take grasshopper sparrows as prey in Oklahoma and Florida (Stewart 1990, Vickery 1996). Many other species, especially those not dependent upon sight to find nests, are likely to be predators. Seasonal flooding in some areas may be a source of mortality during the nesting season (Vickery 1996).

Mowing and haying operations be the source of mortality for grasshopper sparrows directly and indirectly. Haying may reduce height and cover of herbaceous vegetation, destroy active nests, kill nestlings and fledglings, cause nest abandonment, and increase nest exposure and predation levels (Bollinger *et al.* 1990).

Habitat Requirements

Grasshopper sparrows prefer grasslands of intermediate height and are often associated with clumped vegetation interspersed with patches of bare ground (Bent 1968, Blankespoor 1980, Vickery 1996). Other habitat requirements include moderately deep litter and sparse coverage of woody vegetation (Smith 1963; Bent 1968; Wiens 1969, 1970; Kahl et al. 1985; Arnold and Higgins 1986). In east central Oregon grasshopper sparrows occupied relatively undisturbed native bunchgrass communities dominated by *Agropyron spicatum* and/or *Festuca idahoensis*, particularly north-facing slopes on the Boardman Bombing Range, Columbia Basin (Holmes and Geupel 1998). Vander Haegen *et al.* (2000) found no significant relationship with vegetation type (i.e., shrubs, perennial grasses, or annual grasses), but did find one with the percent cover perennial grass.

In portions of Colorado, Kansas, Montana, Nebraska, Oklahoma, South Dakota, Texas, Wisconsin, and Wyoming, abundance of grasshopper sparrows was positively correlated with percent grass cover, percent litter cover, total number of vertical vegetation hits, effective vegetation height, and litter depth; abundance was negatively correlated with percent bare ground, amount of variation in litter depth, amount of variation in forb or shrub height, and the amount of variation in forb and shrub heights (Rotenberry and Wiens 1980).

Grasshopper sparrows have also been found breeding in Conservation Reserve Program (CRP) fields, pasture, hayland, airports, and reclaimed surface mines (Wiens 1970, 1973; Harrison 1974; Ducey and Miller 1980; Whitmore 1980; Kantrud 1981; Renken 1983; Laubach 1984; Renken and Dinsmore 1987; Bollinger 1988; Frawley and Best 1991; Johnson and Schwartz 1993; Klute 1994; Berthelsen and Smith 1995; Hull et al. 1996; Patterson and Best 1996; Delisle and Savidge 1997; Prescott 1997; Koford 1999; Jensen 1999; Horn and Koford 2000). In Alberta, Manitoba, and Saskatchewan, grasshopper sparrows are more common in grasslands enrolled in the Permanent Cover Program (PCP) than in cropland (McMaster and Davis 1998). PCP was a Canadian program that paid farmers to seed highly erodible land to perennial cover; it differed from CRP in that haying and grazing were allowed annually in PCP.

Grasshopper sparrows occasionally inhabit cropland, such as corn and oats, but at a fraction of the densities found in grassland habitats (Smith 1963, Smith 1968, Ducey and Miller 1980, Basore et al. 1986, Faanes and Lingle 1995, Best *et al.* 1997).

Grasshopper sparrows are also included as members of shrub-steppe communities, occupying the steppe habitats having the habitat features shown in Table 1 (Altman and Holmes 2000).

Table 1. Key habitat relationships required for breeding grasshopper sparrows (Altman and Holmes 2000).

Conservation Focus	Key Habitat Relationships			
	Vegetative Composition	Vegetation Structure	Landscape/ Patch Size	Special Considerations
native bunchgrass cover	native bunchgrasses	bunchgrass cover >15% and >60% total grass cover; bunchgrass >25 cm tall; shrub cover <10%	>40 ha (100 ac)	larger tracts better; exotic grass detrimental; vulnerable in agricultural habitats from mowing, spraying, etc.

Focal Species Population and Distribution
Population
Historic
According to the ICBEMP terrestrial vertebrate habitat analyses, historical source habitats for grasshopper sparrow within our planning unit occurred primarily along the eastern portions of the Columbia Plateau Ecological Reporting Unit (ERU) and the northern portion of the Owyhee Uplands ERU with a small amount in the northern portion of the Great Basin (Wisdom et al. 2000). Within this core of historical habitat, the current amount of source habitat has been reduced dramatically from historical levels by 91% in the Columbia Plateau and 85% in the Owyhee Uplands. Within the entire Interior Columbia Basin, overall decline in source habitats for this species (71%) was third greatest among 91 species of vertebrates analyzed (Wisdom *et al.* 2000).

Wing (1941) described the grasshopper sparrow as occupies the edge between the *Agropyron-Poa* type and the *Festuca-Agropyron* type. Jewett *et al.* (1953) gave its distribution in summer as north to Sprague, east to Pullman, south to Anatone and Prescott, and west to Toppenish.

Current
No data are available

Distribution
Grasshopper sparrows are found from North to South America, Ecuador, and in the West Indies

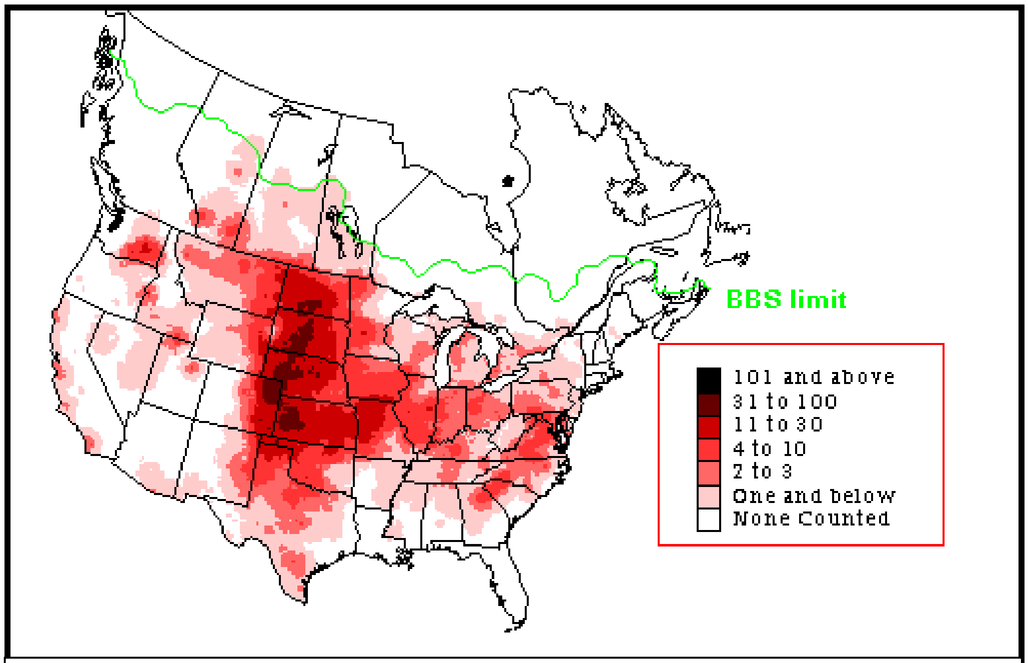

Figure 1. Breeding Range and Abudance of grasshopper sparrow in the U.S. based on Breeding Bird Survey data 1985-2001. Scale represents average number of individuals detected per route per year (Sauer 2003).

(Vickery 1996, AOU 1957). They are common breeders throughout much of the continental United States, ranging from southern Canada south to Florida, Texas, and California. Additional populations are locally distributed from Mexico to Colombia and in the West Indies (Delany et al. 1985, Delany 1996a, Vickery 1996).

The subspecies breeding in eastern Washington is *Ammodramus savannarum perpallidus* (Coues) which breeds from northwest California, where it is uncommon, into eastern Washington, northeast and southwest Oregon, where it is rare and local, into southeast B.C., where it is considered endangered, east into Nevada, Utah, Colorado, Oklahoma, Texas, and possibly to Illinois and Indiana (Vickery 1996).

Historic

Larrison (1981) called it a local irregular summer resident and/or migrant mostly through the arid interior of the Northwest and rare west of the Cascades in southwestern B.C. and Oregon. In Idaho, it was considered an uncommon irregular summer resident and migrant in the northern portion (Larrison 1981).

Jewett *et al.* (1953) classified the grasshopper sparrow as a rare summer resident between May and probably August or September locally in the bunch-grass associations of the lower Transition Zone of eastern Washington, occurring locally in the Upper Sonoran also.

Current

Grasshopper sparrows have a spotty distribution at best across eastern Washington. Over the

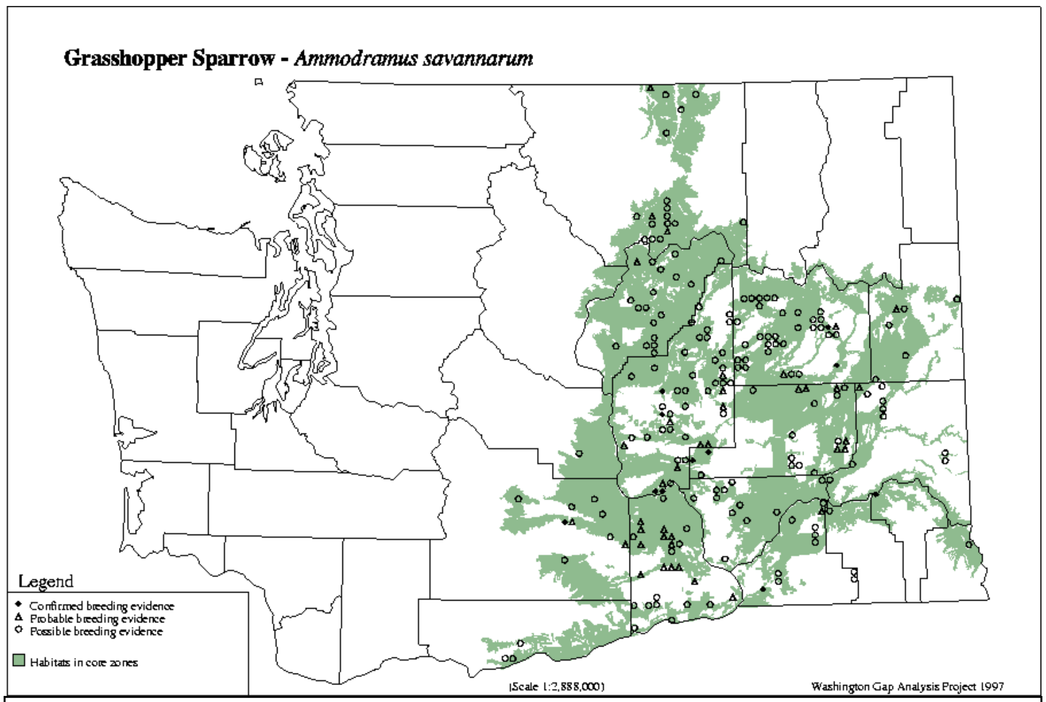

Figure 1. Current distribution of grasshopper sparrow in Washington from GAP analysis (Smith et al. 1997).

years they have been found in various locales including CRP. They appear to utilize CRP on a consistent basis in southeast Washington (Mike Denny pers. Comm).

Focal Species Status and Abundance Trends

Status

No data are available.

Trends

Throughout the U.S., this sparrow has experienced population declines throughout most of its breeding range (Brauning 1992, Brewer *et al.* 1991, Garrett and Dunn 1981). In 1996, Vickery (1996) reported that grasshopper sparrow populations have declined by 69% across the U.S. since the late 1960s.

Approximately 6 million hectares of shrub-steppe have been converted to wheat fields, row crops, and orchards in the interior Columbia Basin (Quigley and Arbelbide 1997). In Washington over 50% of historic shrub-steppe has been converted to agriculture (Dobler *et al*. 1996).

Table 2. Trends for grasshopper sparrow from BBS data 1980-2002 (Sauer *et al.* 2003).

State	1996- 2002 Trend	1980-2002 Trend
Washington	-4.9	-3.0
Idaho	-7.4	-10.7
Oregon	-4.4	-1.6
Intermountain Grassland	-13.0	-12.4

Accordingly, Breeding Bird Survey data show long term declines from 1980 through 2002 of –3.0, -1.6 and –10.7 for Washington, Oregon and Idaho, respectively (see Table 2) (see http://www.mbr-pwrc.usgs.gov/cgi-bin/atlasa02.pl?05460 for this data online). The entire Intermountain Grassland area shows large decrease of –12.4 over this same time period.

Washington, Oregon and the entire Intermountain Grassland area show an increasing negative trend when looking at the more recent time period 1996-2002 time period indicating the populations have increase even more over this time period (Sauer et al. 2003).

Factors Affecting Focal Species Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat Loss and Fragmentation

The principal post-settlement conservation issues affecting bird populations include: habitat loss and fragmentation resulting from conversion to agriculture; and habitat degradation and alteration from livestock grazing, invasion of exotic vegetation, and alteration of historic fire regimes. Conversion of shrub-steppe lands to agriculture adversely affects landbirds in two ways: 1) native habitat is in most instances permanently lost, and 2) remaining shrub-steppe is isolated and embedded in a highly fragmented landscape of multiple land uses, particularly agriculture. Fragmentation resulting from agricultural development or large fires fueled by cheatgrass can have several negative effects on landbirds. These include: insufficient patch size for area-dependent species, and increases in edges and adjacent hostile landscapes, which can result in reduced productivity through increased nest predation, nest parasitism, and reduced pairing success of males. Additionally, fragmentation of shrub-steppe has likely altered the dynamics of dispersal and immigration necessary for maintenance of some populations at a regional scale. In a recent analysis of neotropical migratory birds within the Interior Columbia

Basin, most species identified as being of "high management concern" were shrub-steppe species (Saab and Rich 1997) which includes the grasshopper sparrow.

Approximately 6 million hectares of shrub-steppe have been converted to wheat fields, row crops, and orchards in the interior Columbia Basin (Quigley and Arbelbide 1997). In Washington over 50% of historic shrub-steppe has been converted to agriculture (Dobler et al. 1996).

Large scale reduction and fragmentation of sagebrush habitats have occurred due to a number of activities, including land conversion to tilled agriculture, urban and suburban development, and road and power-line rights of way. Range improvement programs remove sagebrush by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock.

Making this loss of habitat even more severe is that the grasshopper sparrow like other grassland species shows a sensitivity to the grassland patch size (e.g. Herkert 1994, Samson 1980, Vickery 1994a b, Bock et al. 1999). Herkert (1991) in Illinois, found that grasshopper sparrows were not present in grassland patches smaller than 30 hectares (74 acres) despite the fact that their published average territory size is only about 0.3 ha (0.75 acres). Vickery et al. (1994) found the minimum requirement to be 100 hectares and Samson (1980) found the minimum to be 20 ha. in Missouri. Differences in minimum area requirements may be explained by the effect of relative population level on the selectivity of individuals, as has been shown for many species of birds (Vickery et al. 1994). Minimum requirement size in the Northwest is unknown.

Grazing

Grazing can trigger a cascade of ecological changes, the most dramatic of which is the invasion of non-native grasses escalating the fire cycle and converting sagebrush shrublands to annual grasslands. Historical heavy livestock grazing altered much of the sagebrush range, changing plant composition and densities. West (1988, 1996) estimates less than 1 percent of sagebrush steppe habitats remain untouched by livestock; 20 percent is lightly grazed, 30 percent moderately grazed with native understory remaining, and 30 percent heavily grazed with understory replaced by invasive annuals. The effects of grazing in sagebrush habitats is complex, depending on intensity, season, duration and extent of alteration to native vegetation.

Extensive and intensive grazing in w. North America has had negative impacts on this species (Bock and Webb 1984).

The legacy of livestock grazing in the Columbia Plateau has had widespread and severe impacts on vegetation structure and composition. One of the most severe impacts in shrub-steppe has been the increased spread of exotic plants (Altman and Holmes 2000, Weddell 2001)

For instance, the grasshopper sparrow has been found to respond positively to light or moderate grazing in tallgrass prairie (Risser et al 1981). However, it responds negatively to grazing in shortgrass, semidesert, and mixed grass areas (Bock et al 1984).

Invasive Grasses

Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrub-steppe, altering shrubland habitats.

The degree of degradation of terrestrial ecosystems is often diagnosed by the presence and extent of alien plant species (e.g., Andreas and Lichvar 1995); frequently their presence is related to soil disturbance and overgrazing. Increasingly, however, aggressive aliens are becoming established even in ostensibly undisturbed bunchgrass vegetation, wherever their seed can reach. The most notorious alien species in the Palouse region are upland species that can dominate and exclude perennial grasses over a wide range of elevations and substrate types (Weddell 2001).

Fire

Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998).

The historical role of fire in the steppe and meadow steppe vegetation of the Palouse region is less clear (Weddell 2001). Daubenmire (1970) dismissed it as relatively unimportant, whereas others conclude that fires were probably more prevalent in the recent past than at present (Morgan et al. 1996). The lack of information about the presettlement fire frequency of steppe and meadow steppe ecosystems makes it difficult to emulate the natural fire regime in restored communities.

Studies on the effects of burns on grassland birds in North American grasslands have shown similar results as grazing studies: namely, bird response is highly variable. Confounding factors include timing of burn, intensity of burn, previous land history, type of pre-burn vegetation, presence of fire-tolerant exotic vegetation (that may take advantage of the post-burn circumstances and spread even more quickly) and grassland bird species present in the area. It should be emphasized that much of the variation in response to grassland fires lies at the level of species, but that even at this level results are often difficult to generalize. For instance, Mourning Doves have been found to experience positive (Bock and Bock 1992, Johnson 1997) and negative (Zimmerman 1997) effects by fire in different studies. Similarly, grasshopper sparrow have been found to experience positive (Johnson 1997), negative (Bock and Bock 1992, Zimmerman 1997, Vickery et al 1999), and no significant (Rohrbaugh 1999) effects of fire. Species associated with short and/or open grass areas will most likely experience short-term benefits from fires. Species that prefer taller and denser grasslands most likely will demonstrate a negative response to fire. (CPIF 2000).

Avoid burning during breeding season. Encroachment of woody vegetation in grassland areas will be detrimental to most grassland species. For instance, grasshopper sparrows have been found to be absent from areas with greater than 30% shrub cover. In areas of good grassland bird diversity and productivity, efforts should be made to keep woody vegetation from reducing open grassland habitat. (CPIF 2000).

Mowing/Haying

Mowing and haying affects grassland birds directly and indirectly. It may reduce height and cover of herbaceous vegetation, destroy active nests, kill nestlings and fledglings, cause nest abandonment, and increase nest exposure and predation levels (Bollinger et al. 1990). Studies on grasshopper sparrow have indicated higher densities and nest success in areas not mowed until after July 15 (Shugaart and James 1973, Warner 1992). Grasshopper sparrows are vulnerable to early mowing of fields, while light grazing, infrequent and post-season burning or mowing can be beneficial (Vickery 1996).

Brood Parasitism

Grasshopper sparrows may be multiply-parasitized (Elliott 1976, 1978; Davis and Sealy 2000). In Kansas, cowbird parasitism cost grasshopper sparrows about 2 young/parasitized nest, and there was a low likelihood of nest abandonment occurring due to cowbird parasitism (Elliott 1976, 1978). In Manitoba, mean number of host young fledged from successful, unparasitized nests was significantly higher than from successful, parasitized nests; cowbird parasitism cost Grasshopper Sparrows about 1.3 young/successful nest (Davis and Sealy 2000).

Predators

Predators of the grasshopper sparrow are hawks, Loggerhead Shrikes, mammals and snakes (Vickery 1996).

Out-of-Subbasin Effects and Assumptions

No data are available.

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SAGE SPARROW
Amphispiza belli

Original Species Account Authors: Paul Ashley and Stacy Stoval, as appeared in the Southeast Washington Ecoregional Assessment, January 2004

Introduction

Sage sparrow (*Amphispiza belli*) is a species of concern in the West due to population decline in some regions and the degradation and loss of breeding and wintering habitats. Vulnerable to loss and fragmentation of sagebrush habitat, sage sparrows may require large patches for breeding. Sage sparrow can likely persist with moderate grazing and other land management activities that maintain sagebrush cover and the integrity of native vegetation.
Sagebrush habitats may be very difficult to restore where non-native grasses and other invasive species are pervasive, leading to an escalation of fire cycles that permanently convert sagebrush habitats to annual grassland.

Sage sparrows are still common throughout much of sagebrush country and have a high probability of being sustained wherever large areas (e.g., 130 hectares observed in Washington, Vader Haegen, pers. comm.) of sagebrush and other preferred native shrubs exist for breeding. Sage sparrows are likely to return to areas where sagebrush and other native vegetation have been restored. However, sagebrush habitats can be very difficult to reclaim once invaded by cheatgrass and other noxious non-native vegetation, leading to an escalation of fire frequency and fire intensity that permanently converts shrub-steppe to annual grassland.

Life History, Key Environmental Correlates, and Habitat Requirements
Life History
Diet

Sage sparrows eat insects, spiders, seeds, small fruits, and succulent vegetation. They forage on the ground, usually under or near shrubs. They may occasionally be observed gleaning prey items from main stems and leaves. Consumed vegetation and insect prey provide most water requirements (Martin and Carlson 1998).

Reproduction

Sage sparrow clutch size usually is three to four, sometimes five. Incubation lasts about 13 days. Nestlings are altricial. Individual females produce one to three broods annually. Reproductive success is greater in wetter years (Rotenberry and Wiens 1991).
In eastern Washington, 70 percent (n = 53) of clutches examined had 3 eggs (Rotenberry and Wiens 1989). Annual reproductive success in Idaho was 1.3 fledglings/nest and probability of nest success was 40 percent (Reynolds 1981). Estimate of nest success in eastern Washington is 32 percent (M. Vander Haegen, unpub. data in Altman and Holmes 2000).

Nesting

Sage sparrows form monogamous pair bonds in early spring; nesting behavior occurs from March to July. Nests are constructed by females in or under sagebrush shrubs and pairs raise 1-2 broods a season (Martin and Carlson 1998).

Brown-headed cowbirds will parasitize sage sparrow nests; parasitized nests are often abandoned (Rich 1978).

Chicks are altricial and fledge when 9-10 days of age. Both parents feed young for more than two weeks after fledging. Fledglings often sit low in shrubs or on the ground under shrubs (Martin and Carlson 1998).

Migration
Sage sparrow populations in Washington are migratory. Sage sparrows are present only during the breeding season, arriving in late February-early March. Birds winter in shrub-steppe habitats of the southwestern United States and northwestern Mexico.

Mortality
Little information is available on estimates of annual survival rates (Martin and Carlson 1998). Typical nest predators include, common raven (*Corvus corax*), Townsend's ground squirrel (*Spermophilus townsendi*), and gopher snakes (*Pituophis catenifer*) (Martin and Carlson 1998, Rotenberry and Wiens 1989). Predators of juvenile and adult birds include loggerhead shrike (*Lanius ludovicianus*) and raptors (Martin and Carlson 1998).

Habitat Requirements
Similar to other shrub-steppe obligate species, sage sparrows are associated with habitats dominated by big sagebrush (*Artemisia tridentata*) and perennial bunchgrasses (Paige and Ritter 1999). In shrub-steppe habitat in southwestern Idaho, habitat occupancy by sage sparrows increased with increasing spatial similarity of sites, shrub patch size, and sagebrush cover; landscape features were more important in predicting presence of sage sparrows than cover values of shrub species and presence of sagebrush was more important than shadscale (Knick and Rotenberry 1995).

Nesting
Habitat in the vicinity of sage sparrow nests in southwestern Idaho was characterized by lower sagebrush cover (23 percent), greater shrub dispersion (clumped vs. uniform), and taller shrub height (18 in.) than surrounding areas. Sage sparrows preferred nesting in large, live sagebrush plants; birds frequently nested in shrubs 16-39 in. tall, shrubs < 6 in. or > 39 in. were rarely used (Petersen and Best 1985). In eastern Washington, height of sagebrush nest shrubs averaged 90 cm (35 in.) (Vander Haegen 2003). In Idaho, nests were constructed an average distance of 34 cm (13 in.) above ground, 11 in. from the top, and 8 in. from the shrub perimeter (Petersen and Best 1985). Although sage sparrows generally place nests in sagebrush shrubs they frequently nest on the ground (Vander Haegen 2003).

Breeding
Washington breeders represent the northern subspecies *A. b. nevadensis.* In the northern Great Basin, sage sparrow is associated with low and tall sagebrush/bunchgrass, juniper/sagebrush, mountain mahogany/shrub, and aspen/sagebrush/bunchgrass communities for breeding and foraging (Maser et al. 1984). In Idaho, sage sparrows are found in sagebrush of 11 to 14 percent cover (Rich 1980). Martin and Carlson (1998) report a preference for evenly spaced shrubs; other authors (Rotenberry and Wiens 1980; Peterson and Best 1985) report association where sagebrush is clumped or patchy. Sage sparrows prefer semi-open habitats, shrubs 1-2 meters tall (Martin and Carlson 1998). Habitat structure (vertical structure, shrub density, and habitat patchiness) is important to habitat selection (Martin and Carlson 1998). Sage sparrow is positively correlated with big sagebrush (*Artemisia tridentata*), shrub cover, bare ground, above-

average shrub height, and horizontal patchiness; it is negatively correlated with grass cover (Rotenberry and Wiens 1980; Wiens and Rotenberry 1981; Larson and Bock 1984).

The subspecies *nevadensis* breeds in brushland dominated by big sagebrush or sagebrush-saltbush (Johnson and Marten 1992). Sage sparrows nest on the ground or in a shrub, up to about one meter above ground (Terres 1980). In the Great Basin, nests are located in living sagebrush where cover is sparse but shrubs are clumped (Petersen and Best 1985). Nest placement may be related to the density of vegetative cover over the nest, and will nest higher in a taller shrub (Rich 1980).

Breeding territory size in eastern Washington averages 1.5-3.9 ac but may vary among sites and years (Wiens et al. 1985). Territories are located in relatively large tracts of continuous sagebrush-dominated habitats. Territory size can vary with plant community composition and structure, increasing with horizontal patchiness (see Wiens et al. 1985). Sage sparrows are absent on sagebrush patches < 325 ac (Vander Haegen et al. 2000; M. Vander Haegen unpub. data in Altman and Holmes 2000).

Non-breeding

In migration and winter, sage sparrows are found in arid plains with sparse bushes, grasslands and open areas with scattered brush, mesquite, and riparian scrub, preferring to feed near woody cover (Martin and Carlson 1998; Meents et al. 1982; Repasky and Schluter 1994). Flocks of sage sparrows in the Mojave Desert appear to follow water courses (Eichinger and Moriarty 1985). Wintering birds in honey mesquite of lower Colorado River select areas of higher inkweed (*Suaeda torreyana*) density (Meents et al. 1982).

Population and Distribution

Population

Historic

No data are available.

Current

Sage sparrow populations are most abundant in areas of deep loamy soil and continuous sagebrush cover 3.3-6.6 feet high (Vander Haegen et al. 2000). In south-central Washington sage sparrows are one of the most common shrub-steppe birds (Vander Haegen et al. 2001). Sage sparrow breeding density was estimated at 121-207 individuals/km2 over a two-year study at the Arid Lands Ecology Reservation in southern Washington (Wiens et al. 1987). Density estimates ranged from 33-90 birds/km2 in sagebrush habitat on the Yakima Training Center (Shapiro and Associates 1996), whereas Schuler et al. (1993) on Hanford Reservation, reported density from 0.23-21.03 birds/km2.

The sedentary subspecies *belli* is found in the foothills of the Coast Ranges (northern California to northwestern Baja California) and the western slope of the central Sierra Nevada in California (Johnson and Marten 1992).

The subspecies *canescens* breeds in the San Joaquin Valley and northern Mohave Desert in California and extreme western Nevada, winters in the southwestern U.S. (Johnson and Marten 1992).

The subspecies *nevadensis* breeds from central interior Washington eastward to southwestern Wyoming and northwestern Colorado, south to east-central California, central Nevada, northeastern Arizona, and northwestern New Mexico. *Nevadensis* winters in the southwestern U.S. and northern Mexico (Johnson and Marten 1992).

Distribution
Historic
Jewett et al. (1953) described the distribution of the sage sparrow as a common summer resident probably at least from March to September in portions of the sagebrush of the Upper Sonoran Zone and of the neighboring bunchgrass areas of the Transition zone in eastern Washington. They describe its summer range as north to Wilbur and Waterville, Grand Coulee; east to Connell and Wilbur; south to Kiona, Kennewick, and Lower Flat, Walla Walla County; and west to Waterville, Moxee City, Sunnyside, Yakima, and Soap Lake. Jewett et al. (1953) also note that the sage sparrow was found practically throughout the sagebrush of eastern Washington, and in a few places, notably in the vicinity of Wilbur, Waterville, Prescott, and Horse Heaven, it ranges into the bunch grass as well. Jewett et al. (1953) report that Snodgrass found it the predominant sparrow in the sagebrush west of Connell. Hudson and Yocom (1954) described the sage sparrow as a summer resident and migrant in sagebrush areas of Adams, Franklin, and Grant counties. They report that Snodgrass reported it as common in western Walla Walla County.

Current
Data are not available.

Breeding
During the breeding season, sage sparrows are found in central Washington, eastern Oregon, southern Idaho, southwestern Wyoming, and northwestern Colorado south to southern California, central Baja California, southern Nevada, southwestern Utah, northeastern Arizona, and northwestern New Mexico (AOU 1983; Martin and Carlson 1998).

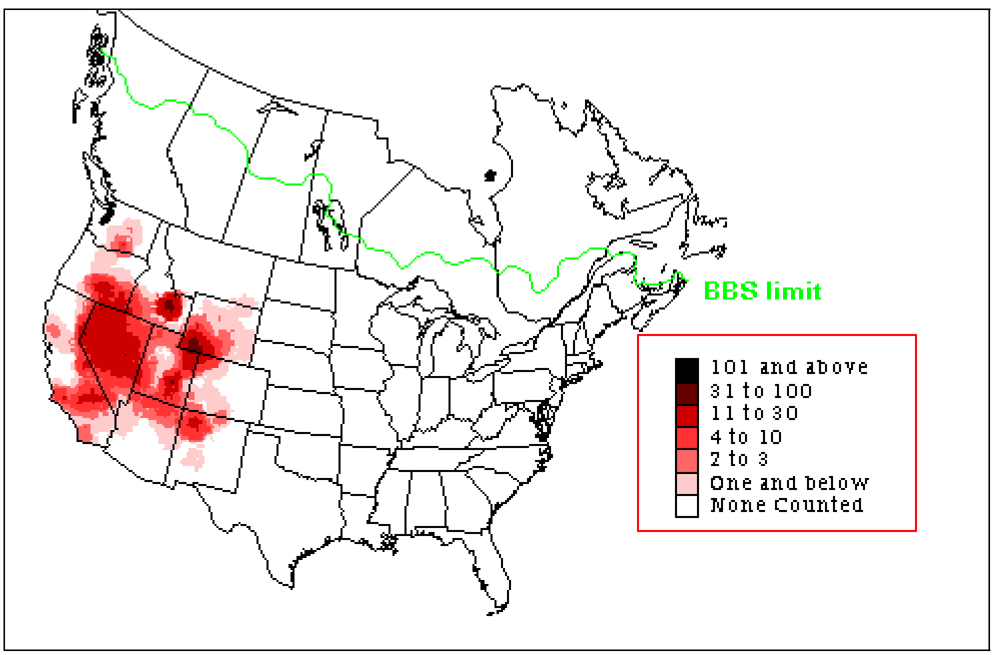

Figure 2. Sage sparrow breeding season abundance (from BBS data) (Sauer et al. 2003).

Non-breeding

Sage sparrows are found in central California, central Nevada, southwestern Utah, northern Arizona, and central New Mexico south to central Baja California, northwestern mainland of Mexico, and western Texas (AOU 1983; Martin and Carlson 1998).

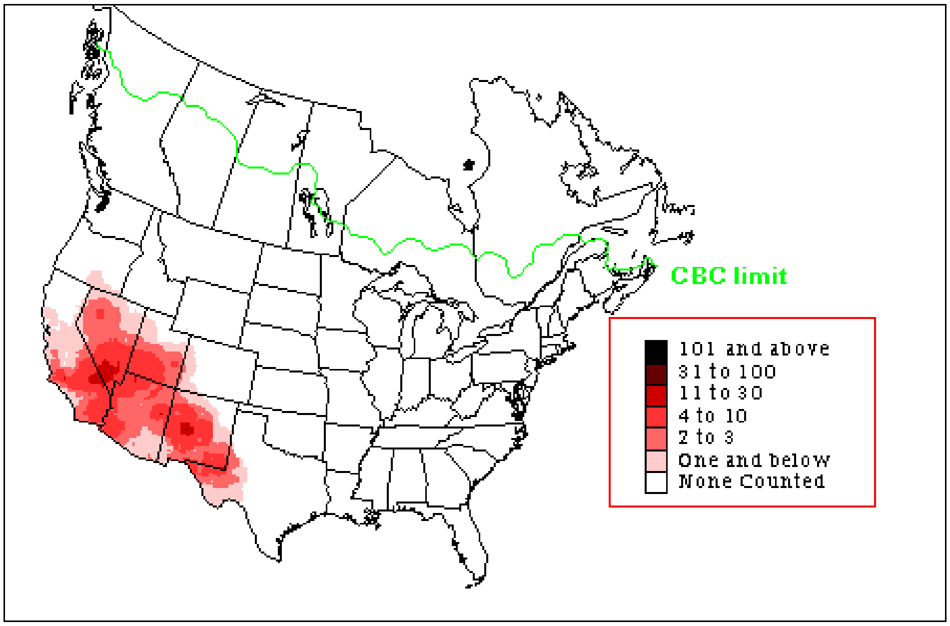

Figure 3. Sage sparrow winter season abundance (from CBC data) (Sauer et al. 2003).

Sage Sparrow Status and Abundance Trends

Status

North American Breeding Bird Survey (BBS) data indicate that sage sparrows have declined 1.0-2.3 percent in recent decades (1966-1991); greatest declines have occurred in Arizona, Idaho, and Washington (Martin and Carlson 1998). Sage sparrows are listed as a ‘candidate’ species (potentially threatened or endangered) by the Washington Department of Fish and Wildlife and are listed by the Oregon-Washington chapter of Partners in Flight as a priority species, and on the National Audubon Society Watch List. Based on genetic and morphometric differences, the subspecies *A. b. nevadensis* (currently found in east-central Washington) may be reclassified as a distinct species. Such an action would likely prompt increased conservation interest at the federal level.

Trends

The BBS data (1966-1996) for Washington State show a non-significant 0.3 percent average annual increase in sage sparrow survey-wide (n = 187 survey routes). There has been a significant decline of -4.8 percent average per year for 1966-1979 (n = 73), and a recent significant increase of 2.0 percent average per year, 1980-1996 (n = 154; Sauer et al. 1997). BBS data indicate recent non-significant declines in California and Wyoming, 1980-1995. Generally, low sample sizes make trend estimates unreliable for most states and physiographic regions. Highest sage sparrow summer densities occur in the Great Basin, particularly Nevada, southeastern Oregon, southern Idaho, and Wyoming (Sauer et al. 1997).

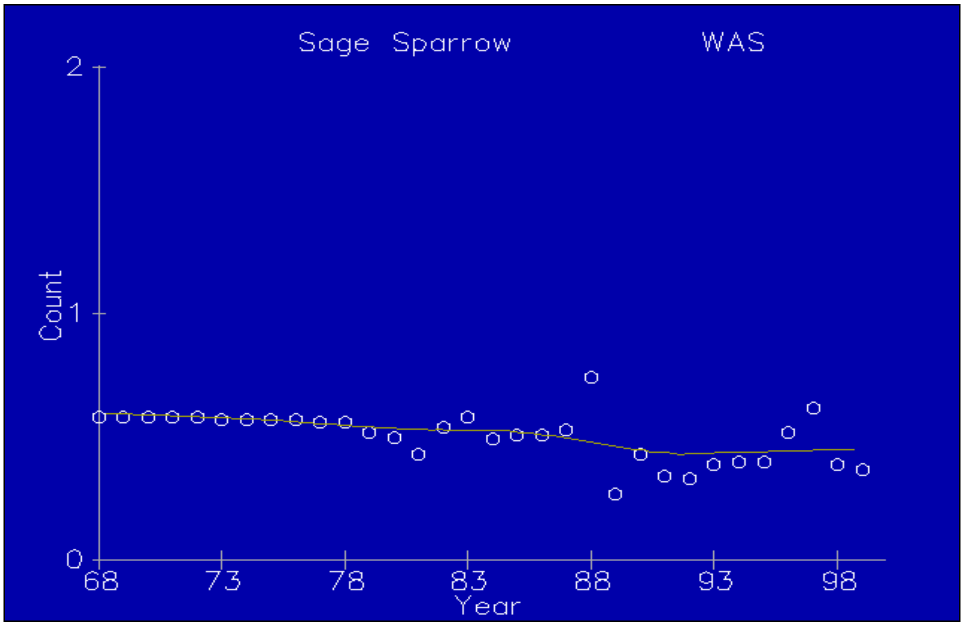

Figure 4. Sage sparrow population trend data (from BBS), Washington (Sauer et al. 2003).

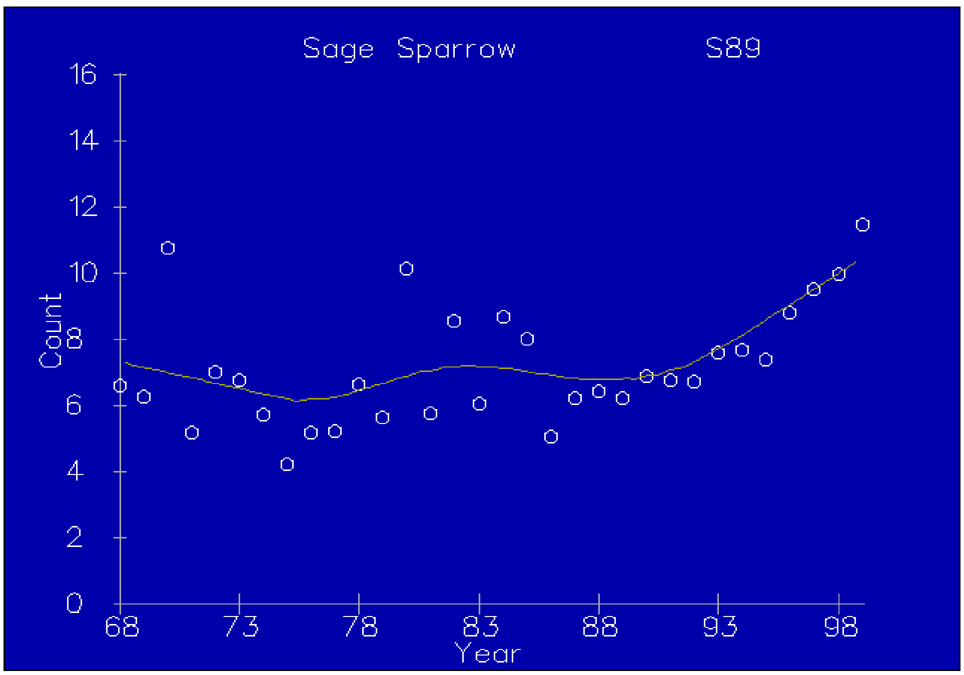

Figure 5. Sage sparrow trend results (from BBS data), Columbia Plateau (Sauer et al. 2003).

Christmas Bird Count (CBC) data show a significant decline in sage sparrows (-2.1 percent average per year; n = 160 survey circles) survey-wide for the period from 1959-1988. Sage sparrow trend estimates show declines in Arizona, New Mexico, and a significant decline in Texas (-2.2 percent average per year; n = 16). The highest sage sparrow winter counts occur in southern Nevada, southern California, Arizona, New Mexico, and west Texas (Sauer et al. 1996).

According to the ICBEMP terrestrial vertebrate habitat analysis, historical source habitats for sage sparrow occurred throughout most of the three ERUs within our planning unit (Wisdom et al. in press). Declines in source habitats were moderately high in the Columbia Plateau (40 percent), but relatively low in the Owyhee Uplands (13 percent) and Northern Great Basin (7 percent). However, declines in big sagebrush (e.g., 50 percent in Columbia Plateau ERU), which is likely higher quality habitat, are masked by an increase in juniper sagebrush (>50 percent in Columbia Plateau ERU), which is likely reduced quality habitat. Within the entire Interior Columbia Basin, over 48 percent of watersheds show moderately or strongly declining trends in source habitats for this species (Wisdom et al. in press) (from Altman and Holmes 2000).

Factors Affecting Sage Sparrow Population Status
Key Factors Inhibiting Populations and Ecological Processes
Habitat Loss
Because sage sparrows are shrub-steppe obligates. Sagebrush shrublands are vulnerable to a number of activities that reduce or fragment sagebrush habitat, including land conversion to tilled agriculture, urban and suburban development, and road and powerline rights of way. Range improvement programs remove sagebrush by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock.

Agricultural set-aside programs (such as the Conservation Reserve Program [CRP]) may eventually increase the quantity of potential breeding habitat for sage sparrows but it is not clear how long this will take. Habitat objectives recommended for sage sparrows include; dominant sagebrush canopy with 10 - 25 percent sagebrush cover, mean sagebrush height >50 cm, high foliage density, mean native grass cover > 10 percent, mean exotic annual grass cover < 10 percent, mean open ground cover > 10 percent, and where appropriate provide suitable habitat conditions in patches >1000 ha (400ac) (Altman and Holmes 2000).

Fragmentation
The presence of relatively large tracts of sagebrush-dominated habitats is important as research in Washington indicates a negative relationship between sage sparrow occurrence and habitat fragmentation (Vander Haegen et al. 2000). Additionally, fragmentation of shrub-steppe habitat may increase vulnerability of sage sparrows to nest predation by generalist predators such as the common raven (*Corvus corax*) and black-billed magpie (*Pica hudsonia*) (Vander Haegen et al. 2002).

Livestock Management
Response to variation in grazing intensity is mixed. Sage sparrows respond negatively to heavy grazing of greasewood/Great Basin wild rye and shadscale/Indian ricegrass communities. They respond positively to heavy grazing of Nevada bluegrass/sedge communities, moderate grazing of big sage/bluebunch wheatgrass community, and to unspecified grazing intensity of big sage communities (see review by Saab et al. 1995). Because sage sparrows nest on the ground in early spring, and forage on the ground, maintenance of >50 percent of annual vegetative herbaceous growth of perennial bunchgrasses through the following season is recommended (Altman and Holmes 2000).

Pesticides/Herbicides
Large scale (16 km2) aerial spraying of sagebrush habitat with the herbicide 2,4-D resulted in a significant decline in sage sparrow abundance 2 years post treatment. Because sage sparrows display high site fidelity to breeding areas birds may occupy areas that have been rendered unsuitable (Wiens and Rotenberry 1985).

Fire
Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing habitat for sage sparrow (Paige and Ritter 1998).

Invasive Grasses
Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrub-steppe.

Brood Parasitism
Sage sparrow is an occasional host for brown-headed cowbird (*Molothrus ater*), and may abandon the nest (e.g., see Reynolds 1981). Prior to European-American settlement, sage sparrow was probably largely isolated from cowbird brood parasitism, but is now vulnerable where the presence of livestock, land conversion to agriculture, and fragmentation of shrublands creates a contact zone between the species (Rich 1978).

Predation
In Oregon, predation by Townsend ground squirrel (*Spermophilus townsendi*) affected sage sparrow reproductive success when squirrel densities were high. Sage sparrow populations in southeastern Washington and northern Nevada incurred high rates of nest predation, probably mainly by gopher snakes (*Pituophis melanoleucus*) (Rotenberry and Wiens 1989). Loggerhead shrikes (*Lanius ludovicianus*) prey on both adults and altricial young in nest, and can significantly reduce nest production (Reynolds 1979). Feral cats near human habitations may increase predation (Martin and Carlson 1998).

Out-of-Subbasin Effects and Assumptions
No data could be found on the migration and wintering grounds of the sage sparrow. It is a short distance migrant, wintering in the southwestern U.S. and northern Mexico, and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions is likely happening along its entire migration route (H. Ferguson, WDFW, pers. comm., 2003). Management requires the protection shrub, shrub-steppe, desert scrub habitats, and the elimination or control of noxious weeds. Migration routes, corridors, and wintering grounds need to be identified and protected just as its breeding area.

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COLUMBIA SPOTTED FROG
Rana luteiventris

Original Species Account Author: Keith Paul, United States Fish and Wildlife Service

Introduction
The Columbia spotted frog (CSF) is olive green to brown in color, with irregular black spots. They may have white, yellow, or salmon coloration on the underside of the belly and legs (Engle 2004). The hind legs are relatively short relative to body length and there is extensive webbing between the toes on the hind feet. The eyes are upturned (Amphibia Web 2004). Tadpoles are black when small, changing to a dark then light brown as they increase in size. CSFs are about one inch in body length at metamorphosis (Engle 2004). Females may grow to approximately 100 mm (4 inches) snout-to-vent length, while males may reach approximately 75 mm (3 inches) snout-vent length (Nussbaum et al. 1983; Stebbins 1985; Leonard et al. 1993).

Life History, Key Environmental Correlates, and Habitat Requirements
Life History
Diet
The CSF eats a variety of food including arthropods (e.g., spiders, insects), earthworms and other invertebrate prey (Whitaker et al. 1982). Adult CSFs are opportunistic feeders and feed primarily on invertebrates (Nussbaum et al. 1983). Larval frogs feed on aquatic algae and vascular plants, and scavenged plant and animal materials (Morris and Tanner 1969).

Reproduction
The timing of breeding varies widely across the species range owing to differences in weather and climate, but the first visible activity begins in late winter or spring shortly after areas of ice-free water appear at breeding sites (Licht 1975; Turner 1958; Leonard et al 1996). Breeding typically occurs in late March or April, but at higher elevations, breeding may not occur until late May or early June (Amphibia Web 2004). Great Basin population CSFs emerge from wintering sites soon after breeding sites thaw (Engle 2001).

Adults exhibit a strong fidelity to breeding sites, with oviposition typically occurring in the same areas in successive years. Males arrive first, congregating around breeding sites, periodically vocalizing "advertisement calls" in a rapid series of 3-12 "tapping" notes that have little carrying power (Davidson 1995; Leonard et al. 1996). As a female enters the breeding area, she is approached by and subsequently pairs with a male in a nuptial embrace referred to as amplexus. From several hours to possibly days later, the female releases her complement of eggs into the water while the male, still clinging to the female, releases sperm upon the ova (Amphibia Web 2004). Breeding is explosive (as opposed to season-long), occurring only in the first few weeks following emergence (USFWS 2002a). After breeding is completed, adults often disperse into adjacent wetland, riverine and lacustrine habitats (Amphibia Web 2004).

CSF's have a strong tendency to lay their eggs communally and it is not uncommon to find 25 or more egg masses piled atop one another in the shallows (Amphibia Web 2004). Softball-sized egg masses are usually found in groups, typically along northeast edges of slack water amongst emergent vegetation (USFWS 2002a). After a few weeks thousands of small tadpoles emerge and cling to the remains of the gelatinous egg masses. Newly-hatched larvae remain clustered for several days before moving throughout their natal site (USFWS 2002a). In the Columbia

Basin tadpoles may grow to 100 mm (4 in) total length prior to metamorphosing into froglets in their first summer or fall. At high-elevation montane sites, however, tadpoles barely reach 45 mm (1.77 in) in total length prior to the onset of metamorphosis in late fall (Amphibia Web 2004). As young-of-the-year transform, many leave their natal sites and can be found in nearby riparian corridors (USFWS 2002a).

Females may lay only one egg mass per year; yearly fluctuations in the sizes of egg masses are extreme (Utah Division of Wildlife Resources 1998). Successful egg production and the viability and metamorphosis of CSF's are susceptible to habitat variables such as temperature, depth, and pH of water, cover, and the presence/absence of predators (e.g., fishes and bullfrogs) (Morris and Tanner 1969; Munger et al. 1996; Reaser 1996).

Migration

[David Pilliod observed movements of approximately 2,000 m (6,562 ft) linear distance within a basin in montane habitats (Reaser and Pilliod, in press). Pilliod et al. 1996 (in Koch et al. 1997) reported that individual high mountain lake populations of *R. luteiventris* in Idaho are actually interdependent and are part of a larger contiguous metapopulation that includes all the lakes in the basin. In Nevada, Reaser (1996; in Koch et al. 1997) determined that one individual of *R. luteiventris* traveled over 5 km (3.11 mi) in a year (NatureServe 2003)].

[In a three-year study of *R. luteiventris* movement within the Owyhee Mountain subpopulation of the Great Basin population in southwestern Idaho, Engle (2000) PIT-tagged over 1800 individuals but documented only five (of 468) recaptures over 1,000 m (3,281 ft) from their original capture point. All recaptures were along riparian corridors and the longest distance between capture points was 1,765 m (5,791). Although gender differences were observed, 88 percent of all movement documented was less than 300 m (984 ft) from the original capture point (NatureServe 2003)].

[Though movements exceeding 1 km (0.62 mi) and up 5 km (3.11 mi) have been recorded, these frogs generally stay in wetlands and along streams within 0.6 km (0.37 mi) of their breeding pond (Turner 1960, Hollenbeck 1974, Bull and Hayes 2001). Frogs in isolated ponds may not leave those sites (Bull and Hayes 2001) (NatureServe 2003)].

[In the Toiyabe Range in Nevada, Reaser (2000) captured 887 individuals over three years, with average mid-season density ranging from 2 to 24 frogs per 150 m (492 ft) of habitat (NatureServe 2003)].

Mortality

Based on recapture rates in the Owyhee Mountains, some individuals live for at least five years. Skeletochronological analysis in 1998 revealed a 9-year old female (Engle and Munger 2000).

Mortality of eggs, tadpoles, and newly metamorphosed frogs is high, with approximately 5% surviving the first winter (David Pilliod, personal communication, cited in Amphibia Web 2004).

Habitat Requirements

General

This species is relatively aquatic and is rarely found far from water. It occupies a variety of still water habitats and can also be found in streams and creeks (Hallock and McAllister 2002). CSF's are found closely associated with clear, slow-moving or ponded surface waters, with little shade (Reaser 1997). CSF's are found in aquatic sites with a variety of vegetation types, from grasslands to forests (Csuti 1997). A deep silt or muck substrate may be required for hibernation and torpor (Morris and Tanner 1969). In colder portions of their range, CSF's will use areas where water does not freeze, such as spring heads and undercut streambanks with overhanging vegetation (IDFG et al. 1995). CSF's may disperse into forest, grassland, and brushland during wet weather (NatureServe 2003). They will use stream-side small mammal burrows as shelter. Overwintering sites in the Great Basin include undercut banks and spring heads (Blomquist and Tull 2002).

Breeding

Reproducing populations have been found in habitats characterized by springs, floating vegetation, and larger bodies of pooled water (e.g., oxbows, lakes, stock ponds, beaver-created ponds, seeps in wet meadows, backwaters) (IDFG et al. 1995; Reaser 1997). Breeding habitat is the temporarily flooded margins of wetlands, ponds, and lakes (Hallock and McAllister 2002). Breeding habitats include a variety of relatively exposed, shallow-water (<60 cm), emergent wetlands such as sedge fens, riverine over-bank pools, beaver ponds, and the wetland fringes of ponds and small lakes. Vegetation in the breeding pools generally is dominated by herbaceous species such as grasses, sedges (*Cares spp*.) and rushes (*Juncus spp*.) (Amphibia Web 2004).

Population and Distribution

Distribution

Populations of the CSF are found from Alaska and British Columbia to Washington east of the Cascades, eastern Oregon, Idaho, the Bighorn Mountains of Wyoming, the Mary's, Reese, and Owyhee River systems of Nevada, the Wasatch Mountains, and the western desert of Utah (Green et al. 1997). Genetic evidence (Green et al. 1996) indicates that Columbia spotted frogs may be a single species with three subspecies, or may be several weakly-differentiated species.

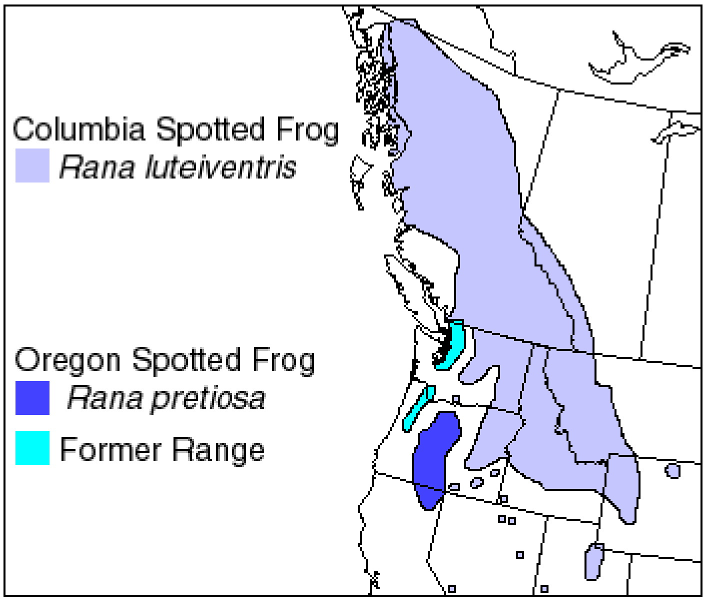
The FWS recognizes four distinct population segments (DPS) based on disjunct distribution: the Wasatch Front DPS (Utah), West Desert DPS (White Pine County, NV and Toole County Utah), Great Basin DPS (southeast Oregon, southwest Idaho, and northcentral/northeast Nevada), and the Northern DPS (includes northeastern Oregon, eastern Washington, central and northern parts of Idaho, western Montana, northwestern Wyoming, British Columbia and Alaska) (C. Mellison, J. Engle, pers. comm., 2004).

There is still some uncertainty about whether the northeast Oregon frogs and the southeastern Washington frogs are part of the Great Basin or Northern population. This group of frogs (Blue and Wallowa Mountains) is isolated from the Great Basin population based on geography, and the habitat in the Anthony Lakes area is more like that of the Northern population (montane) than the Great Basin (high desert). It has been considered to make the Snake River a boundary between the Northern and Great Basin populations, but further genetics work will need to be done to clarify the issue (J. Engle, pers. comm., 2004).

Two populations of CSFs are found within the Columbia River Basin: Northern DPS and Great Basin DPS. The Great Basin DPS is further divided into five subpopulations: southeastern Oregon, Owyhee, Jarbidge-Independence, Ruby Mountains, and Toiyabe (J. Engle, C. Mellison, pers. comm., 2004). Of the five subpopulations, only the eastern Oregon, Owyhee, and the Jarbidge-Independence occur in the Columbia River subbasin.

Historic
Historic range of the Northern population is most likely similar to that of the current range. Moving south into the southern populations (Great Basin, Wasatch Front, and West Desert) the range was most likely larger in size. Due to habitat loss and alteration, fragmentation, water diversion, dams, and loss of beaver the current distribution and abundance of CSF and suitable habitat has dramatically decreased.

Current



USGS, Northern Prairie Wildlife Research Center; range acquired from Green et al. 1997.

<u>Wasatch Front DPS</u>
[Spotted frog populations in Utah represent the southern extent of the species range (Stebbins 1985). The Wasatch Front population occurs in isolated springs or riparian wetlands in Juab, Sanpete, Summit, Utah, and Wasatch counties in Utah. These counties are located within the Bonneville Basin of Utah. The Bonneville Basin encompasses the area that was covered by ancient Lake Bonneville and which, today, lies within the Great Basin province. The largest known concentration is currently in the Heber Valley; the remaining six locations are Jordanelle/Francis, Springville Hatchery, Holladay Springs, Mona Springs Complex/Burraston Ponds, Fairview, and Vernon (USFWS 2002b)].

<u>West Desert DPS</u>
[The West Desert spotted frog population occurs mainly in four large spring complexes. One new population, Vernon, was recently discovered in the eastern-most portion of the West Desert geographic management unit (GMU). CSFs in the West Desert DPS can be found along the eastern border of White Pine County, NV and Toole County, Utah. Populations have been extirpated from the northern portions of the West Desert range (USFWS 2002b)].

<u>Northern DPS</u>
The Northern DPS includes northeastern Oregon, eastern Washington, central and northern parts of Idaho, western Montana, northwestern Wyoming, British Columbia and Alaska (J. Engle, C.

Mellison, pers. comm., 2004). Populations within the Blue and Wallowa Mountains are found within this DPS.

Great Basin DPS

Nevada

The Great Basin population of Columbia spotted frogs in Nevada is geographically separated into three distinct subpopulations; the Jarbidge-Independence Range, Ruby Mountains, and Toiyabe Mountains subpopulations (USFWS 2002c).

[The largest of Nevada's three subpopulation areas is the Jarbidge-Independence Range in Elko and Eureka counties. This subpopulation area is formed by the headwaters of streams in two major hydrographic basins. The South Fork Owyhee, Owyhee, Bruneau, and Salmon Falls drainages flow north into the Snake River basin. Mary's River, North Fork of the Humboldt, and Maggie Creek drain into the interior Humboldt River basin. The Jarbidge-Independence Range subpopulation is considered to be genetically and geographically most closely associated with Columbia spotted frogs in southern Idaho (Reaser 1997)(USFWS 2002c)].

[Columbia spotted frogs occur in the Ruby Mountains in the areas of Green Mountain, Smith, and Rattlesnake creeks on lands in Elko County managed by the U.S. Forest Service (Forest Service). Although geographically, Ruby Mountains spotted frogs are close to the Jarbidge-Independence Range subpopulation, preliminary allozyme evidence suggests they are genotypically different (J. Reaser, pers. comm., 1998). The Ruby Mountains subpopulation is considered discrete because of this difference (J. Reaser, pers. comm., 1998) and because it is geographically isolated from the Jarbidge-Independence Range subpopulation area to the north by an undetermined barrier (e.g., lack of suitable habitat, connectivity, and/or predators), and from the Toiyabe Mountains subpopulation area to the southwest by a large gap in suitable Humboldt River drainage habitat (USFWS 2002c)].

[In the Toiyabe Range, spotted frogs are found in seven drainages in Nye County, Nevada; the Reese River (Upper and Lower), Cow and Ledbetter Canyons, and Cloverdale, Stewart, Illinois, and Indian Valley Creeks. Although historically they also occurred in Lander County, preliminary surveys have found them absent from this area (J. Tull, Forest Service, pers. comm., 1998). Toiyabe Range spotted frogs are geographically isolated from the Ruby Mountains and Jarbidge-Independence Range subpopulations by a large gap in suitable habitat and they represent *R. luteiventris* in the southern-most extremity of its range. Genetic analyses of Great Basin Columbia spotted frogs from the Toiyabe Range suggest that these frogs are distinctive in comparison to frogs from the Ruby Mountains and Jarbidge-Independence Range subpopulation areas (Green et al. 1996, 1997; J. Reaser, pers. comm., 1998). Genetic (mtDNA) differences between the Toiyabe Range frogs and the Ruby Mountains frogs are less than those between the Toiyabe Range frogs and the Jarbidge-Independence Range frogs, but this may be because of similar temporal and spatial isolation (J. Reaser, pers. comm., 1998) (USFWS 2002c)].

Idaho and Oregon

[Surveys conducted in the Raft River and Goose Creek drainages in Idaho failed to relocate spotted frogs (Reaser 1997; Shipman and Anderson 1997; Turner 1962). In 1994 and 1995, the Bureau of Land Management (BLM) conducted surveys in the Jarbidge and Snake River Resource Areas in Twin Falls County, Idaho. These efforts were also unsuccessful in locating spotted frogs (McDonald 1996). Only six historical sites were known in the Owyhee Mountain range in Idaho, and only 11 sites were known in southeastern Oregon in Malheur County prior to 1995 (Munger et al. 1996) (USFWS 2002c)].

Currently, Columbia spotted frogs appear to be widely distributed throughout southwestern Idaho (mainly in Owyhee County) and eastern Oregon, but local populations within this general area appear to be isolated from each other by either natural or human induced habitat disruptions. The largest local population of spotted frogs in Idaho occurs in Owyhee County in the Rock Creek drainage. The largest local population of spotted frogs in Oregon occurs in Malheur County in the Dry Creek Drainage (USFWS 2002c).

Population, Status, and Abundance Trends

Nevada

[Declines of Columbia spotted frog populations in Nevada have been recorded since 1962 when it was observed that in many Elko County localities where spotted frogs were once numerous, the species was nearly extirpated (Turner 1962). Extensive loss of habitat was found to have occurred from conversion of wetland habitats to irrigated pasture and spring and stream dewatering by mining and irrigation practices. In addition, there was evidence of extensive impacts on riparian habitats due to intensive livestock grazing. Recent work by researchers in Nevada have documented the loss of historically known sites, reduced numbers of individuals within local populations, and declines in the reproduction of those individuals (Hovingh 1990; Reaser 1996a, 1996b, 1997). Surveys in Nevada between 1994 and 1996 indicated that 54 percent of surveyed sites known to have frogs before 1993 no longer supported individuals (Reaser 1997) (USFWS 2002c)].

[Little historical or recent data are available for the largest subpopulation area in Nevada, the Jarbidge-Independence Range. Presence/absence surveys have been conducted by Stanford University researchers and the Forest Service, but dependable information on numbers of breeding adults and trends is unavailable. Between 1993 and 1998, 976 sites were surveyed for the presence of spotted frogs in northeastern Nevada, including the Ruby Mountains subpopulation area (Shipman and Anderson 1997; Reaser 2000). Of these, 746 sites (76 percent) that were believed to have characteristics suitable for frogs were unoccupied. For these particular sites there is no information on historical presence of spotted frogs. Of 212 sites that were known to support frogs before 1992, 107 (50 percent) sites no longer had frogs, while 105 sites did support frogs. At the occupied sites, surveyors observed more than 10 adults at only 13 sites (12 percent). Frogs in this area appear widely distributed (Reaser 1997). No monitoring or surveying has taken place in northeastern Nevada since 1998. The Forest Service is planning on surveying the area during the summer of 2002 (USFWS 2002c)].

[Between 1993 and 1998, 339 sites were surveyed for the presence of Columbia spotted frogs in the Toiyabe Range. Surveyors visited 118 sites (35 percent) with suitable habitat characteristics where no frogs were present. Ten historical frog sites no longer had frogs when surveyed by Reaser between 1993 and 1996 (Reaser 1997). However, at 211 other historical sites, frogs were still present during this survey period. Of these 211 sites, surveyors reported greater than 10 adult frogs at 133 sites (63 percent) (Reaser 1997). In 2000, frog mark-recapture surveys of the Toiyabe Range subpopulation was conducted by the University of Nevada, Reno. Preliminary estimates of frog numbers in the Indian Valley Creek drainage were around 5,000 breeding individuals, which is greater than previously believed (K. Hatch, pers. comm., 2001). However, during the 2000-2001 winter, Hatch (2002) noted a large population decrease, ranging between 66 and 86.5 percent at several sites. Research is currently being conducted to help understand this apparent winterkill. Lack of standardized or extensive monitoring and routine surveying has prevented dependable determinations of frog population numbers or trends in Nevada (USFWS 2002c)].

Idaho and Oregon
[Extensive surveys since 1996 throughout southern Idaho and eastern Oregon, have led to increases in the number of known spotted frog sites. Although efforts to survey for spotted frogs have increased the available information regarding known species locations, most of these data suggest the sites support small numbers of frogs. Of the 49 known local populations in southern Idaho, 61 percent had 10 or fewer adult frogs and 37 percent had 100 or fewer adult frogs (Engle 2000; Idaho Conservation Data Center (IDCDC) 2000). The largest known local population of spotted frogs occurs in the Rock Creek drainage of Owyhee County and supports under 250 adult frogs (Engle 2000). Extensive monitoring at 10 of the 46 occupied sites since 1997 indicates a general decline in the number of adult spotted frogs encountered (Engle 2000; Engle and Munger 2000; Engle 2002). All known local populations in southern Idaho appear to be functionally isolated (Engle 2000; Engle and Munger 2000) (USFWS 2002c)].

[Of the16 sites that are known to support Columbia spotted frogs in eastern Oregon, 81 percent of these sites appear to support fewer than 10 adult spotted frogs. In southeastern Oregon, surveys conducted in 1997 found a single population of spotted frogs in the Dry Creek drainage of Malheur County. Population estimates for this site are under 300 adult frogs (Munger et al. 1996). Monitoring (since 1998) of spotted frogs in northeastern Oregon in Wallowa County indicates relatively stable, small local populations (less than five adults encountered) (Pearl 2000). All of the known local populations of spotted frogs in eastern Oregon appear to be functionally isolated (USFWS 2002c)].

Legal Status
In 1989, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list the spotted frog (referred to as *Rana pretiosa*) under ESA (Federal Register 54[1989]:42529). The USFWS ruled on April 23, 1993, that the listing of the spotted frog was warranted and designated it a candidate for listing with a priority 3 for the Great Basin population, but was precluded from listing due to higher priority species (Federal Register 58[87]:27260). The major impetus behind the petition was the reduction in distribution apparently associated with impacts from water developments and the introduction of nonnative species.

On September 19, 1997 (Federal Register 62[182]:49401), the USFWS downgraded the priority status for the Great Basin population of Columbia spotted frogs to a priority 9, thus relieving the pressure to list the population while efforts to develop and implement specific conservation measures were ongoing. As of January 8, 2001 (Federal Register 66[5]:1295- 1300), however, the priority ranking has been raised back to a priority 3 due to increased threats to the species. This includes the Great Basin DPS Columbia spotted frog populations

Factors Affecting Columbia Spotted Frog Population Status
Key Factors Inhibiting Populations and Ecological Processes
The present or threatened destruction, modification, or curtailment of its habitat or range
[Spotted frog habitat degradation and fragmentation is probably a combined result of past and current influences of heavy livestock grazing, spring development, agricultural development, urbanization, and mining activities. These activities eliminate vegetation necessary to protect frogs from predators and UV-B radiation; reduce soil moisture; create undesirable changes in

water temperature, chemistry and water availability; and can cause restructuring of habitat zones through trampling, rechanneling, or degradation which in turn can negatively affect the available invertebrate food source (IDFG et al. 1995; Munger et al. 1997; Reaser 1997; Engle and Munger 2000; Engle 2002). Spotted frog habitat occurs in the same areas where these activities are likely to take place or where these activities occurred in the past and resulting habitat degradation has not improved over time. Natural fluctuations in environmental conditions tend to magnify the detrimental effects of these activities, just as the activities may also magnify the detrimental effects of natural environmental events (USFWS 2002c)].

[Springs provide a stable, permanent source of water for frog breeding, feeding, and winter refugia (IDFG et al. 1995). Springs provide deep, protected areas which serve as hibernacula for spotted frogs in cold climates. Springs also provide protection from predation through underground openings (IDFG et al. 1995; Patla and Peterson 1996). Most spring developments result in the installation of a pipe or box to fully capture the water source and direct water to another location such as a livestock watering trough. Loss of this permanent source of water in desert ecosystems can also lead to the loss of associated riparian habitats and wetlands used by spotted frogs. Developed spring pools could be functioning as attractive nuisances for frogs, concentrating them into isolated groups, increasing the risk of disease and predation (Engle 2001). Many of the springs in southern Idaho, eastern Oregon, and Nevada have been developed (USFWS 2002c)].

[The reduction of beaver populations has been noted as an important feature in the reduction of suitable habitat for spotted frogs. Beaver are important in the creation of small pools with slow-moving water that function as habitat for frog reproduction and create wet meadows that provide foraging habitat and protective vegetation cover, especially in the dry interior western United States (St. John 1994). Beaver trapping is still common in Idaho and harvest is unregulated in most areas (IDFG et al. 1995). In some areas, beavers are removed because of a perceived threat to water for agriculture or horticultural plantings. As indicated above, permanent ponded waters are important in maintaining spotted frog habitats during severe drought or winter periods. Removal of a beaver dam in Stoneman Creek in Idaho is believed to be directly related to the decline of a spotted frog subpopulation there. Intensive surveying of the historical site where frogs were known to have occurred has documented only one adult spotted frog (Engle 2000) (USFWS 2002c)].

[Fragmentation of habitat may be one of the most significant barriers to spotted frog recovery and population persistence. Recent studies in Idaho indicate that spotted frogs exhibit breeding site fidelity (Patla and Peterson 1996; Engle 2000; Munger and Engle 2000; J. Engle, IDFG, pers. comm., 2001). Movement of frogs from hibernation ponds to breeding ponds may be impeded by zones of unsuitable habitat. As movement corridors become more fragmented due to loss of flows within riparian or meadow habitats, local populations will become more isolated (Engle 2000; Engle 2001). Vegetation and surface water along movement corridors provide relief from high temperatures and arid environmental conditions, as well as protection from predators. Loss of vegetation and/or lowering of the water table as a result of the above mentioned activities can pose a significant threat to frogs moving from one area to another. Likewise, fragmentation and loss of habitat can prevent frogs from colonizing suitable sites elsewhere (USFWS 2002c)].

[Though direct correlation between spotted frog declines and livestock grazing has not been studied, the effects of heavy grazing on riparian areas are well documented (Kauffman et al.

1982; Kauffman and Kreuger 1984; Skovlin 1984; Kauffman et al. 1985; Schulz and Leininger 1990). Heavy grazing in riparian areas on state and private lands is a chronic problem throughout the Great Basin. Efforts to protect spotted frog habitat on state lands in Idaho have been largely unsuccessful because of lack of cooperation from the State. In northeast Nevada, the Forest Service has completed three riparian area protection projects in areas where spotted frogs occur. These projects include altering stocking rates or changing the grazing season in two allotments known to have frogs and constructing riparian fencing on one allotment. However, these three sites have not been monitored to determine whether efforts to protect riparian habitat and spotted frogs have been successful. In the Toiyabe Range, a proposal to fence 3.2 kilometers (km) (2 miles (mi)) of damaged riparian area along Cloverdale Creek to protect it from grazing is scheduled to occur in the summer of 2002. In addition to the riparian exclosure, BLM biologists located a diversion dam in 1998 on Cloverdale Creek which was completely de- watering approximately 1.6 km (1 mi) of stream. During the summer of 2000, this area was reclaimed and water was put back into the stream. This area of the stream is not currently occupied by spotted frogs but it is historical habitat (USFWS 2002c)].

[The effects of mining on Great Basin Columbia spotted frogs, specifically, have not been studied, but the adverse effects of mining activities on water quality and quantity, other wildlife species, and amphibians in particular have been addressed in professional scientific forums (Chang et al. 1974; Birge et al. 1975; Greenhouse 1976; Khangarot et al. 1985) (USFWS 2002c)].

<u>Disease or predation</u>

[Predation by fishes is likely an important threat to spotted frogs. The introduction of nonnative salmonid and bass species for recreational fishing may have negatively affected frog species throughout the United States. The negative effects of predation of this kind are difficult to document, particularly in stream systems. However, significant negative effects of predation on frog populations in lacustrine systems have been documented (Hayes and Jennings 1986; Pilliod et al. 1996, Knapp and Matthews 2000). One historic site in southern Idaho no longer supports spotted frog although suitable habitat is available. This may be related to the presence of introduced bass in the Owyhee River (IDCDC 2000). The stocking of nonnative fishes is common throughout waters of the Great Basin. The Nevada Division of Wildlife (NDOW) has committed to conducting stomach sampling of stocked nonnative and native species to determine the effects of predation on spotted frogs. However, this commitment will not be fulfilled until the spotted frog conservation agreements are signed. To date, NDOW has not altered fish stocking rates or locations in order to benefit spotted frogs (USFWS 2002c)].

[The bull frog (*Rana catesbeiana*), a nonnative ranid species, occurs within the range of the spotted frog in the Great Basin. Bullfrogs are known to prey on other frogs (Hayes and Jennings 1986). They are rarely found to co-occur with spotted frogs, but whether this is an artifact of competitive exclusion is unknown at this time (USFWS 2002c)].

[Although a diversity of microbial species is naturally associated with amphibians, it is generally accepted that they are rarely pathogenic to amphibians except under stressful environmental conditions. *Chytridiomycosis* (chytrid) is an emerging panzootic fungal disease in the United States (Fellers et al. 2001). Clinical signs of amphibian chytrid include abnormal posture, lethargy, and loss of righting reflex. Gross lesions, which are usually not apparent, consist of abnormal epidermal sloughing and ulceration; hemorrhages in the skin, muscle, or eye; hyperemia of digital and ventrum skin, and congestion of viscera. Diagnosis is by identification of characteristic intracellular flask-shaped sporangia and septate thalli within the epidermis. Chytrid can be identified in some species of frogs by examining the oral discs of tadpoles which may be abnormally formed or lacking pigment (Fellers et al. 2001) (USFWS 2002c)].

[Chytrid was confirmed in the Circle Pond site, Idaho, where long term monitoring since 1998 has indicated a general decline in the population (Engle 2002). It is unclear whether the presence of this disease will eventually result in the loss of this subpopulation. Two additional sites may have chytrid, but this has yet to be determined (J. Engle, pers. comm., 2001). Protocols to prevent further spread of the disease by researchers were instituted in 2001. Chytrid has also been found in the Wasatch Columbia spotted frog distinct population segment (K. Wilson, pers comm., 2002). Chytrid has not been found in Nevada populations of spotted frogs (USFWS 2002c)].

<u>The inadequacy of existing regulatory mechanisms</u>
[Spotted frog occurrence sites and potential habitats occur on both public and private lands. This species is included on the Forest Service sensitive species list; as such, its management must be considered during forest planning processes. However, little habitat restoration, monitoring or surveying has occurred on Forest Service lands (USFWS 2002c)].

[In the fall of 2000, 250 head of cattle were allowed to graze for 45 days on one pasture in the Indian Valley Creek drainage of the Humboldt-Toiyabe National Forest in central Nevada for the first time in 6 years (M. Croxen, pers. comm., 2002). Grazing was not allowed in this allotment in 2001. Recent mark-recapture data indicated that this drainage supports more frogs than previously presumed, potentially around 5,000 individuals (K. Hatch, pers. comm., 2000). Perceived improvements in the status of frog populations in the Indian Valley Creek area may be a result of past removal of livestock grazing. The reintroduction of grazing disturbance into this relatively dense area of frogs has yet to be determined (USFWS 2002c)].

[BLM policies direct management to consider candidate species on public lands under their jurisdiction. To date, BLM efforts to conserve spotted frogs and their habitat in Idaho, Oregon, and Nevada have not been adequate to address threats (USFWS 2002c)].

[The southernmost known population of spotted frogs can be found on the BLM San Antone Allotment south of Indian Valley Creek in the Toiyabe Range. Grazing is allowed in this area from November until June (L. Brown, pers. comm., 2002). The season of use is a very sensitive portion of the spotted frog annual life cycle which includes migration from winter hibernacula to breeding ponds, breeding, egg laying and hatching, and metamorphosing of young. Additionally, the riparian Standards and Guidelines were not met in 1996, the last time the allotment was evaluated (USFWS 2002c)].

[The status of local populations of spotted frogs on Yomba-Shoshone or Duck Valley Tribal lands is unknown. Tribal governments do not have regulatory or protective mechanisms in place to protect spotted frogs (USFWS 2002c)].

[The Nevada Division of Wildlife classifies the spotted frog as a protected species, but they are not afforded official protection and populations are not monitored. Though the spotted frog is on the sensitive species list for the State of Idaho, this species is not given any special protection by the State. Columbia spotted frogs are not on the sensitive species list for the State of Oregon. Protection of wetland habitat from loss of water to irrigation or spring development is difficult because most water in the Great Basin has been allocated to water rights applicants based on historical use and spring development has already occurred within much of the known habitat of spotted frogs. Federal lands may have water rights that are approved for wildlife use, but these rights are often superceded by historic rights upstream or downstream that do not provide for minimum flows. Also, most public lands are managed for multiple use and are subject to livestock grazing, silvicultural activities, and recreation uses that may be incompatible with spotted frog conservation without adequate mitigation measures (USFWS 2002c)].

<u>Other natural or manmade factors affecting its continued existence</u>
[Multiple consecutive years of less than average precipitation may result in a reduction in the number of suitable sites available to spotted frogs. Local extirpations eliminate source populations from habitats that in normal years are available as frog habitat (Lande and Barrowclough 1987; Schaffer 1987; Gotelli 1995). These climate events are likely to exacerbate the effects of other threats, thus increasing the possibility of stochastic extinction of subpopulations by reducing their size and connectedness to other subpopulations (see Factor A for additional information). As movement corridors become more fragmented, due to loss of flows within riparian or meadow habitats, local populations will become more isolated (Engle 2000). Increased fragmentation of the habitat can lead to greater loss of populations due to demographic and/or environmental stochasticity (USFWS 2002c)].

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YELLOW WARBLER
Dendroica petechia

Original Species Account Authors: Paul Ashley and Stacy Stoval, as appeared in the Southeast Washington Ecoregional Assessment, January 2004

Introduction

The yellow warbler (*Dendroica petechia*) is a common species strongly associated with riparian and wet deciduous habitats throughout its North American range. In Washington it is found in many areas, generally at lower elevations. It occurs along most riverine systems, including the Columbia River, where appropriate riparian habitats have been protected. The yellow warbler is a good indicator of functional subcanopy/shrub habitats in riparian areas.

Life History, Key Environmental Correlates, and Habitat Requirements

Life History

Diet

Yellow warblers capture and consume a variety of insect and arthropod species. The species taken vary geographically. Yellow warblers consume insects and occasionally wild berries (Lowther *et al.* 1999). Food is obtained by gleaning from subcanopy vegetation; the species also sallies and hovers to a much lesser extent (Lowther *et al.* 1999) capturing a variety of flying insects.

Reproduction

Although little is known about yellow warbler breeding behavior in Washington, substantial information is available from other parts of its range. Pair formation and nest construction may begin within a few days of arrival at the breeding site (Lowther *et al.* 1999). The reproductive process begins with a fairly elaborate courtship performed by the male who may sing up to 3,240 songs in a day to attract a mate. The responsibility of incubation, construction of the nest and most feeding of the young lies with the female, while the male contributes more as the young develop. In most cases only one clutch of eggs is laid; renesting may occur, however, following nest failure or nest parasitism by brown-headed cowbirds (Lowther *et al.* 1999). The typical clutch size ranges between 4 and 5 eggs in most research studies of the species (Lowther *et al.* 1999). Egg dates have been reported from British Columbia, and range between 10 May and 16 August; the peak period of activity there was between 7 and 23 June (Campbell *et al.* in press). The incubation period lasts about 11 days and young birds fledge 8-10 days after hatching (Lowther *et al.* 1999). Young of the year may associate with the parents for up to 3 weeks following fledging (Lowther *et al.* 1999).

Nesting

Results of research on breeding activities indicate variable rates of hatching and fledging. Two studies cited by Lowther *et al.* (1999) had hatching rates of 56 percent and 67 percent. Of the eggs that hatched, 62 percent and 81 percent fledged; this represented 35 percent and 54 percent, respectively, of all eggs laid. Two other studies found that 42 percent and 72 percent of nests fledged at least one young (Lowther *et al.* 1999); the latter study was from British Columbia (Campbell *et al.* in press).

Migration
The yellow warbler is a long-distance neotropical migrant. Spring migrants begin to arrive in the region in April. Early dates of 2 April and 10 April have been reported from Oregon and British Columbia, respectively (Gilligan *et al.* 1994, Campbell *et al.* in press). Average arrival dates are somewhat later, the average for south-central British Columbia being 11 May (Campbell *et al.* in press). The peak of spring migration in the region is in late May (Gilligan *et al.* 1994). Southward migration begins in late July, and peaks in late August to early September; very few migrants remain in the region in October (Lowther *et al.* 1999).

Mortality
Little has been published on annual survival rates. Roberts (1971) estimated annual survival rates of adults at 0.526 ±0.077 SE, although Lowther *et al.* (1999) felt this value underestimated survival because it did not account for dispersal. The oldest yellow warbler on record lived to be nearly 9 years old (Klimkiewicz *et al.* 1983).

Yellow warblers have developed effective responses to nest parasitism by the brown-headed cowbird (*Molothrus ater*). The brown-headed cowbird is an obligate nest brood parasite that does not build a nest and instead lays eggs in the nests of other species. When cowbird eggs are recognized in the nest the yellow warbler female will often build a new nest directly on top of the original. In some cases, particularly early in the incubation phase, the female yellow warbler will bury the cowbird egg within the nest. Some nests are completely abandoned after a cowbird egg is laid (Lowther *et al.* 1999). Up to 40 percent of yellow warbler nests in some studies have been parasitized (Lowther *et al.* 1999).

Habitat Requirements
The yellow warbler is a riparian obligate species most strongly associated with wetland habitats and deciduous tree cover. Yellow warbler abundance is positively associated with deciduous tree basal area, and bare ground; abundance is negatively associated with mean canopy cover, and cover of Douglas-fir (*Pseudotsuga menziesii*), Oregon grape (*Berberis nervosa*), mosses, swordfern (*Polystuchum munitum*), blackberry (*Rubus discolor*), hazel (*Corylus cornuta*), and oceanspray (*Holodiscus discolor*) (Rolph 1998).

Partners in Flight have established biological objectives for this species in the lowlands of western Oregon and western Washington. These include providing habitats that meet the following definition: >70 percent cover in shrub layer (<3 m) and subcanopy layer (>3 m and below the canopy foliage) with subcanopy layer contributing >40 percent of the total; shrub layer cover 30-60 percent (includes shrubs and small saplings); and a shrub layer height >2 m. At the landscape level, the biological objectives for habitat included high degree of deciduous riparian heterogeneity within or among wetland, shrub, and woodland patches; and a low percentage of agricultural land use (Altman 2001).

Nesting
Radke (1984) found that nesting yellow warblers occurred more in isolated patches or small areas of willows adjacent to open habitats or large, dense thickets (i.e., scattered cover) rather

than in the dense thickets themselves. At Malheur National Wildlife Refuge, in the northern Great Basin, nest success 44 percent (n = 27), however, cowbird eggs and young removed; cowbird parasitism 33 percent (n = 9) (Radke 1984).

Breeding

Breeding yellow warblers are closely associated with riparian hardwood trees, specifically willows, alders, or cottonwood. They are most abundant in riparian areas in the lowlands of eastern Washington, but also occur in west-side riparian zones, in the lowlands of the western Olympic Peninsula, where high rainfall limits hardwood riparian habitat. Yellow warblers are less common (Sharpe 1993). There are no BBA records at the probable or confirmed level from subalpine habitats in the Cascades, but Sharpe (1993) reports them nesting at 4000 feet in the Olympics. Numbers decline in the center of the Columbia Basin, but this species can be found commonly along most rivers and creeks at the margins of the Basin. A local breeding population exists in the Potholes area.

Non-breeding

Fall migration is somewhat inconspicuous for the yellow warbler. It most probably begins to migrate the first of August and is generally finished by the end of September. The yellow warbler winters south to the Bahamas, northern Mexico, south to Peru, Bolivia and the Brazilian Amazon.

Yellow Warbler Population and Distribution
Population
Historic

No historic data could be found for this species.

Current

No current data could be found for this species.

Distribution
Historic

Jewett *et al.* (1953) described the distribution of the yellow warbler as a common migrant and summer resident from April 30 to September 20 in the deciduous growth of Upper Sonoran and Transition Zones in eastern Washington and in the prairies and along streams in southwestern Washington. They describe its summer range as north to Neah Bay, Blaine, San Juan Islands, Monument 83; east to Conconully, Swan Lake, Sprague, Dalkena, and Pullman; south to Cathlamet, Vancouver and Bly, Blue Mts., Prescott, Richland, and Rogersburg; and west to Neah Bay, Grays Harbor, and Long Beach. Jewett *et al. (*1953) also note that the yellow warbler was common in the willows and alders along the streams of southeastern Washington and occurs also in brushy thickets. They state that its breeding range follows the deciduous timber into the mountains, where it probably nests in suitable habitat to 3,500 or perhaps even to 4,000 feet – being common at Hart Lake in the Chelan region around 4,000 feet. They noted it was a common nester along the Grande Ronde River, around the vicinity of Spokane, around Sylvan Lake, and along the shade trees along the streets of Walla Walla.

Current

The yellow warbler breeds across much of the North American continent, from Alaska to Newfoundland, south to western South Carolina and northern Georgia, and west through parts of the southwest to the Pacific coast (AOU 1998). Browning (1994) recognized 43 subspecies; two of these occur in Washington, and one of them, *D.p. brewsteri*, is found in western Washington. This species is a long-distance migrant and has a winter range extending from western Mexico south to the Amazon lowlands in Brazil (AOU 1998). Neither the breeding nor winter ranges appear to have changed (Lowther *et al.* 1999).

The yellow warbler is a common breeder in riparian habitats with hardwood trees throughout the state at lower elevations. It is a locally common breeder along rivers and creeks in the Columbia Basin, where it is declining in some areas. Core zones of distribution in Washington are the forested zones below the subalpine fir and mountain hemlock zones, plus steppe zones other than the central arid steppe and canyon grassland zones, which are peripheral.

The yellow warbler breeds across much of the North American continent, from Alaska to Newfoundland, south to western South Carolina and northern Georgia, and west through parts of the southwest to the Pacific coast (AOU 1998).

Non-Breeding

This data is not readily available; however, the yellow warbler is a long-range neotropical migrant. Its winter range is from Northern Mexico south to Northern Peru.

Status and Abundance Trends

Status

Yellow warblers are demonstrably secure globally. Within the state of Washington, yellow warblers are apparently secure and are not of conservation concern (Altman 1999).

Trends

Yellow warbler is one of the more common warblers in North America (Lowther *et al.* 1999). Information from Breeding Bird Surveys indicates that the population is stable in most areas. Some subspecies, particularly in southwestern North America, have been impacted by degradation or destruction of riparian habitats (Lowther *et al.* 1999). Because the Breeding Bird Survey dates back only about 30 years, population declines in Washington resulting from habitat loss dating prior to the survey would not be accounted for by that effort.

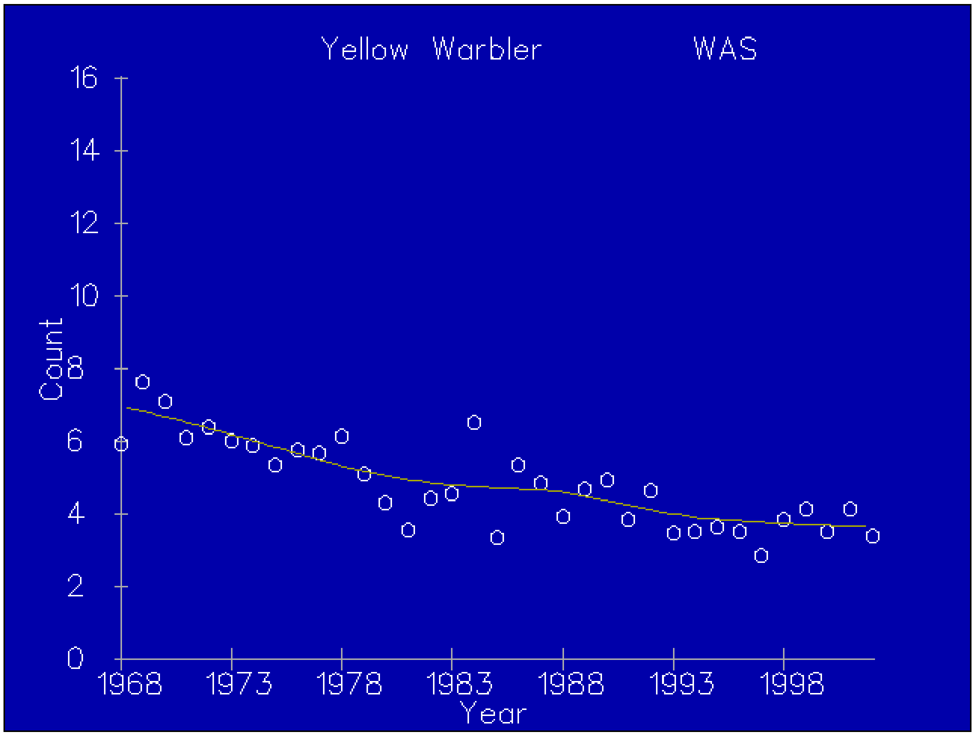

Figure 6. Breeding Bird Survey data for Washington State show a significant population decline of 2.9 percent per year ($p < .1$) from 1966 to 1991 (Peterjohn 1991).

Factors Affecting Yellow Warbler Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat loss due to hydrological diversions and control of natural flooding regimes (e.g., dams) resulting in reduction of overall area of riparian habitat, conversion of riparian habitats, inundation from impoundments, cutting and spraying for ease of access to water courses, gravel mining, etc.

Habitat degradation from: loss of vertical stratification in riparian vegetation, lack of recruitment of young cottonwoods, ash, willows, and other subcanopy species; stream bank stabilization (e.g., riprap) which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation; invasion of exotic species such as reed canary grass and blackberry; overgrazing which can reduce understory cover; reductions in riparian corridor widths which may decrease suitability of the habitat and may increase encroachment of nest predators and nest parasites to the interior of the stand.

Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird) and domestic predators (cats), and be subject to high levels of human disturbance.

Recreational disturbances, particularly during nesting season, and particularly in high-use recreation areas.

Increased use of pesticide and herbicides associated with agricultural practices may reduce insect food base.

Out-of-Subbasin Effects and Assumptions

No data could be found on the migration and wintering grounds of the yellow warbler. It is a long-distance migrant and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions is likely happening along its entire migration route (H. Ferguson, WDFW, pers. comm. 2003). Riparian management requires the protection of riparian shrubs and understory and the elimination of noxious weeds. Migration routes, corridors and wintering grounds need to be identified and protected just as its breeding areas. In addition to loss of habitat, the yellow warbler, like many wetland or riparian associated birds, faces increased pesticide use in the metropolitan areas, especially with the outbreak of mosquito born viruses like West Nile Virus.

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AMERICAN BEAVER
Castor canadensis

Original Species Account Authors: Paul Ashley and Stacy Stoval, as appeared in the Southeast Washington Ecoregional Assessment, January 2004

Introduction
The American beaver (*Castor canadensis*) is a large, highly specialized aquatic rodent found in the immediate vicinity of aquatic habitats (Hoffman and Pattie 1968). The species occurs in streams, ponds, and the margins of large lakes throughout North America, except for peninsular Florida, the Arctic tundra, and the southwestern deserts (Jenkins and Busher 1979). In Oregon, beavers can be found in suitable habitats throughout the state (Verts and Carraway 1998). Beavers construct elaborate lodges and burrows and store food for winter use. The species is active throughout the year and is usually nocturnal in its activities. Adult beavers are nonmigratory.

Life History, Key Environmental Correlates, and Habitat Requirements
Life History
Diet
Beavers are exclusively vegetarian in diet. A favorite food item is the cambial, or growing, layer of tissue just under the bark of shrubs and trees. Many of the trees that are cut are stripped of bark, or carried to the pond for storage under water as a winter food cache. Buds and roots are also consumed, and when they are needed, a variety of plant species are accepted. The animals may travel some distance from water to secure food. When a rich food source is exploited, canals may be dug from the pond to the pasture to facilitate the transportation of the items to the lodge.

Much of the food ingested by a beaver consists of cellulose, which is normally indigestible by mammals. However, these animals have colonies of microorganisms living in the cecum, a pouch between the large and small intestine, and these symbionts digest up to 30 percent of the cellulose that the beaver takes in. An additional recycling of plant food occurs when certain fecal pellets are eaten and run through the digestive process a second time (Findley 1987). Woody and herbaceous vegetation comprise the diet of the beaver. Herbaceous vegetation is a highly preferred food source throughout the year, if it is available.

Woody vegetation may be consumed during any season, although its highest utilization occurs from late fall through early spring. It is assumed that woody vegetation (trees and/or shrubs) is more limiting than herbaceous vegetation in providing an adequate food source. In summer, a variety of green herbaceous vegetation, especially aquatic species, is eaten (Jenkins and Busher 1979; Svendsen 1980, cited in Verts and Carraway 1998). In autumn and winter as green herbaceous vegetation disappears, beavers shift their diet to stems, leaves, twigs, and bark of many of the woody species that grow near the water (Verts and Carraway 1998). Bulbous roots of aquatic species also may be eaten in winter (Beer 1942, cited in Verts and Carraway 1998). Beavers cut mostly deciduous trees such as cottonwood, will, alder, maple, and birch, but in some regions, coniferous species may be used (Jenkins 1979, cited in Verts and Carraway 1998).

Denney (1952) summarized the food preferences of beavers throughout North America and reported that, in order of preference, beavers selected aspen (*Populus tremuloides*), willow (*Salix spp.*), cottonwood (*P. balsamifera*), and alder (*Alnus spp*.). Although several tree species have often been reported to be highly preferred foods, beavers can inhabit, and often thrive in, areas where these tree species are uncommon or absent (Jenkins 1975). Aspen and willow are considered preferred beaver foods; however, these are generally riparian tree species that may be more available for beaver foraging but are not necessarily preferred over all other deciduous tree species (Jenkins 1981). In southeastern Oregon, riparian-zone trees have been reduced or eliminated in many areas by browsing herbivores. However, comparison of growth of red willow (*Salix lasiandra*) in an area inaccessible to cattle but occupied by beavers with that in an area inaccessible to both cattle and beavers, indicated that beavers were not responsible for the deterioration. Although beavers harvested 82% of available stems annually, they cut them at a season after growth was completed and reserves were translocated to roots. Subsequent growth of cut willows increase exponentially in relation to the proportion of the stems cut by beavers (Kindschy 1985, cited in Verts and Carraway 1998).

Beavers have been reported to subsist in some areas by feeding on coniferous trees, generally considered a poor quality source of food (Brenner 1962; Williams 1965). Major winter foods in North Dakota consisted principally of red-osier dogwood (*Cornus stolonifera*), green ash (*Fraxinus pennsylvanica*), and willow (Hammond 1943). Rhizomes and roots of aquatic vegetation also may be an important source of winter food (Longley and Moyle 1963; Jenkins pers. comm.). The types of food species present may be less important in determining habitat quality for beavers than physiographic and hydrologic factors affecting the site (Jenkins 1981).

Aquatic vegetation, such as duck potato (*Sagittaria spp.),* duckweed (*Lemna spp.),* pondweed (*Potamogeton spp.),* and water weed (Elodea spp.), are preferred foods when available (Collins 1976a). Water lilies (*Nymphaea* spp.), with thick, fleshy rhizomes, may be used as a food source throughout the year (Jenkins 1981). If present in adequate amounts, water lily rhizomes may provide an adequate winter food source, resulting in little or no tree cutting or food caching of woody materials. Jenkins (1981) compared the rate of tree cutting by beavers adjacent to two Massachusetts ponds that contained stands of water lilies. A pond dominated by yellow water lily (*Y. variegatum*) and white water lily (*N. odorata*), which have thick rhizomes, had low and constant tree cutting activity throughout the fall. Conversely, the second pond, dominated by watershield (*Brasenia schreberi*), which lacks thick rhizomes, had increased fall tree cutting activity by beavers.

Reproduction

The basic composition of a beaver colony is the extended family, comprised of a monogamous pair of adults, subadults (young of the previous year), and young of the year (Svendsen 1980). Female beavers are sexually mature at 2.5 years old. Females normally produce litters of three to four young with most kits being born during May and June. Gestation is approximately 107 days (Linzey 1998). Kits are born with all of their fur, their eyes open, and their incisor teeth erupted.

Dispersal of subadults occurs during the late winter or early spring of their second year and coincides with the increased runoff from snowmelt or spring rains. Subadult beavers have been reported to disperse as far as 236 stream km (147 mi) (Hibbard 1958), although average emigration distances range from 8 to 16 stream km (5 to 10 mi) (Hodgdon and Hunt 1953; Townsend 1953; Hibbard 1958; Leege 1968). The daily movement patterns of the beaver centers around the lodge or burrow and pond (Rutherford 1964). The density of colonies in favorable habitat ranges from 0.4 to 0.8/km2 (1 to 2/mi2) (Lawrence 1954; Aleksiuk 1968; Voigt *et al.* 1976; Bergerud and Miller 1977 cited by Jenkins and Busher 1979).

Home Range

The mean distance between beaver colonies in an Alaskan riverine habitat was 1.59 km (1 mi) (Boyce 1981). The closest neighbor was 0.48 km (0.3 mi) away. The size of the colony's feeding range is a function of the interaction between the availability of food and water and the colony size (Brenner 1967). The average feeding range size in Pennsylvania, excluding water, was reported to be 0.56 ha (1.4 acre). The home range of beaver in the Northwest Territory was estimated as a 0.8 km (0.5 mi) radius of the lodge (Aleksiuk 1968). The maximum foraging distance from a food cache in an Alaskan riverine habitat was approximately 800 m (874 yds) upstream, 300 m (323 yds) downstream, and 600 m (656 yds) on oxbows and sloughs (Boyce 1981).

Mortality

Beavers live up to 11 years in the wild, 15 to 21 years in captivity (Merritt 1987, Rue 1967). Beavers have few natural predators. However, in certain areas, beavers may face predation pressure from wolves (*Canis lupus*), coyotes (*Canis latrans*), lynx (*Felis lynx*), fishers (*Martes pennanti*), wolverines (*Gulo gulo*), and occasionally bears (*Ursus spp*.). Alligators, minks (*Mustela vison*), otters (*Lutra canadensis*), hawks, and owls periodically prey on kits (Lowery 1974, Merritt 1987, Rue 1967).

Beavers often carry external parasites, one of which, *Platypsylla castoris*, is a beetle found only on beavers.

Harvest

Historic

Because of the high commercial value of their pelts, beavers figured importantly in the early exploration and settlement of western North America. Thousands of their pelts were harvested annually, and it was not many years before beavers were either exterminated entirely or reduced to very low populations over a considerable part of their former range. By 1910 their populations were so low everywhere in the United States that strict regulation of the harvest or complete protection became imperative. In the 1930s live trapping and restocking of depleted areas became a widespread practice which, when coupled with adequate protection, has made it possible for the animals to make a spectacular comeback in many sections.

Current

Harvest of beavers in Oregon between 1969 and 1992 per 1,000 hectares in Union and Wallowa Counties were <1 and 1-10 respectively (ODFW, annual reports, cited in Verts and Carraway 1998). Trapping was terminated by initiative in Washington. No commercial or recreational trapping of beaver occurs in southeast Washington. Between 1991 and 1999, the beaver harvest in the four counties of southeast Washington ranged from 56 to 162/year, and averaged 107/year. Since the initiative to ban trapping, the beaver harvest has declined 95%, and has averaged about

5/year for southeast Washington. As a result of the declining harvest, populations appear to be increasing along with complaints from landowners. Beavers have become a problem in some tributaries, damming farm irrigation and causing problems for fish passage.

Harvest trends will not indicate population trend, because the price of beaver pelts often determines the level of harvest. The higher the pelt price, the higher the harvest because trappers put more effort into trapping beaver. If pelt prices are low, little effort is expended to trap beaver, regardless of population size.

Habitat Requirements
The beaver almost always is associated with riparian or lacustrine habitats bordered by a zone of trees, especially cottonwood and aspen (Populus), willow (Salix), alder (Alnus), and maple (Acer) (Verts and Carraway 1998). Small streams with a constant flow of water that meander through relatively flat terrain in fertile valleys and rare subject to being dammed seem especially productive of beavers (Hill 1982, cited in Verts and Carraway 1998). Streams with rocky bottoms through steep terrain and more subject to wide fluctuations in water levels are less suitable to beavers. In large lakes with broad expanses subject to extensive wave action, beavers usually are restricted to protected inlets (Verts and Carraway 1998).

All wetland cover types (e.g., herbaceous wetland and deciduous forested wetland) must have a permanent source of surface water with little or no fluctuation in order to provide suitable beaver habitat (Slough and Sadleir 1977). Water provides cover for the feeding and reproductive activities of the beaver. Lakes and reservoirs that have extreme annual or seasonal fluctuations in the water level will be unsuitable habitat for beaver. Similarly, intermittent streams, or streams that have major fluctuations in discharge (e.g., high spring runoff) or a stream channel gradient of 15 percent or more, will have little year-round value as beaver habitat. Assuming that there is an adequate food source available, small lakes [< 8 ha (20 acres) in surface area] are assumed to provide suitable habitat. Large lakes and reservoirs [> 8 ha (20 acres) in surface area] must have irregular shorelines (e.g., bays, coves, and inlets) in order to provide optimum habitat for beaver.

Beavers can usually control water depth and stability on small streams, ponds, and lakes; however, larger rivers and lakes where water depth and/or fluctuation cannot be controlled are often partially or wholly unsuitable for the species (Murray 1961; Slough and Sadleir 1977). Rivers or streams that are dry during some parts of the year are assumed to be unsuitable beaver habitat. Beavers are absent from sizable portions of rivers in Wyoming, due to swift water and an bsence of suitable dwelling sites during periods of high and low water levels (Collins 1976b).

In riverine habitats, stream gradient is the major determinant of stream morphology and the most significant factor in determining the suitability of habitat for beavers (Slough and Sadleir 1977). Stream channel gradients of 6 percent or less have optimum value as beaver habitat. Retzer *et al.* (1956) reported that 68 percent of the beaver colonies recorded in Colorado were in valleys with a stream gradient of less than 6 percent, 28 percent were associated with stream gradients from 7 to 12 percent, and only 4 percent were located along streams with gradients of 13 to 14 percent. No beaver colonies were recorded in streams with a gradient of 15 percent or more. Valleys that were only as wide as the stream channel were unsuitable beaver habitat, while valleys wider than the stream channel were frequently occupied by beavers. Valley widths of 46 m (150 ft) or more were considered the most suitable. Marshes, ponds, and lakes were nearly always occupied by beavers when an adequate supply of food was available.

Foraging

Beavers are generalized herbivores; however, they show strong preferences for particular plant species and size classes (Jenkins 1975; Collins 1975a; Jenkins 1979). The leaves, twigs, and bark f woody plants are eaten, as well as many species of aquatic and terrestrial herbaceous vegetation. Food preferences may vary seasonally, or from year to year, as a result of variation in the nutritional value of food sources (Jenkins 1979).

An adequate and accessible supply of food must be present for the establishment of a beaver colony (Slough and Sadleir 1977). The actual biomass of herbaceous vegetation will probably not limit the potential of an area to support a beaver colony (Boyce 1981). However, total biomass of winter food cache plants (woody plants) may be limiting. Low marshy areas and streams flowing in and out of lakes allow the channelization and damming of water, allowing access to, and transportation of, food materials. Steep topography prevents the establishment of a food transportation system (Williams 1965; Slough and Sadleir 1977). Trees and shrubs closest to the pond or stream periphery are generally utilized first (Brenner 1962; Rue 1964). Jenkins (1980) reported that most of the trees utilized by beaver in his Massachusetts study area were within 30 m (98.4 ft) of the water's edge. However, some foraging did extend up to 100 m (328 ft). Foraging distances of up to 200 m (656 ft) have been reported (Bradt 1938). In a California study, 90 percent of all cutting of woody material was within 30 m (98.4 ft) of the water's edge (Hall 1970).

Woody stems cut by beavers are usually less than 7.6 to 10.1 cm (3 to 4 inches) DBH (Bradt 1947; Hodgdon and Hunt 1953; Longley and Moyle 1963; Nixon and Ely 1969). Jenkins (1980) reported a decrease in mean stem size cut and greater selectivity for size and species with increasing distance from the water's edge. Trees of all size classes were felled close to the water's edge, while only smaller diameter trees were felled farther from the shore.

Beavers rely largely on herbaceous vegetation, or on the leaves and twigs of woody vegetation, during the summer (Bradt 1938, 1947; Brenner 1962; Longley and Moyle 1963; Brenner 1967; Aleksiuk 1970; Jenkins 1981). Forbs and grasses comprised 30 percent of the summer diet in Wyoming (Collins 1976a). Beavers appear to prefer herbaceous vegetation over woody vegetation during all seasons of the year, if it is available (Jenkins 1981).

Cover

Lodges or burrows, or both, may be used by beavers for cover (Rue 1964). Lodges may be surrounded by water or constructed against a bank or over the entrance to a bank burrow. Water protects the lodges from predators and provides concealment for the beaver when traveling to and from food gathering areas and caches.

The lodge is the major source of escape, resting, thermal, and reproductive cover (Jenkins and Busher 1979). Mud and debarked tree stems and limbs are the major materials used in lodge construction although lesser amounts of other woody, as well as herbaceous vegetation, may be used (Rue 1964). If an unexploited food source is available, beavers will reoccupy abandoned lodges rather than build new ones (Slough and Sadleir 1977). On lakes and ponds, lodges are frequently situated in areas that provide shelter from wind, wave, and ice action. A convoluted shoreline, which prevents the buildup of large waves or provides refuge from waves, is a habitat requirement for beaver colony sites on large lakes.

Population and Distribution
Population
Historic
Historically, beaver populations were more expansive until populations were reduced by unregulated trapping, as they were throughout much of the western United States (P. Fowler, WDFW, personal communications, 2003).

Current
Beaver populations exist in all major watersheds in the Blue Mountains. In the Walla Walla subbasin, beaver can be found in the Walla Walla and Touchet River drainages; Mill Creek, Coppei Creek, North Touchet, South Touchet. Beaver can be found in the Tucannon subbasin in the Tucannon River and its tributaries. Beaver can be found in the Asotin watershed, Asotin Creek and its tributaries. Beaver also occur in the Snake River.

Captive Breeding Programs, Transplants, Introductions
Historic
No data are available.

Current
No data are available.

Distribution
Historic
No data are available.

Current
The beaver is found throughout most of North America except in the Arctic tundra, peninsular Florida, and the Southwestern deserts (Allen 1983; VanGelden 1982; Zeveloff 1988).

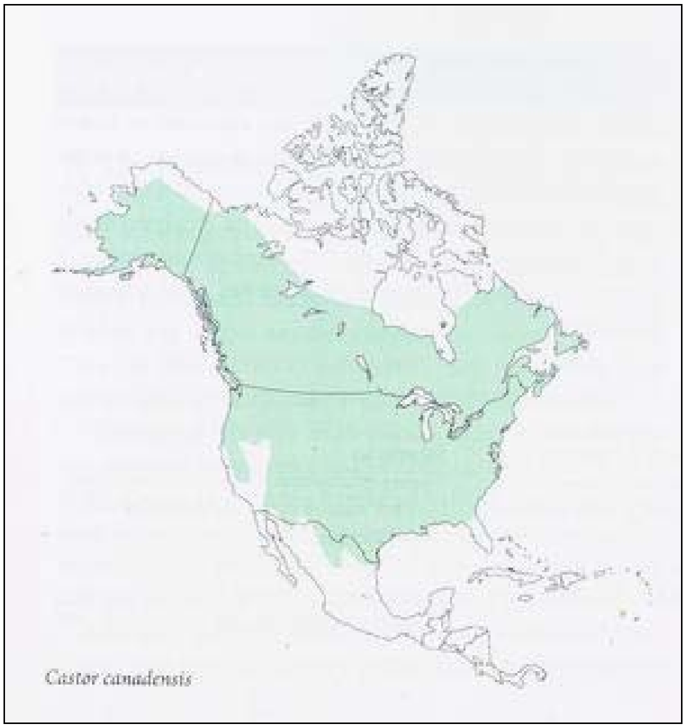

Figure 7. Geographic distribution of American beaver (*Castor canadensis*) (From Linzey and Brecht 2002).

Status and Abundance Trends

Status

Status is generally unknown, but beaver populations appear to be stable or increasing slightly in southeast Washington (P. Fowler, WDFW, personal communication, 2003).

Trends

Trend information is not available. No population data is available for northeast Oregon.

Factors Affecting American Beaver Population Status

Agriculture. Riparian habitat along many water ways has been removed in order to plant agricultural crops, thus removing important habitat and food sources for beaver in northeast Oregon.

Agricultural Conflict. Beaver may be removed when complaints are received from farmers about blocked irrigation canals or pumps.

Conflict with Fisheries. Beaver sometimes create dams that restrict fish passage, and are removed in order to restore fish passage. Beaver cutting tree planted to improve riparian habitat have also been removed.

Key Factors Inhibiting Populations and Ecological Processes

No data are available.

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Great Blue Heron
Ardea herodias

Original Species Account Authors: Paul Ashley and Stacy Stoval, as appeared in the Southeast Washington Ecoregional Assessment, January 2004

Introduction
The great blue heron (*Ardea herodias*) is the largest, most widely distributed, and best known of the American herons (Henny 1972). Great blue herons occur in a variety of habitats from freshwater lakes and rivers to brackish marshes, lagoons, mangrove areas, and coastal wetlands (Spendelow and Patton in prep.).

Life History, Key Environmental Correlates, and Habitat Requirements
Life History
Diet
Fish are preferred food items of the great blue heron in both inland and coastal waters (Kirkpatrick 1940; Palmer 1962; Kelsall and Simpson 1980), although a large variety of dietary items has been recorded. Frogs and toads, tadpoles and newts, snakes, lizards, crocodilians, rodents and other mammals, birds, aquatic and land insects, crabs, crayfish, snails, freshwater and marine fish, and carrion have all been reported as dietary items for the great blue heron (Bent 1926; Roberts 1936; Martin *et al.* 1951; Krebs 1974; Kushlan1978). Fish up to about 20 cm in length dominated the diet of herons foraging in southwestern Lake Erie (Hoffman 1978). Ninety-five percent of the fish eaten in a Wisconsin study were 25 cm in length (Kirkpatrick 1940).

Great blue herons feed alone or occasionally in flocks. Solitary feeders may actively defend a much larger feeding territory than do feeders in a flock (Meyerriecks 1962; Kushlan 1978). Flock feeding may increase the likelihood of successful foraging (Krebs 1974; Kushlan 1978) and usually occurs in areas of high prey density where food resources cannot effectively be defended.

In southeast Washington, blue herons are often seen hunting along rivers and streams. In the winter months they are often seen hunting rodents in alfalfa fields (P. Fowler, WDFW, pers. comm.. 2003).

Reproduction
The great blue heron typically breeds during the months of March - May in its northern range and November through April in the southern hemisphere. The nest usually consists of an egg clutch between 3-7 eggs, with clutch size increasing from south to north. Chicks fledge at about two months.

Nesting
Great blue herons normally nest near the tree tops. Usually, nests are about 1 m in diameter and have a central cavity 10 cm deep with a radius of 15 cm. This internal cavity is sometimes lined with twigs, moss, lichens, or conifer needles. Great blue herons are inclined to renest in the same area year after year. Old nests may be enlarged and reused (Eckert 1981).

The male gathers nest-building materials around the nest site, from live or dead trees, from neighboring nests, or along the ground, and the female works them into the nest. Ordinarily, a pair takes less than a week to build a nest solid enough for eggs to be laid and incubated. Construction continues during almost the entire nesting period. Twigs are added mostly when the eggs are being laid or when they hatch. Incubation, which is shared by both partners, starts with the laying of the first egg and lasts about 28 days. Males incubate during the days and females at night.

Herons are particularly sensitive to disturbance while nesting. Scientists suggest as a general rule that there should be no development within 300 m of the edge of a heron colony and no disturbance in or near colonies from March to August.

Mortality

The great blue heron lives as long as 17 years. The adult birds have few natural enemies. Birds of prey occasionally attack them, but these predators are not an important limiting factor on the heron population. Draining of marshes and destruction of wetland habitat is the most serious threat. The number of herons breeding in a local area is directly related to the amount of feeding habitat.

Mortality of the young is high: both the eggs and young are preyed upon by crows, ravens, gulls, birds of prey, and raccoons. Heavy rains and cold weather at the time of hatching also take a heavy toll. Pesticides are suspected of causing reproductive failures and deaths, although data obtained up to this time suggest that toxic chemicals have not caused any decline in overall population levels.

Habitat Requirements

Minimum Habitat Area

Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before a species will live and reproduce in an area. Minimum habitat area for the great blue heron includes wooded areas suitable for colonial nesting and wetlands within a specified distance of the heronry where foraging can occur. A heronry frequently consists of a relatively small area of suitable habitat. For example, heronries in the Chippewa National Forest, Minnesota, ranged from 0.4 t o 4.8 ha in size and averaged 1.2 ha (Mathisen and Richards 1978). Twelve heronries in western Oregon ranged from 0.12 t o 1.2 ha in size and averaged 0.4 ha (Werschkul *et al.* 1977).

Foraging

Short and Cooper (1985) provide criteria for suitable great blue heron foraging habitat. Suitable great blue heron foraging habitats are within 1.0 km of heronries or potential heronries. The suitability of herbaceous wetland, scrub-shrub wetland, forested wetland, riverine, lacustrine or estuarine habitats as foraging areas for the great blue heron is ideal if these potential foraging habitats have shallow, clear water with a firm substrate and a huntable population of small fish. A potential foraging area needs to be free from human disturbances several hours a day while the herons are feeding. Suitable great blue heron foraging areas are those in which there is no human disturbance near the foraging zone during the four hours following sunrise or preceding sunset or the foraging zone is generally about 100m from human activities and habitation or about 50m from roads with occasional, slow-moving traffic.

A smaller energy expenditure by adult herons is required to support fledglings if an abundant source of food is close to the nest site than if the source of food is distant. Nest sites frequently are located near suitable foraging habitats. Social feeding is strongly correlated with colonial nesting (Krebs 1978), and a potential feeding site is valuable only if it is within “commuting” distance of an active heronry. For example, 24 of 31 heronries along the Willamette River in Oregon were located within 100m of known feeding areas (English 1978). Most heronries along the North Carolina coast were located near inlets, which have large concentrations of fish (Parnell and Soots 1978). The average distance from heronries to inlets was 7.0 to 8.0 km. The average distance of heronries to possible feeding areas (lakes 140 ha in area) varied from 0 to 4.2 km and averaged 1.8 km on the Chippewa National Forest in Minnesota (Mathisen and Richards 1978). Collazo (1981) reported the distance from the nearest feeding grounds to a heronry site as 0.4 and 0.7 km. The maximum observed flight distance from an active heronry to a foraging area was 29 km in Ohio (Parris and Grau 1979).

Great blue herons feed anywhere they can locate prey (Burleigh 1958). This includes the terrestrial surface but primarily involves catching fish in shallow water, usually 150m deep (Bent 1926; Meyerriecks 1960; Bayer 1978).

Thompson (1979b) reported that great blue herons along the Mississippi River commonly foraged in water containing emergent or submergent vegetation, in scattered marshy ponds, sloughs, and forested wetlands away from the main channel. He noted that river banks, jetties, levees, rip-rapped banks, mudflats, sandbars, and open ponds were used to a lesser extent. Herons near southwestern Lake Erie fed intensively in densely vegetated areas (Hoffman 1978).

Other studies, however, have emphasized foraging activities in open water (Longley 1960; Edison Electric Institute 1980). Exposed mud flats and sandbars are particularly desirable foraging sites at low tides in coastal areas in Oregon (Bayer 1978), North Carolina (Custer and Osborn 1978), and elsewhere (Kushlan 1978). Cooling ponds (Edison Electric Institute 1980) and dredge spoil settling ponds (Cooper *et al.* in prep.) also are used extensively by foraging great blue herons.

Water

The great blue heron routinely feeds on soft animal tissues from an aquatic environment, which provides ample opportunity for the bird to satisfy its physiological requirements for water.

Cover

Cover for concealment does not seem to be a limiting factor for the great blue heron. Heron nests often are conspicuous, although heronries frequently are isolated. Herons often feed in marshes and areas of open water, where there is no concealing cover.

Reproduction

Short and Cooper (1985) describe suitable great blue heron nesting habitat as a grove of trees at least 0.4 ha in area located over water or within 250m of water. These potential nest sites may be on an island with a river or lake, within a woodland dominated swamp, or in vegetation near a river or lake. Trees used as nest sites are at least 5m high and have many branches at least 2.5 cm in diameter that are capable of supporting nests. Trees may be alive or dead but must have an “open canopy” that allows an easy access to the nest. The suitability of potential heronries diminishes as their distance from current or former heronry sites increases because herons develop new heronries in suitable vegetation close to old heronries.

A wide variety of nesting habitats is used by the great blue heron throughout its range in North America. Trees are preferred heronry sites, with nests commonly placed from 5 to 15 m above ground (Burleigh 1958; Cottrille and Cottrille 1958; Vermeer 1969; McAloney 1973). Smaller trees, shrubs, reeds (*Phragmites communis*), the ground surface, rock ledges along coastal cliffs, and artificial structures may be utilized in the absence of large trees, particularly on islands (Lahrman 1957; Behle 1958; Vermeer 1969; Soots and Landin 1978; Wiese 1978). Most great blue heron colonies along the Atlantic coast are located in riparian swamps (Ogden 1978). Most colonies along the northern Gulf coast are in cypress - tupelo (*Taxodium Nyssa*) swamps (Portnoy 1977). Spendelow and Patton (in prep.) state that many birds in coastal Maine nest on spruce (*Picea spp*.) trees on islands. Spruce trees also are used on the Pacific coast (Bayer 1978), and black cottonwood (*Populus trichocarpa*) trees frequently are used as nest sites along the Willamette River in Oregon (English 1978). Miller (1943) stated that the type of tree was not as important as its height and distance from human activity. Dead trees are commonly used as nest sites (McAloney 1973). Nests usually consist of a platform of sticks, sometimes lined with smaller twigs (Bent 1926; McAloney 1973), reed stems (Roberts 1936), and grasses (Cottrille and Cottrille 1958).

Heron nest colony sites vary, but are usually near water. These areas often are flooded (Sprunt 1954; Burleigh 1958; English 1978). Islands are common nest colony sites in most of the great blue heron's range (Vermeer 1969; English 1978; Markham and Brechtel 1979). Many colony sites are isolated from human habitation and disturbance (Mosely 1936; Burleigh 1958). Mathisen and Richards (1978) recorded all existing heronries in Minnesota as at least 3.3 km from human dwellings, with an average distance of 1.3 km to the nearest surfaced road. Nesting great blue herons may become habituated to noise (Grubb 1979), traffic (Anderson 1978), and other human activity (Kelsall and Simpson 1980). Colony sites usually remain active until the site is disrupted by land use changes.

A few colony sites have been abandoned because the birds depleted the available nest building material and possibly because their excrement altered the chemical composition of the soil and the water. Heron exretia can have an adverse effect on nest trees (Kerns and Howe 19667; Wiese 1978).

Population and Distribution
Population
Historic

In the past, herons and egrets were shot for their feathers, which were used as cooking utensils and to adorn hats and garments, and they also provided large, accessible targets. The slaughter of these birds went relatively unchecked until 1900 when the federal government passed the Lacey Act, which prohibits the foreign and interstate commercial trade of feathers. Greater protection was afforded in 1918 with the Migratory Bird Treaty Act, which empowered the federal government to set seasons and bag limits on the hunting of waterfowl and waterbirds. With this protection, herons and other birds have made dramatic comebacks.

In southeast Washington, few historical colonies have been reported. The Foundation Island colony is the oldest, but has been taken over by cormorants. It appears blue herons numbers in the colony have declined significantly.

One colony was observed from a helicopter in 1995 on the Touchet River just upriver from Harsha, but that colony appears to have been destroyed by a wind storm (trees blown down), and no current nesting has been observed in the area (Fowler per. com.)

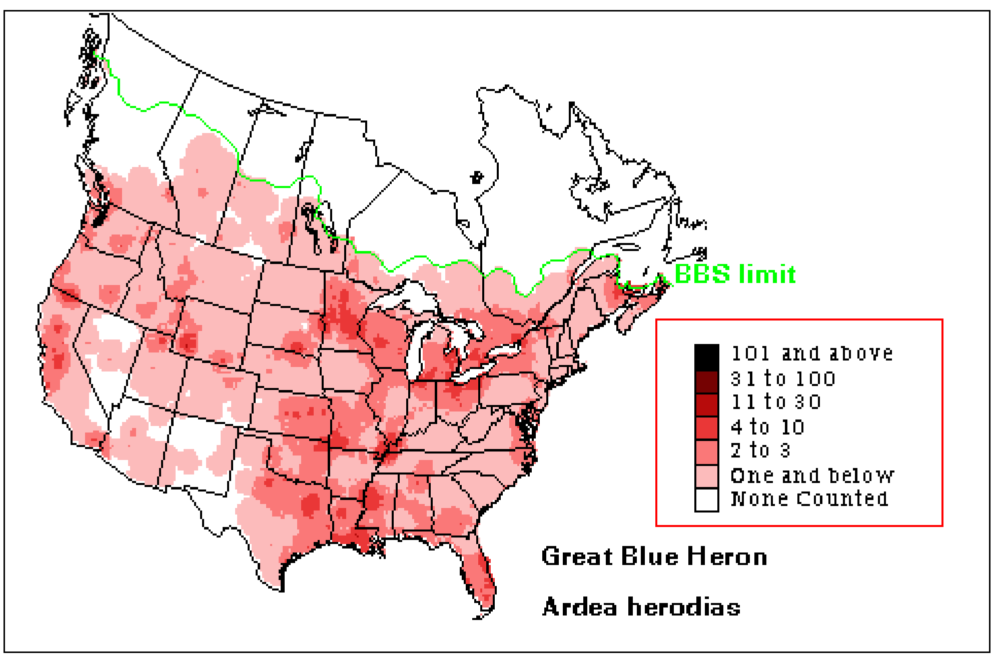
Current
The great blue heron breeds throughout the U.S. and winters as far north as New England and southern Alaska (Bull and Farrand 1977). The nationwide population is estimated at 83,000 individuals (NACWCP 2001).

In southeast Washington, three new colonies have been discovered over the last few years. One colony on the Walla Walla River contains approximately 24 nests. This colony has been active for approximately 12 years. Two new colonies were discovered in 2003, one on a railroad bridge over the Snake River at Lyons Ferry, and one near Chief Timothy Park on the Snake River. The Lyons Ferry colony contained approximately 11 nests, and the Chief Timothy colony 5 nests (P. Fowler, WDFW, personal communication, 2003).

Distribution
Two known heron rookeries occur within the Walla Walla subbasin, one on the Walla Walla and one on the Touchet River (NPPC 2001). The Walla Walla River rookery contains approximately 13 active nests. The Touchet River rookery contains approximately 8-10 active nests. Blue herons are observed throughout the lowlands of southeast Washington near rivers or streams (P. Fowler, WDFW, personal communication, 2003).

Historic
No data are available.

Current
Figure 8Great blue heron breeding distribution from Breeding Bird Survey (BBS) data (Sauer *et al.* 2003).



Status and Abundance Trends

Status

Surveys of blue heron populations are not conducted. However, populations appear to be stable and possibly expanding in some areas. Two new nesting colonies have been found in on the Lower Snake River (P. Fowler, WDFW, personal communication, 2003).

Trends

Populations in southeast Washington appear to be stable, and may actually be increasing.

Factors Affecting Great Blue Heron Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat destruction and the resulting loss of nesting and foraging sites, and human disturbance probably have been the most important factors contributing to declines in some great blue heron populations in recent years (Thompson 1979a; Kelsall and Simpson 1980; McCrimmon 1981).

Habitat Loss

Natural generation of new nesting islands, created when old islands and headlands erode, has decreased due to artificial hardening of shorelines with bulkheads. Loss of nesting habitat in certain coastal sites may be partially mitigated by the creation of dredge spoil islands (Soots and Landin 1978). Several species of wading birds, including the great blue heron, use coastal spoil islands (Buckley and McCaffrey 1978; Parnell and Soots 1978; Soots and Landin 1978). The amount o f usage may depend on the stage of plant succession (Soots and Parnell 1975; Parnell and Soots 1978), although great blue herons have been observed nesting in shrubs (Wiese 1978), herbaceous vegetation (Soots and Landin 1978), and on the ground on spoil islands.

Water Quality

Poor water quality reduces the amount of large fish and invertebrate species available in wetland areas. Toxic chemicals from runoff and industrial discharges pose yet another threat. Although great blue herons currently appear to tolerate low levels of pollutants, these chemicals can move through the food chain, accumulate in the tissues of prey and may eventually cause reproductive failure in the herons.

Several authors have observed eggshell thinning in great blue heron eggs, presumably as a result of the ingestion of prey containing high levels of organochlorines (Graber *et al.* 1978; Ohlendorf *et al.* 1980). Konermann *et al.* (1978) blamed high levels of dieldrin and DDE use for reproductive failure, followed by colony abandonment in Iowa. Vermeer and Reynolds (1970) recorded high levels of DDE in great blue herons in the prairie provinces of Canada, but felt that reproductive success was not diminished as a result. Thompson (1979a) believed that it was too early to tell if organochlorine residues were contributing to heron population declines in the Great Lakes region.

Human Disturbance

Heronries often are abandoned as a result of human disturbance (Markham and Brechtel 1979). Werschkul *et al.* (1976) reported more active nests in undisturbed areas than in areas that were being logged. Tree cutting and draining resulted in the abandonment of a mixed-species heronry in Illionois (Bjorkland 1975). Housing and industrial development (Simpson and Kelsall 1979) and water recreation and highway construction (Ryder *et al.* 1980) also have resulted in the abandonment of heronries. Grubb (1979) felt that airport noise levels could potentially disturb a heronry during the breeding season.

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Appendix D: Information on Focal Habitats from IBIS

No. 5. Interior Mixed Conifer Forest

Author: Rex C. Crawford

Geographic Distribution: The Eastside Mixed Conifer Forest habitat appears primarily the Blue Mountains, East Cascades, and Okanogan Highland Ecoregions of Oregon, Washington, adjacent Idaho, and western Montana. It also extends north into British Columbia.

Douglas-fir-ponderosa pine forests occur along the eastern slope of the Oregon and Washington Cascades, the Blue Mountains, and the Okanogan Highlands of Washington. Grand fir-Douglas-fir forests and western larch forests are widely distributed throughout the Blue Mountains and, lesser so, along the east slope of the Cascades south of Lake Chelan and in the eastern Okanogan Highlands. Western hemlock-western redcedar-Douglas-fir forests are found in the Selkirk Mountains of eastern Washington, and on the east slope of the Cascades south of Lake Chelan to the Columbia River Gorge.

Physical Setting: The Eastside Mixed Conifer Forest habitat is primarily mid-montane with an elevation range of between 1,000 and 7,000 ft (305-2,137 m), mostly between 3,000 and 5,500 ft (914-1,676 m). Parent materials for soil development vary. This habitat receives some of the greatest amounts of precipitation in the inland northwest, 30-80 inches (76-203 cm)/year. Elevation of this habitat varies geographically, with generally higher elevations to the east.

Landscape Setting: This habitat makes up most of the continuous montane forests of the inland Pacific Northwest. It is located between the subalpine portions of the Montane Mixed Conifer Forest habitat in eastern Oregon and Washington and lower tree line Ponderosa Pine and Forest and Woodlands.

Structure: Eastside Mixed Conifer habitats are montane forests and woodlands. Stand canopy structure is generally diverse, although single-layer forest canopies are currently more common than multilayered forests with snags and large woody debris. The tree layer varies from closed forests to more open-canopy forests or woodlands. This habitat may include very open stands. The undergrowth is complex and diverse. Tall shrubs, low shrubs, forbs or any combination may dominate stands. Deciduous shrubs typify shrub layers. Prolonged canopy closure may lead to development of a sparsely vegetated undergrowth.

Composition: This habitat contains a wide array of tree species (9) and stand dominance patterns. Douglas-fir (*Pseudotsuga menziesii*) is the most common tree species in this habitat. It is almost always present and dominates or co-dominates most overstories. Lower elevations or drier sites may have ponderosa pine (*Pinus ponderosa*) as a co-dominant with Douglas-fir in the overstory and often have other shade-tolerant tree species growing in the undergrowth. On moist sites, grand fir (*Abies grandis*), western redcedar (*Thuja plicata*) and/or western hemlock (*Tsuga heterophylla*) are dominant or co-dominant with Douglas-fir. Other conifers include western larch (*Larix occidentalis*) and western white pine (*Pinus monticola*) on mesic sites, Engelmann spruce (*Picea engelmannii*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*) on colder sites. Rarely, Pacific yew (*Taxus brevifolia*) may be an abundant undergrowth tree or tall shrub.

Undergrowth vegetation varies from open to nearly closed shrub thickets with 1 to many layers. Throughout the eastside conifer habitat, tall deciduous shrubs include vine maple (*Acer circinatum*) in the Cascades, Rocky Mountain maple (*A. glabrum*), serviceberry (*Amelanchier alnifolia*), oceanspray (*Holodiscus discolor*), mallowleaf ninebark (*Physocarpus malvaceus*), and Scouler's willow (*Salix scouleriana*) at mid- to lower elevations. Medium-tall deciduous shrubs at higher elevations include fools huckleberry (*Menziesia ferruginea*), Cascade azalea (*Rhododendron albiflorum*), and big huckleberry (*Vaccinium membranaceum*). Widely distributed, generally drier site mid-height to short deciduous shrubs include baldhip rose *(Rosa gymnocarpa*), shiny-leaf spirea (*Spiraea betulifolia)*, and snowberry (*Symphoricarpos albus, S. mollis, and S. oreophilus*). Low shrubs of higher elevations include low huckleberries (*Vaccinium cespitosum, and V. scoparium*) and five-leaved bramble (*Rubus pedatus*). Evergreen shrubs represented in this habitat are chinquapin (*Castanopsis chrysophylla*), a tall shrub in southeastern Cascades, low to mid-height dwarf Oregongrape (*Mahonia nervosa* in the east Cascades and *M. repens* elsewhere), tobacco brush (*Ceanothus velutinus*), an increaser with fire, Oregon boxwood (*Paxistima myrsinites*) generally at mid- to lower elevations, beargrass (*Xerophyllum tenax*), pinemat manzanita (*Arctostaphylos nevadensis*) and kinnikinnick (*A. uva-ursi*).

Herbaceous broadleaf plants are important indicators of site productivity and disturbance. Species generally indicating productive sites include western oakfern (*Gymnocarpium dryopteris)*, vanillaleaf (*Achlys triphylla*), wild sarsparilla (*Aralia nudicaulis*), wild ginger (*Asarum caudatum*), queen's cup (*Clintonia uniflora*), goldthread (*Coptis occidentalis)*, false bugbane (*Trautvetteria caroliniensis*), windflower (*Anemone oregana, A. piperi, A. lyallii*), fairybells (*Disporum hookeri*), Sitka valerian (*Valeriana sitchensis*), and pioneer violet (*Viola glabella*). Other indicator forbs are dogbane (*Apocynum androsaemifolium*), false solomonseal (*Maianthemum stellata*), heartleaf arnica (*Arnica cordifolia*), several lupines (*Lupinus caudatus, L. latifolius, L. argenteus ssp. argenteus var laxiflorus*), western meadowrue (*Thalictrum occidentale*), rattlesnake plantain (*Goodyera oblongifolia*), skunkleaf polemonium (*Polemonium pulcherrimum*), trailplant (*Adenocaulon bicolor*), twinflower (*Linnaea borealis*), western starflower *(Trientalis latifolia*), and several wintergreens (*Pyrola asarifolia, P. picta, Orthilia secunda).*

Graminoids are common in this forest habitat. Columbia brome (*Bromus vulgaris*), oniongrass (*Melica bulbosa*), northwestern sedge (*Carex concinnoides*) and western fescue (*Festuca occidentalis*) are found mostly in mesic forests with shrubs or mixed with forb species. Bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue

(*Festuca idahoensis*), and junegrass (*Koeleria macrantha*) are found in drier more open forests or woodlands. Pinegrass (*Calamagrostis rubescens*) and Geyer's sedge (*C. geyeri*) can form a dense layer under Douglas-fir or grand fir trees.

Other Classifications and Key References: This habitat includes the moist portions of the *Pseudotsuga menziesii*, the *Abies grandis*, and the *Tsuga heterophylla* zones of eastern Oregon and Washington [88]. This habitat is called Douglas-fir (No. 12), Cedar-Hemlock-Pine (No. 13), and Grand fir-Douglas-fir (No. 14) forests in Kuchler [136]. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are the eastside Douglas-fir dominant-mixed conifer forest, ponderosa pine dominant mixed conifer forest, and the northeast Oregon mixed conifer forest. Quigley and Arbelbide [181] referred to this habitat as Grand fir/White fir, the Interior Douglas-fir, Western larch, Western redcedar/Western hemlock, and Western white pine cover types and the Moist Forest potential vegetation group. Other references detail forest associations for this habitat [45, 59, 117, 118, 123, 122, 144, 148, 208, 209, 212, 221, 228].

Natural Disturbance Regime: Fires were probably of moderate frequency (30-100 years) in presettlement times. Inland Pacific Northwest Douglas-fir and western larch forests have a mean fire interval of 52 years 22. Typically, stand-replacement fire-return intervals are 150-500 years with moderate severity-fire intervals of 50-100 years. Specific fire influences vary with site characteristics. Generally, wetter sites burn less frequently and stands are older with more western hemlock and western red cedar than drier sites. Many sites dominated by Douglas-fir and ponderosa pine, which were formerly maintained by wildfire, may now be dominated by grand fir (a fire sensitive, shade-tolerant species).

Succession and Stand Dynamics: Successional relationships of this type reflect complex interrelationships between site potential, plant species characteristics, and disturbance regime [228]. Generally, early seral forests of shade-intolerant trees (western larch, western white pine, ponderosa pine, Douglas-fir) or tolerant trees (grand fir, western redcedar, western hemlock) develop some 50 years following disturbance. This stage is preceded by forb- or shrub- dominated communities. These early stage mosaics are maintained on ridges and drier topographic positions by frequent fires. Early seral forest develops into mid-seral habitat of large trees during the next 50-100 years. Stand replacing fires recycle this stage back to early seral stages over most of the landscape. Without high-severity fires, a late-seral condition develops either single-layer or multilayer structure during the next 100-200 years. These structures are typical of cool bottomlands that usually only experience low-intensity fires.

Effects of Management and Anthropogenic Impacts: This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on large shade-intolerant species in mid- and late-seral forests, leaving shade-tolerant species. Fire suppression enforces those logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than in historical, native systems

[181]. Late-seral forests of shade-intolerant species are now essentially absent. Early-seral forest abundance is similar to that found historically but lacks snags and other legacy features.

Status and Trends: Quigley and Arbelbide [181] concluded that the Interior Douglas-fir, Grand fir, and Western redcedar/Western hemlock cover types are more abundant now than before 1900, whereas the Western larch and Western white pine types are significantly less abundant. Twenty percent of Pacific Northwest Douglas-fir, grand fir, western redcedar, western hemlock, and western white pine associations listed in the National Vegetation Classification are considered imperiled or critically imperiled [10]. Roads, timber harvest, periodic grazing, and altered fire regimes have compromised these forests. Even though this habitat is more extensive than pre-1900, natural processes and functions have been modified enough to alter its natural status as functional habitat for many species.

No. 7. Ponderosa Pine Forest and Woodlands

Authors: Rex C. Crawford and Jimmy Kagan

Geographic Distribution: This habitat occurs in much of eastern Washington and eastern Oregon, including the eastern slopes of the Cascades, the Blue Mountains and foothills, and the Okanogan Highlands. Variants of it also occur in the Rocky Mountains, the eastern Sierra Nevada, and mountains within the Great Basin. It extends into south-central British Columbia as well.

In the Pacific Northwest, ponderosa pine-Douglas-fir woodland habitats occur along the eastern slope of the Cascades, the Okanogan Highlands, and in the Blue Mountains. Ponderosa pine woodland and savanna habitats occur in the foothills of the Blue Mountains, along the eastern base of the Cascade Range, the Okanogan Highlands, and in the Columbia Basin in northeastern Washington. Ponderosa pine is widespread in the pumice zone of south-central Oregon between Bend and Crater Lake east of the Cascade Crest. Ponderosa pine-Oregon white oak habitat appears east of the Cascades in the vicinity of Mt. Hood near the Columbia River Gorge north to the Yakama Nation and south to the Warm Springs Nation. Oak dominated woodlands follow a similar distribution as Ponderosa Pine-White Oak habitat but are more restricted and less common.

Physical Setting: This habitat generally occurs on the driest sites supporting conifers in the Pacific Northwest. It is widespread and variable, appearing on moderate to steep slopes in canyons, foothills, and on plateaus or plains near mountains. In Oregon, this habitat can be maintained by the dry pumice soils, and in Washington it can be associated with serpentine soils. Average annual precipitation ranges from about 14 to 30 inches (36 to 76 cm) on ponderosa pine sites in Oregon and Washington and often as snow. This habitat can be found at elevations of 100 ft (30m) in the Columbia River Gorge to dry, warm areas over 6,000 ft (1,829 m). Timber harvest, livestock grazing, and pockets of urban development are major land uses.

Landscape Setting: This woodland habitat typifies the lower treeline zone forming transitions with Eastside Mixed Conifer Forest and Western Juniper and Mountain Mahogany Woodland, Shrub-steppe, Eastside Grassland, or Agriculture habitats. Douglas-fir-ponderosa pine woodlands are found near or within the Eastside Mixed Conifer Forest habitat. Oregon oak woodlands appear in the driest most restricted landscapes in transition to Eastside Grassland or Shrub-steppe.

Structure: This habitat is typically a woodland or savanna with tree canopy coverage of 10- 60%, although closed-canopy stands are possible. The tree layer is usually composed of widely spaced large conifer trees. Many stands tend towards a multilayered condition with encroaching conifer regeneration. Isolated taller conifers above broadleaf deciduous trees characterize part of this habitat. Deciduous woodlands or forests are an important part of the structural variety of this habitat. Clonal deciduous trees can create dense patches across a grassy landscape rather than scattered individual trees. The undergrowth may include dense stands of shrubs or, more often, be dominated by grasses, sedges, or forbs. Shrub-steppe shrubs may be prominent in some stands and create a distinct tree-shrub-sparse-grassland habitat.

Composition: Ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) are the most common evergreen trees in this habitat. The deciduous conifer, western larch (*Larix occidentalis*), can be a co-dominant with the evergreen conifers in the Blue Mountains of Oregon, but seldom as a canopy dominant. Grand fir (*Abies grandis*) may be frequent in the undergrowth on more productive sites giving stands a multilayer structure. In rare instances, grand fir can be co-dominant in the upper canopy. Tall ponderosa pine over Oregon white oak (*Quercus garryana*) trees form stands along part of the east Cascades. These stands usually have younger cohorts of pines. Oregon white oak dominates open woodlands or savannas in limited areas.

The undergrowth can include dense stands of shrubs or, more often, be dominated by grasses, sedges, and/or forbs. Some Douglas-fir and ponderosa pine stands have a tall to medium-tall deciduous shrub layer of mallowleaf ninebark (*Physocarpus malvaceus*) or common snowberry (*Symphoricarpos albus*). Grand fir seedlings or saplings may be present in the undergrowth. Pumice soils support a shrub layer represented by green-leaf or white-leaf manzanita (*Arctostaphylos patula or A. viscida*). Short shrubs, pinemat manzanita (*Arctostaphylos nevadensis*) and kinnikinnick (*A. uva-ursi*) are found across the range of this habitat. Antelope bitterbrush (*Purshia tridentata),* big sagebrush (*Artemisia tridentata*), black sagebrush (*A. nova*), green rabbitbrush (*Chrysothamnus viscidiflorus),* and in southern Oregon, curl-leaf mountain mahogany (*Cercocarpus ledifolius*) often grow with Douglas-fir, ponderosa pine and/or Oregon white oak, which typically have a bunchgrass and shrub-steppe ground cover.

Undergrowth is generally dominated by herbaceous species, especially graminoids. Within a forest matrix, these woodland habitats have an open to closed sodgrass undergrowth dominated by pinegrass (Calamagrostis rubescens), Geyer's sedge (*Carex geyeri),* Ross' sedge (*C. rossii*), long-stolon sedge (*C. inops*), or blue wildrye (*Elymus* *glaucus)*. Drier savanna and woodland undergrowth typically contains bunchgrass steppe species, such as Idaho fescue (*Festuca idahoensis*), rough fescue (*F. campestris*), bluebunch wheatgrass (*Pseudoroegneria spicata*), Indian ricegrass (Oryzopsis *hymenoides),* or needlegrasses (*Stipa comata, S. occidentalis*). Common exotic grasses that may appear in abundance are cheatgrass (*Bromus tectorum*), and bulbous bluegrass (*Poa bulbosa*). Forbs are common associates in this habitat and are too numerous to be listed.

Other Classifications and Key References: This habitat is referred to as Merriam's Arid Transition Zone, Western ponderosa forest (*Pinus),* and Oregon Oak wood (*Quercus*) in Kuchler [136], and as Pacific ponderosa pine-Douglas-fir and Pacific ponderosa pine, and Oregon white oak by the Society of American Foresters. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are ponderosa pine forest and woodland, ponderosa pine-white oak forest and woodland, and ponderosa pine-lodgepole pine on pumice. Other references describe elements of this habitat [45, 62, 88, 117, 118, 121, 122, 123, 144, 148, 209, 212, 221, 222].

Natural Disturbance Regime: Fire plays an important role in creating vegetation structure and composition in this habitat. Most of the habitat has experienced frequent low-severity fires that maintained woodland or savanna conditions. A mean fire interval of 20 years for ponderosa pine is the shortest of the vegetation types listed by Barrett et al.[22]. Soil drought plays a role in maintaining an open tree canopy in part of this dry woodland habitat.

Succession and Stand Dynamics.: This habitat is climax on sites near the dry limits of each of the dominant conifer species and is more seral as the environment becomes more favorable for tree growth. Open seral stands are gradually replaced by more closed shade-tolerant climax stands. Oregon white oak can reproduce under its own shade but is intolerant of overtopping by conifers. Oregon white oak woodlands are considered fire climax and are seral to conifers. In drier conditions, unfavorable to conifers, oak is climax. Oregon white oak sprouts from the trunk and root crown following cutting or burning and form clonal patches of trees.

Effects of Management and Anthropogenic Impacts: Pre-1900, this habitat was mostly open and park like with relatively few undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multilayered canopy. For example, this habitat includes previously natural fire-maintained stands in which grand fir can eventually become the canopy dominant. Fire suppression has lead to a buildup of fuels that in turn increase the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Fire suppression combined with grazing creates conditions that support cloning of oak and invasion by conifers. Large late-seral ponderosa pine, Douglas-fir, and Oregon white oak are harvested in much of this habitat. Under most management regimes, typical tree size decreases and tree density increases in this habitat. Ponderosa pine-Oregon white oak habitat is now denser than in the past and may contain more shrubs than in presettlement habitats. In some areas, new woodlands have been created by patchy tree establishment at the forest-steppe boundary.

Status and Trends: Quigley and Arbelbide [181] concluded that the Interior Ponderosa Pine cover type is significantly less in extent than pre-1900 and that the Oregon White Oak cover type is greater in extent than pre-1900. They included much of this habitat in their Dry Forest potential vegetation group [181,] which they concluded has departed from natural succession and disturbance conditions. The greatest structural change in this habitat is the reduced extent of the late-seral, single-layer condition. This habitat is generally degraded because of increased exotic plants and decreased native bunchgrasses. One third of Pacific Northwest Oregon white oak, ponderosa pine, and dry Douglas-fir or grand fir community types listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

No. 8. Upland Aspen Forest

Authors: Rex C. Crawford and Jimmy Kagan

Geographic Distribution: Quaking aspen groves are the most widespread habitat in North America, but are a minor type throughout eastern Washington and Oregon. Upland Aspen habitat is found in isolated mountain ranges of Southeastern Oregon, e.g. Steens Mountains, and in the northeastern Cascades of Washington. Aspen stands are much more common in the Rocky Mountain states.

Physical Setting: This habitat generally occurs on well-drained mountain slopes or canyon walls that have some moisture. Rockfalls, talus, or stony north slopes are often typical sites. It may occur in steppe on moist microsites. This habitat is not associated with streams, ponds, or wetlands. This habitat is found from 2,000 to 9,500 ft (610 to 2,896 m) elevation.

Landscape Setting: Aspen forms a "subalpine belt" above the Western Juniper and Mountain Mahogany Woodland habitat and below Montane Shrub-steppe Habitat on Steens Mountain in southern Oregon. It can occur in seral stands in the lower Eastside Mixed Conifer Forest and Ponderosa Pine Forest and Woodlands habitats. Primary land use is livestock grazing.

Structure: Deciduous trees usually <48 ft (15 m) tall dominate this woodland or forest habitat. The tree layer grows over a forb-, grass-, or low-shrub-dominated undergrowth. Relatively simple 2-tiered stands characterize the typical vertical structure of woody plants in this habitat. This habitat is composed of 1 to many clones of trees with larger trees toward the center of each clone. Conifers invade and create mixed evergreen-deciduous woodland or forest habitats.

Composition: Quaking aspen (*Populus tremuloides*) is the characteristic and dominant tree in this habitat. It is the sole dominant in many stands although scattered ponderosa pine (*Pinus ponderosa*) or Douglas-fir (*Pseudotsuga menziesii*) may be present.

Snowberry (*Symphoricarpos oreophilus* and less frequently, *S. albus*) is the most common dominant shrub. Tall shrubs, Scouler's willow (*Salix scouleriana*) and serviceberry (*Amelanchier alnifolia*) may be abundant. On mountain or canyon slopes, antelope bitterbrush (*Purshia tridentata*), mountain big sagebrush (*Artemisia tridentata ssp. vaseyana)*, low sagebrush (*A. arbuscula*), and curl-leaf mountain mahogany (*Cercocarpus ledifolius*) often occur in and adjacent to this woodland habitat.

In some stands, pinegrass (*Calamagrostis rubescens*) may dominate the ground cover without shrubs. Other common grasses are Idaho fescue (*Festuca idahoensis*), California brome (*Bromus carinatus*), or blue wildrye (*Elymus glaucus*). Characteristic tall forbs include horsemint (*Agastache spp.*), aster (*Aster spp.*), senecio (*Senecio spp.*), coneflower *(Rudbeckia spp.*). Low forbs include meadowrue (*Thalictrum spp.*), bedstraw (*Galium spp.*), sweetcicely (*Osmorhiza spp.*), and valerian (*Valeriana spp.*).

Other Classifications and Key References: This habitat is called "Aspen" by the Society of American Foresters and "Aspen woodland" by the Society of Range Management. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Type 127 that would represent this type is aspen groves. Other references describe this habitat [2, 88, 119, 161, 222.]

Natural Disturbance Regime: Fire plays an important role in maintenance of this habitat. Quaking aspen will colonize sites after fire or other stand disturbances through root sprouting. Research on fire scars in aspen stands in central Utah 119 indicated that most fires occurred before 1885, and concluded that the natural fire return interval was 7-10 years. Ungulate browsing plays a variable role in aspen habitat; ungulates may slow tree regeneration by consuming aspen sprouts on some sites, and may have little influence in other stands.

Succession and Stand Dynamics: There is no generalized successional pattern across the range of this habitat. Aspen sprouts after fire and spreads vegetatively into large clonal or multiclonal stands. Because aspen is shade intolerant and cannot reproduce under its own canopy, conifers can invade most aspen habitat. In central Utah, quaking aspen was invaded by conifers in 75-140 years. Apparently, some aspen habitat is not invaded by conifers, but eventually clones deteriorate and succeed to shrubs, grasses, and/or forbs. This transition to grasses and forbs occurs more likely on dry sites.

Effects of Management and Anthropogenic Impacts: Domestic sheep reportedly consume 4 times more aspen sprouts than do cattle. Heavy livestock browsing can adversely impact aspen growth and regeneration. With fire suppression and alteration of fine fuels, fire rejuvenation of aspen habitat has been greatly reduced since about 1900. Conifers now dominate many seral aspen stands and extensive stands of young aspen are uncommon.

Status and Trends: With fire suppression and change in fire regimes, the Aspen Forest habitat is less common than before 1900. None of the 5 Pacific Northwest upland quaking aspen community types in the National Vegetation Classification is considered imperiled [10].

No. 13. Western Juniper and Mountain Mahogany Woodlands

Authors: Rex. C. Crawford and Jimmy Kagan

Geographic Distribution: This habitat is distributed from the Pacific Northwest south into southern California and east to western Montana and Utah, where it often occurs with pinyon-juniper habitat. In Oregon and Washington, this dry woodland habitat appears primarily in the Owyhee Uplands, High Lava Plains, and northern Basin and Range ecoregions. Secondarily, it develops in the foothills of the Blue Mountains and East Cascades ecoregions, and seems to be expanding into the southern Columbia Basin ecoregion, where it was naturally found in outlier stands.

Western juniper woodlands with shrub-steppe species appear throughout the range of the habitat primarily in central and southern Oregon. Many isolated mahogany communities occur throughout canyons and mountains of eastern Oregon. Juniper-mountain mahogany communities are found in the Ochoco and Blue Mountains.

Physical Setting: This habitat is widespread and variable, occurring in basins and canyons, and on slopes and valley margins in the southern Columbia Plateau, and on fire-protected sites in the northern Basin and Range province. It may be found on benches and foothills. Western juniper and/or mountain mahogany woodlands are often found on shallow soils, on flats at mid- to high elevations, usually on basalts. Other sites range from deep, loess soils and sandy slopes to very stony canyon slopes. At lower elevations, or in areas outside of shrub-steppe, this habitat occurs on slopes and in areas with shallow soils. Mountain mahogany can occur on steep rimrock slopes, usually in areas of shallow soils or protected slopes. This habitat can be found at elevations of 1,500- 8,000 ft (457-2,438 m), mostly between 4,000-6,000 ft (1,220-1,830 m). Average annual precipitation ranges from approximately 10 to 13 inches (25 to 33 cm), with most occurring as winter snow.

Landscape Setting: This habitat reflects a transition between Ponderosa Pine Forest and Woodlands and Shrub-steppe, Eastside Grasslands, and rarely Desert Playa and Salt Desert Scrub habitats. Western juniper generally occurs on higher topography, whereas the shrub communities are more common in depressions or steep slopes with bunchgrass undergrowth. In the Great Basin, mountain mahogany may form a distinct belt on mountain slopes and ridgetops above pinyon-juniper woodland. Mountain-mahogany can occur in isolated, pure patches that are often very dense. The primary land use is livestock grazing.

Structure: This habitat is made up of savannas, woodlands, or open forests with 10-60% canopy cover. The tallest layer is composed of short (6.6-40 ft [2-12 m] tall) evergreen trees. Dominant plants may assume a tall-shrub growth form on some sites. The short trees appear in a mosaic pattern with areas of low or medium-tall (usually evergreen) shrubs alternating with areas of tree layers and widely spaced low or medium-tall shrubs. The herbaceous layer is usually composed of short or medium tall bunchgrass or, rarely, a rhizomatous grass-forb undergrowth. These vegetated areas can be interspersed with rimrock or scree. A well-developed cryptogam layer often covers the ground, although bare rock can make up much of the ground cover.

Composition: Western juniper and/or mountain mahogany dominate these woodlands either with bunchgrass or shrub-steppe undergrowth. Western juniper (*Juniperus occidentalis*) is the most common dominant tree in these woodlands. Part of this habitat will have curl-leaf mountain mahogany (*Cercocarpus ledifolius*) as the only dominant tall shrub or small tree. Mahogany may be co-dominant with western juniper. Ponderosa pine (*Pinus ponderosa*) can grow in this habitat and in some rare instances may be an important part of the canopy.

The most common shrubs in this habitat are basin, Wyoming, or mountain big sagebrush (*Artemisia tridentata ssp. tridentata, ssp. wyomingensis,* and *ssp. vaseyana*) and/or bitterbrush (*Purshia tridentata*). They usually provide significant cover in juniper stands. Low or stiff sagebrush (*Artemisia arbuscula* or *A. rigida*) are dominant dwarf shrubs in some juniper stands. Mountain big sagebrush appears most commonly with mountain mahogany and mountain mahogany mixed with juniper. Snowbank shrubland patches in mountain mahogany woodlands are composed of mountain big sagebrush with bitter cherry (*Prunus emarginata*), quaking aspen (*Populus tremuloides*), and serviceberry (*Amelanchier alnifolia*). Shorter shrubs such as mountain snowberry (*Symphoricarpos oreophilus*) or creeping Oregongrape (*Mahonia repens*) can be dominant in the undergrowth. Rabbitbrush (*Chrysothamnus nauseosus* and *C. viscidiflorus*) will increase with grazing.

Part of this woodland habitat lacks a shrub layer. Various native bunchgrasses dominate different aspects of this habitat. Sandberg bluegrass (*Poa sandbergii*), a short bunchgrass, is the dominant and most common grass throughout many juniper sites. Medium-tall bunchgrasses such as Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), needlegrasses (*Stipa occidentalis, S. thurberiana, S. lemmonii*), bottlebrush squirreltail (*Elymus elymoides*) can dominate undergrowth. Threadleaf sedge (*Carex filifolia*) and basin wildrye (*Leymus cinereus*) are found in lowlands and Geyer's and Ross' sedge (*Carex geyeri, C. rossii*), pinegrass (*Calamagrostis rubescens*), and blue wildrye (*E. glaucus*) appear on mountain foothills. Sandy sites typically have needle-and-thread (*Stipa comata*) and Indian ricegrass (*Oryzopsis hymenoides*). Cheatgrass (*Bromus tectorum*) or bulbous bluegrass (*Poa bulbosa*) often dominate overgrazed or disturbed sites. In good condition this habitat may have mosses growing under the trees.

Other Classifications and Key References: This habitat is also called Juniper Steppe Woodland [136]. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are ponderosa pine-western juniper woodland, western juniper woodland, and mountain mahogany shrubland. Other references describe this habitat [64, 79, 122, 207].

Natural Disturbance Regime: Both mountain mahogany and western juniper are fire intolerant. Under natural high-frequency fire regimes both species formed savannas or occurred as isolated patches on fire-resistant sites in shrub-steppe or steppe habitat. Western juniper is considered a topoedaphic climax tree in a number of sagebrush-grassland, shrub-steppe, and drier conifer sites. It is an increaser in many earlier seral communities in these zones and invades without fires. Most trees >13 ft (4 m) tall can survive low-intensity fires. The historic fire regime of mountain mahogany communities varies with community type and structure. The fire-return interval for mountain mahogany (along the Salmon River in Idaho) was 13-22 years until the early 1900's and has increased ever since. Mountain mahogany can live to 1,350 years in western and central Nevada. Some old-growth mountain mahogany stands avoid fire by growing on extremely rocky sites.

Succession and Stand Dynamics: Juniper invades shrub-steppe and steppe and reduces undergrowth productivity. Although slow seed dispersal delays recovery time, western juniper can regain dominance in 30-50 years following fire. A fire-return interval of 30-50 years typically arrests juniper invasion. The successional role of curl-leaf mountain mahogany varies with community type. Mountain brush communities where curl-leaf mountain mahogany is either dominant or co-dominant are generally stable and successional rates are slow.

Effects of Management and Anthropogenic Impacts: Over the past 150 years, with fire suppression, overgrazing, and changing climatic factors, western juniper has increased its range into adjacent shrub-steppe, grasslands, and savannas. Increased density of juniper and reduced fine fuels from an interaction of grazing and shading result in high severity fires that eliminate woody plants and promote herbaceous cover, primarily annual grasses. Diverse mosses and lichens occur on the ground in this type if it has not been too disturbed by grazing. Excessive grazing will decrease bunchgrasses and increase exotic annual grasses plus various native and exotic forbs. Animals seeking shade under trees decrease or eliminate bunchgrasses and contribute to increasing cheatgrass cover.

Status and Trends: This habitat is dominated by fire-sensitive species, and therefore, the range of western juniper and mountain mahogany has expanded because of an interaction of livestock grazing and fire suppression. Quigley and Arbelbide [181] concluded that in the Inland Pacific Northwest, Juniper/Sagebrush, Juniper Woodlands, and Mountain Mahogany cover types now are significantly greater in extent than before 1900. Although it covers more area, this habitat is generally in degraded condition because of increased exotic plants and decreased native bunchgrasses. One third of Pacific Northwest juniper and mountain mahogany community types listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

No. 15. Interior Grasslands

Authors: Rex. C. Crawford and Jimmy Kagan

Geographic Distribution: This habitat is found primarily in the Columbia Basin of Idaho, Oregon, and Washington, at mid- to low elevations and on plateaus in the Blue Mountains, usually within the ponderosa pine zone in Oregon.

Idaho fescue grassland habitats were formerly widespread in the Palouse region of southeastern Washington and adjacent Idaho; most of this habitat has been converted to agriculture. Idaho fescue grasslands still occur in isolated, moist sites near lower treeline in the foothills of the Blue Mountains, the Northern Rockies, and east Cascades near the Columbia River Gorge. Bluebunch wheatgrass grassland habitats are common throughout the Columbia Basin, both as modified native grasslands in deep canyons and the dry Palouse and as fire-induced representatives in the shrub-steppe. Similar grasslands appear on the High Lava Plains ecoregion, where they occur in a matrix with big sagebrush or juniper woodlands. In Oregon they are also found in burned shrub-steppe and canyons in the Basin and Range and Owyhee Uplands. Sand dropseed and three-awn needlegrass grassland habitats are restricted to river terraces in the Columbia Basin, Blue Mountains, and Owyhee Uplands of Oregon and Washington. Primary location of this habitat extends along the Snake River from Lewiston south to the Owyhee River.

Physical Setting: This habitat develops in hot, dry climates in the Pacific Northwest. Annual precipitation totals 8-20 inches (20-51 cm); only 10% falls in the hottest months, July through September. Snow accumulation is low (1-6 inches [3-15 cm]) and occurs only in January and February in eastern portions of its range and November through March in the west. More snow accumulates in grasslands within the forest matrix. Soils are variable: (1) highly productive loess soils up to 51 inches (130 cm) deep, (2) rocky flats, (3) steep slopes, and (4) sandy, gravel or cobble soils. An important variant of this habitat occurs on sandy, gravelly, or silty river terraces or seasonally exposed river gravel or Spokane flood deposits. The grassland habitat is typically upland vegetation but it may also include riparian bottomlands dominated by non-native grasses. This habitat is found from 500 to 6,000 ft (152-1,830 m) in elevation.

Landscape Setting: Eastside grassland habitats appear well below and in a matrix with lower treeline Ponderosa Pine Forests and Woodlands or Western Juniper and Mountain Mahogany Woodlands. It can also be part of the lower elevation forest matrix. Most grassland habitat occurs in 2 distinct large landscapes: plateau and canyon grasslands. Several rivers flow through narrow basalt canyons below plateaus supporting prairies or shrub-steppe. The canyons can be some 2,132 ft (650 m) deep below the plateau. The plateau above is composed of gentle slopes with deep silty loess soils in an expansive rolling dune-like landscape. Grasslands may occur in a patchwork with shallow soil scablands or within biscuit scablands or mounded topography. Naturally occurring grasslands are beyond the range of bitterbrush and sagebrush species. This habitat exists today in the shrub-steppe landscape where grasslands are created by brush removal, chaining or spraying, or by fire. Agricultural uses and introduced perennial plants on abandoned or planted fields are common throughout the current distribution of eastside grassland habitats.

Structure: This habitat is dominated by short to medium-tall grasses (<3.3 ft [1 m]). Total herbaceous cover can be closed to only sparsely vegetated. In general, this habitat is an open and irregular arrangement of grass clumps rather than a continuous sod cover. These medium-tall grasslands often have scattered and diverse patches of low shrubs, but few or no medium-tall shrubs (<10% cover of shrubs are taller than the grass layer). Native forbs may contribute significant cover or they may be absent. Grasslands in canyons are dominated by bunchgrasses growing in lower densities than on deep-soil prairie sites. The soil surface between perennial plants can be covered with a diverse cryptogamic or microbiotic layer of mosses, lichens, and various soil bacteria and algae. Moister environments can support a dense sod of rhizomatous perennial grasses. Annual plants are a common spring and early summer feature of this habitat.

Composition: Bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca idahoensis*) are the characteristic native bunchgrasses of this habitat and either or both can be dominant. Idaho fescue is common in more moist areas and bluebunch wheatgrass more abundant in drier areas. Rough fescue (*F. campestris*) is a characteristic dominant on moist sites in northeastern Washington. Sand dropseed (*Sporobolus cryptandrus*) or three-awn (*Aristida longiseta*) are native dominant grasses on hot dry sites in deep canyons. Sandberg bluegrass (*Poa sandbergii*) is usually present, and occasionally codominant in drier areas. Bottlebrush squirreltail (*Elymus elymoides*) and Thurber needlegrass (*Stipa thurberiana*) can be locally dominant. Annual grasses are usually present; cheatgrass (*Bromus tectorum*) is the most widespread. In addition, medusahead (*Taeniatherum caput-medu*sae), and other annual bromes (*Bromus commutatus, B. mollis, B. japonicus*) may be present to co-dominant. Moist environments, including riparian bottomlands, are often co-dominated by Kentucky bluegrass *(Poa pratensis*).

A dense and diverse forb layer can be present or entirely absent; >40 species of native forbs can grow in this habitat including balsamroots (*Balsamorhiza spp*.), biscuitroots (*Lomatium spp*.), buckwheat (*Eriogonum spp*.), fleabane (*Erigeron spp*.), lupines (*Lupinus spp*.), and milkvetches (*Astragalus spp*.). Common exotic forbs that can grow in this habitat are knapweeds (*Centaurea solstitialis, C. diffusa, C. maculosa*), tall tumblemustard (*Sisymbrium altissimum*), and Russian thistle (*Salsola kali*).

Smooth sumac (*Rhus glabra*) is a deciduous shrub locally found in combination with these grassland species. Rabbitbrushes (*Chrysothamnus nauseosus, C. viscidiflorus*) can occur in this habitat in small amounts, especially where grazed by livestock. In moist Palouse regions, common snowberry (*Symphoricarpos albus*) or Nootka rose (*Rosa nutkana*) may be present, but is shorter than the bunchgrasses. Dry sites contain low succulent pricklypear (*Opuntia polyacantha*). Big sagebrush (*Artemisia tridentata*) is occasional and may be increasing in grasslands on former shrub-steppe sites. Black hawthorn (*Crataegus douglasii*) and other tall shrubs can form dense thickets near Idaho fescue grasslands. Rarely, ponderosa pine (*Pinus ponderosa*) or western juniper (*Juniperus occidentalis*) can occur as isolated trees.

Other Classifications and Key References: This habitat is called Palouse Prairie, Pacific Northwest grassland, steppe vegetation, or bunchgrass prairie in general ecological literature. Quigley and Arbelbide [181] called this habitat Fescue-Bunchgrass and Wheatgrass Bunchgrass and the dry Grass cover type. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are northeast Oregon canyon grassland, forest-grassland mosaic, and modified grassland; Washington Gap [37] types [13, 21, 22, 24, 29-31, 82, and 99] map this habitat. Kuchler [136] includes this within Fescue-wheatgrass and wheatgrass-bluegrass. Franklin and Dyrness [88] include this habitat in steppe zones of Washington and Oregon. Other references describe this habitat [28, 60, 159, 166, 206, 207].

Natural Disturbance Regime: The fire-return interval for sagebrush and bunchgrass is estimated at 25 years [22]. The native bunchgrass habitat apparently lacked extensive herds of large grazing and browsing animals until the late 1800's. Burrowing animals and their predators likely played important roles in creating small-scale patch patterns.

Succession and Stand Dynamics: Currently fires burn less frequently in the Palouse grasslands than historically because of fire suppression, roads, and conversions to cropland [159]. Without fire, black hawthorn shrubland patches expand on slopes along with common snowberry and rose. Fires covering large areas of shrub-steppe habitat can eliminate shrubs and their seed sources and create eastside grassland habitat. Fires that follow heavy grazing or repeated early season fires can result in annual grasslands of cheatgrass, medusahead, knapweed, or yellow star-thistle. Annual exotic grasslands are common in dry grasslands and are included in modified grasslands as part of the Agriculture habitat.

Effects of Management and Anthropogenic Impacts: Large expanses of grasslands are currently used for livestock ranching. Deep soil Palouse sites are mostly converted to agriculture. Drier grasslands and canyon grasslands, those with shallower soils, steeper topography, or hotter, drier environments, were more intensively grazed and for longer periods than were deep-soil grasslands [207]. Evidently, these drier native bunchgrass grasslands changed irreversibly to persistent annual grass and forblands. Some annual grassland, native bunchgrass, and shrub-steppe habitats were converted to intermediate wheatgrass, or more commonly, crested wheatgrass (*Agropyron cristatum*)-dominated areas. Apparently, these form persistent grasslands and are included as modified grasslands in the Agriculture habitat. With intense livestock use, some riparian bottomlands become dominated by non-native grasses. Many native dropseed grasslands have been submerged by dam reservoirs.

Status and Trends: Most of the Palouse prairie of southeastern Washington and adjacent Idaho and Oregon has been converted to agriculture. Remnants still occur in the foothills of the Blue Mountains and in isolated, moist Columbia Basin sites. The Palouse is one of the most endangered ecosystems in the U.S. [166] with only 1% of the original habitat remaining; it is highly fragmented with most sites <10 acres. All these areas are subject to weed invasions and drift of aerial biocides. Since 1900, 94% of the Palouse grasslands have been converted to crop, hay, or pasture lands. Quigley and Arbelbide [181] concluded that Fescue-Bunchgrass and Wheatgrass bunchgrass cover types have significantly decreased in area since pre-1900, while exotic forbs and annual grasses have significantly increased since pre-1900. Fifty percent of the plant associations recognized as components of eastside grassland habitat listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

No. 16. Shrub-steppe

Authors: Rex. C. Crawford and Jimmy Kagan

Geographic Distribution: Shrub-steppe habitats are common across the Columbia Plateau of Washington, Oregon, Idaho, and adjacent Wyoming, Utah, and Nevada. It extends up into the cold, dry environments of surrounding mountains.

Basin big sagebrush shrub-steppe occurs along stream channels, in valley bottoms and flats throughout eastern Oregon and Washington. Wyoming sagebrush shrub-steppe is the most widespread habitat in eastern Oregon and Washington, occurring throughout the Columbia Plateau and the northern Great Basin. Mountain big sagebrush shrub-steppe habitat occurs throughout the mountains of the eastern Oregon and Washington. Bitterbrush shrub-steppe habitat appears primarily along the eastern slope of the Cascades, from north-central Washington to California and occasionally in the Blue Mountains. Three-tip sagebrush shrub-steppe occurs mostly along the northern and western Columbia Basin in Washington and occasionally appears in the lower valleys of the Blue Mountains and in the Owyhee Upland ecoregions of Oregon. Interior shrub dunes and sandy steppe and shrub-steppe habitat is concentrated at low elevations near the Columbia River and in isolated pockets in the Northern Basin and Range and Owyhee Uplands. Bolander silver sagebrush shrub-steppe is common in southeastern Oregon. Mountain silver sagebrush is more prevalent in the Oregon East Cascades and in montane meadows in the southern Ochoco and Blue Mountains.

Physical Setting: Generally, this habitat is associated with dry, hot environments in the Pacific Northwest although variants are in cool, moist areas with some snow accumulation in climatically dry mountains. Elevation range is wide (300-9,000 ft [91-2,743 m]) with most habitat occurring between 2,000 and 6,000 ft (610-1,830 m). Habitat occurs on deep alluvial, loess, silty or sandy-silty soils, stony flats, ridges, mountain slopes, and slopes of lake beds with ash or pumice soils.

Landscape Setting: Shrub-steppe habitat defines a biogeographic region and is the major vegetation on average sites in the Columbia Plateau, usually below Ponderosa Pine Forest and Woodlands, and Western Juniper and Mountain Mahogany Woodlands habitats. It forms mosaic landscapes with these woodland habitats and Eastside Grasslands, Dwarf Shrub-steppe, and Desert Playa and Salt Scrub habitats. Mountain sagebrush shrub-steppe occurs at high elevations occasionally within the dry Eastside Mixed Conifer Forest and Montane Mixed Conifer Forest habitats. Shrub-steppe habitat can appear in large landscape patches. Livestock grazing is the primary land use in the shrub-steppe although much has been converted to irrigation or dry land agriculture. Large areas occur in military training areas and wildlife refuges.

Structure: This habitat is a shrub savanna or shrubland with shrub coverage of 10-60%. In an undisturbed condition, shrub cover varies between 10 and 30%. Shrubs are generally evergreen although deciduous shrubs are prominent in many habitats. Shrub height typically is medium-tall (1.6-3.3 ft [0.5-1.0 m]) although some sites support shrubs approaching 9 ft (2.7 m) tall. Vegetation structure in this habitat is characteristically an open shrub layer over a moderately open to closed bunchgrass layer. The more northern or productive sites generally have a denser grass layer and sparser shrub layer than southern or more xeric sites. In fact, the rare good-condition site is better characterized as grassland with shrubs than a shrubland. The bunchgrass layer may contain a variety of forbs. Good-condition habitat has very little exposed bare ground, and has mosses and lichens carpeting the area between taller plants. However, heavily grazed sites have dense shrubs making up >40% cover, with introduced annual grasses and little or no moss or lichen cover. Moist sites may support tall bunchgrasses (>3.3 ft [1 m]) or rhizomatous grasses. More southern shrub-steppe may have native low shrubs dominating with bunchgrasses.

Composition: Characteristic and dominant mid-tall shrubs in the shrub-steppe habitat include all 3 subspecies of big sagebrush, basin (*Artemisia tridentata ssp. tridentata*), Wyoming (*A. t. ssp. wyomingensis*) or mountain (*A. t. ssp. vaseyana*), antelope bitterbrush (*Purshia tridentata*), and 2 shorter sagebrushes, *silver (A. cana*) and three-tip (*A. tripartita*). Each of these species can be the only shrub or appear in complex seral conditions with other shrubs. Common shrub complexes are bitterbrush and Wyoming big sagebrush, bitterbrush and three-tip sagebrush, Wyoming big sagebrush and three-tip sagebrush, and mountain big sagebrush and silver sagebrush. Wyoming and mountain big sagebrush can codominate areas with tobacco brush (*Ceanothus velutinus*). Rabbitbrush (*Chrysothamnus viscidiflorus*) and short-spine horsebrush (*Tetradymia spinosa*) are common associates and often dominate sites after disturbance. Big sagebrush occurs with the shorter stiff sagebrush *(A. rigida*) or low sagebrush *(A. arbuscula*) on shallow soils or high elevation sites. Many sandy areas are shrub-free or are open to patchy shrublands of bitterbrush and/or rabbitbrush. Silver sagebrush is the dominant and characteristic shrub along the edges of stream courses, moist meadows, and ponds. Silver sagebrush and rabbitbrush are associates in disturbed areas.

When this habitat is in good or better ecological condition a bunchgrass steppe layer is characteristic. Diagnostic native bunchgrasses that often dominate different shrub-steppe habitats are (1) mid-grasses: bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), bottlebrush squirreltail (*Elymus elymoides*), and Thurber needlegrass (*Stipa thurberiana*); (2) short grasses: threadleaf sedge (*Carex filifolia*) and Sandberg bluegrass (*Poa sandbergii*); and (3) the tall grass, basin wildrye *(Leymus cinereus*). Idaho fescue is characteristic of the most productive shrub-steppe vegetation.

Bluebunch wheatgrass is codominant at xeric locations, whereas western needlegrass *(Stipa occidentalis*), long-stolon (*Carex inops*) or Geyer's sedge (*C. geyeri*) increase in abundance in higher elevation shrub-steppe habitats. Needle-and-thread (*Stipa comata*) is the characteristic native bunchgrass on stabilized sandy soils. Indian ricegrass *(Oryzopsis hymenoides*) characterizes dunes. Grass layers on montane sites contain slender wheatgrass (*Elymus trachycaulus*), mountain fescue (*F. brachyphylla*), green fescue (*F. viridul*a), Geyer's sedge, or tall bluegrasses (*Poa spp*.). Bottlebrush squirreltail can be locally important in the Columbia Basin, sand dropseed (*Sporobolus cryptandrus*) is important in the Basin and Range and basin wildrye is common in the more alkaline areas. Nevada bluegrass (*Poa secunda*), Richardson muhly (*Muhlenbergia richardson*is), or alkali grass (*Puccinella spp.)* can dominate silver sagebrush flats. Many sites support non-native plants, primarily cheatgrass (*Bromus tectorum*) or crested wheatgrass (*Agropyron cristatum*) with or without native grasses. Shrub-steppe habitat, depending on site potential and disturbance history, can be rich in forbs or have little forb cover. Trees may be present in some shrub-steppe habitats, usually as isolated individuals from adjacent forest or woodland habitats.

Other Classifications and Key References.: This habitat is called Sagebrush steppe and Great Basin sagebrush by Kuchler [136]. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are big sagebrush shrubland, sagebrush steppe, and bitterbrush-big sagebrush shrubland. Franklin and Dyrness [88] discussed this habitat in shrub-steppe zones of Washington and Oregon. Other references describe this habitat [60, 116, 122, 123, 212, 224, 225].

Natural Disturbance Regime: Barrett et al. [22] concluded that the fire-return interval for this habitat is 25 years. The native shrub-steppe habitat apparently lacked extensive herds of large grazing and browsing animals until the late 1800's. Burrowing animals and their predators likely played important roles in creating small-scale patch patterns.

Succession and Stand Dynamics: With disturbance, mature stands of big sagebrush are reinvaded through soil-stored or windborne seeds. Invasion can be slow because sagebrush is not disseminated over long distances. Site dominance by big sagebrush usually takes a decade or more depending on fire severity and season, seed rain, postfire moisture, and plant competition. Three-tip sagebrush is a climax species that reestablishes (from seeds or commonly from sprouts) within 5-10 years following a disturbance. Certain disturbance regimes promote three-tip sagebrush and it can out-compete herbaceous species. Bitterbrush is a climax species that plays a seral role colonizing by seed onto rocky and/or pumice soils. Bitterbrush may be declining and may be replaced by woodlands in the absence of fire. Silver sagebrush is a climax species that establishes during early seral stages and coexists with later arriving species. Big sagebrush, rabbitbrush, and short-spine horsebrush invade and can form dense stands after fire or livestock grazing. Frequent or high-intensity fire can create a patchy shrub cover or can eliminate shrub cover and create Eastside Grasslands habitat.

Effects of Management and Anthropogenic Impacts: Shrub density and annual cover increase, whereas bunchgrass density decreases with livestock use. Repeated or intense disturbance, particularly on drier sites, leads to cheatgrass dominance and replacement of native bunchgrasses. Dry and sandy soils are sensitive to grazing, with needle-and-thread replaced by cheatgrass at most sites. These disturbed sites can be converted to modified grasslands in the Agriculture habitat.

Status and Trends: Shrub-steppe habitat still dominates most of southeastern Oregon although half of its original distribution in the Columbia Basin has been converted to agriculture. Alteration of fire regimes, fragmentation, livestock grazing, and the addition of >800 exotic plant species have changed the character of shrub-steppe habitat. Quigley and Arbelbide [181] concluded that Big Sagebrush and Mountain Sagebrush cover types are significantly smaller in area than before 1900, and that Bitterbrush/Bluebunch Wheatgrass cover type is similar to the pre-1900 extent. They concluded that Basin Big Sagebrush and Big sagebrush-Warm potential vegetation type's successional pathways are altered, that some pathways of Antelope Bitterbrush are altered and that most pathways for Big Sagebrush-Cool are unaltered. Overall this habitat has seen an increase in exotic plant importance and a decrease in native bunchgrasses. More than half of the Pacific Northwest shrub-steppe habitat community types listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

No. 22. Herbaceous Wetlands

Authors: Rex C. Crawford, Jimmy Kagan, and Christopher B. Chappell

Geographic Distribution: Herbaceous wetlands are found throughout the world and are represented in Oregon and Washington wherever local hydrologic conditions promote their development. This habitat includes all those except bogs and those within Subalpine Parkland and Alpine.

Freshwater aquatic bed habitats are found throughout the Pacific Northwest, usually in isolated sites. They are more widespread in valley bottoms and high rainfall areas (e.g., Willamette Valley, Puget Trough, coastal terraces, coastal dunes), but are present in montane and arid climates as well. Hardstem bulrush-cattail-burreed marshes occur in wet areas throughout Oregon and Washington. Large marshes are common in the lake basins of Klamath, Lake, and Harney counties, Oregon. Sedge meadows and montane meadows are common in the Blue and Ochoco mountains of central and northeastern Oregon, and in the valleys of the Olympic and Cascade mountains and Okanogan Highlands. Extensive wet meadow habitats occur in Klamath, Deschutes, and western Lake counties in Oregon.

Physical Setting: This habitat is found on permanently flooded sites that are usually associated with oxbow lakes, dune lakes, or potholes. Seasonally to semi-permanently flooded wetlands are found where standing freshwater is present through part of the growing season and the soils stay saturated throughout the season. Some sites are temporarily to seasonally flooded meadows and generally occur on clay, pluvial, or alluvial deposits within montane meadows, or along stream channels in shrubland or woodland riparian vegetation. In general, this habitat is flat, usually with stream or river channels or open water present. Elevation varies between sea level to 10,000 ft (3,048 m), although infrequently above 6,000 ft (1,830 m).

Landscape Setting: Herbaceous wetlands are found in all terrestrial habitats except Subalpine Parkland, Alpine Grasslands, and Shrublands habitats. Herbaceous wetlands commonly form a pattern with Westside and Eastside Riparian-Wetlands and Montane Coniferous Wetlands habitats along stream corridors. These marshes and wetlands also occur in closed basins in a mosaic with open water by lakeshores or ponds. Extensive deflation plain wetlands have developed between Coastal Dunes and Beaches habitat and the Pacific Ocean. Herbaceous wetlands are found in a mosaic with alkali grasslands in the Desert Playa and Salt Scrub habitat.

Structure: The herbaceous wetland habitat is generally a mix of emergent herbaceous plants with a grass-like life form (graminoids). These meadows often occur with deep or shallow water habitats with floating or rooting aquatic forbs. Various wetland communities are found in mosaics or in nearly pure stands of single species. Herbaceous cover is open to dense. The habitat can be comprised of tule marshes >6.6 ft (2 m) tall or sedge meadows and wetlands <3.3 ft (1 m) tall. It can be a dense, rhizomatous sward or a tufted graminoid wetland. Graminoid wetland vegetation generally lacks many forbs, although the open extreme of this type contains a diverse forb component between widely spaced tall tufted grasses.

Composition: Various grasses or grass-like plants dominate or co-dominate these habitats. Cattails (*Typha latifolia*) occur widely, sometimes adjacent to open water with aquatic bed plants. Several bulrush species (*Scirpus acutus, S. tabernaemontani, S. maritimus, S. americanus, S. nevadensis*) occur in nearly pure stands or in mosaics with cattails or sedges (*Carex spp*.). Burreed (*Sparganium angustifolium , S. eurycarpum*) are the most important graminoids in areas with up to 3.3 ft (1m) of deep standing water. A variety of sedges characterize this habitat. Some sedges (*Carex aquatilis, C. lasiocarpa, C. scopulorum, C. simulata, C. utriculata, C. vesicaria*) tend to occur in cold to cool environments. Other sedges *(C. aquatilis var. dives, C. angustata, C. interior, C. microptera, C. nebrascensis)* tend to be at lower elevations in milder or warmer environments. Slough sedge (*C. obnupta*), and several rush species (*Juncus falcatus, J. effusus, J. balticus*) are characteristic of coastal dune wetlands that are included in this habitat. Several spike rush species (*Eleocharis spp.)* and rush species can be important. Common grasses that can be local dominants and indicators of this habitat are American sloughgrass (*Beckmannia syzigachne*), bluejoint reedgrass (*Calamagrostis canadensis*), mannagrass (*Glyceria spp*.) and tufted hairgrass (*Deschampsia caespitosa*). Important introduced grasses that increase and can dominate with disturbance in this wetland habitat include reed canary grass (*Phalaris arundinacea*), tall fescue (*Festuca arundinacea*) and Kentucky bluegrass (*Poa pratensis*).

Aquatic beds are part of this habitat and support a number of rooted aquatic plants, such as, yellow pond lily (*Nuphar lutea*) and unrooted, floating plants such as pondweeds (*Potamogeton spp*.), duckweed (*Lemna min*or), or water-meals (*Wolffia spp*.). Emergent herbaceous broadleaf plants, such as Pacific water parsley (*Oenanthe sarmentosa*), buckbean (*Menyanthes trifoliata*), water star-warts (*Callitriche spp.),* or bladderworts (*Utricularia spp*.) grow in permanent and semi-permanent standing water. Pacific silverweed (*Argentina egedii*) is common in coastal dune wetlands. Montane meadows occasionally are forb dominated with plants such as arrowleaf groundsel (*Senecio triangularis)* or ladyfern (*Athyrium filix-femina*). Climbing nightshade (*Solanum dulcamara*), purple loosestrife (*Lythrum salicaria*), and poison hemlock (*Conium maculatum)* are common non-native forbs in wetland habitats.

Shrubs or trees are not a common part of this herbaceous habitat although willow (*Salix spp*.) or other woody plants occasionally occur along margins, in patches or along streams running through these meadows.

Other Classifications and Key References: This habitat is called Palustrine emergent wetlands in Cowardin et al. [53]. Other references describe this habitat [43, 44, 57, 71, 131, 132, 138, 147, 219]. This habitat occurs in both lotic and lentic systems. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are wet meadow, palustrine emergent, and National Wetland Inventory (NWI) palustrine shrubland.

Natural Disturbance Regime: This habitat is maintained through a variety of hydrologic regimes that limit or exclude invasion by large woody plants. Habitats are permanently flooded, semi-permanently flooded, or flooded seasonally and may remain saturated through most of the growing season. Most wetlands are resistant to fire and those that are dry enough to burn usually burn in the fall. Most plants are sprouting species and recover quickly. Beavers play an important role in creating ponds and other impoundments in this habitat. Trampling and grazing by large native mammals is a natural process that creates habitat patches and influences tree invasion and success.

Succession and Stand Dynamics: Herbaceous wetlands are often in a mosaic with shrub- or tree-dominated wetland habitat. Woody species can successfully invade emergent wetlands when this herbaceous habitat dries. Emergent wetland plants invade open-water habitat as soil substrate is exposed; e.g., aquatic sedge and Northwest Territory sedge (*Carex utriculata*) are pioneers following beaver dam breaks. As habitats flood, woody species decrease to patches on higher substrate (soil, organic matter, large woody debris) and emergent plants increase unless the flooding is permanent. Fire suppression can lead to woody species invasion in drier herbaceous wetland habitats; e.g., Willamette Valley wet prairies are invaded by Oregon ash (*Fraxinus latifolia*) with fire suppression.

Effects of Management and Anthropogenic Impacts: Direct alteration of hydrology (i.e., channeling, draining, damming) or indirect alteration (i.e., roading or removing vegetation on adjacent slopes) results in changes in amount and pattern of herbaceous wetland habitat. If the alteration is long term, wetland systems may reestablish to reflect new hydrology, e.g., cattail is an aggressive invader in roadside ditches. Severe livestock grazing and trampling decreases aquatic sedge, Northwest Territory sedge (*Carex utriculata*), bluejoint reedgrass, and tufted hairgrass. Native species, however, such as

Nebraska sedge, Baltic and jointed rush (*Juncus nodosus*), marsh cinquefoil (*Comarum palustris*), and introduced species dandelion (*Taraxacum officinale*), Kentucky bluegrass, spreading bentgrass (*Agrostis stolonifera*), and fowl bluegrass (Poa palustris) generally increase with grazing.

Status and Trends: Nationally, herbaceous wetlands have declined and the Pacific Northwest is no exception. These wetlands receive regulatory protection at the national, state, and county level; still, herbaceous wetlands have been filled, drained, grazed, and farmed extensively in the lowlands of Oregon and Washington. Montane wetland habitats are less altered than lowland habitats even though they have undergone modification as well. A keystone species, the beaver, has been trapped to near extirpation in parts of the Pacific Northwest and its population has been regulated in others. Herbaceous wetlands have decreased along with the diminished influence of beavers on the landscape. Quigley and Arbelbide [181] concluded that herbaceous wetlands are susceptible to exotic, noxious plant invasions.

No. 25. Interior Riparian-Wetlands

Authors: Rex C. Crawford and Jimmy Kagan

Geographic Distribution: Riparian and wetland habitats dominated by woody plants are found throughout eastern Oregon and eastern Washington.

Mountain alder-willow riparian shrublands are major habitats in the forested zones of eastern Oregon and eastern Washington. Eastside lowland willow and other riparian shrublands are the major riparian types throughout eastern Oregon and Washington at lower elevations. Black cottonwood riparian habitats occur throughout eastern Oregon and Washington, at low to middle elevations. White alder riparian habitats are restricted to perennial streams at low elevations, in drier climatic zones in Hells Canyon at the border of Oregon, Washington, and Idaho, in the Malheur River drainage and in western Klickitat and southcentral Yakima counties, Washington. Quaking aspen wetlands and riparian habitats are widespread but rarely a major component throughout eastern Washington and Oregon. Ponderosa pine-Douglas-fir riparian habitat occurs only around the periphery of the Columbia Basin in Washington and up into lower montane forests.

Physical Setting: Riparian habitats appear along perennial and intermittent rivers and streams. This habitat also appears in impounded wetlands and along lakes and ponds. Their associated streams flow along low to high gradients. The riparian and wetland forests are usually in fairly narrow bands along the moving water that follows a corridor along montane or valley streams. The most typical stand is limited to 100-200 ft (31-61 m) from streams. Riparian forests also appear on sites subject to temporary flooding during spring runoff. Irrigation of streamsides and toeslopes provides more water than precipitation and is important in the development of this habitat, particularly in drier climatic regions. Hydrogeomorphic surfaces along streams supporting this habitat have seasonally to temporarily flooded hydrologic regimes. Eastside riparian and wetland habitats are found from 100- 9,500 ft (31-2,896 m) in elevation.

Landscape Setting: Eastside riparian habitats occur along streams, seeps, and lakes within the Eastside Mixed Conifer Forest, Ponderosa Pine Forest and Woodlands, Western Juniper and Mountain Mahogany Woodlands, and part of the Shrub-steppe habitat. This habitat may be described as occupying warm montane and adjacent valley and plain riparian environments.

Structure: The Eastside riparian and wetland habitat contains shrublands, woodlands, and forest communities. Stands are closed to open canopies and often multilayered. A typical riparian habitat would be a mosaic of forest, woodland, and shrubland patches along a stream course. The tree layer can be dominated by broadleaf, conifer, or mixed canopies. Tall shrub layers, with and without trees, are deciduous and often nearly completely closed thickets. These woody riparian habitats have an undergrowth of low shrubs or dense patches of grasses, sedges, or forbs. Tall shrub communities (20-98 ft [6-30 m], occasionally tall enough to be considered woodlands or forests) can be interspersed with sedge meadows or moist, forb-rich grasslands. Intermittently flooded riparian habitat has ground cover composed of steppe grasses and forbs. Rocks and boulders may be a prominent feature in this habitat.

Composition: Black cottonwood (*Populus balsamifera ssp. trichocarpa*), quaking aspen *(P. tremuloides),* white alder *(Alnus rhombifolia*), peachleaf willow (*Salix amygdaloides*) and, in northeast Washington, paper birch (*Betula papyrifera*) are dominant and characteristic tall deciduous trees. Water birch (*B. occidentalis*), shining willow (*Salix lucida ssp. caudata*) and, rarely, mountain alder (*Alnus incana*) are co-dominant to dominant mid-size deciduous trees. Each can be the sole dominant in stands. Conifers can occur in this habitat, rarely in abundance, more often as individual trees. The exception is ponderosa pine (*Pinus ponderosa)* and Douglas-fir (*Pseudotsuga menziesii*) that characterize a conifer-riparian habitat in portions of the shrub-steppe zones.

A wide variety of shrubs are found in association with forest/woodland versions of this habitat. Red-osier dogwood (*Cornus sericea*), mountain alder, gooseberry (*Ribes* spp.), rose (*Rosa spp*.), common snowberry (*Symphoricarpos albus*) and Drummonds willow (*Salix drummondii*) are important shrubs in this habitat. Bog birch (B. nana) and Douglas spiraea (*Spiraea douglasii*) can occur in wetter stands. Red-osier dogwood and common snowberry are shade-tolerant and dominate stand interiors, while these and other shrubs occur along forest or woodland edges and openings. Mountain alder is frequently a prominent shrub, especially at middle elevations. Tall shrubs (or small trees) often growing under or with white alder include chokecherry (*Prunus virginiana*), water birch, shining willow, and netleaf hackberry (*Celtis reticulata*).

Shrub-dominated communities contain most of the species associated with tree communities. Willow species (*Salix bebbiana, S. boothii, S. exigua, S geyeriana*, or *S. lemmonii)* dominate many sites. Mountain alder can be dominant and is at least codominant at many sites. Chokecherry, water birch, serviceberry (*Amelanchier alnifolia*), black hawthorn (*Crataegus douglasii*), and red-osier dogwood can also be codominant to dominant. Shorter shrubs, Woods rose, spiraea, snowberry and gooseberry are usually present in the undergrowth.

The herb layer is highly variable and is composed of an assortment of graminoids and broadleaf herbs. Native grasses (*Calamagrostis canadensis, Elymus glaucus, Glyceria spp*., and *Agrostis spp*.) and sedges (*Carex aquatilis, C. angustata, C. lanuginosa, C. lasiocarpa, C. nebrascensis, C. microptera,* and *C. utriculata*) are significant in many habitats. Kentucky bluegrass (*Poa pratensis*) can be abundant where heavily grazed in the past. Other weedy grasses, such as orchard grass (*Dactylis glomerata*), reed canarygrass (*Phalaris arundinac*ea), timothy (*Phleum pratense*), bluegrass (*Poa bulbosa, P. compressa*), and tall fescue (*Festuca arundinacea*) often dominate disturbed areas. A short list of the great variety of forbs that grow in this habitat includes Columbian monkshood (*Aconitum columbianum*), alpine leafybract aster (*Aster foliaceus*), ladyfern *(Athyrium filix-femina*), field horsetail (*Equisetum arvense*), cow parsnip (*Heracleum maximum*), skunkcabbage (*Lysichiton americanus*), arrowleaf groundsel (*Senecio triangularis*), stinging nettle (*Urtica dioica*), California false hellebore (*Veratrum californicum*), American speedwell (*Veronica americana*), and pioneer violet (*Viola glabella*).

Other Classifications and Key References: This habitat is called Palustrine scrub-shrub and forest in Cowardin et al. [53]. Other references describe this habitat [44, 57, 60, 131, 132, 147, 156]. This habitat occurs in both lotic and lentic systems. The Oregon Gap II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are eastside cottonwood riparian gallery, palustrine forest, palustrine shrubland, and National Wetland Inventory (NWI) palustrine emergent.

Natural Disturbance Regime: This habitat is tightly associated with stream dynamics and hydrology. Flood cycles occur within 20-30 years in most riparian shrublands although flood regimes vary among stream types. Fires recur typically every 25-50 years but fire can be nearly absent in colder regions or on topographically protected streams. Rafted ice and logs in freshets may cause considerable damage to tree boles in mountain habitats. Beavers crop younger cottonwood and willows and frequently dam side channels in these stands. These forests and woodlands require various flooding regimes and specific substrate conditions for reestablishment. Grazing and trampling is a major influence in altering structure, composition, and function of this habitat; some portions are very sensitive to heavy grazing.

Succession and Stand Dynamics: Riparian vegetation undergoes "typical" stand development that is strongly controlled by the site’s initial conditions following flooding and shifts in hydrology. The initial condition of any hydrogeomorphic surface is a sum of the plants that survived the disturbance, plants that can get to the site, and the amount of unoccupied habitat available for invasions. Subsequent or repeated floods or other influences on the initial vegetation selects species that can survive or grow in particular life forms. A typical woody riparian habitat dynamic is the invasion of woody and herbaceous plants onto a new alluvial bar away from the main channel. If the bar is not scoured in 20 years, a tall shrub and small deciduous tree stand will develop.

Approximately 30 years without disturbance or change in hydrology will allow trees to overtop shrubs and form woodland. Another 50 years without disturbance will allow conifers to invade and in another 50 years a mixed hardwood-conifer stand will develop. Many deciduous tall shrubs and trees cannot be invaded by conifers. Each stage can be reinitiated, held in place, or shunted into different vegetation by changes in stream or wetland hydrology, fire, grazing, or an interaction of those factors.

Effects of Management and Anthropogenic Impacts: Management effects on woody riparian vegetation can be obvious, e.g., removal of vegetation by dam construction, roads, logging, or they can be subtle, e.g., removing beavers from a watershed, removing large woody debris, or construction of a weir dam for fish habitat. In general, excessive livestock or native ungulate use leads to less woody cover and an increase in sod-forming grasses particularly on fine-textured soils. Undesirable forb species, such as stinging nettle and horsetail, increase with livestock use.

Status and Trends: Quigley and Arbelbide [181] concluded that the Cottonwood-Willow cover type covers significantly less in area now than before 1900 in the Inland Pacific Northwest. The authors concluded that although riparian shrubland was a minor part of the landscape, occupying 2%, they estimated it to have declined to 0.5% of the landscape. Approximately 40% of riparian shrublands occurred above 3,280 ft (1,000 m) in elevation pre-1900; now nearly 80% is found above that elevation. This change reflects losses to agricultural development, roading, dams and other flood-control activities. The current riparian shrublands contain many exotic plant species and generally are less productive than historically. Quigley and Arbelbide [181] found that riparian woodland was always rare and the change in extent from the past is substantial.

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Appendix E – EDT Products

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
Alka	Alkalinity	Alkalinity, or acid neutralizing capacity (ANC), measured as milliequivalents per liter or mg/l of either HCO3 or CaCO3.	Very low (average value typically would be 0-5 mg/l)	Moderately low (average value typically would be 5-10 mg/l)	Moderately high (average value typically would be 10-40 mg/l)	High (average value typically would be 40-100 mg/l)	Very high (average value typically would be 100-300 mg/l)
BdScour	Bed scour	Average depth of bed scour in salmonid spawning areas (i.e., in pool-tailouts and small cobble-gravel riffles) during the annual peak flow event over approximately a 10-year period. The range of annual scour depth over the period could vary substantially. Particle sizes of substrate modified from Platts et al. (1983) based on information in Gordon et a. (1991): gravel (0.2 to 2.9 inch diameter), small cobble (2.9 to 5 inch diameter), large cobble (5 to 11.9 inch diameter), boulder (>11.9 inch diameter).	Average depth of scour >0 cm and <2 cm	Average depth of scour >2 cm and <10 cm	Average depth of scour >10 cm and <18 cm	Average depth of scour >18 cm and <24 cm	Average depth of scour >24 cm and <40 cm

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
BenComRch	Benthos diversity and production	Measure of the diversity and production of the benthic macroinvertebrate community. Three types of measures are given (choose one): a simple EPT count, Benthic Index of Biological Integrity (B-IBI)—a multimetric approach (Karr and Chu 1999), or a multivariate approach using the BORIS (Benthic evaluation of ORegon RIverS) model (Canale 1999). B-IBI rating definitions from Morley (2000) as modified from Karr et al. (1986). BORIS score definitions based on ODEQ protocols, after Barbour et al. (1994).	(1) Simple EPT index -- Macroinvertebrates abundant; multiple species of families Emphemeroptera, Plecoptera, and Trichoptera are present. OR (2) B-IBI (10 metrics) -- >=45Comparable to least disturbed reference condition; overall high taxa diversity, particularly of mayflies, stoneflies, caddisflies, long-lived clinger, and intolerant taxa. Relative abundance of predators high. OR (3) BORIS score -- Minimal impairment in benthic community — <1 standard deviation from the reference mean AND considered "ideal or good watershed and stream condition for reference condition."	(1) Simple EPT index -- Intermediate OR (2) B-IBI (10 metrics) -- >=37 and <45.Slightly divergent from least disturbed condition; absence of some long-lived and intolerant taxa; slight decline in richness of mayflies, stoneflies, and caddisflies; proportion of tolerant taxa increases. OR (3) BORIS score -- Minimal impairment in benthic community — <1 standard deviation from the reference mean AND considered "marginal watershed and stream condition for reference condition."	(1) Simple EPT index -- Macroinvertebrates common or abundant but 1-2 families among Emphemeroptera, Plecoptera, and Trichoptera are not present. OR (2) B-IBI (10 metrics) -- >=27 and <37.Total taxa reduced—particularly intolerant, long-lived, stonefly, and clinger taxa. Relative abundance of predator declines; proportion of tolerant taxa continues to increase. OR (3) BORIS score -- Moderate impairment in benthic community — >1 and <2 standard deviations from the reference mean.	(1) Simple EPT index -- Intermediate. OR (2) B-IBI (10 metrics) -- >=17 and <27.Overall taxa diversity depressed; proportion of predators greatly reduced as is long-lived taxa richness; few stoneflies or intolerant taxa present; dominance by three most abundant taxa often very high. OR (3) BORIS score -- Severe impairment in benthic community —>2 and <2.5 standard deviations from the reference mean.	(1) Simple EPT index -- Macroinvertebrates are present only at extremely low densities and/or biomass. OR (2) B-IBI (10 metrics) -- <17.Overall taxa diversity very low and dominated by a few highly tolerant taxa; mayfly, stonefly, caddisfly, clinger, long-lived and intolerant taxa largely absent. Relative abundance of predators very low. OR (3) BORIS score -- Extremely severe impairment in benthic community—>2.5 standard deviations from the reference mean.
ChLngth	Channel length	Length of the primary channel contained with the stream reach -- Note: this attribute will not be given by a categories but rather will be a point estimate. Length of channel is given for the main channel only--multiple channels do not add length.					

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
WidthMx	Channel width - month maximum width (ft)	Average width of the wetted channel during peak flow month (average monthly conditions). If the stream is braided or contains multiple channels, then the width would represent the sum of the wetted widths along a transect that extends across all channels. Note: Categories are not to be used for calculation of wetted surface area; categories here are used to designate relative stream size.	< 15 ft	> 15 ft and < 60 ft	> 60 ft and < 100 ft	> 100 ft and 360 ft	> 360 ft
WidthMn	Channel width - month minimum width (ft)	Average width of the wetted channel. If the stream is braided or contains multiple channels, then the width would represent the sum of the wetted widths along a transect that extends across all channels. Note: Categories are not to be used for calculation of wetted surface area; categories here are used to designate relative stream size.	< 15 ft	> 15 ft and < 60 ft	> 60 ft and < 100 ft	> 100 ft and 360 ft	> 360 ft

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
ConfineHdro	Confinement – Hydromodifica-tions	The extent that man-made structures within or adjacent to the stream channel constrict flow (as at bridges) or restrict flow access to the stream's floodplain (due to streamside roads, revetments, diking or levees) or the extent that the channel has been ditched or channelized, or has undergone significant streambed degradation due to channel incision/entrenchment (associated with the process called "headcutting"). Flow access to the floodplain can be partially or wholly cutoff due to channel incision. Note: Setback levees are to be treated differently than narrow-channel or riverfront levees--consider the extent of the setback and its effect on flow and bed dynamics and micro-habitat features along the stream margin in reach to arrive at rating conclusion. Reference condition for this attribute is the natural, undeveloped state.	The stream channel within the reach is essentially fully connected to its floodplain. Very minor structures may exist in the reach that do not result in flow constriction or restriction. Note: this describes both a natural condition within a naturally unconfined channel as well as the natural condition within a canyon.	Some portion of the stream channel, though less than 10% (of the sum of lengths of both banks), is disconnected from its floodplain along one or both banks due to man-made structures or ditching.	More than 10% and less than 40% of the entire length of the stream channel (sum of lengths of both banks) within the reach is disconnected from its floodplain along one or both banks due to man-made structures or ditching.	More than 40% and less than 80% of the entire length of the stream channel (sum of lengths of both banks) within the reach is disconnected from its floodplain along one or both banks due to man-made structures or ditching.	Greater than 80% of the entire length of the stream channel (sum of lengths of both banks) within the reach is disconnected from its floodplain along one or both banks due to man-made structures or ditching.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
Confine	Confinement - natural	The extent that the valley floodplain of the reach is confined by natural features. It is determined as the ratio between the width of the valley floodplain and the bankful channel width. Note: this attribute addresses the natural (pristine) state of valley confinement only.	Reach mostly unconfined by natural features -- Average valley width > 4 channel widths.	Reach comprised approximately equally of unconfined and moderately confined sections.	Reach mostly moderately confined by natural features -- Average valley width 2 - 4 channel widths.	Reach comprised approximately equally of moderately confined and confined sections.	Reach mostly confined by natural features -- Average valley width < 2 channel widths.
DisOxy	Dissolved oxygen	Average dissolved oxygen within the water column for the specified time interval.	> 8 mg/L (allows for all biological functions for salmonids without impairment at temperatures ranging from 0-25 C)	> 6 mg/L and < 8 mg/L (causes initial stress symptoms for some salmonids at temperatures ranging from 0-25 C)	> 4 and < 6 mg/L (stress increased, biological function impaired)	> 3 and < 4 mg/L (growth, food conversion efficiency, swimming performance adversely affected)	< 3 mg/L
Emb	Embeddedness	The extent that larger cobbles or gravel are surrounded by or covered by fine sediment, such as sands, silts, and clays. Embeddedness is determined by examining the extent (as an average %) that cobble and gravel particles on the substrate surface are buried by fine sediments. This attribute only applies to riffle and tailout habitat units and only where cobble or gravel substrates occur.	< 10% of surface covered by fine sediment	> 10 and < 25 % covered by fine sediment	> 25 and < 50 % covered by fine sediment	> 50 and < 90 % covered by fine sediment	> 90% covered by fine sediment

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
FnSedi	Fine sediment	Percentage of fine sediment within salmonid spawning substrates, located in pool-tailouts, glides, and small cobble-gravel riffles. Definition of "fine sediment" here depends on the particle size of primary concern in the watershed of interest. In areas where sand size particles are not of major interest, as they are in the Idaho Batholith, the effect of fine sediment on egg to fry survival is primarily associated with particles <1mm (e.g., as measured by particles <0.85 mm). Sand size particles (e.g., <6 mm) can be the principal concern when excessive accumulations occur in the upper stratum of the stream bed (Kondolf 2000). See guidelines on possible benefits accrued due to gravel cleaning by spawning salmonids.	Particle sizes <0.85 mm: < 6% OR Particle sizes <6.3 mm: <10%	Particle sizes <0.85 mm: > 6% and < 11% OR Particle sizes <6.3 mm: >10% and <25%	Particle sizes <0.85 mm: > 11% and < 18% OR Particle sizes <6.3 mm: >25% and <40%	Particle sizes <0.85 mm: > 18% and < 30% OR Particle sizes <6.3 mm: >40% and <60%	Particle sizes <0.85 mm: > 30% fines OR Particle sizes <6.3 mm: >60%
FshComRch	Fish community richness	Measure of the richness of the fish community (no. of fish taxa, i.e., species).	2 or fewer fish taxa	3-7 fish taxa	8-17 fish taxa	18-25 fish taxa	> 25 fish taxa

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
FshPath	Fish pathogens	The presence of pathogenic organisms (relative abundance and species present) having potential for affecting survival of stream fishes.	No historic or recent fish stocking in drainage and no known incidences of whirling disease, C. shasta, IHN, or IPN	Historic fish stocking, but no fish stocking records within the past decade, or sockeye population currently existing in drainage, or known incidents of viruses among kokanee populations within the watershed.	On-going periodic, frequent, or annual fish stocking in drainage or known viral incidents within sockeye, chinook, or steelhead populations in the watershed.	Operating hatchery within the reach or in the reach immediately downstream or upstream	Known presence of whirling disease or C. shasta within the watershed.
FSpIntro	Fish species introductions	Measure of the richness of the fish community (no. of fish taxa). Taxa here refers to species.	No non-native species reported or known to be in the sub-drainage of interest.	1-2 non-native species reported or known to be in the sub-drainage of interest.	3-7 non-native species reported or known to be in the sub-drainage of interest.	8-14 non-native species reported or known to be in the sub-drainage of interest.	15 or more non-native species reported or known to be in the sub-drainage of interest.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
FlwHigh	Flow - change in average annual peak flow	The extent of relative change in average peak annual discharge compared to an undisturbed watershed of comparable size, geology, orientation, topography, and geography (or as would have existed in the pristine state). Evidence of change in peak flow can be empirical where sufficiently long data series exists, can be based on indicator metrics (such as T_{Qmean}, see Konrad [2000]), or inferred from patterns corresponding to watershed development. Relative change in peak annual discharge here is based on changes in the peak annual flow expected on average once every two years (Q_{2yr}).	Peak annual flows expected to be strongly reduced relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >40% and <100% decrease in Q_{2yr} based on a long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state) or as known by regulated flow levels. This condition is associated with flow regulation or water diversion projects.	Peak annual flows expected to be moderately reduced relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >20% and <40% decrease in Q_{2yr} based on a long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state) or as known by regulated flow levels. This condition is associated with flow regulation or water diversion projects.	Peak annual flows expected to be comparable to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR <20% change in Q_{2yr} based on a long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state); OR <5% reduction in average T_{Qmean} compared to the undeveloped watershed state.	Peak annual flows expected to be moderately increased relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >20% and <40% increase in Q_{2yr} based on a long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state); OR >5% and <15% reduction in average T_{Qmean} compared to the undeveloped watershed state. This condition exemplified in some forested watersheds with high road density that experience significant rain on snow events, as the North Fork Stillaguamish River (Pess et al. *in review*). Note: many managed forested watersheds in the Pacific Northwest exhibit slight, if any, increases in peak annual flows since logging commenced (see Ziemer and Lisle 1998).	Peak annual flows expected to be strongly increased relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >40% and <110%+ increase in Q_{2yr} based on a long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state); OR >15% and <45% reduction in average T_{Qmean} compared to the undeveloped watershed state. This condition exemplified in watersheds with significant urbanization (e.g., >20%).

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
FlwLow	Flow - change in average annual low flow	The extent of relative change in average daily flow during the normal low flow period compared to an undisturbed watershed of comparable size, geology, and flow regime (or as would have existed in the pristine state). Evidence of change in low flow can be empirically-based where sufficiently long data series exists, or known through flow regulation practices, or inferred from patterns corresponding to watershed development. Note: low flows are not systematically reduced in relation to watershed development, even in urban streams (Konrad 2000). Factors affecting low flow are often not obvious in many watersheds, except in clear cases of flow diversion and regulation.	Average daily low flows expected to be strongly increased compared to an undisturbed watershed of similar size, geology, and flow regime (or the pristine state for the watershed of interest); OR >75% increase in the 45 or 60-day consecutive lowest average daily flow on a sufficiently long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state) or as known through flow regulation.	Average daily low flows expected to be moderately increased compared to an undisturbed watershed of similar size, geology, and flow regime (or the pristine state for the watershed of interest); OR >20% and <75% increase in the 45 or 60-day consecutive lowest average daily flow on a sufficiently long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state) or as known through flow regulation.	Average daily low flows expected to be comparable to an undisturbed watershed of similar size, geology, and flow regime (or the pristine state for the watershed of interest); OR <20% change in the 45 or 60-day consecutive lowest average daily flow on a sufficiently long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state).	Average daily low flows expected to be moderately reduced compared to an undisturbed watershed of similar size, geology, and flow regime (or the pristine state for the watershed of interest); OR >20% and <50% reduction in the 45 or 60-day consecutive lowest average daily flow on a sufficiently long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state) or as known through flow regulation.	Average daily low flows expected to be severely reduced compared to an undisturbed watershed of similar size, geology, and flow regime (or the pristine state for the watershed of interest); OR >50% and <=100% reduction in the 45 or 60-day consecutive lowest average daily flow on a sufficiently long time series (~40 yrs or longer with at least 20 yrs pertaining to a watershed development state) or as known through flow regulation.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
FlwDielVar	Flow - Intra daily (diel) variation	Average diel variation in flow level during a season or month. This attribute is informative for rivers with hydroelectric projects or in heavily urbanized drainages where storm runoff causes rapid changes in flow.	Essentially no variation in discharge during an average 24-hr period during season or month. This characterizes conditions not influenced by flow ramping or accelerated storm runoff. This rating also would apply to small suburban-urbanized drainages with impervious surfaces of <10% in high rainfall climates (e.g., Puget Lowlands) and with little or no flow detention systems in place.	Slight to low variation in flow stage during an average 24-hr period during season or month. This pattern typical of routine (everyday) slight to low ramping condition associated with flow regulation, averaging <2 inches change in stage per hour. This condition has both slight to low rates of change in flow and high frequency with which it occurs. This rating also would apply to small suburban-urbanized drainages with impervious surfaces of ~10-25% in high rainfall climates (e.g., Puget Lowlands) and with little or no flow detention systems in place.	Low to moderate variation in flow stage during an average 24-hr period during season or month. This pattern typical of routine (everyday) low to moderate ramping condition associated with flow regulation, averaging >2 inches and <6 inches change in stage per hour. This condition has both moderate to high rates of change in flow and high frequency with which it occurs. This rating also would apply to small suburban- urbanized drainages with impervious surfaces of ~25-40% in high rainfall climates (e.g., Puget Lowlands) and with little or no flow detention systems in place.	Moderate to high variation in flow stage during an average 24-hr period during season or month. This pattern typical of routine (everyday) moderate to high ramping condition associated with flow regulation, averaging between 6 inches to 12 inches change in stage per hour. This condition has both moderate to high rates of change in flow and high frequency with which it occurs. This rating also would apply to small suburban to urbanized drainages with impervious surfaces of ~40-50% in high rainfall climates (e.g., Puget Lowlands) and with little or no flow detention systems in place.	Extreme variation in flow stage during an average 24-hr period during season or month. This pattern typical of routine (everyday) extreme ramping condition associated with flow regulation, averaging between 12 inches to 24 inches change in stage per hour. This condition is both extreme in the rate of change in flow and the frequency with which it occurs. This rating would apply to small, heavily urbanized drainages with impervious surfaces of 50-80% in high rainfall climates (e.g., Puget Lowlands) and with little or no flow detention systems in place.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
FlwIntraAnn	Flow - intra-annual flow pattern	The average extent of intra-annual flow variation during the wet season -- a measure of a stream's "flashiness" during storm runoff. Flashiness is correlated with % total impervious area and road density, but is attenuated as drainage area increases. Evidence for change can be empirically derived using flow data (e.g., using the metric T_{Qmean}, see Konrad [2000]), or inferred from patterns corresponding to watershed development.	Storm runoff response (rates of change in flow) expected to be slowed greatly relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >15% increase in average T_{Qmean} compared to the undeveloped watershed state or as known by regulated flow levels. This condition is associated with flow regulation.	Storm runoff response (rates of change in flow) expected to be moderately slower relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >5% and <15% increase in average T_{Qmean} compared to the undeveloped watershed state or as known by regulated flow levels. This condition is associated with flow regulation.	Storm runoff response (rates of change in flow) comparable to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR <5% reduction in average T_{Qmean} compared to the undeveloped watershed state.	Storm runoff response (rates of change in flow) expected to be moderately increased relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >5% and <15% reduction in average T_{Qmean} compared to the undeveloped watershed state. This condition exemplified in some managed forested watersheds with high road density, likely most evident in small drainages.	Storm runoff response (rates of change in flow) expected to be strongly increased relative to an undisturbed watershed of similar size, geology, orientation, topography, and geography (or the pristine state for the watershed of interest); OR >15% and <45% reduction in average T_{Qmean} compared to the undeveloped watershed state. This condition exemplified in watersheds with significant urbanization.
Grad	Gradient	Average gradient of the main channel of the reach over its entire length. Note: Categorical levels are shown here but values are required to be input as point estimates for each reach.	0 - 0.1%	>0.10% and <0.5%	>0.5% and <1%	>1% and <2%	>2% and <4%
HbBckPls	Habitat type - backwater pools	Percentage of the wetted channel surface area comprising backwater pools.	0 - <0.25% of wetted surface area encompasses this habitat type	>0.25% and <5% of wetted surface area encompasses this habitat type	>5% and <25% of wetted surface area encompasses this habitat type	>25% and <50% of wetted surface area encompasses this habitat type	>50% of wetted surface area encompasses this habitat type

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
HbBvrPnds	Habitat type - beaver ponds	Percentage of the wetted channel surface area comprising beaver ponds. Note: these are pools located in the main or side channels, not part of off-channel habitat.	0 - <0.25% of wetted surface area encompasses this habitat type	>0.25% and <5% of wetted surface area encompasses this habitat type	>5% and <25% of wetted surface area encompasses this habitat type	>25% and <50% of wetted surface area encompasses this habitat type	>50% of wetted surface area encompasses this habitat type
HbGlide	Habitat type - glide	Percentage of the wetted channel surface area comprising glides. Note: There is a general lack of consensus regarding the definition of glides (Hawkins et al. 1993), despite a commonly held view that it remains important to recognize a habitat type that is intermediate between pool and riffle. The definition applied here is from the ODFW habitat survey manual (Moore et al. 1997): an area with generally uniform depth and flow with no surface turbulence, generally in reaches of <1% gradient. Glides may have some small scour areas but are distinguished from pools by their overall homogeneity and lack of structure. They are generally deeper than riffles with few major flow obstructions and low habitat complexity.	0 - <0.25% of wetted surface area encompasses this habitat type	>0.25% and <5% of wetted surface area encompasses this habitat type	>5% and <25% of wetted surface area encompasses this habitat type	>25% and <50% of wetted surface area encompasses this habitat type	>50% of wetted surface area encompasses this habitat type

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
HbLrgCbl	Habitat type - large cobble/boulder riffles	Percentage of the wetted channel surface area comprising large cobble/boulder riffles. Particle sizes of substrate modified from Platts et al. (1983) based on information in Gordon et a. (1991): gravel (0.2 to 2.9 inch diameter), small cobble (2.9 to 5 inch diameter), large cobble (5 to 11.9 inch diameter), boulder (>11.9 inch diameter).	0 - <0.25% of wetted surface area encompasses this habitat type	>0.25% and <5% of wetted surface area encompasses this habitat type	>5% and <25% of wetted surface area encompasses this habitat type	>25% and <50% of wetted surface area encompasses this habitat type	>50% of wetted surface area encompasses this habitat type
HbOfChFctr	Habitat type - off-channel habitat factor	A multiplier used to estimate the amount of off-channel habitat based on the wetted surface area of the all combined in-channel habitat.	No off-channel habitat present	>0 X and < 0.05 X	>0.05 X and < 0.25 X	>0.25 X and < 0.5 X	>0.5 X
HbPlTails	Habitat type - pool tailouts.	Percentage of the wetted channel surface area comprising pool tailouts.	0 - <0.25% of wetted surface area encompasses this habitat type	>0.25% and <5% of wetted surface area encompasses this habitat type	>5% and <25% of wetted surface area encompasses this habitat type	>25% and <50% of wetted surface area encompasses this habitat type	>50% of wetted surface area encompasses this habitat type
HbPls	Habitat type - primary pools	Percentage of the wetted channel surface area comprising pools, excluding beaver ponds	0 - <0.25% of wetted surface area encompasses this habitat type	>0.25% and <5% of wetted surface area encompasses this habitat type	>5% and <25% of wetted surface area encompasses this habitat type	>25% and <50% of wetted surface area encompasses this habitat type	>50% of wetted surface area encompasses this habitat type

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
HbSmlCbl	Habitat type - small cobble/gravel riffles	Percentage of the wetted channel surface area comprising small cobble/gravel riffles. Particle sizes of substrate modified from Platts et al. (1983) based on information in Gordon et a. (1991): gravel (0.2 to 2.9 inch diameter), small cobble (2.9 to 5 inch diameter), large cobble (5 to 11.9 inch diameter), boulder (>11.9 inch diameter).	0 - <0.25% of wetted surface area encompasses this habitat type	>0.25% and <5% of wetted surface area encompasses this habitat type	>5% and <25% of wetted surface area encompasses this habitat type	>25% and <50% of wetted surface area encompasses this habitat type	>50% of wetted surface area encompasses this habitat type
Harass	Harassment	The relative extent of poaching and/or harassment of fish within the stream reach.	Reach is distant from human population centers, no road access or no local concentration of human activity.	Reach is distant from human population centers, but with partial road access or little local concentration of human activity.	Reach is near human population center, but has limited public access (through roads or boat launching sites).	Extensive road and/or boat access to the reach with localized concentrations of human activity.	Reach is near human population center or has extensive recreational activities, and has extensive road access and/or opportunities for boat access.
HatFOutp	Hatchery fish outplants	The magnitude of hatchery fish outplants made into the drainage over the past 10 years. Note: Enter specific hatchery release numbers if the data input tool allows. "Drainage" here is defined loosely as being approximately the size that encompasses the spawning distribution of recognized populations in the watershed.	No stocking records in the past decade.	No more than two instances of fish releases in the past decade in the drainage.	Fish releases made into the drainage every 1-3 years at isolated locations within the drainage.	Fish releases made at multiple sites in the drainage, but only in 1-3 years during the past decade. When the species released is the same as focus species, chance for some superimposition can occur here.	Fish releases made every 1-3 years and at multiple sites in the drainage. When the species released is the same as focus species, superimposition can occur here.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
HydroRegime Natural	Hydrologic regime - natural	The natural flow regime within the reach of interest. Flow regime typically refers to the seasonal pattern of flow over a year; here it is inferred by identification of flow sources. This applies to an unregulated river or to the pre-regulation state of a regulated river.	Groundwater-source-dominated; strongly buffered peak flows (as in a springbrook or in river like the Metolius in central Oregon)	Spring snowmelt dominated, non-glacial; temporally consistent and moderate peak and low flows	Rain-on-snow transitional; consistent spring peak and low flows with inconsistent and flashy winter or early spring rain-on-snow peaks	Rainfall-dominated; flashy winter and early spring peaks, consistently low summer flows and variable spring and fall flows.	Glacial runoff system; high, turbid low flows, generally buffered peak flows except with occasional outburst floods and infrequent rain-on-snow events
HydroRegime Reg	Hydrologic regime - regulated	The change in the natural hydrograph caused by the operation of flow regulation facilities (e.g., hydroelectric, flood storage, domestic water supply, recreation, or irrigation supply) in a watershed. Definition does not take into account daily flow fluctuations (See Flow-Intra-daily variation attribute).	No artificial flow regulation occurs upstream to affect hydrograph.	Project operations have not changed median flows between months or season as the project is operated as a run-of-river facility, or project storage is < 15 days of the annual mean daily flow of the river.	Project operations have not changed median flows between months or season as the project is operated as a run-of-river facility, or project storage is > 15 and < 30-days of the annual mean daily flow of the river.	Project operations have resulted in a measurable shift in median flows between months or seasons. The project provides limited flood control during periods of high run-off (winter or spring). The project's reservoir is operated each year to store more than 30 but less than 60-days of the annual mean daily flow of the river.	Project operations have resulted in a major shift in median flows between months or seasons. The project is operated to provide significant flood control during high run-off periods (winter or spring). The project's reservoir is operated each year to store more than 60-days of the annual mean daily flow of the river.
Icing	Icing	Average extent (magnitude and frequency) of icing events over a 10-year period. Icing events can have severe effects on the biota and the physical structure of the stream in the short-term. It is recognized that icing events can under some conditions have long-term beneficial effects to habitat structure.	Anchor ice and icing events do not occur.	Some anchor ice may occur infrequently, having little or no impact to physical structure of stream, in-stream structure, and stream banks/bed.	Likelihood for some anchor ice and/or icing events is moderate to high each year and effects on stream, in-stream structure, and stream banks/beds is considered low to moderate.	Likelihood for anchor ice and/or icing events is high each year, having effects on stream, in-stream structure, and stream banks/beds that differ widely within the reach--from low to high across the reach.	Likelihood of severe anchor ice or overbank ice jams is high each year, having major and extensive effects on stream, in-stream structure, and stream banks across the reach.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
MetWatCol	Metals - in water column	The extent of dissolved heavy metals within the water column.	No toxicity expected due to dissolved heavy metals to salmonids under prolonged exposure (1 month exposure assumed).	May exert some low level chronic toxicity to salmonids (1 month exposure assumed).	Consistently chronic toxicity expected to salmonids(1 month exposure assumed).	Usually acutely toxic to salmonids (1 month exposure assumed).	Always acutely toxic to salmonids (1 month exposure assumed).
MetSedSls	Metals/Pollutants - in sediments/soils	The extent of heavy metals and miscellaneous toxic pollutants within the stream sediments and/or soils adjacent to the stream channel.	Metals/pollutants at natural (background) levels with no or negligible effects on benthic dwelling organisms or riparian vegetation (under continual exposure).	Deposition of metals/pollutants in low concentrations such that some stress symptoms occur to benthic dwelling organisms or riparian vegetation root/shoot growth is impaired (under continual exposure).	Stress symptoms increased or biological functions moderately impaired to benthic dwelling organisms; or few areas within the riparian zone present where no vegetation exists (slickens); ecotonal to these areas occupied only by tolerant species; horizons containing metals/pollutant concentrations influencing root growth and composition are common within the riparian corridor.	Growth, food conversion, reproduction, or mobility of benthic organisms severely affected; or large areas of the riparian zone devoid of vegetation; ecotonal areas occupied only by metals/pollutant-tolerant species; few areas in the riparian zones which are unaffected.	Metals/pollutant concentrations in sediments/soils are lethal to large numbers of the benthic species and/or riparian zone is practically devoid of vegetation.
MscToxWat	Miscellaneous toxic pollutants - water column	The extent of miscellaneous toxic pollantants (other than heavy metals) within the water column.	No substances present that may periodically be at or near chronic toxicity levels to salmonids.	One substance present that may only periodically rise to near chronic toxicity levels (may exert some chronic toxicity) to salmonids.	More than one substance present that may periodically rise to near chronic toxicity levels or one substance present > chronic threshold and < acute threshold (consistently chronic toxicity) to salmonids.	One or more substances present > acute toxicity threshold but < 3X acute toxicity threshold (usually acutely toxic) to salmonids.	One or more substances present with > 3X acute toxicity (always acutely toxic) to salmonids.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
NutEnrch	Nutrient enrichment	The extent of nutrient enrichment (most often by either nitrogen or phosporous or both) from anthropogenic activities. Nitrogen and phosphorous are the primary macro-nutrients that enrich streams and cause build ups of algae. These conditions, in addition to leading to other adverse conditions, such as low DO can be indicative of conditions that are unhealthy for salmonids. Note: care needs to be applied when considering periphyton composition since relatively large mats of green filamentous algae can occur in Pacific Northwest streams with no nutrient enrichment when exposed to sunlight.	Unenriched streams (corresponding to benthic chlorophyll *a* values 0.5-3 mg/m2). Nutrient levels typical of oligotrophic conditions (small supply of nutrients, low production of organic matter, low rates of decomposition, and high DO). No enrichment is occurring nor is suspected. Green filamentous algae may be present at certain times of year, particularly in unshaded areas.	Very small amount of enrichment suspected to be occurring through land use activities (corresponding to benthic chlorophyll *a* values 3-20 mg/m2). Green filamentous algae present in summer months in unshaded reaches.	Nutrient levels typical of oligotrophic conditions (small supply of nutrients, low production of organic matter, low rates of decomposition, and high DO). Some enrichment known to be occurring (corresponding to benthic chlorophyll *a* values 20-60 mg/m2), often associated with failing skeptics tanks or runoff from areas of heavy fertilizer usage. Dense mats of green or brown filamentous algae present in summer months.	Euthrophic (abundant nutrients associated with high level of primary production, frequently resulting in oxygen depletion).Very obvious enrichment of reach is occurring from point sources or numerous non-point sources (corresponding to benthic chlorophyll *a* values 60-600 mg/m2). Large, dense mats of green or brown filamentous algae will be present during summer months.	Super enrichment of reach is strongly evident. Known, major point sources of organic waste inputs, such as runoff from large feedlot operation, wash water from farm products processing, or significant sewage facilities with inadequate treatment (corresponding to benthic chlorophyll *a* values 600-1200 mg/m2). In most severe cases, filamentous bacteria abundant, associated with low D.O. and hydrogen sulfide. In less severe cases, large dense mats of green or brown filamentous algae generally cover the substrate.
Obstr	Obstructions to fish migration	Obstructions to fish passage by physical barriers (not dewatered channels or hinderances to migration caused by pollutants or lack of oxygen). Note: Rating here is used as a flag in the database. The nature of the obstruction is required to be defined more carefully in a follow-up form.	None documented or inferred.	One or barriers to juvenile migrants at certain flow levels.	One or barriers to juvenile migrants at all flow levels.	One or barriers to juvenile migrants at all flow levels and barrier(s) to adult migration at certain flow levels.	One or more barriers to all fish migration at all flow levels.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
PredRisk	Predation risk	Level of predation risk on fish species due to presence of top level carnivores or unusual concentrations of other fish eating species. This is a classification of per-capita predation risk, in terms of the likelihood, magnitude and frequency of exposure to potential predators (assuming other habitat factors are constant). NOTE: This attribute is being updated to distinguish risk posed to small bodied fish (<10 in) from that to large bodied fish (>10 in).	Many or most native predators are depressed or rare, none are greatly increased over natural levels, and there is expected a significant numerical survival advantage to fish as a result compared to historical predator abundance.	Some native predators are moderately depressed, none are greatly increased over natural levels, and there is expected some small to moderate numerical survival advantage to fish as a result compared to historical predator abundance.	Diversity and per-capita abundance of predators exists so that predation risk is at near-natural level and distribution.	Moderate increase in population density or moderately concentrated population of predator species exists due to artifacts of human alteration of the environment (e.g., top-down food web effects, habitat manipulations) compared to historical condition.	Excessive population density or concentrated population of predator species exists due to artifacts of human alteration of the environment (e.g., top-down food web effects, habitat manipulations) compared to historic condition.
RipFunc	Riparian function	A measure of riparian function that has been altered within the reach.	Strong linkages with no anthropogenic influences.	>75-90% of functional attributes present (overbank flows, vegetated streambanks, groundwater interactions typically present).	50-75% functional attribute rating- significant loss of riparian functioning- minor channel incision, diminished riparian vegetation structure and inputs etc.	25-50% similarity to natural conditions in functional attributes- many linkages between the stream and its floodplain are severed.	< 25% functional attribute rating: complete severing of floodplain-stream linkages

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
SalmCarcass	Salmon Carcasses	Relative abundance of anadromous salmonid carcasses within watershed that can serve as nutrient sources for juvenile salmonid production and other organisms. Relative abundance is expressed here as the density of salmon carcasses within subdrainages (or areas) of the watershed, such as the lower mainstem vs the upper mainstem, or in mainstem areas vs major tributary drainages.	Super abundant -- average number of carcasses per mile of main channel habitat (within an appropriately designated area) >800.	Very abundant -- average number of carcasses per mile of main channel habitat (within an appropriately designated area) >400 and < 800.	Moderately abundant -- average number of carcasses per mile of main channel habitat (within an appropriately designated area) >200 and < 400.	Not abundant -- average number of carcasses per mile of main channel habitat (within an appropriately designated area) >25 and <200.	Very few or none -- average number of carcasses per mile of main channel habitat (within an appropriately designated area) <25.
TmpMonMx	Temperature - daily maximum (by month)	Maximum water temperatures within the stream reach during a month.	Warmest day < 10 C	Warmest day>10 C and <16 C	> 1 d with warmest day 22-25 C or 1-12 d with >16 C	> 1 d with warmest day 25-27.5 C or > 4 d (non-consecutive) with warmest day 22-25 C or >12 d with >16 C	> 1 d with warmest day 27.5 C or 3 d (consecutive) >25 C or >24 d with >21 C
TmpMonMn	Temperature - daily minimum (by month)	Minimum water temperatures within the stream reach during a month.	Coldest day >4 C	< 7 d with <4 C and minimum >1 C	1 to 7 d < 1 C	8 to 15 days < 1 C	> 15 winter days < 1 C
TmpSptVar	Temperature - spatial variation	The extent of water temperature variation within the reach as influenced by inputs of groundwater.	Groundwater discharge into surface waters is the major source of flow in reach.	Abundant sites of groundwater discharge into surface waters.	Intermittent sites of groundwater discharge into surface waters and total quantity of groundwater discharge not a major source of flow in reach.	Infrequent sites of groundwater discharge into surface waters and total quantity of groundwater discharge not a major source of flow in reach.	No evidence of concentrated groundwater inputs.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
Turb	Turbidity	The severity of suspended sediment (SS) episodes within the stream reach. (Note: this attribute, which was originally called turbidity and still retains that name for continuity, is more correctly thought of as SS, which affects turbidity.) SS is sometimes characterized using turbidity but is more accurately described through suspended solids, hence the latter is to be used in rating this attribute. Turbidity is an optical property of water where suspended, including very fine particles such as clays and colloids, and some dissolved materials cause light to be scattered; it is expressed typically in nephelometric turbidity units (NTU). Suspended solids represents the actual measure of mineral and organic particles transported in the water column, either expressed as total suspended solids (TSS) or suspended sediment concentration (SSC)—both as mg/l. Technically, turbidity is not SS but the two are usually well correlated. If only NTUs are available, an approximation of SS can be obtained through relationships that correlate the two. The metric applied here is the Scale of Severity (SEV) Index taken from Newcombe and Jensen (1996), derived from: SEV = a + b(lnX) + c(lnY) , where, X = duration in hours, Y = mg/l, a = 1.0642 , b = 0.6068, and c = 0.7384. Duration is the number of hours out of month (with highest SS typically) when that concentration or higher normally occurs. Concentration would be represented by grab samples reported by USGS. See rating guidelines.	SEV Index <= 4.5 Clear with infrequent (short duration-- several days per year) concentrations of low concentrations (< 50 mg/l) of suspended sediment. No adverse effects on biota of these low doses.	SEV Index >4.5 and <= 7.5 Occasional episodes (days) of low to moderate concentrations (<500 mg/L), though very short duration episodes (hours) may occur with of higher concentrations (500 to 1000). These concentrations are always sublethal to juvenile and adult salmonids-though some behavioral modification may occur.	SEV Index >7.5 and <= 10.5 Occasional episodes of moderate to relatively high concentrations (>500 and <1000 mg/L), though shorter duration episodes (<1 week) may occur with higher concentrations (1000-5000 mg/L). The higher concentrations stated can be expected to result in major behavioral modification, severe stress, severely reduced forage success and direct mortality.	SEV Index >10.5 and <= 12.5 On-going or occasional episodes (periodic events annually lasting weeks at a time) of high concentrations of suspended sediment (>5000 and <10000 mg/L), or shorter duration episodes lasting hours or days of higher concentrations. These conditions result in direct, high mortality rates.	SEV Index >12.5 Extended periods (month) of very high concentrations (>10000 mg/L). These represent the most extreme severe conditions encountered and result in very high mortality of fish species.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
Wdrwl	Water withdrawals	The number and relative size of water withdrawals in the stream reach.	No withdrawals.	Very minor water withdrawals with or without screening (entrainment probability considered very low).	Several of significant water withdrawals along reach though all sites known or believed to be screened with effective screening devices. (Note: one site that withdraws substantial portion of flow without screening falls into this category.)	Several sites of significant water withdrawals along reach without screening or screening believed to be ineffective. (Note: one site that withdraws substantial portion of flow without screening falls into this category.)	Frequent sites of significant water withdrawals along reach without screening or screening believed to be ineffective.

Description of EDT Level 2 Environmental Attributes

Code	Correlate	Definition	Index Value 0	Index Value 1	Index Value 2	Index Value 3	Index Value 4
WdDeb	Wood	The amount of wood (large woody debris or LWD) within the reach. Dimensions of what constitutes LWD are defined here as pieces >0.1 m diameter and >2 m in length. Numbers and volumes of LWD corresponding to index levels are based on Peterson et al. (1992), May et al. (1997), Hyatt and Naiman (2001), and Collins et al. (2002). Note: channel widths here refer to average wetted width during the high flow month (< bank full), consistent with the metric used to define high flow channel width. Ranges for index values are based on LWD pieces/CW and presence of jams (on larger channels). Reference to "large" pieces in index values uses the standard TFW definition as those > 50 cm diameter at midpoint.	A complex mixture of single large pieces and accumulations consisting of all sizes, decay classes, and species origins; cross-channel jams are present where appropriate vegetation and channel conditions facilitate their existence; large wood pieces are a dominant influence on channel diversity (e.g., pools, gravel bars, and mid-channel islands) where channel gradient and flow allow such influences. Density of LWD (pieces per channel width CW) consistent with the following: channel width <25 ft -- 3-10 pieces/CW, 25-50 ft -- 3-10 pieces/CW, 50-150 ft -- 7-30 pieces/CW , 150-400 ft -- 20-50 pieces/CW in conjunction with large jams in areas where accumulations might occur, >400 ft -- 15-37 pieces/CW in conjunction with large jams in areas where accumulations might occur.	Complex array of large wood pieces but fewer cross channel bars and fewer pieces of sound large wood due to less recruitment than index level 1; influences of large wood and jams are a prevalent influence on channel morphology where channel gradient and flow allow such influences. Density of LWD (pieces per channel width CW) consistent with the following: channel width <25 ft -- 2-3 pieces/CW, 25-50 ft -- 2-4 pieces/CW, 50-150 ft -- 3-7 pieces/CW , 150-400 ft -- 10-20 pieces/CW (excluding large jams) in conjunction with large jams in areas where accumulations might occur, >400 ft -- 8-15 pieces/CW (excluding large jams) in conjunction with large jams in areas where accumulations might occur.	Few pieces of large wood and their lengths are reduced and decay classes older due to less recruitment than in index level 1; small debris jams poorly anchored in place; large wood habitat and channel features of large wood origin are uncommon where channel gradient and flow allow such influences. Density of LWD (pieces per channel width CW) consistent with the following: channel width <25 ft -- 1-2 pieces/CW, 25-50 ft -- 1-2 pieces/CW, 50-150 ft -- 1-3 pieces/CW , 150-400 ft -- 10-20 pieces/CW without large jams in areas where accumulations might occur, >400 ft -- 8-15 pieces/CW without large jams in areas where accumulations might occur.	Large pieces of wood rare and the natural function of wood pieces limited due to diminished quantities, sizes, decay classes and the capacity of the riparian streambank vegetation to retain pieces where channel gradient and flow allow such influences. Density of LWD (pieces per channel width CW) consistent with the following: channel width <25 ft -- 0.33-1 pieces/CW, 25-50 ft -- 0.33-1 pieces/CW, 50-150 ft -- 0.33-1 pieces/CW , 150-400 ft -- 3-10 pieces/CW without large jams in areas where accumulations might occur, >400 ft -- 2-8 pieces/CW without large jams in areas where accumulations might occur.	Pieces of LWD rare. Density of LWD (pieces per channel width CW) consistent with the following: channel width <25 ft -- <0.33 pieces/CW, 25-50 ft -- <0.33 pieces/CW, 50-150 ft -- <0.33 pieces/CW , 150-400 ft -- <3 pieces/CW with accumulations where they might occur, >400 ft -- <2 pieces/CW with no accumulations where they might occur.

Umatilla Summer Steelhead
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	Channel stability/landsc.1/	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
GA1			•		•		•		•					•	⬤	●		•
GA11			•		•		•		•					•	•	•		
GA12		◯	•				•		•		●		•		●	⬤		●
GA13		◯	●				●		●	•	●		•		●	⬤		●
GA14	◯		•				•		•						●	●		●
GA15	∘	◯	•				•		•		●				●	●		●
GA16	∘		•				•		•							•		●
GA17		∘	•				•		•	•					●	⬤		●
GA18	∘	∘	•				•		•						●	•		●
GA19	◯	∘					•		•							•		●
GA2	∘	∘	•		•		•		•					•	⬤	•		
GA20		∘	•				•		•	●				•	●	•		⬤
GA21		◯	•				•		●		⬤		●	•	●	⬤		●
GA22			•				•		•				•			⬤		●
GA24			•				•		•							●		●
GA25			•		•		•		•					•	⬤	•		
GA26							•		•						⬤	•		
GA27		∘	•				●		•						⬤	⬤		•
GA28		◯	•		•		•		•				●	•	●	⬤		•
GA29		∘					•		•				•		⬤	⬤		●
GA3			•				●		●						⬤			●
GA30			•				•	•	•							⬤		●
GA31			•				•	•							●	⬤		●
GA32		◯	•				•	•	•						●	⬤		●
GA33	◯	◯	•		•		•	•	•					•		⬤		●
GA34			•		•		•		•					•	•			•
GA35	◯	◯			•		•		•		⬤			•		•		•
GA36	∘	◯	•		•		•		•					•		⬤		●
GA37	◯				•		•		•					•				●
GA38			•		•		•		●					•	⬤			●
GA39					•		•				•			•	⬤			●
GA4		∘	•				●		●	•					⬤	⬤		●
GA40	◯	◯	•				•		•							⬤		•
GA41			•				•	•	•									●
GA42	◯	∘	•															
GA43	◯	∘	•				•	•	•									
GA44	◯						•	•										
GA45	◯	∘	•				•	•	•									●
GA46	◯						•		•									
GA5		◯	•				●		●	•	⬤		•		⬤	⬤		●
GA6		∘	•				●		●	•					⬤			●
GA7			•				•		•				•		⬤	⬤		●
GA8			•				•		•				•		⬤	⬤		●
GA9	◯	∘	•		•		•		•					•	●			

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Key to strategic priority (corresponding Benefit Category letter also shown)

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low		Indirect or General

Umatilla Spring Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	*Channel stability/landsc.1/*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
GA1	∘	∘	•				•		•					•	⬤	•		•
GA11	∘	∘	•				•		•		•			•	•	●		
GA12	∘	◯	•				●		●				•		●	⬤		●
GA13		◯	●				●		⬤	•			•		●	⬤		●
GA17	◯	◯	•				●		●	•					•	⬤		⬤
GA18	◯	∘	•				•		●									●
GA2	∘	∘	•				•		•		●			•	⬤	•		•
GA20	◯	◯	•				•	•	●	●					●			⬤
GA21		◯	•				•	•	●				•		●	⬤		●
GA24	◯	◯	•				•		●				•		•	⬤		●
GA25	◯	◯	●		•		●	•	⬤	•			•	•	⬤	⬤		
GA28	◯	◯	•				•		•				•	•	●	⬤		●
GA3			•				●		⬤						⬤			●
GA31	◯	∘	•				•	•	●						●	⬤		●
GA32	∘	∘	•				•	•	●						●	⬤		●
GA33	◯	◯	•		•		•	•	●					•		⬤		●
GA35	◯	◯	•		•		•	•	●					•		●		●
GA40	◯	◯	•				•		●							⬤		●
GA42	◯	∘							•									
GA43	◯	∘	•				•	•	●									
GA46	◯	∘					•	•	●									
GA9	◯	◯	•				•		•		•			•	●	•		

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Key to strategic priority (corresponding Benefit Category letter also shown)

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low		Indirect or General

Umatilla Fall Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	Channel stability/landsc.1/	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
GA1		○	●				•		●	•			•	•	⬤	●		•
GA11	○	○	●				•		•				•	•	⬤	●		
GA12	○	○	•				●		●				•		●	●		●
GA2	○	○	●				•		•	•	●		•	•	⬤	●		•
GA20	○	○	•				•	•	●	●					●			⬤
GA21	○	○	•				•	•	●				•		●	⬤		●
GA25	○	○	•				●	•	●	•			•	•	⬤	⬤		
GA28	○	○	•				•		•				•	•	•	●		•
GA3	○	○	•				●		⬤						⬤	•		●
GA33	○	○	•		•		•	•	●					•		●		●
GA40	○	○	•				•		●							•		●
GA9	○	○	●				•		●					•	⬤	●		

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Key to strategic priority (corresponding Benefit Category letter also shown)

A		B		C		D & E	
○	High	○	Medium	∘	Low		Indirect or General
⬤		●		•			

Umatilla Coho
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	Channel stability/landsc.1/	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
GA1		C	A		C		C		A	C				C	A	A		C
GA11		A	B		C		C		C					C	A	A		
GA12	C	A	C				B		C						B	A		B
GA13		C	A				B		B	C					B	A		B
GA14	A		C				C		B						C			B
GA15	C	C	B				B		A							B		B
GA17	A	C	B				B		B						C	C		B
GA18	A		C				B	C	C									B
GA19	A	C	C				B		B									B
GA2		A	A		C		C		B	C	C			C	A	B		C
GA20			C				C	C	C	B					B			A
GA21		A	C				C	C	B						B	A		B
GA22		C	B				B	C	A							B		B
GA24	A	C	C				B		B							B		B
GA25		A	B		B		B	C	A	C				C	B	A		C
GA26		A	C				B		B						A	B		B
GA28	A	A	C		C		C		C					C	B	A		C
GA3									B									C
GA30	C	C	C				B	C	B							C		B
GA31	A	C	C				C	C	C						B	C		B
GA32	A		C				C	C	C						B	C		B
GA33	A	A	C		C		C	C	B					C		B		B
GA35	A				C		C		B					C		C		C
GA4		A	C				B		B	C					A	C		B
GA40	A	C	C				C		B							C		B
GA42	A								B									
GA43	C		C				C	C	B									
GA46							C	C	C									
GA5		A	B				B		B	C					B	A		B
GA7	C	A	C				C		C						B	A		B
GA8	C	A	C				B		B						B	C		B
GA9		A	B		C		C		B					C	A	B		

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
High	Medium	Low	Indirect or General

DRAFT: Limiting Factors for Umatilla R.

Mobrand Biometrics, Inc. May 17, 2004

Geographic Area 1

Description: GA1 consists of four reaches in the Umatilla River from its confluence with the Columbia River to Thirteenmile Dam. This geographic area includes Brownell Dam.

Limiting Factors: Table 1 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA1. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 1 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 2.

GA1 has a relatively low protection rank and indirect or general protection benefit for all four species, as indicated in Table 1 (indicated by small or no circles under Protection Benefit and Restoration Benefit in Table 1). Restoration of GA1 is most important for fall Chinook salmon, with a restoration rank of 4 out of 12 geographic areas and a medium restoration benefit.

Sediment load is the most limiting survival factor for all four species (Table 1), attributed to increased embeddedness and fine sediment (Table 2). Fall Chinook salmon productivity is impacted by fine sediment and embeddedness, primarily to the egg incubation and fry colonization life stages. While Table 1 indicates that all four species are limited by sediment load, fall Chinook salmon are the most impacted because they spawn in GA1. The survival of the other species is impacted at a low level by sediment load at the 0-age inactive and 0,1-age inactive life stages. As shown in Table 1, coho and fall Chinook salmon survival is limited to a higher degree by Channel Stability (caused by decreased Riparian Function in Table 2), Habitat Diversity (caused by decreased amounts of large wood and decreased Riparian Function in Table 2) and Temperature (caused by increased maximum temperature in Table 2). Decreased habitat diversity and key habitat quantity in GA1 impacts the productivity of the rearing life stages for all species and prespawning holding for fall Chinook salmon, coho and summer steelhead trout. Increased maximum daily temperatures have reduced productivity for all species (Table 2). The degraded temperature conditions have had a low to high impact on survival, with the least effect on spring Chinook salmon survival and the greatest impact on coho survival (Table 1). The productivity of each of the four species is also depressed by the presence of exotic fish species, harassment, and hatchery outplants.

Key habitat quantity has been reduced to a low extent for all species (Table 1). This can be attributed to channelization and a reduction in the minimum wetted width of the river in GA1 (Table 2).

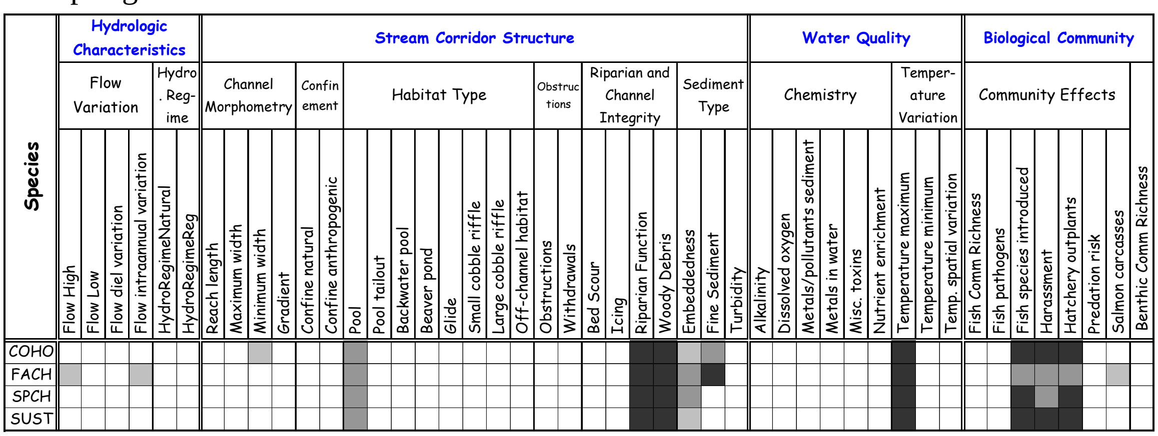
Table 1. Protection and restoration strategic priority summary for Umatilla subbasin GA1.
Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative

Geographic Area Description	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Umatilla R from confluence with Columbia to Thirteenmile Dam	COHO	24/32	12/32			•	⬤	⬤	•			⬤			⬤		•		•		•
	FACH	11/12	4/12		○	•	●	●	•			⬤			●				•	•	•
	SPCH	14/22	18/22			•	•	•	•			⬤			•				•		
	SUST	19/44	23/44			•	•	•	•			⬤			●		•		•		

A	B	C	D & E
○ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

contribution of each EDT survival factor to the Restoration Benefit.

Table 2. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA1. Environmental



Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in

Geographic Area 2

Description: GA2 consists of eight Umatilla River reaches from Thirteenmile Dam to the confluence of Butter Creek, including Thirteenmile Dam and Boyd's Diversion Dam.

Limiting Factors: Table 3 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA2. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 3 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 4.

GA2 has a moderate protection rank for summer steelhead trout (12 out of 44 areas relevant to the population) and spring Chinook salmon (11 out of 22 areas relevant to the population) (Table 3). Protecting GA2 ranks low for coho salmon (21 out of 32) and fall Chinook salmon (10 out of 12). Summer steelhead trout have a low protection benefit for GA2, while the other three species would indirectly benefit from protecting GA2. The restoration benefit is high for coho (ranked 3 out of 32) and fall Chinook salmon (ranked 3 out of 12), with a medium restoration benefit. Summer steelhead trout (18 out of 44) and spring Chinook salmon (11 out of 22) would indirectly benefit from restoring GA2.

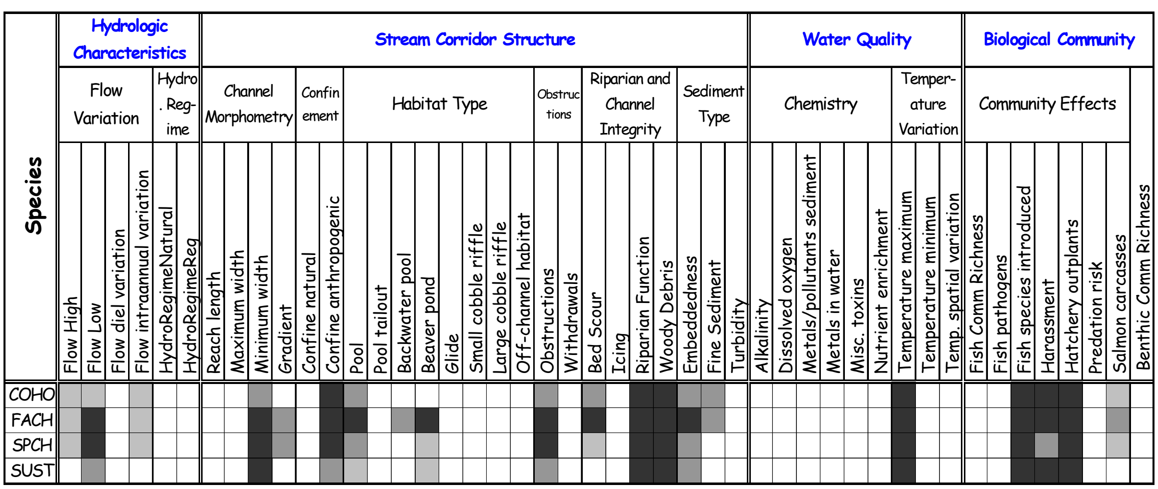
Sediment Load (Table 3), attributed to increased embeddedness and fine sediment (Table 4), is the most limiting survival factor for all four species (Table 3). Fall Chinook salmon productivity is impacted by fine sediment and embeddedness, primarily to the egg incubation and fry colonization life stages. Temperature, Channel Stability, and Habitat Diversity, and are limiting to all three species to varying degrees. High maximum daily temperatures (Table 4) reduce the survival of coho and fall Chinook salmon more so than the other two species. Channel Stability, attributed to decreased Riparian Function and increased bed scour in Table 4, is highly limiting to coho salmon; spring and fall Chinook salmon and summer steelhead trout are affected to a lesser degree. Decreased amounts of large wood and impaired Riparian Function (Table 4) influence Habitat Diversity, which is moderately limiting to coho salmon in GA2. Flow, Key Habitat Quantity, and Predation are limiting at a low level. Flow limitations are attributed to increased high flows, decreased low flows and increased intra-annual variation (Table 4). Key Habitat Quantity (Table 3) is influenced by anthropogenic confinement and reduced minimum wetted widths (Table 4). Competition with hatchery fish reduces the survival of coho salmon and summer steelhead trout. Coho and fall Chinook salmon are also impacted by harassment.

Table 3. Protection and restoration strategic priority summary for Umatilla subbasin GA2.
Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Umatilla R from Thirteenmile Dam to Butter Cr	COHO	21/32	3/32		○	•	⬤	●	•	•		⬤			●		•		•		•
	FACH	10/12	3/12		○	•	●	•	•	●		⬤			●				•	•	•
	SPCH	11/22	11/22			•	•	•	•	●		⬤			•				•		
	SUST	12/44	18/44	∘		•	•	•				⬤			•		•		•		

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low	(blank)	Indirect or General

Table 4. Measurable environmental attributes contributing to Survival Factors in Umatilla area GA2 for coho, fall Chinook salmon, spring Chinook salmon and summer steelhead trout. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 3.



Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 3
Description: GA3 consists of the North Hermiston Drain from its confluence with the Umatilla River to Umatilla River Road.
Limiting Factors: Table 5 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA3. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 5 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 6.
GA3 has a moderate to low protection rank for each of the species, with indirect protection benefits, as indicated by the lack of circles under Protection Benefit (Table 5). GA3 has low restoration ranks for Coho salmon (ranked 25 out of 32), fall Chinook salmon (ranked 10 out of 12), spring Chinook salmon (ranked 19 out of 22), and summer steelhead trout (ranked 33 out of 44). Restoring GA3 would provide indirect or general benefits to each species (Table 5).
Sediment Load (Table 5), attributed to increased embeddedness (Table 6), is the most limiting survival factor for all species except coho salmon (Table 5). Fall Chinook salmon productivity is impacted by fine sediment and embeddedness, primarily to the egg incubation and fry colonization life stages. Habitat Diversity, Flow, and Channel Stability are limiting to fall and spring Chinook salmon and summer steelhead trout to varying degrees. Decreased amounts of large wood and impaired Riparian Function (Table 6) influence Habitat Diversity, which is highly limiting to fall and spring Chinook salmon in GA3. Flow limitations are attributed to increased high flows, decreased low flows and increased intra-annual variation (Table 6). Channel Stability, attributed to decreased Riparian Function in Table 6, affects the survival of these three species to a lesser degree. Flow, Key Habitat Quantity, and Predation are limiting at a low level. Key habitat quantity has been reduced to a low extent for all species (Table 5). This can be attributed to channelization in GA3 (Table 6). High maximum daily temperatures (Table 6) further reduce the survival of fall Chinook salmon.

Table 5. Protection and restoration strategic priority summary for Umatilla subbasin GA3.
Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
NH Drain from confluence with Umatilla R to Umatilla R Rd	COHO	19/32	25/32					●	•												
	FACH	9/12	10/12			●	•	⬤	●			⬤			•						
	SPCH	16/22	19/22			●	•	⬤	●			⬤									
	SUST	31/44	33/44			●	•	●	●			⬤									

A	B	C	D&E
⬤ High	● Medium	• Low	Indirect or General

Table 6. Measurable environmental attributes contributing to Survival Factors in Umatilla area GA3 for coho, fall Chinook salmon, spring Chinook salmon and summer steelhead trout. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 5.

Species	Hydrologic Characteristics						Stream Corridor Structure														
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat
COHO												■								
FACH		■										■								
SPCH		■										■								
SUST		▒										■	▒							

Species	Stream Corridor Structure (cont.)									Water Quality								
	Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation		
	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO					■	■										▒		
FACH					■	■	▒									░		
SPCH					■	■										▒		
SUST					■	■	▒									■		

Species	Biological Community							
	Community Effects							
	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO			▒	▒				
FACH			░					
SPCH			▒					
SUST				▒				

Legend
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
■ Reduction in productivity >or =0.0005
▒ Reduction in productivity between 0.0005 and 0.00005
░ Reduction in productivity between 0.00005 and 0.000005
□ Reduction in productivity < or =0.000005

Geographic Area 4

Description: GA4 consists of four reaches in Butter Creek from its confluence with the Umatilla River to the Madison diversion at section line 25/30. This geographic area includes an obstruction reach for the Interstate 84 crossing, which allows fish passage. Butter Creek supports coho salmon and summer steelhead trout.

Limiting Factors: Table 7 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA4. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 7 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 8.

GA4 has a relatively low to moderate protection rank and indirect or general protection benefit for both species (indicated in Table 7 by small or no circles under Protection Benefit). GA4 has a moderately high restoration rank for coho salmon (7 out of 32), with a low restoration benefit. Restoring GA4 would have an indirect or general benefit to summer steelhead trout, ranked 15 out of 44 geographic areas.

As shown in Table 7, survival is limited to a high degree by Sediment Load (attributed to increased embeddedness and fine sediments in Table 8), followed by Temperature (caused by increased maximum daily temperature in Table 8). Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 8), and Habitat Diversity (caused by decreased amounts of large wood, Riparian Function and pool/beaver pond habitat in Table 8) have a medium impact on survival of coho salmon and steelhead trout in GA4. In addition to changes in habitat quality, the overall reduction in Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 8) moderately limits the survival of both species. Channel Stability and Harassment are limiting to both species to a lesser degree. Channel Stability (Table 7) is influenced by decreased Riparian Function (Table 8).

Table 7. Protection and restoration strategic priority summary for Umatilla subbasin GA4.
Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS																
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Butter Cr from confluence with Umatilla R to Madison diversion at section line 25/30	COHO	21/32	7/32		○	●	•	●	●			⬤			•						•
	FACH	--	--																		
	SPCH	--	--																		
	SUST	37/44	15/44			●	•	●	●			⬤			⬤						•

A: ◯ / ⬤ High; B: ○ / ● Medium; C: ◦ / • Low; D & E: Indirect or General

Table 8. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA4. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 7.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry							Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 5

Description: GA5 consists of Butter Creek from the Madison diversion at section line 25/30 to East Fork Butter Creek. This geographic area includes 5 reaches, one of which is the Madison Diversion. Butter Creek supports coho salmon and summer steelhead trout.

Limiting Factors: Table 9 depicts the protection and restoration ranks and benefits and survival factors for both species in GA5. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 9 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 10.

GA5 has a relatively low to moderate protection rank and indirect or general protection benefit for both species (indicated in Table 9 by blank cells under Protection Benefit and Restoration Benefit). GA5 has a high restoration benefit and rank for coho (1 out of 32) and summer steelhead trout (2 out of 44).

As shown in Table 9, coho salmon and summer steelhead trout survival is limited to a high degree by Temperature (due to increased maximum temperature in Table 10) and Sediment Load (caused by increased embeddedness and fine sediments in Table 10). Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 10), Channel Stability (caused by decreased Riparian Function in Table 10), and Habitat Diversity (caused by decreased amounts of large wood and Riparian Function and limited pool/beaver pond habitat in Table 10) have a medium impact on survival of coho and steelhead trout in GA5. In addition to changes in habitat quality, the overall reduction in Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 10) further limits the survival of both species. The productivity of coho salmon and summer steelhead trout is also depressed by harassment. Madison Diversion is a barrier to migrating adult summer steelhead trout.

Table 9. Protection and restoration strategic priority summary for Umatilla subbasin GA5.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Butter Cr from Madison diversion at section line 25/30 to EF Butter Cr	COHO	16/32	1/32		◯	●	●	●	●			●			⬤						•
	FACH	--	--																		
	SPCH	--	--																		
	SUST	35/44	2/44		◯	●	•	●	●	⬤		⬤			⬤					•	•

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 10. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA5. Environmental attributes are measurable qualities of the environment that are used in EDT to define the

Hydrologic Characteristics

Species	Flow Variation				Hydro. Regime	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
COHO						
FACH						
SPCH						
SUST						

Stream Corridor Structure

Species	Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO																							
FACH																							
SPCH																							
SUST																							

Water Quality

Species	Chemistry						Temperature Variation		
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO									
FACH									
SPCH									
SUST									

Biological Community

Species	Community Effects							
	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO								
FACH								
SPCH								
SUST								

Legend:

FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout

Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Survival Factors in Table 9.

Geographic Area 6
Description: GA6 consists of one reach in Little Butter Creek from its confluence with Butter Creek to the headwaters at 4,400-ft elevation. Little Butter Creek only supports summer steelhead trout.
Limiting Factors: Table 11 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA6. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 11 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 12.
GA6 has a moderate protection rank (27 out of 44) and restoration rank (16 out of 44), with an indirect or general protection and restoration benefits, as indicated in Table 11. Sediment load is the most limiting survival factor for summer steelhead trout in GA6(Table 11), attributed to increased embeddedness and fine sediment (Table 12). Sediment Load reduces survival during the egg incubation, fry colonization and 0,1-age active rearing life stages. Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 12), Habitat Diversity (caused by decreased amounts of large wood and Riparian Function and limited pool/beaver pond habitat in Table 12) and the overall reduction in Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 12) have a medium impact on survival of summer steelhead trout in GA6. The current condition of Key Habitat Quantity is most limiting for 0-age active rearing and prespawning holding life stages, followed by fry colonization and 1-age active rearing. As shown in Table 11, the productivity of summer steelhead trout is also depressed by Channel Stability (attributed to decreased Riparian Function in Table 12) and harassment to a lesser extent.

Table 11. Protection and restoration strategic priority summary for Umatilla subbasin GA6.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Little Butter Cr from mainstem Butter Cr to headwaters at 4,400-ft level	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	27/44	16/44			●	•	●	●			⬤									•

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 12. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA6. Environmental attributes are measurable qualities of the environment that are used in EDT to define the

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST	▒	▒		▒								▓	▒		▒	▒									▓	▓	▓	▓														▒				

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
█ Reduction in productivity >or =0.0005
▓ Reduction in productivity between 0.0005 and 0.00005
▒ Reduction in productivity between 0.00005 and 0.000005
□ Reduction in productivity < or =0.000005

Survival Factors in

Geographic Area 7

Description: GA7 consists of four reaches in East Fork Butter Creek from its confluence with Butter Creek to the forks at the southeast edge of the Big Pot. This geographic area also includes Tunnel and Buckhorn creeks, each of which have one reach. East Fork Butter Creek supports coho salmon and summer steelhead trout. Tunnel and Buckhorn creeks only support summer steelhead trout.

Limiting Factors: Table 13 depicts the protection and restoration ranks and benefits and survival factors for both species in GA7. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 13 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 14.

GA7 has a relatively low to moderate protection rank for summer steelhead trout (36 out of 44) and coho (13 out of 32), with indirect or general protection benefit for both species (indicated in Table 13 by the lack of circles under Protection Benefit). GA7 has a high restoration rank for coho (5 out of 32) and a low restoration benefit (indicated in Table 13 by a small circle under Restoration Benefit). The restoration benefit to summer steelhead trout is indirect or general, with a restoration rank of 25 out of 44 geographic areas.

As shown in Table 13, coho salmon and summer steelhead trout survival is limited to a high degree by Temperature (caused by increased maximum temperature in Table 14) and Sediment Load (caused by increased embeddedness and fine sediments in Table 14). In addition to changes in habitat quality, the overall reduction in Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 14) moderately limits the survival of both species. Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 14), Channel Stability (caused by decreased Riparian Function in Table 14), and Habitat Diversity (caused by decreased amounts of large wood and Riparian Function and limited pool/beaver pond habitat in Table 14) have a low impact on survival of coho and steelhead trout in GA7.

Temperature and Pathogens are not limiting to the survival of summer steelhead trout in Tunnel and Buckhorn creeks.

Table 13. Protection and restoration strategic priority summary for Umatilla subbasin GA7.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
EF Butter Cr from confluence with mainstem to forks at SE edge of The Big Pot, including Tunnel and Buckhorn creeks	COHO	13/32	5/32		◦	•	•	•	●			●			⬤						
	FACH	--	--																		
	SPCH	--	--																		
	SUST	36/44	25/44			•	•	•	●			⬤			⬤					•	

A	B	C	D & E
○ / ⬤ High	○ / ● Medium	◦ / • Low	Indirect or General

Table 14. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA7. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 13.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO	L	L		L								L											L		L	M	M									M										
FACH																																														
SPCH																																														
SUST	L	M											L										L		L	M	D									D										

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
D: Reduction in productivity >or =0.0005
M: Reduction in productivity between 0.0005 and 0.00005
L: Reduction in productivity between 0.00005 and 0.000005
(blank): Reduction in productivity < or =0.000005

Geographic Area 8

Description: GA8 consists of nine reaches in Butter Creek from East Fork Butter Creek to 4,160 ft elevation, including Spring Hollow, Johnson, and Swale creeks. Mainstem Butter Creek supports coho salmon and summer steelhead trout; coho salmon do not inhabit the tributaries.

Limiting Factors: Table 15 depicts the protection and restoration ranks and benefits and survival factors for both species in GA8. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 15 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 16.

GA8 has a relatively low to moderate protection rank for summer steelhead trout (34 out of 44) and coho salmon (11 out of 32), with indirect or general protection benefits for both species (indicated in Table 15 by the lack of circles under Protection Benefit). GA8 has a high restoration rank for coho salmon (3 out of 32) and a medium restoration benefit (indicated in Table 15 by a medium circle under Restoration Benefit). The restoration benefit to summer steelhead trout is indirect or general, with a restoration rank of 21 out of 44 geographic areas.

As shown in Table 15, coho salmon and summer steelhead trout survival in GA8 is predominantly limited by Sediment Load (due to increased embeddedness in Table 16) and Temperature (attributed to increased maximum temperature in Table 16). In addition to changes in habitat quality, the overall reduction in Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 16) moderately limits the survival of both species. Summer steelhead trout are most impacted by limited habitat for prespawning holding. Key Habitat Quantity is limiting to coho salmon during prespawning holding, 0-age active rearing, and fry colonization life stages. Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 16), Channel Stability (caused by decreased Riparian Function in Table 16), and Habitat Diversity (caused by decreased amounts of large wood and Riparian Function and limited pool habitat in Table 16) have a low to moderate impact on survival of coho salmon and low impact on summer steelhead trout survival in GA8. Temperature and Pathogens are not limiting to summer steelhead trout in Swale Creek

Table 15. Protection and restoration strategic priority summary for Umatilla subbasin GA8. Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	SURVIVAL FACTORS: Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Butter Cr from EF Butter Cr to 4,160-ft level, including Spring Hollow, Johnson and Swale creeks	COHO	11/32	3/32		○	●	•	●	●			●			•						
	FACH	--	--																		
	SPCH	--	--																		
	SUST	34/44	21/44			•	•	•	●			⬤			⬤					•	

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low		Indirect or General

Table 16. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA8. Environmental attributes are measurable qualities of the environment that are used in EDT to define the

Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Regime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Survival Factors in Table 15.

Geographic Area 9

Description: GA9 consists of 15 reaches in the mainstem Umatilla River from Butter Creek to McKay Creek, excluding the portion between Westland and Furnish dams. This geographic area includes Maxwell, Dillon, Furnish and Taylor Diversion dams. Fall Chinook salmon and coho salmon spawn within GA9.

Limiting Factors: Table 17 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA9. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 17 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 18.

Of the four species, GA9 has the highest protection rank for spring Chinook salmon (5 out of 22 geographic areas). GA9 has a moderate protection rank for summer steelhead trout (10 out of 44) and coho salmon (17 out of 32). The protection rank for fall Chinook salmon is low (8 out of 12). The protection benefit is low for fall Chinook salmon, spring Chinook salmon and summer steelhead trout, and is indirect or general for coho salmon (indicated by small or no circles under Protection Benefit in Table 17). Restoration of GA9 is most important for fall Chinook salmon, with a restoration rank of 1 out of 12 geographic areas and coho salmon (2 out of 32), with a corresponding high Restoration Benefit. The restoration benefit for spring Chinook salmon and summer steelhead trout is indirect or general, as depicted by the lack of circles under Restoration Benefit in Table 17.

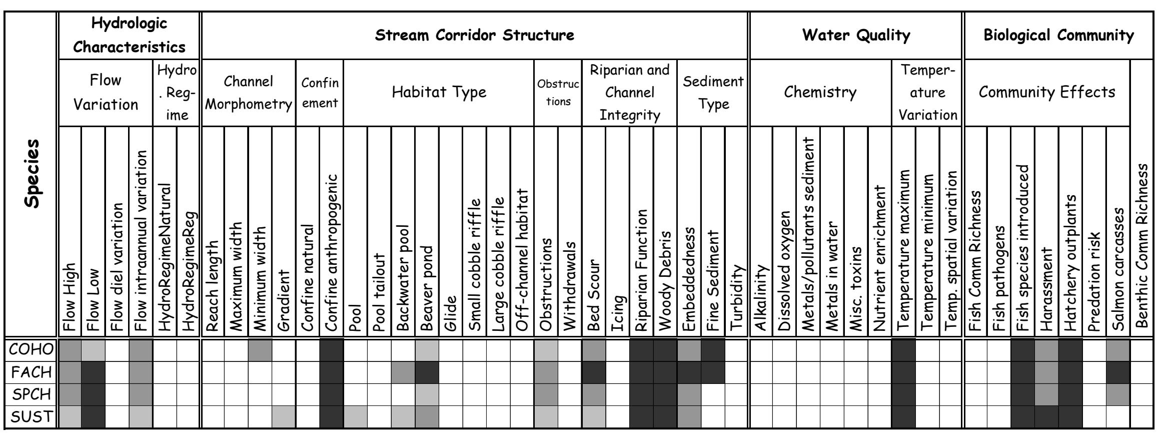
Sediment Load is the most limiting survival factor for all four species (Table 17), attributed to increased embeddedness and fine sediment (Table 18). Fall Chinook salmon productivity is impacted by fine sediment and embeddedness, primarily to the egg incubation and fry colonization life stages. As shown in Table 17, Channel Stability (attributed to decreased Riparian Function in Table 18), Habitat Diversity (caused by decreased amounts of large wood and decreased Riparian Function in Table 18) and Temperature (caused by increased maximum temperature in Table 18) are degraded from a low to moderate extent. Coho salmon and fall Chinook salmon survival is impacted by these three survival factors more so than spring Chinook salmon and summer steelhead trout. Decreased habitat diversity and key habitat quantity in GA9 impacts the productivity of the rearing life stages for all species and prespawning holding for fall Chinook salmon, coho salmon and summer steelhead trout. Increased maximum daily temperatures have reduced productivity for all species (Table 18). Flow, attributed to increased high flows, decreased low flows and increased intra-annual variation, and Predation slightly impact the survival of all four species. The productivity of each of the four species is also depressed by the presence of exotic fish species, harassment, and hatchery outplants, with the most pronounced effect on coho salmon and summer steelhead trout. Maxwell Dam is a partial barrier to 1-age migrant coho salmon. Dillon Dam is a partial barrier to 1-age migrant coho and spring Chinook salmon and summer steelhead trout, as well as migrating adult spring Chinook salmon.

Table 17. Protection and restoration strategic priority summary for Umatilla subbasin GA9.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS															
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Umatilla R from Butter Cr to McKay Cr	COHO	17/32	2/32		◯	•	●	●				⬤			●		•		•		
	FACH	8/12	1/12	∘	◯	•	●	●				⬤			●				•		
	SPCH	5/22	10/22	∘		•	•	•		•		●			•				•		
	SUST	10/44	15/44	∘		•	•	•				●					•		•		

A	B	C	D & E
◯ ⬤ High	○ ● Medium	∘ • Low	Indirect or General

Table 18. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA9. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 17.



Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 10

Table 19. Protection and restoration strategic priority summary for Umatilla subbasin GA10.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Table 20. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA10. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 19.

Geographic Area 11

Description: GA11 consists of four reaches in the Umatilla River from Westland Dam to Furnish Dam, including Westland Dam.

Limiting Factors: Table 21 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA11. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 21 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 22.

GA11 has a moderate to low protection rank for all four species, with an indirect or general protection benefit (indicated by the lack of circles under Protection Benefit in Table 21). Restoration of GA11 is most important for fall Chinook salmon, with a restoration rank of 5 out of 12 geographic areas. The restoration rank is moderate to low for the other three species. GA11 has a low Restoration Benefit for fall Chinook and coho salmon, as depicted by the small circles under Restoration Benefit in Table 21.

In general, Sediment Load, attributed to increased embeddedness and fine sediment (Table 22), and Temperature (due to increased maximum daily temperature in Table 22) are the most limiting survival factors in GA11 (Table 21). As shown in Table 21, Channel Stability (caused by decreased Riparian Function in Table 22), Habitat Diversity (caused by decreased amounts of large wood, Riparian Function, and pool habitat in Table 22) and Flow, attributed to increased high flows, decreased low flows and increased intra-annual variation, contribute to a low to moderate decrease in survival for all species. Coho and fall Chinook salmon survival is impacted by Channel Stability more so than spring Chinook salmon and summer steelhead trout. Predation has a low negative impact on the survival of all four species. The productivity of each of the four species is also depressed by the presence of exotic fish species, harassment, and hatchery outplants, with the most pronounced effect on coho and summer steelhead trout. Pathogens further limit the survival of fall Chinook salmon (Table 21).

Table 21. Protection and restoration strategic priority summary for Umatilla subbasin GA11.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Umatilla R from Westland Dam to Furnish Dam	COHO	22/32	10/32		∘	•	●	•				⬤			⬤		•		•		
	FACH	9/12	5/12		∘	•	●	•				⬤			●				•	•	
	SPCH	12/22	15/22			•	•	•		•		•			●				•		
	SUST	29/44	32/44			•	•	•				•			•		•		•		

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low		Indirect or General

Table 22. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA11. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 21.

Species	Hydrologic Characteristics					
	Flow Variation				Hydro. Reg-ime	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
COHO	░			░		
FACH	▒			░		
SPCH	░					
SUST		■				

Species	Stream Corridor Structure													
	Channel Morphometry				Confinement		Habitat Type							
	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat
COHO						▒								
FACH				▒		▒	▒							
SPCH				░		▒	▒							
SUST						▒								

Species	Stream Corridor Structure (cont.)								
	Obstructions		Riparian and Channel Integrity				Sediment Type		
	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO			░		▒	▒		▒	
FACH	▒		▒		▒	▒		▒	
SPCH	▒		░		▒	▒	░		
SUST					▒	▒			

Species	Water Quality								
	Chemistry						Temperature Variation		
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO							■		
FACH							■		
SPCH							■		
SUST							■		

Species	Biological Community							
	Community Effects							
	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO			▒	▒	■		░	
FACH			▒	▒	▒		░	
SPCH			■	▒	■			
SUST			▒	▒	▒			

Legend:

FACH	fall chinook salmon
SPCH	spring chinook salmon
SUST	summer steelhead trout
■	Reduction in productivity >or =0.0005
▒	Reduction in productivity between 0.0005 and 0.00005
░	Reduction in productivity between 0.00005 and 0.000005
(blank)	Reduction in productivity < or =0.000005

Geographic Area 12

Description: GA12 consists of ten reaches in Birch Creek from its confluence with the Umatilla River to the confluence of the East and West forks, and Stewart (two reaches) and Ray (one reach) creeks. This geographic area includes Whitney Dam, and Straughan, Hummel and Weinke diversion dams. Spring and fall Chinook salmon only occur within mainstem Birch Creek, while coho salmon and summer steelhead trout inhabit the entire geographic area.

Limiting Factors: Table 23 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA12. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 23 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 24.

GA12 has a moderate to low protection rank and indirect or general protection benefit for all four species except fall Chinook salmon, as indicated in Table 23 (indicated by medium or no circles under Protection Benefit and Restoration Benefit in Table 23). Restoration of GA12 ranks high for summer steelhead trout (1 out of 44) and spring Chinook salmon (3 out of 22). The restoration benefit to spring Chinook salmon and coho salmon is low. Fall Chinook salmon would indirectly benefit from restoration of GA12.

Temperature, due to increased maximum temperature (Table 24) is the most limiting survival factor for all four species (Table 23). Sediment Load, Key Habitat Quantity, Flow and Habitat Diversity moderately limit the survival of all four species. Sediment Load limitations are attributed to increased fine sediment (Table 24). Key Habitat Quantity is impacted by channelization and a reduction in the minimum wetted width (Table 24). Flow affects survival by increased high flows, decreased low flows and increased intra-annual variation (Table 24). Decreased amounts of large wood, Riparian Function, and pool/beaver pond habitat (Table 24), all of which contribute to Habitat Diversity have reduced productivities. As shown in Table 23, fall and spring Chinook salmon survival is limited to a higher degree than coho salmon and summer steelhead trout by Habitat Diversity. Channel Stability (caused by decreased Riparian Function in Table 24) and Pathogens reduce survival to a lesser extent. The productivity of each of the four species is also depressed by the presence of exotic fish species, harassment, and reduced salmon carcasses.

Table 23. Protection and restoration strategic priority summary for Umatilla subbasin GA12.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Birch Cr from confluence with Umatilla R to confluence of WF and EF Birch Crs, including Stewart and Ray creeks	COHO	14/32	8/32		◦	●	•	•	●			●			⬤						
	FACH	7/12	6/12	○		●	•	●	●			●			●					•	
	SPCH	15/22	3/22		◦	●	•	●	●			●			⬤					•	
	SUST	20/44	1/44		◯	•	•	•	●	●		●			⬤					•	

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	◦ / • Low	Indirect or General

Table 24. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA12. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 23.

Species	Hydrologic Characteristics						Stream Corridor Structure																						
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO																													
FACH																													
SPCH																													
SUST																													

Species	Water Quality									Biological Community							
	Chemistry						Temper-ature Variation			Community Effects							
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																	
FACH																	
SPCH																	
SUST																	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 13
Description: GA13 consists of six reaches in West Fork Birch Creek from its confluence with mainstem Birch Creek to Bear Creek, including Hoeft diversion. This geographic area supports coho and spring Chinook salmon and summer steelhead trout.
Limiting Factors: Table 25 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA13. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 25 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 26.
GA13 has a moderate to low protection rank and indirect or general protection benefit for all three species, as indicated in Table 25 by the lack of circles under Protection Benefit. Restoration of GA13 ranks medium for summer steelhead trout (8 out of 44) and low for spring Chinook salmon (10 out of 22) and coho salmon (15 out of 32). The restoration benefit to all three species is indirect or general (Table 25).
Temperature, due to increased maximum temperature (Table 26), is the most limiting survival factor for all four species (Table 25). Channel Stability, Habitat Diversity, Flow, Sediment Load, and Key Habitat Quantity moderately limit the survival of all three species. Channel Stability (caused by decreased Riparian Function in Table 26) has a higher impact on coho salmon survival and a moderate impact to the survival of spring Chinook salmon and summer steelhead trout. Decreased amounts of large wood, Riparian Function, and pool habitat (Table 26), all of which contribute to Habitat Diversity, have reduced productivities. As shown in Table 25, spring Chinook salmon survival is limited to a higher degree by Habitat Diversity. Flow affects survival by increased high flows, decreased low flows and increased intra-annual variation (Table 26). Sediment Load limitations are attributed to increased fine sediment (Table 26). Key Habitat Quantity is impacted by channelization, as depicted in Table 26. Pathogens contribute to a slight decrease in survival of spring Chinook salmon and summer steelhead trout. The productivity of each of the three species is also depressed by harassment. Hoeft is a partial barrier to adult summer steelhead trout.

Table 25. Protection and restoration strategic priority summary for Umatilla subbasin GA13. Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
WF Birch Cr from confluence with mainstem to Bear Cr	COHO	20/32	15/32			●	⬤	●	●			●			⬤						•
	FACH	--	--																		
	SPCH	18/22	10/22			●	●	⬤	●			●			⬤					•	•
	SUST	32/44	8/44			●	●	●	●	●		●			⬤					•	•

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low		Indirect or General

Table 26. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA13. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community								
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 14

Description: GA14 consists of two reaches in Bear Creek from its confluence with West Fork Birch Creek to the forks just inside section 36. This geographic area also includes Owings Creek (two reaches) and Willow Spring Canyon (one reach). Bear Creek supports coho salmon and summer steelhead trout; Owings and Willow Spring Canyon creeks only support summer steelhead trout.

Limiting Factors: Table 27 depicts the protection and restoration ranks and benefits and survival factors for both species in GA14. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 27 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 28.

GA14 has a high protection rank for coho salmon (2 out of 32), with a medium protection benefit (indicated in Table 27 by a medium circle under Protection Benefit). The GA14 protection rank for summer steelhead trout is 9 out of 44 geographic areas, with a low protection benefit. For both species, the restoration rank of GA14 is moderate and the restoration benefit is indirect or general, as indicated in Table 27 by the lack of circles under Restoration Benefit.

Table 27 indicates that habitat quality and quantity is limiting the survival of both species at a medium to indirect level. Coho salmon and summer steelhead trout survival is primarily limited by Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 28), followed by Sediment Load (due to increased fine sediment in Table 28), Habitat Diversity (caused by decreased amounts of large wood and Riparian Function in Table 28) and Temperature (attributed to increased maximum daily temperature in Table 28). Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 28) and Channel Stability (caused by decreased Riparian Function in Table 28) have a low impact on survival of both species in GA14.

In Owings Creek and Willow Spring Canyon, Sediment Load and Temperature are the most limiting factors to the egg incubation life stage. Key Habitat Quantity is most limiting to the prespawning holding life stage.

Table 27. Protection and restoration strategic priority summary for Umatilla subbasin GA14.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS																
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Bear Cr from confluence with WF Birch to forks just inside section 36 line, including Owings Cr and Willow Spr Canyon	COHO	2/32	19/32	○ (B)		• (C)	• (C)	● (B)	● (B)			• (C)									
	FACH	--	--																		
	SPCH	--	--																		
	SUST	9/44	19/44	○ (C)		• (C)	• (C)	• (C)	● (B)			● (B)			● (B)						

A	B	C	D & E
○ / ● High	○ / ● Medium	○ / ● Low	Indirect or General

Table 28. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and steelhead trout in Umatilla subbasin GA14. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in

Hydrologic Characteristics (Flow Variation; Hydro. Regime) and Stream Corridor Structure (Channel Morphometry; Confinement; Habitat Type; Obstructions; Riparian and Channel Integrity; Sediment Type):

Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO	light			light								light													light	medium		light	
FACH																													
SPCH																													
SUST	light	light		light								medium											light		medium	medium			

Water Quality (Chemistry; Temperature Variation) and Biological Community (Community Effects):

Species	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO							light										
FACH																	
SPCH																	
SUST							medium										

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 15
Description: GA15 consists of eight reaches inWest Fork Birch Creek from Bear Creek to an elevation of 3,000 ft. This geographic area also includes Bridge (three reaches) and Stanley (one reach) creeks. Three obstruction reaches occur within GA15: Low Diversion, Yellow Jacket Road culvert, and Hascall Diversion. GA15 supports summer steelhead trout throughout; coho salmon do not inhabit Bridge and Stanley creeks.
Limiting Factors: Table 29 depicts the protection and restoration ranks and benefits and survival factors for both species in GA15. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 29 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 30.
GA15 has a moderate protection rank for coho (12 out of 32) with an indirect or general protection benefit (indicated in Table 29 by the lack of circles under Protection Benefit). The protection benefit of GA15 for summer steelhead trout is low, with a rank of 14 out of 44 geographic areas. GA15 has a high restoration rank for summer steelhead trout (6 out of 44) and a medium restoration benefit (indicated in Table 29 by a medium circle under Restoration Benefit). The restoration benefit to coho is indirect or general, with a restoration rank of 13 out of 32 geographic areas. Both the protection and restoration of GA15 has a higher benefit to summer steelhead trout than coho salmon.
As shown in Table 29, coho salmon and summer steelhead trout survival is moderately impacted by Temperature (due to increased maximum temperature in Table 30), Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 30), and Habitat Diversity (attributed to decreased amounts of large wood and Riparian Function and limited pool habitat in Table 30). Sediment Load (caused by increased embeddedness in Table 30) moderately limits the survival of summer steelhead trout. Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 30) and Channel Stability (caused by decreased Riparian Function in Table 30) have a low (summer steelhead trout) to moderate (coho salmon) impact on survival in GA15.

Table 29. Protection and restoration strategic priority summary for Umatilla subbasin GA15.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
WF Birch Cr from Bear Cr to 3,000-ft level, including Bridge and Stanley Creeks	COHO	12/32	13/32			●	●	⬤	●						●						
	FACH	--	--																		
	SPCH	--	--																		
	SUST	14/44	6/44	◦	○	•	•	•	●	●		●			●						

A		B		C		D & E	
◯	High	○	Medium	◦	Low		Indirect or General
⬤		●		•			

Table 30. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA15. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 29.

Geographic Area 16

Description: GA16 consists of three reaches West Fork Birch Creek from an elevation of 3,000 ft to the headwater forks at section line 13/24. West Fork Birch Creek only supports summer steelhead trout. This geographic area also includes an impassable waterfall.

Limiting Factors: Table 31 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA16. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 31 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 32.

GA16 has a moderate protection rank (15 out of 44) and low restoration rank (29 out of 44). The protection benefit of GA16 for summer steelhead trout is low while the restoration benefit is indirect or general, as indicated in Table 31 by small or no circles under Protection Benefit and Restoration Benefit, respectively.

Key Habitat Quantity (Table 31) is the most limiting survival factor for summer steelhead trout, attributed to anthropogenic confinement as indicated in Table 32. Flow (caused by increased high flows and intra-annual variation in Table 32), Channel Stability (due to decreased Riparian Function in Table 32), Habitat Diversity (caused by decreased amounts of large wood and Riparian Function in Table 32) and Temperature (caused by increased maximum daily temperature in Table 30) have a low impact on survival of steelhead trout in GA16.

Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Table 31. Protection and restoration strategic priority summary for Umatilla subbasin GA16.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
WF Birch Cr from 3,000-ft level to headwater forks at section line 13/24	COHO	--	--																			
	FACH	--	--																			
	SPCH	--	--																			
	SUST	15/44	29/44	○		•	•	•	●						•							

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 32. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA16. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 31.

Species	Hydrologic Characteristics						Stream Corridor Structure																									Water Quality									Biological Community								
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects								
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 17

Description: GA17 consists of five reaches in East Fork Birch Creek from its confluence with mainstem Birch Creek to California Gulch. This geographic area supports coho and spring Chinook salmon and summer steelhead trout.

Limiting Factors: Table 33 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA17. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 33 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 34.

GA17 has a high protection rank for coho salmon (3 out of 32 geographic areas). The protection ranks for spring Chinook salmon (8 out of 22) and summer steelhead trout (24 out of 44) are moderate. Protecting GA17 has low benefit to coho and spring Chinook salmon and indirect or general benefits to summer steelhead trout. For all species, the restoration rank is moderate; restoring GA17 would provide indirect of general benefits to all three species.

Temperature, due to increased maximum daily temperature (Table 34), and Key Habitat Quantity, impacted by channelization and reduced minimum wetted widths, are the most limiting survival factors (Table 33). Flow, Habitat Diversity, Channel Stability and Sediment Load reduce the survival at a low to moderate degree for all three species. Flow affects survival by increased high flows, decreased low flows and increased intra-annual variation (Table 34). Decreased amounts of large wood, Riparian Function, and pool habitat (Table 34), all of which contribute to Habitat Diversity, have reduced productivities. As shown in Table 33, coho and spring Chinook salmon survival is limited to a higher degree than summer steelhead trout by Flow and Habitat Diversity. Channel Stability (caused by decreased Riparian Function in Table 34) has a moderate impact on coho salmon survival and a low impact to the survival of spring Chinook salmon and summer steelhead trout. Sediment Load limitations are attributed to increased fine sediment (Table 34). The productivity of spring Chinook salmon and summer steelhead trout is also depressed by harassment.

Table 33. Protection and restoration strategic priority summary for Umatilla subbasin GA17.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	SURVIVAL FACTORS: Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
EF Birch Cr from mainstem to California Gulch	COHO	3/32	17/32	○		●	●	●	●			•			•						
	FACH	--	--																		
	SPCH	8/22	6/22	○		●	•	●	⬤			•			⬤						•
	SUST	24/44	14/44			•	•	•	●			●			⬤						•

A High; B Medium; C Low; D & E Indirect or General

Table 34. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA17. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 33.

Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
	Hydrologic Characteristics: Flow Variation				Hydro. Regime		Stream Corridor Structure: Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Water Quality: Chemistry						Temperature Variation			Biological Community: Community Effects							
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 18

Description: GA18 consists of four reaches in East Fork Birch Creek from California Gulch to Pearson Creek, including California Gulch and Johnson Creek. This geographic area supports coho and spring Chinook salmon and summer steelhead trout.

Limiting Factors: Table 35 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA18. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 35 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 36.

GA18 has a high protection rank for coho salmon (4 out of 32 geographic areas). The protection ranks for spring Chinook salmon (6 out of 22) and summer steelhead trout (11 out of 44) are on the high side of moderate. Protecting GA18 has low benefit to all three species (Table 35). For all species, the restoration rank is moderate to low. Restoring GA18 would provide indirect or general benefits for all species.

In accordance with the protection ranks, none of the survival factors greatly limit any of the species. Key Habitat Quantity, impacted by channelization and reduced minimum wetted widths, is the most limiting survival factor for all three species (Table 35). Flow, Habitat Diversity, and Channel Stability reduce the survival at a low to moderate degree for the three species. Flow affects survival by increased high flows, decreased low flows and increased intra-annual variation in Table 36. Decreased amounts of large wood, Riparian Function, and pool habitat (Table 36), all of which contribute to Habitat Diversity have reduced productivities. As shown in Table 35, coho and spring Chinook salmon survival is limited to a higher degree by Flow and Habitat Diversity, respectively. Channel Stability (caused by decreased Riparian Function in Table 36) has a low impact on coho, spring Chinook salmon, and steelhead trout survival. Sediment Load, attributed to increased embeddedness and fine sediment (Table 36), has a moderate impact to summer steelhead trout survival. Temperature, due to increased maximum daily temperature (Table 36), slightly impacts summer steelhead trout productivity. The productivity of coho salmon is also depressed by Food, attributed to decreased salmon carcasses.

Table 35. Protection and restoration strategic priority summary for Umatilla subbasin GA18.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
EF Birch Cr from California Gulch to Pearson Cr, including California Gulch and Johnson Cr	COHO	4/32	21/32	◦		●	•	•	●							•					
	FACH	--	--																		
	SPCH	6/22	13/22	◦		•	•	●	●												
	SUST	11/44	17/44	◦		•	•	•	●			●			•						

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	◦ / • Low	Indirect or General

Table 36. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA18. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 35.

Species	Hydrologic Characteristics					
	Flow Variation				Hydro. Reg-ime	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
COHO	░			░		
FACH						
SPCH	░	░		░		
SUST	░	▓		░		

Species	Stream Corridor Structure																						
	Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO						░	░										░		▓	▓			
FACH																							
SPCH			░			▓	░										░		▓	▓			
SUST			▓			▓	░										░		▓	▓	░	░	

Species	Water Quality								
	Chemistry						Temperature Variation		
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO									
FACH									
SPCH									
SUST							░		

Species	Biological Community							
	Community Effects							
	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO								
FACH								
SPCH							░	
SUST				░			░	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout

█	Reduction in productivity >or =0.0005
▓	Reduction in productivity between 0.0005 and 0.00005
░	Reduction in productivity between 0.00005 and 0.000005
	Reduction in productivity < or =0.000005

Geographic Area 19

Description: GA19 consists of three reaches in East Fork Birch Creek from Pearson Creek to an elevation of 4,000 ft. This geographic area also includes Pearson (three reaches), Little Pearson (one reach), Dark Canyon (one reach), South Canyon (one reach) and Westgate (three reaches) creeks. GA19 supports summer steelhead trout throughout; coho salmon occur in East Fork Birch and Pearson creeks.

Limiting Factors: Table 37 depicts the protection and restoration ranks and benefits and survival factors for both species in GA19. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 37 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 38.

GA19 has a moderate protection rank for coho (9 out of 32) with an indirect or general protection benefit (indicated in Table 37 by lack of circles under Protection Benefit). The protection benefit of GA19 for summer steelhead trout is medium, with a high protection rank of 5 out of 44 geographic areas. GA19 has a moderate restoration rank for summer steelhead trout (12 out of 44) and coho (13 out of 32), with an indirect or general restoration benefit (indicated in Table 37 by lack of circles under Restoration Benefit).

As shown in Table 37, coho salmon and summer steelhead trout survival is slightly to moderately impacted by Key Habitat Quantity (caused by anthropogenic confinement, reduced low flows, and reduced minimum wetted widths in Table 38), Habitat Diversity (caused by decreased amounts of large wood, Riparian Function and pool habitat in Table 38) and Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 38). Key Habitat Quantity is most limiting to summer steelhead trout for prespawning holding. Temperature (attributed to increased maximum daily temperature in Table 38) has a low impact on the survival of summer steelhead trout. Coho survival in GA19 is further limited by Channel Stability (caused by decreased Riparian Function in Table 38).

Table 37. Protection and restoration strategic priority summary for Umatilla subbasin GA19.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
EF Birch Cr from Pearson Cr to 4,000-ft level, including Pearson, Little Pearson, Dark Canyon, South Canyon and Westgate Cr	COHO	9/32	13/32			●	•	●	●												
	FACH	--	--																		
	SPCH	--	--																		
	SUST	5/44	12/44	○		•		•	●						•						

A	B	C	D & E
○ ● High	○ ● Medium	∘ • Low	Indirect or General

Table 38. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA19. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 37.

Species	Hydrologic Characteristics						Stream Corridor Structure					
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic
COHO												
FACH												
SPCH												
SUST												

Species	Stream Corridor Structure																
	Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO																	
FACH																	
SPCH																	
SUST																	

Species	Water Quality									Biological Community							
	Chemistry						Temperature Variation			Community Effects							
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																	
FACH																	
SPCH																	
SUST																	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 20
Description: GA20 consists of three reaches in McKay Creek from its confluence with the Umatilla River to McKay Dam.
Limiting Factors: Table 39 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA20. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 39 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 40.
GA20 has a moderate protection rank for all four species. The protection benefit is medium for fall Chinook salmon, low for spring Chinook salmon and indirect or general for coho salmon and summer steelhead trout, as indicated in Table 39. Restoration of GA20 ranks moderate for summer steelhead trout (13 out of 44) and spring Chinook salmon (8 out of 22), and low for coho salmon (22 out of 32) and fall Chinook salmon (9 out of 12). All four species would indirectly benefit from restoration of GA20.
Key Habitat Quantity, the most limiting survival factor in GA20, heavily impacts the survival of all four species (Table 39). Key Habitat Quantity is impacted by channelization and a reduction in the minimum wetted width, as depicted in Table 40. Sediment Load and Harassment moderately limit the survival of all four species. Sediment Load is attributed to increased fine sediment (Table 40). Habitat Diversity, Flow, and Channel Stability reduce the survival of each of the species at a low to moderate degree. Decreased amounts of large wood, Riparian Function, and pool habitat (Table 40), all of which contribute to Habitat Diversity have reduced productivities. As shown in Table 39, fall and spring Chinook salmon survival is limited to a higher degree by Habitat Diversity. The impact of Channel Stability is influenced by decreased Riparian Function in Table 40. The availability and diversity of food reduces coho, fall and spring Chinook salmon productivities. Increased Predation and Temperature, attributed to increased maximum temperature (Table 40), reduces the survival of summer steelhead trout to a lesser extent. The productivity of each of the four species is also depressed by the presence of exotic fish species, hatchery outplants, and reduced salmon carcasses.

Table 39. Protection and restoration strategic priority summary for Umatilla subbasin GA20.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS															
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
McKay Cr from confluence with Umatilla R to McKay Dam	COHO	21/32	22/32			•	•	•	⬤			●				•					●
	FACH	5/12	9/12	○		•	•	●	⬤			●				•					●
	SPCH	6/22	8/22	◦		•	•	●	⬤			●				•					●
	SUST	21/44	13/44			•	•	•	⬤			●			•				•		●

A ◯ ⬤ High

B ○ ● Medium

C ◦ • Low

D & E Indirect or General

Table 40. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA20. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 39.

Species	Hydrologic Characteristics						Stream Corridor Structure															
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals
COHO												medium grey	light grey									
FACH												medium grey	light grey									
SPCH												medium grey	light grey									
SUST				light grey					light grey			medium grey	light grey									

Species	Stream Corridor Structure							Water Quality									Biological Community							
	Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO			medium grey	medium grey		medium grey								light grey					light grey	medium grey	light grey		light grey	
FACH	light grey		medium grey	medium grey		medium grey								light grey					light grey	medium grey	light grey		light grey	
SPCH	light grey		medium grey	dark grey		medium grey								medium grey					medium grey	medium grey	light grey		light grey	
SUST	light grey		medium grey	medium grey		light grey								light grey					light grey	medium grey	light grey		light grey	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 21

Description: GA21 consists of McKay Creek from McKay Dam to North Fork McKay Creek. Summer steelhead trout and coho, fall and spring Chinook salmon inhabit GA21.

Limiting Factors: Table 41 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA21. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 41 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 42.

GA21 has a high protection rank for fall Chinook salmon (4 out of 12), with a medium protection benefit (Table 41). The protection ranks for the other three species are relatively low, with general or indirect protection benefits to each. Restoration of GA21 ranks high for spring Chinook salmon (2 out of 22), with a medium protection benefit (Table 41). The restoration benefit to summer steelhead trout (ranked 7 out of 44) and coho salmon (ranked 8 out of 32) is low. Fall Chinook salmon would indirectly benefit from restoration of GA21.

Temperature, due to increased maximum daily temperatures (Table 42), is the most limiting survival factor in GA21, heavily impacting the survival of all four species (Table 41). Sediment Load, Habitat Diversity, and Key Habitat Quantity are moderately limiting to the survival of all four species. Sediment Load is limiting due to increased embeddedness and fine sediment. Decreased amounts of large wood and impaired Riparian Function, both of which contribute to Habitat Diversity, have reduced productivities. Key Habitat Quantity is impacted by channelization and a reduction in the minimum wetted width, as depicted in Table 42. Flow, Channel Stability, Food and Pathogens reduce the survival of each of the species at a low to moderate degree. The impact of Channel Stability is influenced by decreased Riparian Function (Table 42). The availability and diversity of food reduces coho, fall and spring Chinook salmon productivities. As shown in Table 41, summer steelhead trout survival is limited to a higher degree than the other species by Pathogens. The productivity of each of the four species is also depressed by the presence of exotic fish species, hatchery outplants, and reduced salmon carcasses.

Table 41. Protection and restoration strategic priority summary for Umatilla subbasin GA21.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
McKay Cr from McKay Dam to NF McKay Cr	COHO	18/32	8/32		◦	•	•	●	●			●			⬤	•					
	FACH	4/12	7/12	○		•	•	●	●			●			⬤	•				•	
	SPCH	17/22	2/22		○	•	•	●	●			●			⬤	•				•	
	SUST	38/44	7/44		◦	•	•	●	●	⬤		●			⬤				•	●	

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	◦ / • Low	Indirect or General

Table 42. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA21. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 41.

Species	Hydrologic Characteristics: Flow Variation				Hydro. Reg-ime		Stream Corridor Structure: Channel Morphometry				Confinement	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic
COHO	░			░								▒
FACH	░			░								▒
SPCH	▒			░								▒
SUST	░	▒		░					▒	░		▒

Species	Stream Corridor Structure: Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO											░		▒	▒		░	
FACH											░		▒	▒	░	░	
SPCH											░		▒	▒	▒		
SUST									■		░		▒	▒			

Species	Water Quality: Chemistry						Temperature Variation			Biological Community: Community Effects							
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO							■					░		░		░	
FACH							■					░				░	
SPCH							■					░		░		░	
SUST							■					░		░			

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
■ Reduction in productivity >or =0.0005
▒ Reduction in productivity between 0.0005 and 0.00005
░ Reduction in productivity between 0.00005 and 0.000005
(blank) Reduction in productivity < or =0.000005

Geographic Area 22

Description: GA22 consists of six reaches in North Fork McKay Creek from its confluence with mainstem McKay Creek to an elevation of 3,420 ft near a power line. This geographic area also includes Calamity, Bell Cow, Lost Pin, Darr and Deadman Pass creeks, each of which has been designated one reach. GA22 supports summer steelhead trout throughout; coho salmon only occur in North Fork McKay Creek.

Limiting Factors: Table 43 depicts the protection and restoration ranks and benefits and survival factors for both species in GA22. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 43 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 44.

GA22 has a low protection rank for coho salmon (20 out of 32) and summer steelhead trout (38 out of 44), with an indirect or general protection benefit for both species (indicated in Table 43 by a lack of circles under Protection Benefit). The restoration rank of GA22 is moderate for coho salmon (16 out of 32) and low for summer steelhead trout (35 out of 44), with an indirect or general restoration benefit for both species, as indicated in Table 43 by a lack of circles under Restoration Benefit.

Table 43 indicates that habitat quality and quantity is limiting the survival of both species. Coho salmon and summer steelhead trout survival is primarily limited by Temperature (caused by increased maximum daily temperature in Table 44), Key Habitat Quantity (due to anthropogenic confinement and reduced low flows in Table 44), and Habitat Diversity (attributed to decreased amounts of large wood, Riparian Function and pool habitat in Table 44). Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 44) and Channel Stability (caused by decreased Riparian Function in Table 44) have a moderate impact on coho salmon survival and a low impact on summer steelhead trout survival. Coho salmon survival is further depressed by Food.

Table 43. Protection and restoration strategic priority summary for Umatilla subbasin GA22.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
NF McKay Cr from mainstem to 3,420-ft level near powerline, including Calamity, Bell Cow, Lost Pin, Darr and Deadman Pass	COHO	20/32	16/32			●	●	⬤	●						●	•					
	FACH	--	--																		
	SPCH	--	--																		
	SUST	38/44	35/44			•	•	•	●						⬤					•	

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low	(blank)	Indirect or General

Table 44. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA22. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 43.

Hydrologic Characteristics

Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
	Flow Variation				Hydro. Regime	
COHO	light			light		
FACH						
SPCH						
SUST	light	medium		light		

Stream Corridor Structure

Species	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
	Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
COHO						medium											light		medium	medium			
FACH																							
SPCH																							
SUST						medium	light										light		medium	medium			

Water Quality

Species	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
	Chemistry						Temperature Variation		
COHO							medium		
FACH									
SPCH									
SUST							dark		

Biological Community

Species	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
	Community Effects							
COHO								
FACH								
SPCH								
SUST							light	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
(dark) Reduction in productivity >or =0.0005
(medium) Reduction in productivity between 0.0005 and 0.00005
(light) Reduction in productivity between 0.00005 and 0.000005
(white) Reduction in productivity < or =0.000005

Geographic Area 24

Description: GA24, comprised of 26 reaches, includes McKay Creek from North Fork McKay Creek to Snipe Creek. This geographic area also includes the following tributaries: Sevenmile, Little Sevenmile, Wood Hollow, Lake, Little Woodhollow, Rail, Bassey, Johnson, Salt, Little Johnson and Bear creeks. GA24 supports summer steelhead trout throughout; coho salmon inhabit McKay, Wood Hollow, and John creeks. Spring Chinook salmon only occur in McKay Creek.

Limiting Factors: Table 45 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA24. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 45 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 46.

GA24 has a high protection rank for coho salmon, 5 out of 32 geographic areas, with a low protection benefit. The protection rank for spring Chinook salmon is moderate (9 out of 22) and low for summer steelhead trout (35 out of 44), with indirect or general protection benefits for both species, as indicated in Table 45 by the lack of circles under Protection Benefit. Restoration of GA24 ranks medium for spring Chinook salmon (6 out of 22) and coho salmon (14 out of 32). This geographic area has a low restoration rank for summer steelhead trout (35 out of 44). The restoration benefit to all three species is indirect or general (Table 45).

Temperature, due to increased maximum temperature (Table 46), is the most limiting survival factor for all three species (Table 45), with the largest impact on spring Chinook salmon survival. Key Habitat Quantity, Habitat Diversity, and Flow are slightly to moderately limiting the survival of all three species. Key Habitat Quantity is impacted by channelization as depicted in Table 46. Decreased amounts of large wood, Riparian Function, and pool habitat (Table 46), all of which contribute to Habitat Diversity have reduced productivities. As shown in Table 45, coho and spring Chinook salmon survival is limited to a higher degree by Habitat Diversity. Flow affects survival by increased high flows, decreased low flows and increased intra-annual variation in Table 46. Channel Stability, caused by decreased Riparian Function (Table 46), has a low impact on the survival of all three species. Sediment Load and fish pathogens slightly reduce the survival of spring Chinook salmon.

Table 45. Protection and restoration strategic priority summary for Umatilla subbasin GA24.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	SURVIVAL FACTORS: Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
McKay Cr from NF McKay Cr to Snipe Cr, including Secenmile, Little Sevenmile, Wood Hollow, Lake, Little Woodhollow, Rail, Bassey, Johnson, Salt, Little Johnson and Bear creeks	COHO	5/32	14/32	∘		●	•	●	●						●						
	FACH	--	--																		
	SPCH	9/22	6/22			•	•	●	●			•			⬤					•	
	SUST	38/44	35/44			•	•	•	●						●						

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 46. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA24. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 45.

Hydrologic Characteristics (Flow Variation; Hydro. Regime)

Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
COHO	L			L		
FACH						
SPCH	L			L		
SUST	M	M		M		

Stream Corridor Structure (Channel Morphometry; Confinement; Habitat Type; Obstructions; Riparian and Channel Integrity; Sediment Type)

Species	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO						M											L		M	M			
FACH																							
SPCH						M											L		M	M			
SUST						M	L										M		M	D	L		

Water Quality (Chemistry; Temperature Variation)

Species	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO							M		
FACH									
SPCH							D		
SUST							D		

Biological Community (Community Effects)

Species	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO								
FACH								
SPCH							L	
SUST							L	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
D: Reduction in productivity >or =0.0005
M: Reduction in productivity between 0.0005 and 0.00005
L: Reduction in productivity between 0.00005 and 0.000005
(blank): Reduction in productivity < or =0.000005

Geographic Area 25
Description: GA25 consists of the Umatilla River from McKay Creek to Mission Bridge, including Tutuilla Creek. This geographic area supports summer steelhead trout, and coho, fall and spring Chinook salmon.
Limiting Factors: Table 47 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA25. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 47 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 48.
GA25 has a moderate protection rank for all four species. Fall Chinook salmon have a medium protection benefit, while the other species would indirectly benefit from protecting GA25. The restoration benefit is low for coho (ranked 6 out of 32) and fall Chinook salmon (ranked 5 out of 12). Summer steelhead trout (30 out of 44) and spring Chinook salmon (7 out of 22) would indirectly benefit from restoring GA47.
Sediment Load, attributed to increased embeddedness and fine sediment (Table 48), and Temperature, due to increased daily maximum temperatures (Table 48) are the most limiting survival factors for all four species (Table 47). Fall Chinook salmon productivity is impacted by fine sediment and embeddedness, primarily to the egg incubation and fry colonization life stages. Habitat Diversity, Flow, and Channel Stability are limiting to all three species to varying degrees. Decreased amounts of large wood and impaired Riparian Function (Table 48) influence Habitat Diversity, which is highly limiting to coho and spring Chinook salmon in GA25. Flow limitations are attributed to increased high flows, decreased low flows and increased intra-annual variation (Table 48). Channel Stability, attributed to decreased Riparian Function and increased bed scour in Table 48, is moderately limiting to coho and spring Chinook salmon; summer steelhead trout and fall Chinook salmon are affected to a lesser degree. The survival of the four species is also negatively impacted by Food, Competition with hatchery fish, Predation, Pathogens and Harassment.

Table 47. Protection and restoration strategic priority summary for Umatilla subbasin GA25.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Umatilla R from McKay Cr to Mission Br, including Tutuilla Cr	COHO	17/32	6/32		C	B	B	A	C			B			A	C	B		C		C
	FACH	6/12	5/12	B	C	B	C	B				A			A	C			C	C	C
	SPCH	10/22	7/22			B	B	A				A			A	C	C		C	C	C
	SUST	26/44	30/44			C	C	C				A			C		C		C		

A	B	C	D & E
High	Medium	Low	Indirect or General

Table 48. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA25. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 47.

Species	Hydrologic Characteristics						Stream Corridor Structure																										Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO	M			L					M			D	L										M		D	D	L	M								D					M	D	M		L	
FACH	L			L								D	L										M		D	D	M	L								D					M	M	M		M	
SPCH	M			L								D	L										M		D	D	M	M								D					M	M	D		L	
SUST		L										M													M	M	L									D					L	M	M			

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout

D	Reduction in productivity >or =0.0005
M	Reduction in productivity between 0.0005 and 0.00005
L	Reduction in productivity between 0.00005 and 0.000005
	Reduction in productivity < or =0.000005

Geographic Area 26

Description: GA26, composed of 25 reaches, consists of Wildhorse Creek from its confluence with the Umatilla River to the Athena Park obstruction. This geographic area also includes West Spring, Little Greasewood, Greasewood, Spring Hollow and Gerking creeks. GA26 supports coho salmon and summer steelhead trout. Coho salmon only occur in Wildhorse Creek.

Limiting Factors: Table 49 depicts the protection and restoration ranks and benefits and survival factors for both species in GA26. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 49 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 50.

GA26 has a low protection rank for coho salmon (24 out of 32) and summer steelhead trout (33 out of 44), with an indirect or general protection benefit (indicated in Table 49 by lack of circles under Protection Benefit). GA26 has a moderately high restoration rank for coho salmon (8 out of 32) and a low restoration benefit (indicated in Table 49 by a small circle under Restoration Benefit). The restoration benefit to summer steelhead trout is indirect or general, with a restoration rank of 34 out of 44 geographic areas.

As indicated in Table 49, survival of both species is heavily impacted by Sediment Load, due to increased embeddedness and fine sediment, as shown in Table 50. Temperature (attributed to increased maximum daily temperature in Table 50), Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 50) and Habitat Diversity (caused by decreased amounts of large wood, Riparian Function and pool habitat in Table 50) moderately reduce coho salmon survival. Summer steelhead trout survival is also impacted by these three survival factors, but to a lesser degree. Key Habitat Quantity (caused by anthropogenic confinement in Table 50) and Channel Stability (impaired by decreased Riparian Function in Table 50) further limit coho salmon survival in Wildhorse Creek.

Table 49. Protection and restoration strategic priority summary for Umatilla subbasin GA26.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Wildhorse Cr from confluence with Umatilla R to Athena City Park obstruction, including W Spring, Little Greasewood, Greasewood, Spring Hollow and Gerking creeks	COHO	24/32	8/32		○	●	●	●	●			●			●						
	FACH	--	--																		
	SPCH	--	--																		
	SUST	33/44	34/44			●		●				●			●						

A		B		C		D & E	
○ / ●	High	○ / ●	Medium	○ / ●	Low		Indirect or General

Table 50. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA26. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 49.

Species	Hydrologic Characteristics: Flow Variation				Hydrologic Characteristics: Hydro. Reg-ime	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
COHO						
FACH						
SPCH						
SUST						

Species	Stream Corridor Structure: Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO																							
FACH																							
SPCH																							
SUST																							

Species	Water Quality: Chemistry						Temperature Variation		
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO									
FACH									
SPCH									
SUST									

Species	Biological Community: Community Effects							
	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO								
FACH								
SPCH								
SUST								

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 27

Description: GA27 consists of six reaches in Wildhorse Creek from the Athena City Park obstruction to a road crossing at an elevation of 3,030 ft, including Eagle Creek. The Athena City Park obstruction occurs within GA27. GA27 only supports summer steelhead trout.

Limiting Factors: Table 51 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA27. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 51 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 52.

GA27 has a moderate protection rank (28 out of 44) and somewhat low restoration rank (11 out of 44), with indirect or general protection and restoration benefits, as indicated in Table 51 by the lack of circles under Protection Benefit and Restoration Benefit.

Summer steelhead trout survival is limited to a high extent by Sediment Load and Temperature (Table 51), attributed to increased embeddedness and maximum daily temperatures (Table 52), respectively. Flow moderately decreases summer steelhead trout survival due to increased high flows, decreased low flows and increased intra-annual variation, as indicated in Table 52. Summer steelhead trout survival is further depressed by Channel Stability (attributed to decreased Riparian Function in Table 52) and Habitat Diversity (caused by decreased amounts of large wood and Riparian Function in Table 52). In addition to decreased habitat quality, the overall reduction in Key Habitat Quantity (due to anthropogenic confinement and reduced low flows in Table 52) has a low impact on survival of summer steelhead trout in GA27.

Table 51. Protection and restoration strategic priority summary for Umatilla subbasin GA27.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Wildhorse Cr from Athena City Park obstruction to road crossing at 3,030-ft level, including Eagle Cr	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	28/44	11/44			●	•	•	•			⬤			⬤						

A	B	C	D & E
High	Medium	Low	Indirect or General

Table 52. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA27. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 51.

Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Regime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
COHO																																														
FACH																																														
SPCH																																														
SUST	░	░		░								░													░	▒	▒									▒										

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
■ Reduction in productivity >or =0.0005
▒ Reduction in productivity between 0.0005 and 0.00005
░ Reduction in productivity between 0.00005 and 0.000005
□ Reduction in productivity < or =0.000005

Geographic Area 28
Description: GA28 consists of the Umatilla River from Mission Bridge to Meacham Creek.
Limiting Factors: Table 53 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA28. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 53 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 54.
Of the four species, GA28 has the highest protection rank and benefit for fall Chinook salmon (2 out of 12 geographic areas) (Table 53). GA28 has a moderate protection rank for coho salmon (6 out of 32) and spring Chinook salmon (7 out of 22), with a low protection benefit for both species. Summer steelhead trout (17 out of 44) would indirectly benefit from protecting GA28, as indicated by the lack of circles under Protection Benefit (Table 53). Overall, restoring GA28 is important for all four species. Restoration of GA28 is most important for spring Chinook salmon, with a restoration rank of 1 out of 22 and a high restoration benefit. Fall Chinook salmon (2 out of 12), coho salmon (4 out of 32), and summer steelhead trout (3 out of 44) have medium restoration benefits in GA28 (Table 53).
Temperature, due to high daily maximum temperatures (Table 54), and Sediment Load, attributed to increased fine sediment (Table 54), are the most limiting survival factors (Table 53). Fall Chinook salmon productivity is impacted by fine sediment and embeddedness, primarily to the egg incubation and fry colonization life stages. As shown in Table 53, Channel Stability (caused by decreased large wood and Riparian Function in Table 54), Habitat Diversity (caused by decreased amounts of large wood and decreased Riparian Function in Table 54), Flow (due to increased high flows, decreased low flows and increased intra-annual variation in Table 54), Predation, and Pathogens limit survival of all four species to a low degree. In addition to habitat quality, Key Habitat Quantity is limiting to all of the species, with a higher affect on spring Chinook salmon. Key Habitat Quantity (Table 53) is influenced by anthropogenic confinement (Table 54). Coho salmon and summer steelhead trout survival is also limited by competition with hatchery fish.

Table 53. Protection and restoration strategic priority summary for Umatilla subbasin GA28.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	SURVIVAL FACTORS: Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Umatilla R from Mission Br to Meacham Cr	COHO	6/32	4/32	○ Low	○ Medium	● Low	● Low	● Low	● Low			● Medium			● High		● Low		● Low		
	FACH	2/12	2/12	○ High	○ Medium	● Low	● Low	● Low	● Low			● Low			● Medium				● Low	● Low	
	SPCH	7/22	1/22	○ Low	○ High	● Low	● Low	● Low	● Medium			● Medium			● High				● Low	● Low	
	SUST	17/44	3/44		○ Medium	● Low	● Low	● Low	● Low			● Medium			● High		● Low		● Low	● Medium	

A	B	C	D & E
High	Medium	Low	Indirect or General

Table 54. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA28. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 53.

Species	Hydrologic Characteristics: Flow Variation: Flow High	Flow Low	Flow diel variation	Flow intraannual variation	Hydro. Regime: HydroRegimeNatural	HydroRegimeReg	Stream Corridor Structure: Channel Morphometry: Reach length	Maximum width	Minimum width	Gradient	Confinement: Confine natural	Confine anthropogenic	Habitat Type: Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions: Obstructions	Withdrawals
COHO	Medium			Medium						Medium		Dark										
FACH	Medium			Medium						Medium		Dark										
SPCH	Medium			Medium						Medium		Dark										
SUST	Light	Dark		Light								Dark										

Species	Riparian and Channel Integrity: Bed Scour	Icing	Riparian Function	Woody Debris	Sediment Type: Embeddedness	Fine Sediment	Turbidity	Water Quality: Chemistry: Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature Variation: Temperature maximum	Temperature minimum	Temp. spatial variation	Biological Community: Community Effects: Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO	Medium		Dark	Dark		Medium								Dark						Medium	Dark		Light	
FACH	Medium		Dark	Dark		Light								Dark						Light	Medium		Light	
SPCH	Medium		Dark	Dark		Light								Dark						Medium	Dark		Medium	
SUST	Light		Dark	Dark		Light								Dark						Light	Dark		Light	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Dark: Reduction in productivity >or =0.0005
Medium: Reduction in productivity between 0.0005 and 0.00005
Light: Reduction in productivity between 0.00005 and 0.000005
Blank: Reduction in productivity < or =0.000005

Geographic Area 29

Description: GA29 consists of Mission Creek from its confluence with the Umatilla River to the fork at an elevation of 1,900 ft. This geographic area includes Cottonwood, Moonshine, and Coonskin creeks. GA29 only supports summer steelhead trout.

Limiting Factors: Table 55 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA29. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 55 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 56.

GA29 has a low protection rank (31 out of 44) and a moderate restoration rank (13 out of 44), with indirect or general protection and restoration benefits, as indicated in Table 55 by the lack of circles under Protection Benefit and Restoration Benefit.

Summer steelhead trout survival is limited to a high extent by Sediment Load and Temperature (Table 55), attributed to increased embeddedness/fine sediment and maximum daily temperatures (Table 56), respectively. In addition to decreased habitat quality, the overall reduction in Key Habitat Quantity (caused by anthropogenic confinement and reduced low flows in Table 56) has a medium impact on survival of summer steelhead trout in GA29. Flow slightly decreases summer steelhead trout survival due to increased high flows, decreased low flows and increased intra-annual variation, as indicated in Table 56. Summer steelhead trout survival is further depressed by Habitat Diversity (attributed to decreased amounts of large wood and Riparian Function in Table 56) and fish pathogens.

Table 55. Protection and restoration strategic priority summary for Umatilla subbasin GA29.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.
Key to strategic priority (corresponding Benefit Category letter also shown):

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Mission Cr from confluence with Umatilla R to fork at 1,900-ft level, including Cottonwood, Moonshine and Coonskin creeks	COHO	--	--																			
	FACH	--	--																			
	SPCH	--	--																			
	SUST	31/44	13/44			•		•	●			⬤			⬤						•	

A	B	C	D & E
○ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 56. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA29. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 55.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Regime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 30
Description: GA30 consists of three reaches in Buckaroo Creek from its confluence with the Umatilla River to the forks at an elevation of 2,400 ft. This geographic area supports coho salmon and summer steelhead trout.
Limiting Factors: Table 57 depicts the protection and restoration ranks and benefits and survival factors for both species in GA30. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 57 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 58.
GA30 has a moderate protection rank for coho salmon (15 out of 32) summer steelhead trout (25 out of 44) with an indirect or general protection benefit (indicated in Table 57 by lack of circles under Protection Benefit). The restoration benefit to both species is also indirect or general. The restoration rank of GA30 for summer steelhead trout is moderate (24 out of 44) and low for coho salmon, which have a restoration rank of 18 out of 32 geographic areas.
As shown in Table 57, summer steelhead trout survival is heavily impacted by Temperature (caused by increased maximum temperature in Table 58). Temperature also has a low effect on coho salmon survival. Key Habitat Quantity has a moderate impact on the survival of both species. Habitat Diversity (caused by decreased amounts of large wood and Riparian Function in Table 58), Flow (attributed to increased high flows and decreased low flows in Table 58), Channel Stability (caused by decreased Riparian Function in Table 58) and Food (attributed to a lack of salmon carcasses) have a low (summer steelhead trout) to moderate (coho salmon) impact on survival in GA30.

Table 57. Protection and restoration strategic priority summary for Umatilla subbasin GA30.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS																
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Buckaroo Cr from confluence with Umatilla R to forks at 2,400-ft level	COHO	15/32	18/32			●	•	●	●						•	•					
	FACH	--	--																		
	SPCH	--	--																		
	SUST	25/44	24/44			•	•	•	●						⬤	•					

A		B		C		D & E	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low		Indirect or General

Table 58. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA30. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 57.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO	░																								░	▒										░									░	
FACH																																														
SPCH																																														
SUST	░	░																							░	░										▒										

Legend:

FACH fall chinook salmon

SPCH spring chinook salmon

SUST summer steelhead trout

█	Reduction in productivity >or =0.0005
▒	Reduction in productivity between 0.0005 and 0.00005
░	Reduction in productivity between 0.00005 and 0.000005
	Reduction in productivity < or =0.000005

Geographic Area 31

Description: GA31 consists of Squaw Creek from its confluence with the Umatilla River to Bachelor Creek. This geographic area supports coho and spring Chinook salmon and summer steelhead trout.

Limiting Factors: Table 59 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA31. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 59 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 60.

GA31 has a high protection rank for coho salmon, 6 out of 32 geographic areas, with a low protection benefit. The protection rank for spring Chinook salmon is moderate (9 out of 22) and low for summer steelhead trout (30 out of 44), with indirect or general protection benefits for both species, as indicated in Table 59 by the lack of circles under Protection Benefit. Restoration of GA31 ranks medium for spring Chinook salmon (12 out of 22), coho salmon (18 out of 32), and summer steelhead trout (25 out of 44). The restoration benefit to all three species is indirect or general (Table 59).

Temperature, due to increased maximum temperature (Table 60), is the most limiting survival factor for all three species (Table 59). Key Habitat Quantity and Sediment Load moderately limit the survival of all three species. Key Habitat Quantity is impacted by channelization as depicted in Table 60. Sediment Load is attributed to increased fine sediment (Table 60). Flow, Channel Stability, and Food also reduce survival of all three species, but to a low degree. The effect of Flow on survival is attributed to increased high flows and intra-annual variation. Channel Stability is caused by decreased Riparian Function (Table 60). As shown in Table 59, Habitat Diversity has a moderate impact on spring Chinook salmon survival and a low impact to the survival of coho salmon. Amounts of large wood and Riparian Function (Table 60) have decreased, both of which contribute to Habitat Diversity.

Table 59. Protection and restoration strategic priority summary for Umatilla subbasin GA31.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS															
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Squaw Cr from confluence with Umatilla R to Bachelor Cr	COHO	6/32	18/32	○		•	•	•	●			●			•	•					
	FACH	--	--																		
	SPCH	9/22	12/22			•	•	●	●			●			⬤	•					
	SUST	30/44	25/44			•	•		●			●			⬤	•					

Table 60. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA31. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 59.

A High B Medium C Low D & E Indirect or General

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Regime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 32
Description: GA32, composed of six reaches, consists of Squaw Creek from Bachelor Creek to confluence at an elevation of 2,780 ft, including Bachelor and Little Squaw creeks and an unnamed tributary. This geographic area supports summer steelhead trout throughout; coho and spring Chinook salmon only occur in Squaw Creek.
Limiting Factors: Table 61 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA32. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 61 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 62.
GA32 has a moderate protection rank and indirect or general protection benefit for each of the three species, as indicated in Table 61 by the lack of circles under Protection Benefit. Restoration of GA32 ranks medium for summer steelhead trout (9 out of 44) and low for spring Chinook salmon (15 out of 22) and coho salmon (20 out of 32). The restoration benefit to all three species is indirect or general (Table 61).
Temperature, due to increased maximum temperature (Table 62), is the most limiting survival factor for spring Chinook salmon and summer steelhead trout (Table 61). Sediment Load and Key Habitat Quantity moderately limit the survival of all three species. Reduced survival from Sediment Load is attributed to increased fine sediment (Table 62). Key Habitat Quantity is impacted by channelization as depicted in Table 62. Habitat Diversity, Channel Stability, Flow and Food further depress the survival of all three species to a lesser extent. Decreased amounts of large wood and impaired Riparian Function, both of which contribute to Habitat Diversity, have reduced productivities for all three species. As shown in Table 61, spring Chinook salmon survival is limited to a higher degree than the other species by Habitat Diversity. Channel Stability limitations are attributed to by decreased Riparian Function (Table 62). Flow affects survival through increased high flows and intra-annual variation (Table 62).

Table 61. Protection and restoration strategic priority summary for Umatilla subbasin GA32.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS																
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Squaw Cr from Bachelor Cr to confluence at 2,780-ft level, including Bachelor and Little Squaw creeks	COHO	8/32	20/32			•	•	•	●			●			•	•					
	FACH	--	--																		
	SPCH	13/22	15/22			•	•	●	●			●			⬤	•					
	SUST	22/44	9/44			•	•	•	●			●			⬤	•					

A	B	C	D & E
○ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 62. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA32. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 61.

Species	Hydrologic Characteristics						Stream Corridor Structure					
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic
COHO	░											
FACH												
SPCH	░											
SUST	░			░								

Species	Stream Corridor Structure										
	Habitat Type									Obstructions	
	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat		Obstructions	Withdrawals
COHO											
FACH											
SPCH											
SUST											

Species	Stream Corridor Structure						
	Riparian and Channel Integrity				Sediment Type		
	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO			░	░		░	
FACH							
SPCH			░	░			
SUST	░		░	▒			

Species	Water Quality								
	Chemistry						Temperature Variation		
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO							░		
FACH									
SPCH							▒		
SUST							▒		

Species	Biological Community							
	Community Effects							
	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO							░	
FACH								
SPCH							░	
SUST							░	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
█ Reduction in productivity >or =0.0005
▒ Reduction in productivity between 0.0005 and 0.00005
░ Reduction in productivity between 0.00005 and 0.000005
☐ Reduction in productivity < or =0.000005

Geographic Area 33
Description: GA33 consists of Meacham Creek from its confluence with the Umatilla River to North Fork Meacham Creek, including Boston Canyon.
Limiting Factors: Table 63 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA33. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 63 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 64.
Of the four species, GA33 has the highest protection benefit for fall Chinook salmon (3 out of 12 geographic areas) (Table 63), followed by coho salmon (2 out of 32) and spring Chinook salmon (3 out of 22). GA33 has a moderate protection rank for summer steelhead trout (9 out of 44), with a low protection benefit. Restoration of GA33 is most important for summer steelhead trout, with a restoration rank of 5 out of 44 and a medium restoration benefit. Spring Chinook salmon (4 out of 22) and coho salmon (9 out of 32) have medium restoration benefits in GA33 (Table 63). Fall Chinook salmon (7 out of 12) would indirectly benefit from restoring GA33.
Temperature, due to high daily maximum temperatures (Table 64), is the most limiting survival factor (Table 63) in GA33. As shown in Table 63, Habitat Diversity, caused by decreased amounts of large wood, Riparian Function, and pool habitat (Table 64), and Key Habitat Quantity are moderately limiting to all four species. Key Habitat Quantity (Table 63) is influenced by anthropogenic confinement (Table 64). Channel Stability (caused by decreased large wood and Riparian Function in Table 64), Flow (due to increased high flows, decreased low flows and increased intra-annual variation in Table 64), Food, Predation, and Competition with hatchery fish limit survival of all four species to a low degree.

Table 63. Protection and restoration strategic priority summary for Umatilla subbasin GA33.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Meacham Cr from confluence with Umatilla R to NF Meacham Cr, including Boston Canyon	COHO	2/32	9/32	B	C	C	C	B	B						B	C	C		C		
	FACH	3/12	7/12	A		C	C	B	B						B	C	C		C		
	SPCH	3/22	4/22	B	C	C	C	B	B						A	C	C		C		
	SUST	9/44	5/44	C	B	C	C	C	B						A	C	C		C		

A High

B Medium

C Low

D & E Indirect or General

Table 64. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA33. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 63.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:

FACH fall chinook salmon

SPCH spring chinook salmon

SUST summer steelhead trout

Reduction in productivity >or =0.0005

Reduction in productivity between 0.0005 and 0.00005

Reduction in productivity between 0.00005 and 0.000005

Reduction in productivity < or =0.000005

Geographic Area 34
Description: GA34 consists of Line, Camp and Duncan Canyon Creeks, all of which only support summer steelhead trout.
Limiting Factors: Table 65 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA34. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 65 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 66.
GA34 has a moderate protection rank (16 out of 44) and restoration rank (20 out of 44), with an indirect or general protection and restoration benefits, as indicated in Table 65 by the lack of circles under Protection Benefit and Restoration Benefit.
Table 65 indicates that summer steelhead trout survival is limited to a low extent by Flow, Channel Stability, Habitat Diversity, Sediment Load, Competition with hatchery fish and Predation. The influence of Channel Stability on survival is caused by decreased Riparian Function, as depicted in Table 66. Habitat Diversity has decreased due to reduced amounts of large wood and impaired Riparian Function (Table 66). Increased fine sediment (Table 66) has negatively impacted Sediment Load (Table 65). In addition to reduced habitat quality, the overall reduction in Key Habitat Quantity (caused by anthropogenic confinement in Table 66) has a low impact on survival of summer steelhead trout in GA34.

Table 65. Protection and restoration strategic priority summary for Umatilla subbasin GA34.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Line, Camp and Duncan Canyon creeks	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	16/44	20/44			•	•	•	•			•					•		•		

A	B	C	D & E
High	Medium	Low	Indirect or General

Table 66. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA34. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 65.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Regime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 35

Description: GA35 consists of 13 reaches in North Fork Meacham Creek from its confluence with mainstem Meacham Creek to an elevation of 3,800 ft, and its tributaries (Sawmill, Bear, Hoskins, Pot and Canyon creeks). North Fork Meacham Creek supports coho and spring Chinook salmon and summer steelhead trout. Coho salmon also occur in Bear and Pot creeks. Summer steelhead trout inhabit the entire geographic area.

Limiting Factors: Table 67 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA35. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 67 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 68.

GA35 has a high protection rank for spring Chinook salmon (2 out of 22) and summer steelhead trout (4 out of 44), with medium protection benefits for both species, as indicated in Table 67 by the medium circles under Protection Benefit. The protection rank of GA35 for coho salmon is moderately high (7 out of 32); the protection benefit of GA35 for coho is low (Table 67). Restoration of GA35 ranks medium for summer steelhead trout (10 out of 44) and spring Chinook salmon (9 out of 22) and low for coho salmon (22 out of 32). The restoration benefit to all three species is indirect or general (Table 67).

Habitat Diversity, Key Habitat Quantity, and Temperature, are the most limiting survival factors for all three species (Table 67). Decreased amounts of large wood and impaired Riparian Function (Table 68), both of which contribute to Habitat Diversity, have reduced productivities. As shown in Table 67, spring Chinook salmon and coho salmon survival is limited to a higher degree than summer steelhead trout by Habitat Diversity. Key Habitat Quantity is impacted by channelization as depicted in Table 68. Temperature limitations are attributed to increased maximum daily temperature (Table 68). Flow, Competition with hatchery fish, and Predation limit the survival of each of the species to a low degree. Channel Stability (caused by decreased Riparian Function in Table 68) and Food are also slightly limiting to spring Chinook salmon in GA35. The waterfall in upper North Fork Meacham Creek is a barrier to migrating adult summer steelhead trout.

Table 67. Protection and restoration strategic priority summary for Umatilla subbasin GA35.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS																
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
NF Meacham Cr from confluence with mainstem to 3,800-ft level, including Sawmill, Bear, Hoskins, Pot and Canyon creeks	COHO	7/32	22/32	∘		•		●	•						•		•		•		
	FACH	--	--																		
	SPCH	2/22	9/22	○		•	•	●	●						●	•	•		•		
	SUST	4/44	10/44	○		•		•	•	⬤					•		•		•		

A	B	C	D & E
◯ ⬤ High	○ ● Medium	∘ • Low	Indirect or General

Table 68. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA35. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 67.

Species	Hydrologic Characteristics						Stream Corridor Structure																						
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO												L											L		M	M			
FACH																													
SPCH												M													M	M			
SUST												L									L				M	M			

Species	Water Quality									Biological Community								
	Chemistry						Temperature Variation			Community Effects								
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO							L							L		L	
FACH																	
SPCH							M							L		L	
SUST							M							M		L	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 36

Description: The five reaches making up GA36 includes of Meacham Creek from North Fork Meacham Creek to an elevation of 3,820 ft and Sheep Creek. GA36 only supports summer steelhead trout.

Limiting Factors: Table 69 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA36. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 69 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 70.

GA36 has a moderate protection rank (13 out of 44) and high restoration rank (7 out of 44), with low protection and restoration benefits, as indicated in Table 69 by small circles under Protection Benefit and Restoration Benefit.

Temperature, attributed to increased maximum daily temperatures (Table 70), is the most limiting survival factor for summer steelhead trout (Table 69). The overall reduction in Key Habitat Quantity, caused by anthropogenic confinement and reduced low flows (Table 70), has a medium impact on survival of summer steelhead trout in GA36. Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 70), Channel Stability (caused by impaired Riparian Function in Table 70), and Habitat Diversity (caused by decreased amounts of large wood and Riparian Function in Table 70) limit summer steelhead trout survival to a low degree. As indicated in Table 69, competition with hatchery fish and increased predation further depresses summer steelhead trout survival.

Table 69. Protection and restoration strategic priority summary for Umatilla subbasin GA36.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK: Protection Rank	RANK: Restoration Rank	BENEFIT: Protection benefit	BENEFIT: Restoration benefit	SURVIVAL FACTORS: Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Meacham Cr from NF Meacham Cr to 3,820-ft level, including Sheep Cr	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	13/44	7/44	∘	∘	•	•	•	●						⬤		•		•		

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 70. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA36. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 69.

Hydrologic Characteristics

Species	Flow Variation: Flow High	Flow Low	Flow diel variation	Flow intraannual variation	Hydro. Regime: HydroRegimeNatural	HydroRegimeReg
COHO						
FACH						
SPCH						
SUST	▒	▒		▒		

Stream Corridor Structure

Species	Channel Morphometry: Reach length	Maximum width	Minimum width	Gradient	Confinement: Confine natural	Confine anthropogenic	Habitat Type: Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions: Obstructions	Withdrawals	Riparian and Channel Integrity: Bed Scour	Icing	Riparian Function	Woody Debris	Sediment Type: Embeddedness	Fine Sediment	Turbidity
COHO																							
FACH																							
SPCH																							
SUST						▒											▒		▓	▓			

Water Quality

Species	Chemistry: Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature Variation: Temperature maximum	Temperature minimum	Temp. spatial variation
COHO									
FACH									
SPCH									
SUST							▓		

Biological Community

Species	Community Effects: Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO								
FACH								
SPCH								
SUST					▓		▒	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
█ Reduction in productivity >or =0.0005
▓ Reduction in productivity between 0.0005 and 0.00005
▒ Reduction in productivity between 0.00005 and 0.000005
□ Reduction in productivity < or =0.000005

Geographic Area 37
Description: GA37 consists of East Meacham Creek from its confluence with Meacham Creek to an elevation of 3,800 ft and includes Owsley and Butcher creeks. GA37, composed of four reaches, only supports summer steelhead trout.
Limiting Factors: Table 71 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA37. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 71 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 72.
GA37 has a high protection rank (8 out of 44), with low protection benefit, as indicated in Table 71 by a small circle under Protection Benefit. The restoration rank of GA37 is moderate (27 out of 44), having an indirect or general restoration benefit.
Key Habitat Quantity, caused by anthropogenic confinement and reduced low flows (Table 72), is the most limiting survival factor for summer steelhead trout (Table 71). Summer steelhead trout survival is impacted at a low level by Flow (attributed to increased high flows in Table 72) and Habitat Diversity (caused by decreased amounts of large wood and Riparian Function in Table 72). As indicated in Table 71, competition with hatchery fish and increased predation further depresses summer steelhead trout survival.

Table 71. Protection and restoration strategic priority summary for Umatilla subbasin GA37.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS																
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
East Meacham from confluence with mainstem to 3,800-ft level, including Owsley and Butcher creeks	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	8/44	27/44	○		•		•	●								•		•		

A: ○ / ● High
B: ○ / ● Medium
C: ○ / • Low
D & E: Indirect or General

Table 72. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA37. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 71.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 38

Description: GA38 consists of Meacham Creek (five reaches) from Sheep Creek to an elevation of 4,000 ft, including Twomile Creek (three reaches). This geographic area only supports summer steelhead trout.

Limiting Factors: Table 73 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA38. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 73 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 74.

GA38 has a moderate protection rank (23 out of 44) and restoration rank (26 out of 44), with an indirect or general protection and restoration benefits, as indicated in Table 73 by the lack of circles under Protection Benefit and Restoration Benefit.

Sediment load is the most limiting survival factor for summer steelhead trout (Table 73), attributed to increased embeddedness and fine sediment (Table 74). The overall reduction in Key Habitat Quantity, caused by anthropogenic confinement and reduced low flows (Table 74), and Habitat Diversity (due to decreased amounts of large wood and Riparian Function in Table 74) have a medium impact on survival of summer steelhead trout in GA38. Flow (caused by increased high flows, decreased low flows and increased intra-annual variation in Table 74) and Channel Stability (caused by impaired Riparian Function in Table 74) decrease summer steelhead trout survival to a low extent. As indicated in Table 73, competition with hatchery fish and increased predation further depresses summer steelhead trout survival.

Table 73. Protection and restoration strategic priority summary for Umatilla subbasin GA38.
Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Meacham Cr from Sheep Cr to 4,000-ft level, including Twomile Cr	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	23/44	26/44			•	•	●	●			⬤					•		•		

A	B	C	D & E
◯ / ⬤ High	○ / ● Medium	∘ / • Low	Indirect or General

Table 74. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA38. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 73.

Species	Hydrologic Characteristics					
	Flow Variation				Hydro. Reg-ime	
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
COHO						
FACH						
SPCH						
SUST						

Species	Stream Corridor Structure																							
	Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			
	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	
COHO																								
FACH																								
SPCH																								
SUST																								

Species	Water Quality									Biological Community								
	Chemistry						Temperature Variation			Community Effects								
	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness	
COHO																		
FACH																		
SPCH																		
SUST																		

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 39
Description: GA39 consists of Beaver Creek (four reaches) from its confluence with the mainstem to an elevation of 4,200 ft, and Little Beaver Creek (one reach). This geographic area only supports summer steelhead trout.
Limiting Factors: Table 75 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA39. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 75 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 76.
GA39 has a moderate protection rank (25 out of 44) and restoration rank (28 out of 44), with an indirect or general protection and restoration benefits, as indicated in Table 75 by the lack of circles under Protection Benefit and Restoration Benefit.
Sediment load is the most limiting survival factor for summer steelhead trout (Table 75), attributed to increased embeddedness and fine sediment (Table 76). The overall reduction in Key Habitat Quantity, caused by anthropogenic confinement (Table 76), has a medium impact on survival of summer steelhead trout in GA39. Flow, due to increased high flows (Table 76), decreases summer steelhead trout survival to a lesser degree. As indicated in Table 75, competition with hatchery fish and increased predation further depresses productivities. Meacham Lake Dam is a partial barrier to migrating adults.

Table 75. Protection and restoration strategic priority summary for Umatilla subbasin GA39.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS																
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Beaver Cr from conluence with mainstem to 4,200-ft level, including Little Beaver Cr	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	25/44	28/44			•			●	•		⬤					•		•		

A	B	C	D & E
○ ⬤ High	○ ● Medium	∘ • Low	Indirect or General

Table 76. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA39. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 75.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Regime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST	░																								░	░	░	░								░							░			

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
█ Reduction in productivity >or =0.0005
▓ Reduction in productivity between 0.0005 and 0.00005
░ Reduction in productivity between 0.00005 and 0.000005
□ Reduction in productivity < or =0.000005

Geographic Area 40
Description: GA40 consists of the Umatilla River from Meacham Creek to the confluence of North and South Fork Umatilla River, including Hillbilly, StarveToDeath, Hagar, Bobsled, Rock, Bear and Lick creeks.
Limiting Factors: Table 77 depicts the protection and restoration ranks and benefits and survival factors for all four species in GA40. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 77 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 78.
GA40 has the highest overall protection rank of any of the geographic areas in the Umatilla subbasin. The protection rank of GA40 is first for coho, fall and spring Chinook salmon and second for summer steelhead trout. Restoration of GA40 is most important for summer steelhead trout, with a restoration rank of 4 out of 44 and a medium restoration benefit. Spring Chinook salmon (5 out of 22) and coho salmon (11 out of 32) have medium restoration benefits in GA40 (Table 77). Fall Chinook salmon (8 out of 12) would indirectly benefit from restoring GA40.
Temperature, due to high daily maximum temperatures (Table 78), is the most limiting survival factor (Table 77) in GA40. Summer steelhead trout and spring Chinook salmon survival is heavily limited by temperature. As shown in Table 77, Habitat Diversity, caused by decreased amounts of large wood and impaired Riparian Function (Table 78), and Key Habitat Quantity are moderately limiting to the three salmon species. Key Habitat Quantity (Table 77) is influenced by anthropogenic confinement (Table 78). Channel Stability (caused by decreased large wood and Riparian Function in Table 78), and Flow (due to increased high flows, decreased low flows and increased intra-annual variation in Table 78) limit survival of all four species to a low degree.

Table 77. Protection and restoration strategic priority summary for Umatilla subbasin GA40.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS																
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Umatilla R from Meacham Cr to NF/SF Umatilla R, including Hillbilly, StarveToDeath, Hagar, Bobsled, Rock, Bear and Lick creeks	COHO	1/32	11/32	High	Low	Low	Low	High	High						Low						
	FACH	1/12	8/12	High		Low	Low	High	High						Low						
	SPCH	1/22	5/22	High	Low	Low	Low	High	High						High						
	SUST	2/44	4/44	High	Medium	Low	Low	Low	Low						High						

A High; B Medium; C Low; D & E Indirect or General

Table 78. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA40. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 77.

Hydrologic Characteristics

	Flow Variation				Hydro. Reg-ime	
Species	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg
COHO	░					
FACH						
SPCH	░			░		
SUST		░				

Stream Corridor Structure

	Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type		
Species	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity
COHO				░		▒											░		▒	▒			
FACH				░		▒				░							▒		■	■			
SPCH				░		■				░							▒		■	■			
SUST				░		▒											░		▒	▒			

Water Quality

	Chemistry						Temperature Variation		
Species	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation
COHO							▒		
FACH							■		
SPCH							■		
SUST							■		

Biological Community

	Community Effects							
Species	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO					░		░	
FACH							▒	
SPCH					░		▒	
SUST					▒		░	

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
■ Reduction in productivity >or =0.0005
▒ Reduction in productivity between 0.0005 and 0.00005
░ Reduction in productivity between 0.00005 and 0.000005
(blank) Reduction in productivity < or =0.000005

Geographic Area 41
Description: GA41 consists of one reach, Ryan Creek from its confluence with the Umatilla River to an elevation of 3,800 ft. This geographic area only supports summer steelhead trout.
Limiting Factors: Table 79 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA41. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 79 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 80.
GA41 has a moderate protection rank (18 out of 44) and low restoration rank (31 out of 44), with an indirect or general protection and restoration benefits, as indicated in Table 79 by the lack of circles under Protection Benefit and Restoration Benefit.
None of the survival factors greatly affect summer steelhead trout survival. The overall reduction in Key Habitat Quantity, the most limiting survival factor in Ryan Creek (Table 79), has a medium impact on survival of summer steelhead trout prespawning holding, spawning and egg incubation life stages. Habitat Diversity (due to decreased amounts of large wood and Riparian Function in Table 80), Flow, and Channel Stability (caused by impaired Riparian Function in Table 80) decrease summer steelhead trout survival to a low extent. The availability and diversity of food further depresses summer steelhead trout productivity.

Table 79. Protection and restoration strategic priority summary for Umatilla subbasin GA41.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS															
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Ryan Cr from confluence with Umatilla R to 3,800-ft level	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	18/44	31/44			•	•	•	●							•					

A	B	C	D & E
○ ● High	○ ● Medium	○ • Low	Indirect or General

Table 80. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA41. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 79.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community								
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 42

Description: GA42, composed of eight reaches, includes the North Fork Umatilla River from its confluence with the mainstem Umatilla River to waterfalls at an elevation of 3,370 feet, and Coyote, Woodward and Johnson creeks. This geographic area supports coho salmon (NF Umatilla and Coyote Creek), spring Chinook salmon (NF Umatilla) and summer steelhead trout (throughout GA42).

Limiting Factors: Table 81 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA42. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 81 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 82.

GA42 has a the highest protection rank for summer steelhead trout (1 out of 44) and a high protection rank (Table 81). This geographic area also has a high protection rank for spring Chinook salmon (4 out of 22) and a low protection benefit. For coho salmon, this geographic area has indirect or general protection benefits, with a protection rank of 10 out of 32 geographic areas. Restoration of GA42 ranks medium for summer steelhead trout (15 out of 44) and low for spring Chinook salmon (17 out of 22) and coho salmon (24 out of 32). The restoration benefit to all three species is indirect or general (Table 81).

In accordance with the high protection ranks for GA42, non of the survival factors are significantly limiting to any of the species. Channel Stability, caused by decreased Riparian Function (Table 82), has a low impact on summer steelhead trout survival. Decreased amounts of large wood, which influences Habitat Diversity, is moderately limiting to coho salmon and has a low impact on spring Chinook salmon.

Table 81. Protection and restoration strategic priority summary for Umatilla subbasin GA42.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS															
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
NF Umatilla R from confluence with mainstem to falls at 3,370-ft level, including Coyote, Woodward, and Johnson creeks	COHO	10/32	24/32					●													
	FACH	--	--																		
	SPCH	4/22	17/22	∘				•													
	SUST	1/44	15/44	○			•														

A	B	C	D & E
○ / ● High	∘ / • Medium	∘ / • Low	Indirect or General

Table 82. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA42. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 81.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 43

Description: GA43 consists of two reaches in West Fork Birch Creek from its confluence with mainstem Birch Creek to Bear Creek. This geographic area supports coho and spring Chinook salmon and summer steelhead trout.

Limiting Factors: Table 83 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA43. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 83 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 84.

GA43 has a high protection rank for spring Chinook salmon (4 out of 22) and summer steelhead trout (7 out of 44), with low protection benefits for both species. The protection benefit of GA43 for coho salmon is indirect or general, as indicated in Table 83 by the lack of circles under Protection Benefit, with a protection rank of 23 out of 32 geographic areas. Restoration of GA43 ranks medium for summer steelhead trout (15 out of 44) and low for spring Chinook salmon (14 out of 22) and coho salmon (23 out of 32). The restoration benefit to all three species is indirect or general (Table 83).

Overall, Habitat Diversity (Table 84) is the most limiting survival factor in GA43 (Table 83). Decreased amounts of large wood and impaired Riparian Function (Table 84) contribute to Habitat Diversity, have reduced productivities. As shown in Table 83, spring Chinook salmon and coho salmon survival is limited to a higher degree than summer steelhead trout by Habitat Diversity. Channel Stability (caused by decreased Riparian Function in Table 84), Flow (attributed to anthropogenic confinement in Table 84), and Food, slightly limit the survival of all three species.

Table 83. Protection and restoration strategic priority summary for Umatilla subbasin GA43.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

		RANK		BENEFIT		SURVIVAL FACTORS															
Geographic Area	Species	Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
SF Umatilla R from confluence with mainstem to Thomas Cr	COHO	12/32	23/32			•	•	●								•					
	FACH	--	--																		
	SPCH	4/22	14/22	◦		•	•	●								•					
	SUST	7/44	15/44	◦		•	•	•								•					

A ○ ● High
B ○ ● Medium
C ◦ • Low
D & E Indirect or General

Table 84. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA43. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 83.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 44

Description: GA44 consists of five reaches in Buck Creek from its confluence with the South Fork Umatilla River to an elevation of 4,820 ft and includes Swamp and Lake creeks. This geographic area only supports summer steelhead trout.

Limiting Factors: Table 85 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA44. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 85 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 86.

GA44 has a high protection rank (3 out of 44) and a moderate restoration rank (22 out of 44) for summer steelhead trout. The protection benefit is high, with an indirect or general restoration benefit, as indicated in Table 85 by the large circle and blank cell under Protection Benefit and Restoration Benefit, respectively.

None of the survival factors affect summer steelhead trout survival to a high or even moderate degree. Flow and the availability and diversity of food (Table 85), due to a lack of salmon carcasses and large wood (Table 86), slightly depresses summer steelhead trout survival.

Table 85. Protection and restoration strategic priority summary for Umatilla subbasin GA44.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Buck Cr from confluence with SF Umatilla R to 4,820-ft level, including Swamp and Lake creeks	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	3/44	22/44	○		•										•					

A		B		C		D & E	
○ / ●	High	○ / ●	Medium	○ / •	Low		Indirect or General

Table 86. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA44. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 85.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 45

Description: GA45 consists of Thomas Creek (five reaches) from its confluence with the South Fork Umatilla River to an elevation of 4,000 ft, Whitman Spring (one reach) and Spring Creek (one reach). This geographic area only supports summer steelhead trout.

Limiting Factors: Table 87 depicts the protection and restoration ranks and benefits and survival factors for summer steelhead trout in GA45. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 87 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 88.

GA45 has a moderately high protection rank (9 out of 44) and a moderate restoration rank (17 out of 44). As indicated in Table 87 by small or no circles under Protection Benefit and Restoration Benefit, respectively, the protection benefit is low while the restoration benefit is indirect or general.

None of the survival factors greatly affect summer steelhead trout survival in GA45. The overall reduction in Key Habitat Quantity, the most limiting survival factor in GA 45 (Table 87), has a medium impact on survival of summer steelhead trout during the spawning and egg incubation life stages. Habitat Diversity (due to decreased amounts of large wood and Riparian Function in Table 88), Flow, and Channel Stability (caused by impaired Riparian Function in Table 88) decrease summer steelhead trout survival to a low extent. The availability and diversity of food further depresses summer steelhead trout survival, attributed to a lack of salmon carcasses (Table 88).

Table 87. Protection and restoration strategic priority summary for Umatilla subbasin GA45.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
Thomas Cr from confluence with SF Umatilla R to 4,000-ft level, including Whitman Spring and Spring Cr	COHO	--	--																		
	FACH	--	--																		
	SPCH	--	--																		
	SUST	9/44	17/44	○		•	•	•	●							•					

A	B	C	D & E
○ ● High	○ ● Medium	○ • Low	Indirect or General

Table 88. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA45. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 87.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Reg-ime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temper-ature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Geographic Area 46

Description: GA46 consists of the two reaches in the South Fork Umatilla River from the confluence with Thomas Creek to an elevation of 4,720 feet. Summer steelhead trout, coho and spring Chinook salmon inhabit the South Fork Umatilla River. This geographic area also includes Shimmiehorn Creek, subdivided into three reaches, which only supports summer steelhead trout.

Limiting Factors: Table 89 depicts the protection and restoration ranks and benefits and survival factors for all three species in GA46. Survival factors define the impact of habitat conditions on the survival of life stages in the Geographic Area. Survival factors in Table 89 are defined within EDT to be composed of one or more measurable attributes of the environment in Table 90.

GA46 has a moderately high protection rank for spring Chinook salmon (6 out of 22) and summer steelhead trout (6 out of 44), with low protection benefits for both species. The protection benefit of GA46 for coho salmon is indirect or general, as indicated in Table 89 by the lack of circles under Protection Benefit, with a protection rank of 23 out of 32 geographic areas. Restoration of GA46 ranks medium for summer steelhead trout (23 out of 44) and low for spring Chinook salmon (16 out of 22) and coho salmon (26 out of 32). The restoration benefit to all three species is indirect or general (Table 89).

Overall, Habitat Diversity, caused by decreased amounts of large wood (Table 90), is the most limiting survival factor in GA46 (Table 89). As shown in Table 89, spring Chinook salmon survival is limited to a higher degree than the other species by Habitat Diversity. Flow slightly limits the survival of all three species. Availability and diversity of food further depresses coho and spring Chinook salmon survival.

Table 89. Protection and restoration strategic priority summary for Umatilla subbasin GA46.Area ranks show the rank for an area out of the total areas appropriate for each population. Benefit shows the Protection and Restoration benefit relative to the total benefits across the Umatilla basin for the population. Survival Factors show the relative contribution of each EDT survival factor to the Restoration Benefit.

Geographic Area	Species	RANK		BENEFIT		SURVIVAL FACTORS															
		Protection Rank	Restoration Rank	Protection benefit	Restoration benefit	Flow	Channel stability/landsc	Habitat diversity	Key habitat quantity	Obstructions	Withdrawals	Sediment load	Oxygen	Chemicals	Temperature	Food	Competition (w/ hatch)	Competition (other sp)	Predation	Pathogens	Harassment/poaching
SF Umatilla R from Thomas Cr to 4,720-ft level, including Shimmiehorn Cr	COHO	23/32	26/32			•		•								•					
	FACH	--	--																		
	SPCH	6/22	16/22	∘		•		●								•					
	SUST	6/44	23/44	∘		•		•													

A		B		C		D & E	
○ / ●	High	○ / ●	Medium	∘ / •	Low		Indirect or General

Table 90. Change in productivity by ecological attribute for coho, fall Chinook salmon, and spring Chinook salmon and summer steelhead trout in Umatilla subbasin GA46. Environmental attributes are measurable qualities of the environment that are used in EDT to define the Survival Factors in Table 89.

Species	Hydrologic Characteristics						Stream Corridor Structure																							Water Quality									Biological Community							
	Flow Variation				Hydro. Regime		Channel Morphometry				Confinement		Habitat Type								Obstructions		Riparian and Channel Integrity				Sediment Type			Chemistry						Temperature Variation			Community Effects							
	Flow High	Flow Low	Flow diel variation	Flow intraannual variation	HydroRegimeNatural	HydroRegimeReg	Reach length	Maximum width	Minimum width	Gradient	Confine natural	Confine anthropogenic	Pool	Pool tailout	Backwater pool	Beaver pond	Glide	Small cobble riffle	Large cobble riffle	Off-channel habitat	Obstructions	Withdrawals	Bed Scour	Icing	Riparian Function	Woody Debris	Embeddedness	Fine Sediment	Turbidity	Alkalinity	Dissolved oxygen	Metals/pollutants sediment	Metals in water	Misc. toxins	Nutrient enrichment	Temperature maximum	Temperature minimum	Temp. spatial variation	Fish Comm Richness	Fish pathogens	Fish species introduced	Harassment	Hatchery outplants	Predation risk	Salmon carcasses	Benthic Comm Richness
COHO																																														
FACH																																														
SPCH																																														
SUST																																														

Legend:
FACH fall chinook salmon
SPCH spring chinook salmon
SUST summer steelhead trout
Reduction in productivity >or =0.0005
Reduction in productivity between 0.0005 and 0.00005
Reduction in productivity between 0.00005 and 0.000005
Reduction in productivity < or =0.000005

Priority areas as identified by EDT are shown in the following series of 8 tables. Geographic areas highlighted in blue were removed from the ranking used in the Assessment and the Management Plan.

Steelhead Priority Geographic Areas for Restoration

GA	GA Description	Priority	Rationale for Removal
GA12	Birch, mouth to forks including Stewart Creek	1	
GA5	Butter Creek, Madison Diversion to East Butter	2	Steelhead currently blocked by barriers and flow
GA28	Umatilla, Mission Bridge to Meacham Creek	3	
GA40	Umatilla, Meacham to Forks including all tribs except Ryan Creek	4	
GA33	Meacham, Mouth to North Fork	5	
GA15	West Birch, Bear top of gorge, including tribs	6	
GA21	Mckay Cr, McKay Dam to North Fork	7	Steelhead blocked by barrier
GA13	West Birch, mouth to Bear Creek	8	
GA32	Squaw Cr, Bachelor Canyon to headwaters, inlcuding tribs	9	
GA35	NF Meacham and tribs	10	
GA27	Wildhorse Cr, Athena to Headwaters, inlcuding tribs	11	Very limitied presence/use
GA19	Pearson Creek (East Birch)	12	
GA20	Mckay Cr, mouth to McKay Dam	13	Adults blocked by barrier
GA17	East Birch mouth to California Gulch	14	
GA42	NF Umatilla, mouth ot headwaters including tribs	15	Wilderness Area
GA6	Little Butter	16	Steelhead currently blocked by barriers and flow
GA18	East Birch, Cal Gulch to headwaters and tribs except Pearson	17	
GA2	Umatilla, Threemile Dam to Butter Creek	18	
GA14	Bear Creek and tribs (West Birch)	19	
GA34	Meacham, Tribs from mouth to NF	20	
GA8	Butter Cr, EF to headwaters and Johnson Creek	21	Steelhead currently blocked by barriers and flow
GA44	Buck Creek and tribs	22	Wilderness Area
GA1	Umatilla, mouth to Threemile Dam	23	Low restoration opportunity for sediment and temperatu
GA 30	Buckaroo Creek	24	
GA7	EF Butter and tribs	25	
GA38	Meacham, Twomile to headwaters, including Twomile	26	

None of the top 15 priority areas for protection for steelhead were removed, and therefore, no table is shown.

Spring Chinook Priority Geographic Areas for Restoration

GA	GA Description	Priority	Rationale for removal
GA28	Umatilla, Mission Bridge to Meacham Creek	1	
GA21	Mckay Cr, McKay Dam to North Fork	2	Barrier
GA12	Birch, mouth to forks including Stewart Creek	3	ChS not currently present
GA33	Meacham, Mouth to North Fork	4	
GA40	Umatilla, Meacham to Forks including all tribs except Ryan Creek	5	
GA24	McKay Cr, NF to headwaters including tribs	6	Barrier
GA25	Umatilla, Mckay Creek to Mission Bridge	7	
GA20	Mckay Cr, mouth to McKay Dam	8	Adult Barrier
GA35	NF Meacham and tribs	9	
GA9	Umatilla, Butter Cr to Westland Dam	10	
GA2	Umatilla, Threemile Dam to Butter Creek	11	
GA31	Squaw Cr, Mouth to Bachelor Canyon	12	
GA18	East Birch, Cal Gulch to headwaters and tribs except Pearson	13	ChS not currently present
GA43	SF Umatilla, mouth to Thomas Creek	14	
GA11	Umatilla, Westland Dam to McKay Creek	15	

Spring Chinook Priority Geographic Areas for Protection

GA	GA Description	Priority	Rationale for Removal
GA40	Umatilla, Meacham to Forks including all tribs except Ryan Creek	1	
GA35	NF Meacham and tribs	2	
GA33	Meacham, Mouth to North Fork	3	
GA42	NF Umatilla, mouth to headwaters including tribs	4	
GA43	SF Umatilla, mouth to Thomas Creek	4	
GA9	Umatilla, Butter Cr to Westland Dam	5	
GA46	SF Umatilla, Thomas Cr to headwaters including shimmiehorn	6	
GA28	Umatilla, Mission Bridge to Meacham Creek	7	
GA17	East Birch mouth to California Gulch	8	ChS not currently present
GA24	McKay Cr, NF to headwaters including tribs	9	Barrier
GA25	Umatilla, Mckay Creek to Mission Bridge	10	
GA2	Umatilla, Threemile Dam to Butter Creek	11	
GA11	Umatilla, Westland Dam to McKay Creek	12	

Coho Priority Geographic Areas for Restoration

GA	GA Description	Priority	Rationale for Removal
GA5	Butter Creek, Madison Diversion to East Butter	1	Blocked Passage and insufficient flows
GA9	Umatilla, Butter Cr to Westland Dam	2	
GA8	Butter Cr, EF to headwaters and Johnson Creek	3	Blocked Passage and insufficient flows
GA28	Umatilla, Mission Bridge to Meacham Creek	4	
GA7	EF Butter and tribs	5	Blocked Passage and insufficient flows
GA25	Umatilla, Mckay Creek to Mission Bridge	6	
GA4	Butter Creek, mouth to Madison Diversion	7	Blocked Passage and insufficient flows
GA26	Wildhorse Cr, mouth to Athena, including tribs	8	
GA33	Meacham, Mouth to North Fork	9	
GA11	Umatilla, Westland Dam to McKay Creek	10	
GA40	Umatilla, Meacham to Forks including all tribs except Ryan Creek	11	
GA1	Umatilla, mouth to Threemile Dam	12	Low opportunity for restoration
GA15	West Birch, Bear top of gorge, including tribs	13	Not Present/Steelhead Sanctuary
GA24	McKay Cr, NF to headwaters including tribs	14	Barrier
GA13	West Birch, mouth to Bear Creek	15	Not Present/Steelhead Sanctuary

Coho Priority Geographic Areas for Protection

GA	GA Description	Priority	Rationale for Removal
GA40	Umatilla, Meacham to Forks including all tribs except Ryan Creek	1	
GA14	Bear Creek and tribs (West Birch)	2	Not Present/Steelhead Sanctuary
GA17	East Birch mouth to California Gulch	3	Not Present/Steelhead Sanctuary
GA18	East Birch, Cal Gulch to headwaters and tribs except Pearson	4	Not Present/Steelhead Sanctuary
GA24	McKay Cr, NF to headwaters including tribs	5	Barrier
GA31	Squaw Cr, Mouth to Bachelor Canyon	6	
GA35	NF Meacham and tribs	7	
GA32	Squaw Cr, Bachelor Canyon to headwaters, inlcuding tribs	8	
GA19	Pearson Creek (East Birch)	9	Not Present/Steelhead Sanctuary
GA42	NF Umatilla, mouth ot headwaters including tribs	10	Really coho habitat?
GA8	Butter Cr, EF to headwaters and Johnson Creek	11	Blocked Passage and insufficient flows
GA15	West Birch, Bear top of gorge, including tribs	12	Not Present/Steelhead Sanctuary
GA7	EF Butter and tribs	13	Blocked Passage and insufficient flows
GA12	Birch, mouth to forks including Stewart Creek	14	
GA 30	Buckaroo Creek	15	

Fall Chinook Priority Geographic Areas for Restoration

GA	GA Description	Priority	Rationale for Removal
GA9	Umatilla, Butter Cr to Westland Dam	1	
GA28	Umatilla, Mission Bridge to Meacham Creek	2	
GA2	Umatilla, Threemile Dam to Butter Creek	3	
GA1	Umatilla, mouth to Threemile Dam	4	Limited restoration opportunity
GA11	Umatilla, Westland Dam to McKay Creek	5	
GA12	Birch, mouth to forks including Stewart Creek	6	Limited fall flows
GA21	Mckay Cr, McKay Dam to North Fork	7	Barrier
GA9	Umatilla, Butter Cr to Westland Dam	9	

Fall Chinook Priority Geographic Areas for Protection

GA	GA Description	Priority	Rationale for Removal
GA40	Umatilla, Meacham to Forks including all tribs except Ryan Creek	1	
GA28	Umatilla, Mission Bridge to Meacham Creek	2	
GA33	Meacham, Mouth to North Fork	3	
GA21	Mckay Cr, McKay Dam to North Fork	4	Barrier
GA20	Mckay Cr, mouth to McKay Dam	5	Adult Barrier
GA25	Umatilla, Mckay Creek to Mission Bridge	6	
GA12	Birch, mouth to forks including Stewart Creek	7	

Appendix F – Inventory Questionnaire and Responses

Below is the letter and inventory questionnaire that was mailed out to stakeholders in 2003, requesting information on their various projects and programs occurring in the Umatilla/Willow subbasin. The list of responses follows.

LETTER SENT TO STAKEHOLDERS

July 7, 2003

Dear Stakeholders and Subbasin Cooperators:

I am asking for your help in providing information necessary for the development of a subbasin plan for the Umatilla/Willow Creek subbasin. Subbasin plans are being developed in response to the Northwest Power Planning Council's (NWPPC) new review and selection process and will serve multiple purposes. They will be used to direct Bonneville Power Administration (BPA) funding of projects that protect, mitigate and enhance fish and wildlife that have been adversely impacted by the development and operation of the Columbia River hydropower system. They will also be used by NWPPC, BPA, the National Oceanic and Atmospheric Administration (NOAA) Fisheries and the U.S. Fish and Wildlife Service (USFWS) to help meet requirements of the 2000 Federal Columbia River Power System Biological Opinion. In addition, NOAA Fisheries and USFWS will use subbasin plans as a foundation for recovery planning for threatened and endangered species.

Part of the plan includes an inventory of existing regulations and activities at the private, local, state, and federal level in the Umatilla/Willow Creek subbasin. Attached is a questionnaire that asks for the information required by the NWPPC for the inventory section of the plan. The quality of our subbasin plan depends on gathering complete and accurate information. Please fill out the attached information as it relates to you or your organization and return it to me by **August 15, 2003**. Please let me know if your response cannot be provided by that date. Your participation in this process is greatly appreciated, and will contribute to the improvement of the future of fish and wildlife in the Umatilla/Willow Creek subbasin.

Sincerely,

Jim Phelps
Project Manager

Inventory Questionnaire for Umatilla/Willow Creek Subbasin Plan

Please answer the following questions as completely as possible.

Part I. Existing Legal Protection

Identify areas in the Umatilla/Willow Creek subbasin with legal protections through stream buffers, municipal or county ordinances, conservation designations, or water resources protection.

Part II. Existing Plans

Identify and briefly describe local, state, tribal, and/or federal fish and/or wildlife management plans and water resource management plans that affect fish and wildlife in the Umatilla/Willow Creek subbasin. We have some listed already -- see the list of "Existing Plans" at the end of this questionnaire -- but please add others that you are aware of that do not appear on the list.

Part III. Existing Management Programs

Identify ongoing or planned public and private management programs or initiatives that have a significant effect on fish, wildlife, water resources, riparian areas, and/or upland areas. As applicable, describe the extent to which these programs extend beyond the subbasin to a larger scale (provincial and basin-wide).

Part IV. Existing Restoration and Conservation Projects

NWPPC requires that we identify all on-the-ground restoration and conservation projects that target fish and wildlife or otherwise provide substantial benefit to fish and wildlife. These include projects implemented within the past five years regardless of funding source.

Complete the following information for each project or program that was active at any time in the last five years (January 1998 to present). *(Please note that projects that are part of a larger program do not need to be addressed separately. For example, a general program such as the Conservation Reserve Program (CRP) can be described instead of individual projects that make up CRP.)*

1) What is the title of the project?

2) Briefly (two or three sentences) describe the project, including its location (electronic versions of maps of the project or program are also appreciated).

3) Briefly, describe the goal(s) or objective(s) of the project (be as quantitative as possible).

4) When did the project begin? When did it end or what is its target date for completion?

5) Who is the manager or lead entity for the project?

6) How was the project authorized?

7) Who is responsible for the project's implementation?

8) What is the funding source?

9) What limiting factors or ecological processes is the activity designed to address?

10) Summarize the accomplishments and/or failures of the activity. Have the projects goals (both short-term and long-term) been met? If not, what problems were encountered?

11) How does this project relate to other activities in the subbasin?

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to a larger scale (provincial and basin-wide).

Part V. Contact Information:
Whom may we contact in your organization if we have questions concerning your answers to this questionnaire?

Name:

Title:

Phone Number:

E-mail:

Regular Mail:

Please return this form as soon as possible, but no later than **August 15, 2003**.

Forms may be e-mailed to david.wooster@oregonstate.edu, or sent to:

Jim Phelps, Project Manager
47019 Kirkpatrick Road
Pendleton, OR 97801
541-276-4898

Existing Plans:

- Umatilla Subbasin Summary. Prepared for the NWPPC by Ecovista. 2001.
- Umatilla River Basin Total Maximum Daily Load (TMDL) and Water Quality Management Plan. Prepared by ODEQ and partners. 2001.
- Umatilla River Subbasin Agricultural Water Quality Management Area Plan. Prepared by the Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee. 1999.
- Meacham Creek Watershed Analysis and Action Plan, Draft. Prepared by Duck Creek Associates. 2002.
- Bull Trout Draft Recovery Plan. United States Fish and Wildlife Service. 2002.
- Willow Creek Agricultural Water Quality Management Area Plan, Draft. Prepared by the Oregon Department of Agriculture. 2003.
- Umatilla Basin Project, Phase I (completed in 1993) and Phase II (completed in 1999).

The questionnaire was sent to the following stake holder groups:

- Umatilla County Soil and Water Conservation District
- Umatilla Basin Watershed Council
- Bureau of Indian Affairs
- Natural Resource Conservation Service (e.g., CAFO)
- Morrow County Soil and Water Conservation District
- Oregon Department of Environmental Quality
- Oregon Department of Agriculture
- Oregon Department of Fisheries and Wildlife
- Oregon Department of Forestry
- Oregon Department of Transportation (e.g., ATV money that goes towards watershed mitigation fund?)
- CTUIR – Fisheries, Habitat, Water Resources, Planning, etc.
- US Forest Service
- US Bureau of Reclamation
- Westland Irrigation District
- Stanfield Irrigation District
- Hermiston Irrigation District
- West Extension Irrigation District
- IRZ Consulting
- Pacific Power and Light
- Umatilla Electric Coop. Assoc.
- Oregon Department of Environmental Quality
- Army Corp of Engineers
- USGS
- Stewards of the Umatilla River Environment – Betty Klepper

- Cities of Pendleton, Hermiston, Stanfield, Echo, Boardman, Heppner, Ione, Lexington (including departments of waste water, planning, etc.)
- Umatilla and Morrow counties (planning and water departments)
- OSU's Pendleton and Hermiston Agricultural Research and Extension Centers.
- Pendleton, Hermiston, Stanfield and other schools and or school districts
- TOAST
- Pheasants Forever
- Trout Unlimited
- Oregon Hunters Association
- Wild Turkey Federation
- Rocky Mountain Elk Foundation
- Nature Conservancy

INVENTORY QUESTIONNAIRE RESPONSES

I. Existing Legal Protection

Identify areas in the Umatilla/Willow Creek subbasin with legal protections through stream buffers, municipal or county ordinances, conservation designations, or water resources protection.

County-Level Legal Protection

From J.R. Cook, Umatilla County Planner (8-12-2003):
The Umatilla County Development Ordinance has several provisions related to protecting fragile areas within the Umatilla Subbasin. For example, the County has numerous sections of ordinance that concern stream set back, including sections §152.063(E), §152.088(E), §152.105(F), §152.119(C), §152.134(D), §152.159(D), §152.218(E), §152.233(E), §152.250(D), §152.264(E), §152.280(D), §152.294(D), §152.310(D) §152.325(D), and §152.339(D). These sections ensure that a minimum distance exists between structures and sewage disposal installations and the high-water line of streams, lakes, and wetlands. The County also has provisions restricting: 1) the removal of riparian vegetation near streams, lakes, and wetlands (Riparian Vegetation: Wetland Drainage-§152.016), 2) the use of lands that are likely to be flooded or to exacerbate floods (Floodplain Ordinance - §152.350-152.36), 3) the development of housing in important elk and deer winter range (Critical Winter Range "CWR" Overlay Zone-§152.455-152.458), and 4) the use of lands that have been designated as "natural areas," or areas that have special value as habitats for rare or endangered plants or wildlife, as wetlands, or as areas that are "ecologically and scientifically important to the understanding of the natural history of the region" (Natural Area "NA" Overlay Zone-§152.470-152.475).

From Carla McLane, Planning Director, Morrow County (8-11-03):
Like Umatilla County, Morrow County also has provisions in its Morrow County Zoning Ordinance that relate to protecting areas that may be vulnerable to flooding. Particularly, one section of the ordinance, the Flood Hazard Overlay Zone (§3.100), assures that

construction and other development within a floodplain meets the Federal Emergency Management Agency standards. This section leads to the protection of water resources and riparian areas by assuring that limited and appropriate development occurs within the floodplain.

Conservation Easements – CTUIR

A total of 90 easements have been secured with private landowners since the project inception in 1987 (Table 2). There are currently 85 easements on 41 different properties with landowners to improve and/or protect riparian, improve passage, and provide streambank and channel stability in the Umatilla subbasin. Targeted areas include portions of the mainstem Umatilla River and stream reaches in Birch, Wildhorse, Mission, Cottonwood, Moonshine, Buckaroo, Iskuulpa and Meacham creek subwatersheds.

Table 2. Conservation easements secured by the CTUIR since 1987.

Easement type	Date of easement	Termination date of easement	Application description	Project map location	Watershed
Riparian Conservation Agreement	7-May-97	7-May-22	Sole purpose of implementing and maintaining riparian habitat improvements	Riparian Corridor through T2N,R35E,Sect 8, Tax Lot 2800	Buckaroo Creek (Rm 1.0-1.3)
Conservation Easement	1-Oct-99	1-Oct-14	Sole purpose of implementing and maintaining riparian habitat improvements on Trust land	Riparian Corridor through T2N,R34E,Sect 8SE, Allotment 978	Buckaroo Creek (Rm 1.3-1.7)
Conservation Easement	1-Oct-99	1-Oct-14	Sole purpose of implementing and maintaining riparian habitat improvements on Fee land	Riparian Corridor through T2N,R35E,Sect 7NE, Tax lot 2400	Buckaroo Creek (Rm 1.7-2.1)
Conservation Easement	1-Oct-99	1-Oct-14	Sole purpose of implementing and maintaining riparian habitat improvements on Trust land	Riparian Corridor through T2N,R34E,Sect 7SE, Allotment 1088	Buckaroo Creek (Rm 2.1-2.2)
Conservation Easement	1-Oct-99	1-Oct-14	Sole purpose of implementing and maintaining riparian habitat improvements on Trust land	Riparian Corridor through T2N,R34E,Sect 7SE, Allotment 992	Buckaroo Creek (Rm 2.2-2.6)
BIA	2-Oct-01	2-Oct-26	Non-exclusive easement for replacement of culvert over, across, in and upon the described lands	Right of way through T2N,R34E, Sect 7NENE	Cottonwood Creek (Rm 0.5)
Riparian Conservation Agreement	1-Sep-02	1-Sep-17	Livestock exclusion and riparian corridor fencing, with noxious weed control, and revegetation.	Riparian Corridor through T2S,R33E,Sect 18NE, Tax Lot 1407	East Birch Creek (Rm 10.3-10.5)
Riparian Conservation Agreement	12-Oct-95	12-Oct-10	Sole purpose of implementing and maintaining riparian habitat improvements	Riparian Corridor through T3N,R34E,Sect 7&18, Tax lots 3200, 9800, & 10000	Greasewood Creek (Rm 0.0-1.5)
Riparian Conservation Agreement	1-Jan-97	1-Jan-12	Livestock exclusion and riparian corridor fencing, with noxious weed control, and revegetation. Constructing and maintaining stream bank stabilization structures.	Riparian Corridor through T1S,R33E,Sect 5, Tax Lot 501	McKay Creek (Rm 18)

Easement type	Date of easement	Termination date of easement	Application description	Project map location	Watershed
Riparian Conservation Agreement	1-Jun-99	1-Jun-14	Livestock exclusion and riparian corridor fencing, with noxious weed control, and revegetation.	Riparian Corridor through T1S,R33E,Sect 5NW, Tax Lots 1001 and 1003	McKay Creek (Rm 21.5)
Lease	31-Mar-90	31-Mar-00 (currently renewing)	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T3N,R36E,Sect 29, 30, 31, & 32 Tax Lots 12600 & 700	Meacham Creek (Rm 0.2-0.35)
Lease	1-Sep-88	1-Sep-03 (currently renewing)	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T2N,R36E,Sect 7, #120506 Lot 2	Meacham Creek (Rm 0.0-0.2)
BIA Instream Riparian Area Corridor Right-Of-Way	13-Apr-89	13-Apr-04	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T2N,R36E,Sect 6, Allotment 1283	Meacham Creek (Rm 2.2-2.6)
BIA Instream Riparian Area Corridor Right-Of-Way	1-Jun-89	1-Jun-04	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T2N,R36E,Sect 18, Allotment 1231	Meacham Creek (Rm 3.8-4.15)
Lease	21-Jun-89	21-Jun-04	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T2N,R36E,Sect 7, #120507 Lots 1, 3, & 4	Meacham Creek (Rm 1.6-2.2)
Lease	1-Aug-89	1-Aug-04	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T3N,R36E,Sect 31, Tax Lot 14700	Meacham Creek (Rm 1.3-1.6)
Lease	31-Jan-90	31-Jan-05	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T2N,R36E,Sect 6, #800 Lot 3; T3N,R36E,Sect 30,31, Tax Lot 122338 and Tax Lot 122366 Lot 14500	Meacham Creek (Rm 3.25-4.15)
Easement	20-Jul-90	20-Jul-05	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T3N,R36E,Sect 29, Allotment 714 & Sect 32, Allotment 863	Meacham Creek (Rm 1.2-1.4)
Riparian Easement	15-Oct-94	15-Oct-09	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T2N,R36E,Sect 18, Allotment 1232	Meacham Creek (Rm 4.15-4.5)
Easement	10-Mar-95	17-Nov-09	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T2N,R36E,Sect 18, Allotments 1138, 1232	Meacham Creek (Rm 4.5-4.8)
Lease	29-Sep-89	29-Sep-04	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian Corridor through T3N,R36E, Sect 30&31,Tax Lot 14000	Meacham Creek (Rm 0-0.1)
Lease	26-Jun-89	26-Jun-03 (currently renewing)	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian corridor through T2N,R36E,Sect 7, #120510 Lot 900	Meacham Creek (Rm 2.0-4.0)

Easement type	Date of easement	Termination date of easement	Application description	Project map location	Watershed
Lease	1-Sep-88	1-Sep-03 (currently renewing)	Sole purpose of installing and maintaining instream fish habitat structures and close to livestock grazing	Riparian corridor through T2N,R36E,Sect 7, #120504 Lot 1	Meacham Creek (Rm 2.9-3.2)
Access, Implementation and Maintenance Agreement	1-Jul-00	1-Jul-05	Sole purpose of constructing and maintaining stream bank stabilization structures and planting native riparian vegetation.	T2N, R30E, Sect 2&11, Tax Lot 1000	Mid Umatilla River (Rm 37.3-37.4)
Riparian Conservation Agreement	1-May-01	1-May-16	Livestock exclusion and riparian corridor fencing, with noxious weed control, off-site livestock water development, and revegetation.	Riparian Corridor through T2N,R31E,Sect 16&17, Tax Lot 3422	Mid Umatilla River (Rm 44.8-46.5)
Riparian Conservation Agreement	25-Jan-03	25-Jan-23	Livestock exclusion and riparian corridor fencing, with noxious weed control, off-site livestock water development, and revegetation.	Riparian Corridor through T2N,R31E,Sect 15SW &16SE, Tax Lot 3400	Mid Umatilla River (Rm 45.5-46.5)
Riparian Conservation Agreement	1-Jan-01	1-Jan-16	Livestock exclusion and riparian corridor fencing, with noxious weed control, off-site livestock water development, and revegetation.	Riparian Corridor through T2N,R31E,Sect 14&15, Tax Lot 3422 & 3001	Mid Umatilla River (Rm 46.5-47.5)
Riparian Conservation Agreement	1-Jan-96	1-Jan-11	Sole purpose of implementing and maintaining riparian habitat improvements and engineered stream ford	Riparian Corridor through T2N,R33E,Sect 24SE, Tax lots 7401 & 7403	Mission Creek (Rm 2.9-3.3)
Riparian Conservation Agreement	10-Sep-96	10-Sep-11	Sole purpose of implementing and maintaining riparian habitat improvements	Riparian Corridor through T3N,R34E,Sect 12, Tax lot 6500	Spring Hollow Creek, tributary to Wildhorse (Rm 3.4-4.0)
Riparian Lease	22-Feb-91	22-Feb-06	Sole purpose of installing and maintaining instream fish habitat structures (holding pools) and closed to livestock grazing	Riparian Corridor through T3N,R36E,Sect 21, Tax lot 9900	Upper Umatilla River (Rm 81.2-81.5)
Riparian Conservation Agreement	1-Jul-00	Perpetual	Sole purpose of constructing and maintaining stream bank and channel stabilization structures and planting native riparian vegetation.	Riparian Corridor through T2N,R33,Sect 11, Tax lots 300 & 400	Upper Umatilla River (Rm 63.5)
Lease	1-Aug-89	1-Aug-04	Sole purpose of installing and maintaining instream fish habitat structures (holding pools) and close to livestock grazing	Riparian Corridor through T3N,R36E,Sects 29, Tax lots 122313, 11901, 122329, 12400	Upper Umatilla River (Rm 78.8-80.1)
Right-Of-Way	9-Aug-89	9-Aug-04	Sole purpose of installing and maintaining instream fish habitat structures (holding pools) and installation and maintenance of riparian corridor fence	Riparian Corridor through T3N,R36E,Sects 29, Tax Allotment 09501 (formerly 714)	Upper Umatilla River (Rm 78.8-80.1)
Riparian Conservation Agreement	1-Jul-00	1-Jul-15	Sole purpose of constructing and maintaining instream enhancement structures	Riparian Corridor through T3N,R36E,Sect 22, Tax Lot 6603	Upper Umatilla River (Rm 83.0-83.2)

Easement type	Date of easement	Termination date of easement	Application description	Project map location	Watershed
Access, Implementation and Maintenance Agreement	15-Jun-99	15-Jun-04	Sole purpose of constructing and maintaining stream bank stabilization structures and planting native riparian vegetation.	T3N, R36E, Sect 13SW, Tax Lot 6007	Upper Umatilla River (Rm 85.0)
Riparian Conservation Agreement	1-Jul-02	1-Jul-17	Livestock exclusion and riparian corridor fencing, with noxious weed control, and revegetation. Constructing and maintaining instream enhancement stuctures (logjams & pointbar).	Riparian Corridor through T3N,R37E,Sect 17N, Tax Lot 4300	Upper Umatilla River (Rm 87.0-87.3)
Riparian Conservation Agreement	12-Oct-95	12-Oct-10	Sole purpose of implementing and maintaining riparian habitat improvements.	Riparian Corridor through T3N,R34E,Sect 7, Tax lot 3300	West Fork Greasewood Creek (Rm 0.0-0.3)
Riparian Conservation Agreement	1-Sep-94	1-Sep-09	Sole purpose of implementing and maintaining riparian habitat improvements. Constructing and maintaining instream sediment retention structures.	Riparian Corridor through T3N,R34E,Sect 8&17, Tax lot 8800	Wildhorse Creek (Rm 10.25-11.0)
Riparian Conservation Agreement	12-Oct-95	12-Oct-10	Sole purpose of implementing and maintaining riparian habitat improvements	Riparian Corridor through T3N,R34E,Sect 9, Tax lots 4200 & 4400	Wildhorse Creek (Rm 11.75-12.0)
Riparian Conservation Agreement	12-Oct-95	12-Oct-10	Sole purpose of implementing and maintaining riparian habitat improvements	Riparian Corridor through T3N,R34E,Sect 9, Tax lot 4300	Wildhorse Creek (Rm 12.0-12.5)
Riparian Conservation Agreement	24-Oct-94	24-Oct-09	Sole purpose of implementing and maintaining riparian habitat improvements. Constructing and maintaining instream sediment retention stuctures.	Riparian Corridor through T3N,R34E,Sect 8,17&18, Tax lots 3300, 3301, & 3400	Wildhorse Creek (Rm 9.5-10.25)

USDA – Umatilla National Forest response from

Del Groat
Fisheries Biologist & Recreation RDMA
Pomeroy Ranger Dist.
71 West Main St.
Pomeroy Washington, 99347
(509) 843-4639, dgroat@fs.fed.us

The Umatilla National Forest must follow the Legal restrictions, procedures and guidelines of several Congressional Acts that offer land use protection. NEPA (National Environmental Policy Act, NFMA (National Forest Management Act), ESA, (Endangered Species Act), the Clean Water Act, and etc. All ongoing activities have been through ESA consultation with the regulatory agencies, i.e. NOAA Fisheries and USFWS. New projects must also be consulted.

Response from Oregon Water Resources Department – Pendleton, OR office
The Oregon Water Resources Department (OWRD) has several plans, programs and policies in place regarding water resources protection for the Umatilla/Willow Creek Subbasin. ORS 536.220 requires the Oregon Water Resources Commission to formulate and implement an integrated, coordinated state water resources policy. These state water resources policies are detailed in OAR Oregon Administrative Rules (OAR) 690-400 and 690-410.

Other water resources protections include the Umatilla Basin Report and associated Umatilla Basin Program adopted in 1988 and codified at OAR 690-507; OAR 690-33; OAR 690-09; OAR 690-; and OAR 690-200 thru 240. These protections are described in greater detail in Part II of this questionnaire.

OWRD, with the assistance of a task force, also developed the McKay and Umatilla River Water Management Plan in 1991. We also shepherd water provided by Phases I and II of the Umatilla Basin Project for the benefit of fish.

Part II. Existing Plans

Identify and briefly describe local, state, tribal, and/or federal fish and/or wildlife management plans and water resource management plans that affect fish and wildlife in the Umatilla/Willow Creek subbasin.

1) From J.R. Cook, Umatilla County Planner (8-12-2003):
Umatilla County's Comprehensive Plan. This plan includes goals that relate to the conservation and preservation of lands, "including those having a direct or indirect impact on fish and wildlife in the Umatilla Subbasin. These goals, and their general applications, include:

- Goal 3 (Agricultural Lands) provides the basis of support for programs such as soil and water conservation management practices that deter activities, such as overgrazing, which aid in the erosion of forage lands and creek banks
- Goal 4 (Forest Lands) implements a conservation plan for grazing/forested areas vital to wildlife and watershed well-being
- Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) establishes the NA (Natural Area) and CWR (Critical Winter Range) overlay zones, as well as other preservation measures such as controlled land use, endangered and threatened species protection, etc.
- Goal 6 (Air, Water and Land Resources Quality) establishes water quality/quantity and pollution abatement measures."

2) Willow Creek Agricultural Water Quality Management Area Plan. This plan "provides guidance for addressing agricultural water quality issues in the Willow Creek Agricultural Water Quality Management Area. The purpose of the plan is to identify strategies to reduce water pollution from agricultural lands through a combination of educational programs, suggested land treatments, management activities, and monitoring. This Area Plan will be used by local management agencies for guiding implementation,

outreach, and assistance efforts and by landowners to enhance their awareness and understanding of water quality issues." (reference, and date)
Other Plans to Describe:

From Mike Lambert, CTUIR:
3) A Program to Manage Rangeland and Pasture Resource on the Umatilla Indian Reservation Umatilla County, Oregon. Environmental assessment draft. Prepared by U.S. Department of the Interior Bureau of Indian Affairs. June 2001.

4) Forest Management Plan for the Umatilla Indian Reservation Draft. Prepared by the Confederated Tribes of the Umatilla Indian Reservation and Mason, Bruce, & Girard Inc. 2003.

5) Oregon Department of Agriculture's (ODAs) Agricultural Water Quality Management (AgWQM) Program

1) What is the title of the project?

2) Briefly describe the project, including its location

The AgWQM Program describes a process for the development and implementation of Agricultural Water Quality Management Area Plans and Rules for all areas in the state where such plans are required by state or federal law.

3) Briefly, describe the goals or objectives of the project

The program addresses the prevention and control of water pollution associated with agricultural lands and activities with a goal of achieving water quality standards. Objectives include strategies to increase awareness of the problems and the range of solutions, motivations for appropriate voluntary action, and the provision for technical and financial assistance to plan and implement effective conservation practices.

4) When did the project begin?

The law was passed in 1993 with development of the Umatilla River Subbasin AgWQMAP completed in 1999 and the Willow Creek AgWQMAP in 2003.

5) Who is the manager or lead entity for the project?

The program is managed by the ODA, Natural Resources Division, Water Quality Program. The local representative is Tom Straughan, ODA Regional Water Quality Planner.

6) How was the project authorized?

The program was created by the Agricultural Water Quality Management Act (Senate Bill 1010) passed by the Oregon Legislature in 1993 with additional legislation in 1995 and 2001.

7) Who is responsible for the project's implementation?

The program is implemented by ODA with assistance from the Local Management Agencies: the Umatilla County and Morrow Soil and Water Conservation Districts. The administrative Area Rules associated with the Area Plan are enforced by ODA.

8) What is the funding source?

State general funds, grants and lottery

9) What limiting factors or ecological processes is the activity designed to address?

Generally, AgWQM Area Plans address water pollution from all agricultural activities and soil erosion. The Area Rules address parameters listed in the 303(d) list. In most areas this includes temperature, sediment, nutrients and bacteria.

The Umatilla River subbasin AgWQM Area Plan addresses these parameters through Prevention and Control Measures for soil erosion and sediment control, waste management, stream-side area management, livestock management, irrigation management, nutrient and farm chemical management and channel and drain management. The Willow Creek AgWQM Area Plan addresses these parameters through waste management, upland management and soil erosion, riparian and streamside area management, and irrigation management measures.

10) Summarize the accomplishments and /or failure of the activity. Have project goals been met?

The Umatilla River subbasin AgWQM Area Plan and Rules were approved in 1999 and are currently undergoing the first biennial review. Except for the waste management rules, which were already in statute, the Area Rules do not become enforceable until 2010. The biennial review will result in a rewrite of the Area Plan to add much more watershed scale information including TMDL and Lower Umatilla GWMA targets.

The Willow Creek AgWQM Area Plan and Rules have undergone the public review and will be approved at the September 2003 meeting of the Board of Agriculture.

The process involved with utilizing a local advisory committee to develop the Area Plans and Rules has led to a great deal of public participation from the public and agricultural interests. The SWCDs continue to do education and outreach to make sure that all affected landowners are aware of the requirements.

11) How does this project relate to other activities in the subbasin?

The AgWQM Area Plan is recognized as the water quality management plan to address the agricultural allocations in the Umatilla Basin TMDL. The rules associated with the AgWQM program provide a mechanism for enforcement of water quality standards.

The AgWQM Area Plans identify concerns related to livestock, covered by the CAFO program and concerns related to groundwater, covered by the LUB GWMA Action Plan.

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to a larger scale.

By the end of 2004, the AgWQM Program will have approved plans and rules for all basins in the state that have water quality limited designations.

Part IV. Contact Information

Name: Tom Straughan
Title: ODA Regional Water Quality Planner
Phone Number: 541-278-6721
E-mail: tstraugh@oda.state.or.us
Address: 1 SW Nye, Suite B, Pendleton, OR 97801

6) Lower Umatilla Basin Groundwater Management Area Action Plan

1) What is the title of the project?

Lower Umatilla Basin Groundwater Management Area Action Plan

2) Briefly, describe the project, including its location.

The northern portion of Morrow county and the northwest portion of Umatilla county, roughly between Cold Springs Reservoir and Willow Creek, were designated a Groundwater Management Area by DEQ in 1990.

3) Briefly, describe the goals or objectives of the project.

The goal of the Action Plan, as directed through statute, is to seek solutions to protect the area's groundwater by bringing the level of nitrate-nitrogen in the groundwater back below 7 mg/l. The federal safe drinking water standard is 10 mg/l.

4) When did the project begin?

The investigation into groundwater contamination began in the 1980's, GWMA designation was in 1990 and the Action Plan was approved in 1997.

5) Who is the manager or lead entity for the project?

The Oregon Department of Environmental Quality (DEQ) is the lead entity with responsibilities for farming practices to the Oregon Department of Agriculture (ODA).

6) How was the project authorized?

The project was authorized by Oregon's Groundwater Protection Act (ORS 468B.180).

7) Who is responsible for the project's implementation?

The Action Plan was created by ODA and DEQ with assistance from a local Groundwater Management Area Committee (GWMAC).

Implementation of the Action plan is the responsibility of ODA and DEQ with designated responsibilities to other agencies including: Umatilla County and Morrow Soil and Water Conservation Districts, OSU Extension Service, U.S. Army, Natural Resources Conservation Service, Umatilla and Morrow Planning Departments, Oregon Water Resources Department and Oregon Health Division.

8) What is the funding source?

State general fund and grants

9) What limiting factors or ecological processes is the activity designed to address?
The project is addressing groundwater nitrate-nitrogen contamination from: irrigated agriculture, food processing, confined animal feeding operations, domestic sewage, and chemical washout of munitions. This contamination limits the use of groundwater for domestic drinking water supplies and some other uses.

10) Summarize the accomplishments and /or failure of the activity. Have project goals been met?

The responsible agencies have continued to implement action items identified in the Action Plan and meet yearly to assess progress toward meeting the goals of the plan. Progress continues to be made towards accomplishing those goals, but to-date, the actual levels of nitrate-nitrogen in sampling wells has been erratic with only a general trend downward. More knowledge is needed about the sources of contamination and the nature of groundwater flows.

11) How does this project relate to other activities in the subbasin?

Because of hydrological connection between surface water and groundwater, this project relates to the Agricultural Water Quality Management program, the Confined Animal Feeding Operation program and the TMDL program.

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to a larger scale.

This designated groundwater management area is limited to portions of the Umatilla-Willow Creek basin. However, knowledge gained will be applied to other similar regions.

Part IV. Contact Information
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Address: 1 SW Nye, Suite B, Pendleton, OR 97801

7) Oregon Department of Agriculture's (ODA's) Confined Animal Feeding Operation (CAFO) Program

1) What is the title of the project?

Oregon Department of Agriculture's (ODA's) Confined Animal Feeding Operation (CAFO) Program

2) Briefly describe the project, including its location.

Oregon law now requires ODA to regulate all livestock feeding operations to satisfy both state and federal water quality laws. This includes defined CAFOs and Animal Feeding Operations (AFOs). CAFOs that meet certain requirements of animal numbers, length of confinement, condition of lots and have wastewater handling facilities or animal contact with surface water will be required to obtain an Oregon CAFO General Permit which meets the requirements of the National Pollutant Discharge Elimination System program.

3) Briefly, describe the goals or objectives of the project.

This program's goal is to satisfy both state water quality laws and the federal Clean Water Act by preventing and controlling pollution of the states waters from livestock feeding operations.

4) When did the project begin?

The program has been in existence for many years but the state laws were revised in 2001 to bring ODA into compliance with federal law. Administrative rules for both the federal program and the state program were approved in 2003.

5) Who is the manager or lead entity for the project?

Debbie Gorham, administrator of ODA's Natural Resources Division, is the program manager. Eric Moeggenberg, ODA Livestock Water Quality Specialist, administers the program for this region.

6) How was the project authorized?

In 2001, the Oregon Legislature passed House Bill 2156, authorizing the program.

7) Who is responsible for the project's implementation?

The program is implemented by ODA with assistance from the local Soil and Water Conservation Districts and OSU Extension Service.

8) What is the funding source?

State general funds and fees.

9) What limiting factors or ecological processes is the activity designed to address?

The program addresses runoff of sediment and animal wastes into waters of the state. Runoff from feeding areas causes degradation of the water by introducing bacteria, nutrients and sediment to the water causing damage to aquatic life and posing risks to human health.

10) Summarize the accomplishments and /or failure of the activity. Have project goals been met?

Prior to implementation of the state's program, some inspections were done by EPA that resulted in fines to a few operators. This and the outreach done by ODA and OSU Extension has greatly increased awareness of the potential problems associated with animal feeding operations and the requirement of the program. Education and outreach to operators is continuing while operators are asked to voluntarily sign up for the permits. An effort is being made by ODA and the SWCD to inventory the existing operations so that all operations will come into compliance within three years.

11) How does this project relate to other activities in the subbasin?

This program sets rules for certain CAFOs while the Agricultural Water Quality Management Program has rules that apply to all other livestock operations for the prevention and control of water pollution.

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to a larger scale.

The rules established under this program apply to all identified animal feeding operations in the state. These rules are consistent with federal rules that apply nation-wide.

Part IV. Contact Information
Name: Tom Straughan
Title: ODA Regional Water Quality Planner

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E-mail: tstraugh@oda.state.or.us
Address: 1 SW Nye, Suite B, Pendleton, OR 97801

8) OREGON TMDL PROGRAM – ALREADY IDENTIFIED IN THE ATTACHED LIST.

CONTACT INFO FOR UMATILLA BASIN AND WILLOW CREEK TMDLS:

Don Butcher
Department of Environmental Quality
700 SE Emigrant, Ste. 330
Pendleton, OR 97801

(541)278-4603
butcher.don@deq.state.or.us

9) Umatilla National Forest

The Umatilla N.F. operates under a number of plans that offer various legal protections. The Umatilla National Forest "Land and Resource Management Plan" 1990 provides legal definitions for aquatic habitat, riparian, old growth, scenic and wildlife designations. An example of this would be "C5" Riparian (Fish and Wildlife). The Goal for C5 is to maintain or enhance water quality and produce fish at a high level of potential habitat capability for all species of fish and wildlife within the designated riparian habitat areas… Some other examples are "C3" - Big Game Winter Range, "E1" - Timber and Forage, "A1" Non-Motorized Dispersed Recreation, each of which have their own definition and objections.

PACFISH ("The Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho and Portions of California," Mar., 1994) and to some extent INFISH are two other plans specific to riparian areas. By definition 300 ft. zones were created around all fish bearing habitat and fall under a certain type of protection from harvest, grazing, burning and etc. Definitions also exist for perennial, intermittent and ephemeral habitats with designated buffering.

We also have a vegetation strategy. "Managing for Competing and Unwanted Vegetation" Nov., 1988. Within this plan is the rules and regulations we must follow for dealing with noxious weeds, non-commercial harvest, and etc.

The Forest Plan is specific to the Umatilla. The other two main documents are FEIS's that govern the implementation of multi-use strategies across Region 6 Forests.

10) Oregon Water Resources Department – Pendleton office

Umatilla Basin Program OAR 690-507. Basin programs are administrative rules adopted by the Water Resources Commission that prescribe future allowable uses of water. The act of specifying the allowable future beneficial uses is called "classification" and is authorized under ORS 536.340. OAR 690-507 classifies the waters of the Umatilla Basin, including Willow Creek Subbasin. These rules were amended in 1988 based on updated information cited in the Umatilla Basin Report-1988. The rules detail the beneficial uses of water that may be eligible for filing an application for a water right permit. The rules also prohibit some new uses in some subbasins of the Umatilla Basin.

Also included in these rules are minimum flows, with most of them being converted to insream water rights, adopted for aquatic life for various rivers or streams in the basin. In addition to minimum flows adopted in these rules, instream water rights have been issued in the basin. See attached table I for these instream water rights.

OAR 690-33: These rules, commonly referred to as the Columbia/Snake Rules, are additional public interest standards that must be considered when evaluating new requests for permits within the State of Oregon. The rules take into consideration whether a new permit would be within the public interest while still protecting existing sensitive, endangered or threatened fish species.

OAR 690-09: These rules guide the OWRD in making determinations whether wells have the potential to cause substantial interference with surface water supplies. These rules are used to determine if a new ground water application for a permit has substantial interference with a surface water supply and if they do, process them similar to a request for surface water. If the surface water is not available, normally, the ground water application is denied.

OAR 690-250: These rules provide more direction and guidance to the OWRD Watermasters on how to distribute, regulate waters of the state, and enforce State Water Laws.

OAR 690-200 thru 240: These rules contain the state's well construction standards for the protection of the ground water resources of the state. Faulty well construction and maintenance of wells have the potential to contaminate aquifers. If these aquifers discharge to surface water sources, they too have the potential for contamination**.**

McKay and Umatilla River Water Management Plan-1991: This plan was officially adopted by the Water Resources Commission and details how water will be managed and regulated within the Umatilla River and McKay Creek. This includes how McKay water is regulated and distributed.

Shepherding water provided by Phase I and II of the Umatilla Basin Project for the benefit of fish: As authorized by the transfer exchange order and subsequent water use permit, OWRD protects water instream for the benefit of the fish in the Umatilla River. This project provides sufficient flow augmentation in the Umatilla River to allow anadromous species to return to the Umatilla Basin.

Part III. Existing Management Programs

Identify ongoing or planned public and private management programs or initiatives that have a significant effect on fish, wildlife, water resources, riparian areas, and/or upland areas. As applicable, describe the extent to which these programs extend beyond the subbasin to a larger scale (provincial and basin-wide).

Programs to Improve Riparian Habitat, In-stream Water Quality, and Groundwater Conditions

1) Lower Umatilla Basin Groundwater Management Area (LUBGWMA) Voluntary Action Plan

From J.R. Cook, Umatilla County Planner (8-12-2003):
The County participates in the ODEQ's Lower Umatilla Basin Groundwater Management Area ("LUBGWMA") Voluntary Action Plan. Implementing the plan indirectly supports fish and wildlife by improving groundwater quality in part of the Subbasin. Phil Richardson, DEQ, can provide more information about LUBGWMA.

2) Hazardous Materials Training for Public Works Employees

From Karen King, Regulatory Specialist for the City of Pendleton.
The Hazardous Materials Training for Public Works Employees was a program which provided hazardous material spill response training for municipal and county public works employees, enabling them to assess a spill hazard and respond accordingly. The program, which was completed in July, 2003, was designed to address concerns that surfaced during the Umatilla Basin Total Maximum Daily Load and Water Quality Management Plan's preparation. Specifically, it was recognized that public works employees throughout the Umatilla Basin needed to better understand how to handle hazardous materials spills both from their own equipment and from other sources. One of the goals of the program was to enhance and protect riparian areas and streams by preventing runoff from hazardous chemical spills that could convey pollutants into these systems. The project was coordinated by Karen King, Regulatory Specialist for City of Pendleton, and was funded by a Regional Geographic Initiative (RGI) grant from U.S. Environmental Protection Agency (EPA) and from in-kind contribution of staff time and materials from Hermiston Fire and Emergency Services, Eastern Oregon Regional Utilities Training Association, Oregon Department of Transportation, U.S. EPA, Oregon Department of Environmental Quality, Hermiston, Pilot Rock and Umatilla County Public Works Departments, and the City of Pendleton Public Works Department.

The Hazardous Materials Training for Public Works Employees project provided basic awareness and initial response training for 85 public works, business and agency employees from 22 agencies in eastern Oregon. The participants are more aware of the dangers associated with handling and clean-up of hazardous materials and are better able to assess chemical spills and determine if they can clean up the spill themselves or require assistance from a hazardous material team. At the same time, the project provided basic spill kits to 13 agencies in the Umatilla River Basin and surrounding area for initial spill response. These kits will be especially useful in cleaning up small spills of automotive fluids or chemicals. The kits included a copy of the *2000 Emergency Response Guidebook* to assist employees in assessing a chemical spill and responding appropriately. This project created an important link between the activities of public works departments and storm water discharge, and increased collaboration between public works employees and the regional hazardous material response team and the Oregon Department of Environmental Quality Hazardous Waste Program.

3) City of Pendleton Water Supply Development Projects
From Karen King, Regulatory Specialist for the City of Pendleton.
The City of Pendleton is involved in a program consisting of several projects whose primary goals are to improve and stabilize drinking water supplies for Pendleton residents and to ensure that drinking water meets federal Safe Drinking Water Act standards. However, completion of these projects will also improve the quantity and quality of in-stream flows of the Umatilla River, protect groundwater from over drafting, and lead to the development of a surface water supply for future economic development. The projects that make up this program include: building a new, membrane filtration water treatment plant; building a new intake/pump station on the Umatilla River; transferring City water rights from current locations to the new intake/pump station location; and modifying city wells for storing and recovering the filtered water from the new water treatment plant in a process known as “aquifer storage and recovery.” The program began in 1995 when the City and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) began discussion on working jointly to improve water supplies for both entities. The City and CTUIR continued to work together on the project throughout the 1990s and completed several studies to determine the best water management options. In 2001, the City began the engineering and design phase of the project, with construction beginning in 2002. The water treatment plant and the intake/pump station were completed in June, 2003. A pilot study on the aquifer storage and recovery project will begin in December, 2003. The manager of the project is Bob Patterson, Pendleton Public Works Director.

Some history of Pendleton’s water system provides context for understanding the development of the water management plan. The City has historically had two main sources of drinking water. The first is a series of infiltration galleries, commonly known as Thornhollow Springs, located approximately 20 miles east of the City near the Umatilla River. The second source consists of 7 deep basalt wells located throughout the City and another deep basalt well located 6 miles east of the City near Mission. In September, 1999, the State of Oregon Drinking Water program determined that the Thornhollow Springs source was “under the direct influence of surface water.” The City was given eighteen months to complete one of four treatment options, and membrane filtration was chosen. In addition to the treatment requirement, the level in the City’s wells has been dropping at a rate of 2-3 ft per year. Clearly, it was necessary for the City to develop a long-term water management plan.

Thus, the water management plan developed by the City included construction of a membrane filtration water treatment plant. The City also chose to transfer all its surface water rights to one location on the Umatilla River and to build an intake/pump station at that location. In order to stabilize the groundwater level in the underground aquifer, the City decided to modify some City wells and to pump filtered water into the underground aquifer. As part of the overall project, the City plans to return the water from the Thornhollow Springs source back to the Umatilla River, and to, instead, withdraw the water at the surface water intake site, approximately 20 miles down the river. The return of the Thornhollow Springs source will provide significant cooling of the downstream reach of the river. The Thornhollow Springs source has traditionally been used year-round, but when the water right transfer is complete, the source will only be used during the winter and spring months when flows in the Umatilla River are above 250 cfs. Thus, the project will reduce in-stream water temperatures and increase in-stream flows during the critical summer months. Currently, water right transfers have not yet been approved by the Oregon Water Resources Department.

4) THE UMATILLA BASIN TOTAL MAXIMUM DAILY LOAD AND ASSOCIATED BASIN-WIDE MANAGEMENT PLAN PROVIDE GOALS FOR RIPARIAN VEGETATION, CHANNEL MORPHOLOGY AND EROSION REDUCTION THROUGHOUT THE MAINSTEM AND TRIBUTARY WATERSHEDS. THE PLAN ALSO LAYS OUT SCHEDULES, RESPONSIBILITIES, RESOURCES, OUTREACH AND PRIORITIES. THE PROGRAM BOUNDARIES ARE THE UMATILLA BASIN 4TH FIELD HUC. THE GOALS ARE DESIGNED TO ADDRESS STREAM TEMPRATURE, PH, AQUATIC WEEDS AND ALGAE, SEDIMENT AND BACTERIA, AND MORE LOCALLY, NITRATE. AS NOTED IN THE ATTACHED LIST, IT WAS COMPLETED AND APPROVED IN 2001.

SIMILARLY, A TMDL IS BEING DEVELOPED FOR WILLOW CREEK (HEPPNER IONE AREA). THIS TMDL IS EXPECTED TO BE COMPLETED IN SPRING OF 2004. THE TMDL WILL FOCUS ON TEMPERATURE (BASIN WIDE) AND PH, WITH MORE LOCALIZED COVERAGE OF BACTERIA (BALM FORK)

CONTACT INFO FOR UMATILLA BASIN AND WILLOW CREEK TMDLS:

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700 SE Emigrant, Ste. 330
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5) Umatilla National Forest response by Del Groat.

Please refer to the Forest Plan above. This plan is scheduled for a revision in 2005. A watershed assessment was completed for some of the Umatilla sub-watersheds titled "Upper Umatilla River and Meacham Creek Watershed Ecosystem Analysis on Fish and Aquatic Habitats" August 5, 1996. Revised November 1999. This is an existing condition document that supplements project, planning purposes.

6) Umatilla County Soil and Water Conservation District Natural Resource Conservation Program

1) What is the title of the project?

Umatilla County Soil and Water Conservation District Natural Resource Conservation Program

2) Briefly (two or three sentences) describe the project, including its location

The Umatilla County Soil and Water Conservation District is:

1. Administered by elected local citizens of Umatilla County who serve without pay.
2. Operated under the Oregon State Statute.
3. Empowered to request and receive assistance from public agencies, federal, state, county and private sources.
4. Authorized to furnish assistance to Umatilla County residents upon request.

3) Briefly, describe the goal(s) or objectives(s) of the project (be quantitative as possible).

See Attached worksheet

4) When did the program begin? When did it end or what is its target date for

completion?

Soil and Water Conservation Districts have been actively involved in conservation programs since 1945 in Umatilla County.

5) Who is the manager or lead entity for the project?

The board of directors of the Umatilla County SWCD is composed of seven directors. All of the directors must be residents of the district and all but two must be managers of more than ten acres of land. The directors are elected by the eligible voters of the district in a non-partisan ballot at the general election for four staggered terms

6) How was the project authorized?

The District was formed by consolidation of the three original districts in Umatilla County signed by the Secretary of State on March 13, 1974. The original districts were formed under the Soil and Water Conservation Districts Law (ORS 568.210-568.800)

7) Who is responsible for the project's implementation?

SWCD directors or staff implements projects and programs. The participating landowners install individual projects.

8) What is the funding source?

Oregon Department of Agriculture
Environmental Protection Agency
Oregon Department of Environmental Quality
Oregon Watershed Enhancement Board
Natural Resources Conservation Service

9) What limiting factors or ecological processes is the activity designed to address?

- Assist the agricultural community in addressing water quality factors related to sedimentation, temperature and nitrates
- Improving degraded habitat for fish and wildlife

10) Summarize the accomplishments and/or failures of the activity. Have the projects' goals (both short-term and long term) been met? If not what problems were encountered?
See # 3

11) How does this project relate to other activities in the subbasin?

All programs and projects implemented by the SWCD support the water quality and quantity conservation activities in the sub basin.

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to larger scale (provincial and basin-wide)

6) Oregon Water Resources Department – Pendleton office
ORS 536.220 requires the Oregon Water Resources Commission to formulate and implement an integrated, coordinated state water resources policy: The rules adopted in OAR 690-400 detail the State Water Resources Policy and OAR 690-410 identify Statewide Water Resources Management. These rules identify how water resource management will occur in various program areas such as: Ground Water; Hydroelectric Power Development; Instream Flow Protection; Interstate Cooperation; Water Resources Protection on Public Riparian Lands; Conservation and Efficient Water Use; Water Allocation; and Water Storage. For the most part, all of these program areas can have significant effect on fish, wildlife and water resources. Water Resources Management is a Statewide program and therefore extends beyond the Umatilla Basin.

The McKay and Umatilla River Water Management Plan-1991: This plan was officially adopted by the Water Resources Commission and details how water will be managed and regulated within the Umatilla River and McKay Creek.

Part IV. Existing Restoration and Conservation Projects

NWPPC requires that we identify all on-the-ground restoration and conservation projects that target fish and wildlife or otherwise provide substantial benefit to fish and wildlife. These include projects implemented within the past five years regardless of funding source.

Complete the following information for each project or program that was active at any time in the last five years (January 1998 to present).

List projects by limiting factors they address:
Examples of limiting factors and factors for decline

- Water quality problems (temperature and sedimentation)
- Passage barriers
- Lack of adequate screening
- Overwinter habitat is insufficient
- Lack of juvenile rearing habitat
- Low fish or wildlife abundance
- Reduced biological function of habitat above blockages

List of Limiting Factors:
Water Quality
Water Quantity
Invasive Species: not only important out of concern for native plants themselves, but native species may be preferable habitat to wildlife and fish, etc. So affects habitat quality, also affects soil erosion? (Janet Greenup's response) Also biodiversity
Fish Passage Barrier

Project 1: Conservation Reserve Program

General Description: The Conservation Reserve Program (CRP), including the Conservation Reserve Enhancement Program (CREP) and Continuous Conservation Reserve Program (CCRP), is active in both Umatilla and Morrow Counties. CRP provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. It does this by encouraging farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. In return, farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish vegetative cover. Up to 25% of eligible cropland in a county may be enrolled in CRP.

Goals of the Program: The goals of CRP are to reduce soil erosion, protect the ability to produce food and fiber, reduce sedimentation in streams and lakes, improve water quality, establish wildlife habitat, and enhance forest and wetland resources.

Location: Umatilla County has 108,000 acres in the program, with grass stands established throughout the subbasin. Of the 108,000 acres, 347 acres are enrolled in CREP, which involves installing riparian forest buffers along streams, and 991 acres are enrolled in the CCRP. Morrow County has 109,921.1 acres in the program (see Table X for more detailed locations), with 97.7 of those acres enrolled in CCRP.

Table X: Details of CRP in Morrow County

Sign-Up Number	Program Type	Total Acreage	HUC/Location	Duration
13	CRP	1,146.4	170702040201	1997-2006
15	CRP	69,039.9	Dry cropland in various locations	1998-2007
16	CRP	21,675.8	Locations vary	1998/99-2007/08
17	CCRP	121.4	Locations vary	1998-2007
18	CRP	11,051.7	Locations vary	2000-2009
19	CCRP	299.7	Locations vary	1999/00-2009/09
20	CRP	6,262.2	Locations vary	2001-2010
21	CCRP	130.1	Locations vary	2000-2009
22	CCRP	10.6	170701033501	2001/02-2009/10
23	CRP	99.8	170702021601,1707010741203	2003-2012
25	CCRP	5.8	170701040601	2003-2012
27	CCRP	4 9.5 38.4 5.4	170701040601 170701040303 170701040301 170701040601	2003-2012

Duration of Program: Established in 1985, the CRP program continues to receive funding through the United States Department of Agriculture (USDA). The program has been active in Morrow County since 1997, with 10 year contracts issued annually.

Lead Entity: The Farm Service Agency (FSA) and the Natural Resources Conservation Service (NRCS)

Project Authorization: The US Congress in the USDA Farm Bill

Responsibility for Project Implementation: FSA, NRCS, Umatilla County SWCD, ODA, ODF, and Department of Forestry, and participating landowners

Funding Source: CRP is generally funded by the US Department of Agriculture Commodity Credit Corporation through the Farm Service Agency. In addition, Oregon funds contribute 25% of the cost share for landowners to implement projects funded under CREP.

Limiting Factors: CRP addresses a variety of limiting factors related to water quality and habitat which are important to both fish and wildlife. CRP increases areas of stable, undisturbed vegetation on lands that need protection from erosion. The resulting decrease in erosion leads to less sedimentation of streams and rivers. Vegetative cover also provides shelter and food for animals, creating vital habitat where a variety of wild populations can breed and expand.

Accomplishments and/or Failures: The CRP has increased grass stands, wildlife habitat, and water availability for wildlife, and has decreased erosion and improved water quality. The acreage signed up in CRP (see Table X for Morrow County) varies from year to year because participation in the program is driven by many factors, including farm commodity prices, weather, and an aging farmer population. However, the fact that over 210,000 acres are now enrolled in CRP programs in Umatilla and Morrow Counties is a testament to its success. The program remains strong; in Umatilla County alone the 26th sign-up for CRP attracted 180 applications from farms in Umatilla County, totaling 30,500 acres. Another 70,000 acres can be enrolled in Umatilla County before reaching the 25% limit.

Although the program is an overall success, several problems have also been encountered, including drought, incorrect seeding, and landowners not meeting seeding deadlines.

Relation to Other Activities in the Subbasin: CRP is related to numerous other activities in the subbasin. Because of its effect on water quality and habitat conservation, it contributes to the goals outlined in various planning documents, such as the TMDL. In addition, Continuous CRP and CREP projects compliment in-stream and riparian restoration projects implemented by the CTUIR and Oregon Department of Fish and Wildlife.

Large Scale Effects: The combined size of new wildlife habitats established by CRP is twice as large as the National Wildlife Refuge System and all state-owned wildlife areas in the contiguous 48 states combined.

Project 2: Willow Creek - Small Grant Stream Protection

General Description: This project will result in riparian fencing, trough installation, and bank seeding, all of which should reduce livestock impacts on a stream in the Willow Creek watershed.
Goals of the Program: The goal of this project is to protect the stream from negative impacts of livestock.
Location: Willow Creek watershed -- HUC 170701040604
Duration of Project: The project began in May 2003 and is scheduled to end in December 2003.
Lead Entity: Morrow SWCD.
Project Authorization: OWEB

Responsibility for Project Implementation: Morrow SWCD and the landowner.
Funding Source: OWEB
Limiting Factors: Water Quality
Accomplishments and/or Failures: The goals of the project are being met.
Relation to Other Activities in the Subbasin: This project complements similar stream improvement projects in the area, such as those implemented through CCRP and OWEB.
Large Scale Effects: The cumulative effect of many small projects should be a general improvement of watershed health, which should translate to improvements in provincial and basin-wide conditions.

Project 3: Resource Conservation and Development Council - Animal Feeding Operation/Confined Animal Feeding Operation

General Description: This project aims to improve feedlots and feeding areas in Morrow, Umatilla, and Gilliam Counties.
Goals of the Program: The goal of this project is to enhance water quality in the Willow Creek watershed by improving livestock feedlots and feeding areas.
Location: Willow Creek watershed -- HUCs 170701041002, 170701040601, and 170701040203
Duration of Project: The project began in 2002 and is scheduled to end in December 2003.
Lead Entity: Columbia Blue Mountain Resource Conservation and Development Council (RC&D)
Project Authorization: ODEQ
Responsibility for Project Implementation: Columbia Blue Mountain RC&D, Morrow SWCD, Umatilla County SWCD, and Gilliam SWCD
Funding Source: ODEQ provided the funding for this project.
Limiting Factors: Water Quality
Accomplishments and/or Failures: Although the project is not complete, the goals of the project are being met at this time.
Relation to Other Activities in the Subbasin: This project complements other attempts in the subbasin to improve practices in feedlots and feeding areas, such as the Willow Creek WS Feeding Area Improvement Project (#).
Large Scale Effects: The cumulative effect of improvements in numerous small scale animal feeding operations should be a general improvement of watershed health, which should translate to improvements in provincial and basin-wide conditions.

Project 4: Willow Creek WS Feeding Area Improvement

General Description: This project aims to improve feedlots and feeding areas in Morrow County.
Goals of the Program: The goal of this project is to enhance water quality in the Willow Creek watershed by improving livestock feedlots and feeding areas.
Location: Willow Creek watershed -- HUC 170701040302
Duration of Project: This project began in February 2002 and will end in June 2004.
Lead Entity: Morrow SWCD
Project Authorization: OWEB
Responsibility for Project Implementation: Morrow SWCD

Funding Source: OWEB
Limiting Factors: Water Quality
Accomplishments and/or Failures: Although the project is not complete, the goals of the project are being met at this time.
Relation to Other Activities in the Subbasin: This project complements other attempts in the subbasin to improve practices in feedlots and feeding areas, such as the Resource Conservation and Development Council - Animal Feeding Operation/Confined Animal Feeding Operation Project (#).
Large Scale Effects: The cumulative effect of improvements in numerous small scale animal feeding operations should be a general improvement of watershed health, which should translate to improvements in provincial and basin-wide conditions.

Project 5: Willow Creek Water Measuring Device Installation

General Description: This project involves installing irrigation water measuring devices and flow meters on diversion points in the Willow Creek watershed.
Goals of the Program: The goal of the project is to improve the management and distribution of irrigation water in the watershed.
Location: Willow Creek watershed -- HUCs 170701040201, 170701040202, 170701040203, 170701040301, 170701040302, 170701040702, 170701040801, 170701040901, and 170701040902
Duration of Project: This project began in February 2003 and will end in December 2004.
Lead Entity: Morrow SWCD
Responsibility for Project Authorization: OWEB and the Oregon Water Resources Department (OWRD)
Project Implementation: OWRD and participating landowners
Funding Source: OWEB
Limiting Factors: Water Quality and Quantity
Accomplishments and/or Failures: The project is just beginning.
Relation to Other Activities in the Subbasin: None known.
Large Scale Effects: None known.

Project 6: Lower Willow Creek Weed Management Area

General Description: This project creates a weed management area on public and private lands in western Morrow County and eastern Gilliam County.
Goals of the Program: The goal of the project is to control weeds on private and public lands so that native grasses can naturally regenerate.
Location: Morrow and Gilliam Counties -- HUCs 170701010501, 170701010801, 170701010901, 170701040101, and 170701040201
Duration of Project: This project began in August 2003 and will end in June 2004.
Lead Entity: Lower Willow Creek Weed Management Area Steering Committee, Morrow SWCD, and The Nature Conservancy (TNC)
Project Authorization: National Fish and Wildlife Foundation (NFWF)
Responsibility for Project Implementation: Lower Willow Creek Weed Management Area Steering Committee, Morrow SWCD, and TNC
Funding Source: NFWF

Limiting Factors: Invasive Species
Accomplishments and/or Failures: The project is just beginning.
Relation to Other Activities in the Subbasin: This project complements other weed control activities that are currently occurring in the subbasin, such as Projects …
Large Scale Effects: This project is part of a national effort to 1) prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships, and 2) increase public awareness of the adverse impacts of invasive and noxious plants.

Project 7: Navy Bombing Range Weed Control

General Description: This project was carried out to control "A" and "B" listed weeds in the Navy Bombing Range in Morrow County.
Goals of the Program: The goal of the project was to control noxious weeds on the Bombing Range so that native grasses can naturally regenerate.
Location: Navy Bombing Range in Morrow County -- HUCs 170701010401, 170701033501, 170701033701, and 170701033502
Duration of Project: This project began in spring and fall of 2202/2003 and ended in September 2003.
Lead Entity: Morrow SWCD
Project Authorization: Department of Navy
Responsibility for Project Implementation: Morrow SWCD
Funding Source: Department of Navy
Limiting Factors: Invasive Species
Accomplishments and/or Failures: The goals of this project were met. One problem encountered was finding a chemical applicator willing to perform the work.
Relation to Other Activities in the Subbasin: This project complements other weed control activities that are currently occurring in the subbasin.
Large Scale Effects: This project is part of a statewide, regional, and national effort to prevent, manage, or eradicate invasive and noxious plants.

Project 8: Morrow County Noxious Weed Control

General Description: This project was carried out to control yellow starthistle in Morrow County by chemically treating 2,766.9 acres.
Goals of the Program: The goal of the project was to assist landowners with chemical and application costs for the control of "A" list noxious weeds in Morrow County.
Location: Morrow County – HUCs 170701040201, 170701040202, 170701040203, 170701040901, 170701040301, 170701040902, 170701040302, 170701040402, 170701010601, 170701033501, and 170701033701
Duration of Project: This project began in March 2000 and ended in March 2001.
Lead Entity: Janet Greenup, Morrow SWCD
Project Authorization: Oregon State Weed Board, OWEB
Responsibility for Project Implementation: Morrow SWCD, Morrow County Weed District
Funding Source: Oregon State Weed Board, OWEB
Limiting Factors: Invasive Species
Accomplishments and/or Failures: The goals of this project were met or exceeded.

Relation to Other Activities in the Subbasin: This project complements other weed control activities that are currently occurring in the subbasin, including efforts by individual landowners.
Large Scale Effects: This project is part of a statewide, regional, and national effort to prevent, manage, or eradicate invasive and noxious plants.

Project 8: Wilson Creek Stream Restoration and Enhancement

General Description: This project replaces fish passage barrier culverts with fish friendly cattle guards.
Goals of the Program: The goal of the project is to remove fish barriers in a perennial stream.
Location: Wilson Creek in Morrow County.
Duration of Project: This project began August 2003 and is scheduled to be completed in June 2005.
Lead Entity: Morrow SWCD
Project Authorization: OWEB
Responsibility for Project Implementation: Morrow SWCD and ODF
Funding Source: OWEB
Limiting Factors: Fish Passage Barrier
Accomplishments and/or Failures: The project is still in progress.
Relation to Other Activities in the Subbasin: This project complements other efforts in the subbasin to remove barriers to fish passage.
Large Scale Effects: The removal of barriers to fish passage in the subbasin will contribute to the success of anadromous fish whose ranges extend into areas beyond the subbasin.

Project 9:

General Description: This project replaces fish passage barrier culverts with fish friendly cattle guards.
Goals of the Program: The goal of the project is to remove fish barriers in a perennial stream.
Location: Wilson Creek in Morrow County.
Duration of Project: This project began August 2003 and is scheduled to be completed in June 2005.
Lead Entity: Morrow SWCD
Project Authorization: OWEB
Responsibility for Project Implementation: Morrow SWCD and ODF
Funding Source: OWEB
Limiting Factors: Fish Passage Barrier
Accomplishments and/or Failures: The project is still in progress.
Relation to Other Activities in the Subbasin: This project complements other efforts in the subbasin to remove barriers to fish passage.
Large Scale Effects: The removal of barriers to fish passage in the subbasin will contribute to the success of anadromous fish whose ranges extend into areas beyond the subbasin.

Project 10: CTUIR Umatilla River Basin Anadromous Fish Habitat Enhancement Project – Riparian Function

General Description: The project is a continuation of existing efforts to improve natural production of salmonids in the subbasin through the protection and enhancement of riparian areas along the Umatilla River and its tributaries.
Goals of the Program: The goal is to enhance fish habitat for improved natural production of steelhead, coho salmon, and Chinook salmon. These goals are achieved through a variety of means including livestock exclusion and riparian corridor fencing, off-stream livestock water development, and revegetation and noxious weed control in riparian zones.
Location: Riparian enhancement projects have been conducted on the Umatilla River, Meacham Creek, Mission Creek, Wildhorse Creek, Greasewood Creek, West Fork of Greasewood Creek, Spring Hollow Creek, Buckaroo Creek, Iskuulpa Creek, McKay Creek, Moonshine Creek, and Cottonwood Creek.
Duration of the Project: The project began on April 1, 1988 and was initially limited to private lands on the Umatilla Indian Reservation. In 1993, the project expanded to include lands outside of the reservation and is ongoing with some riparian conservation agreements with private landowners good through January 25, 2023.
Lead Entity: Confederated Tribes of the Umatilla Indian Reservation
Project Authorization: The project was improved and funded by the Bonneville Power Administration, U.S. Department of Energy as part of the Northwest Power Planning Council's Columbia River Fish and Wildlife Program.
Responsibility for Project Implementation: The Confederated Tribes of the Umatilla Indian Reservation
Funding Source: Primary funding is from the Bonneville Power Administration. Cost-share funding is from the U.S. Bureau of Indian Affairs, U.S. Workforce Investment Act funds, Oregon Watershed Enhancement Board, CTUIR Environmental Protection-Riparian Protection, Umatilla County Roads Department, Pacific Coastal Salmon Recovery Fund-NOAA, Pheasants Forever, and Natural Resources Conservation Service
Limiting Factors: Water temperature, sediment, habitat
Accomplishments and/or Failures: Accomplishments: A total of 47 landowner easements have been attained since 2000 on 10 different property ownerships, and ten miles of stream enhanced. Failures: Lack of funding from Bonneville Power Administration for monitoring and evaluation to examine success of individual projects.
Relation to Other Activities in the Subbasin: This project complements all other projects in the subbasin designed to improve natural productivity of steelhead and salmon.
Large Scale Effects: Elevation of Umatilla River subbasin juvenile outmigration numbers through habitat improvements will assist with the Columbia basin adult escapement goals.

Project 11: CTUIR Umatilla River Basin Anadromous Fish Habitat Enhancement Project – Instream and Stream Bank Improvements

General Description: The project is a continuation of existing efforts to improve natural production of salmonids in the subbasin through the enhancement of instream habitat in the Umatilla River and its tributaries.
Goals of the Program: The goal is to enhance fish habitat for improved natural production of steelhead, coho salmon, and Chinook salmon. These goals are achieved through a variety of means including stream bank revetments, log and boulder weirs, log and boulder deflectors, rock vanes and grade control/sediment retention structures.
Location: Instream and streambank enhancement projects have been conducted on the Umatilla River, Meacham Creek, Mission Creek, Wildhorse Creek, Greasewood Creek, West Fork of Greasewood Creek, Spring Hollow Creek, Buckaroo Creek, Iskuulpa Creek, McKay Creek, Moonshine Creek, and Cottonwood Creek.
Duration of the Project: The project began on April 1, 1988 and was initially limited to private lands on the Umatilla Indian Reservation. In 1993, the project expanded to include lands outside of the reservation and is ongoing with some riparian conservation agreements with private landowners good through January 25, 2023.
Lead Entity: Confederated Tribes of the Umatilla Indian Reservation
Project Authorization: The project was improved and funded by the Bonneville Power Administration, U.S. Department of Energy as part of the Northwest Power Planning Council's Columbia River Fish and Wildlife Program. The project was further approved by the Confedrated Tribes of the Umatilla Indian Reservation Board of Trustees on May 9th, 1988 (Resolution #88-55).
Responsibility for Project Implementation: The Confederated Tribes of the Umatilla Indian Reservation
Funding Source: Primary funding is from the Bonneville Power Administration. Cost-share funding is from the U.S. Bureau of Indian Affairs, U.S. Workforce Investment Act funds, Oregon Watershed Enhancement Board, CTUIR Environmental Protection-Riparian Protection, Umatilla County Roads Department, Pacific Coastal Salmon Recovery Fund-NOAA, Pheasants Forever, and Natural Resources Conservation Service
Limiting Factors: Sediment, habitat
Accomplishments and/or Failures: Accomplishments: A total of 11 landowner easements have been attained since 1999. Failures: Lack of funding from Bonneville Power Administration for monitoring and evaluation to examine success of individual projects.
Relation to Other Activities in the Subbasin: This project complements all other projects in the subbasin designed to improve natural productivity of steelhead and salmon.
Large Scale Effects: Elevation of Umatilla River subbasin juvenile outmigration numbers through habitat improvements will assist with the Columbia basin adult escapement goals.

Project 12: Umatilla River Subbasin Fish Habitat Improvement Program.

General Description: The program works cooperatively with private landowners to implement projects aimed at improving fish habitat for anadromous and resident fish species within the Umatilla subbasin.

Goals of the Program: The goal is to, using cooperative lease agreements, protect (where possible) and enhance/restore (where required) high quality fish habitat, using both passive and active restoration techniques. Individual projects include livestock exclusion fencing to protect riparian habitat and the installation of instream structures to halt/prevent erosion and provide fish habitat. Recently efforts have been made in channel re-design and re-construction to restore stable stream function.

Location: Projects have focused on two watersheds in the Umatilla subbasin, Birch and Meacham Creeks.

Duration of the Project: The program was initiated in 1987, with the earliest projects undertaken in 1988. The program continues to receive funding from BPA. The status of specific projects is dependent on the duration and termination dates of individual lease agreements, which are normally in place for 15 and 25 years. Present lease agreements will be allowed to expire, except in cases where future involvement is considered to be a high priority.

Lead Entity: ODFW

Project Authorization: This program has evolved from the rolling provincial review process developed by the Northwest Power Planning Council in response to recommendations from the Independent Scientific Review Panel and the Columbia Basin Fish and Wildlife Authority.

Responsibility for Project Implementation: BPA and ODFW

Funding Source: BPA

Limiting Factors: water quality, habitat

Accomplishments and/or Failures: Accomplishments: As of the end of 2003, outputs from individual projects include: 319.8 acres under lease, 16.32 miles of riparian fencing, 53 stream crossings, 23 water gaps, 350 instream structures within 12.56 miles of stream. These projects have benefited the primary target species (summer steelhead) in addition to other resident fish and wildlife in the subbasin by re-establishing key riparian habitat features, stabilizing streambanks, improved floodplain function, and provide overhead canopy cover inside the leased corridors. Failures: Early projects were often washed out by floods. It was determined that these projects were too narrow in scope, and did not address the root problems. More recent projects have been more successful by recreating sinuous/stable channel configurations, planting copious amounts of native vegetation to recreate riparian habitat, and moving existing fences further out on the floodplain to prevent livestock damage of newly created buffers.

Relation to Other Activities in the Subbasin: This project works jointly with the CTUIR's program to Enhance Umatilla River Basin Anadromous Fish Habitat.

Large Scale Effects: This program plays a significant role in implementing measures to augment the recovery of the summer steelhead Middle Columbia River Evolutionarily Significant Unit (ESU), which is federally listed as threatened. Specifically, habitat measures implemented in the Umatilla subbasin are expected to increase numbers of steelhead in the Umatilla subbasin which will benefit the Middle Columbia ESU. The impact of this program extends, in an ecological context, throughout the life cycle of summer steelhead including the Columbia River and Pacific Ocean.

Project 13: Morrow County Conversion from Flood Irrigation to Sprinkler HUC 170701010401

1) Project Title.

OWEB Small Grants

2) Project description, location.

Convert from flood irrigation to sprinkler. HUC 170701010401

3) Goal(s) or objective(s).

Increase irrigation efficiency in West Extension Irrigation District.

4) Project beginning, ending or target completion date.

Begin 8/2003; Target completion date 2/2004.

5) Project manager.

Morrow SWCD

6) Project authorization.

OWEB

7) Project implementation responsibility.

Morrow SWCD/West Extension Irrigation District (WEID)

8) Funding source.

OWEB/WEID/landowners.

9) Limiting factors or ecological processes project is designed to address.

Water quality/quantity

10) Accomplishments and/or failures. Goals met or if not, what problems were encountered.
11) Relation to other activities in the subbasin.
12) Program extension beyond subbasin (provincial & basin-wide).

Part V. Contact Information:
Name: Janet Greenup

Title: District Manager

Phone Number: 541-676-5452 x109
E-Mail: janet-greenup@or.nacdnet.org

Regular Mail: Morrow SWCD; PO Box 127; Heppner, OR 97836

Project 14: Morrow County Livestock disbursement/watering facility/spring developments

1) Project Title.

OWEB Small Grants

2) Project description, location.

Livestock disbursement/watering facility/spring developments. HUC 170701040902; 170701033201; 170701033401

3) Goal(s) or objective(s).

Develop existing springs for livestock, disburse livestock for more efficient use of range/pastureland.

4) Project beginning, ending or target completion date.

Begin 5/2003. Scheduled ending 12/2003

5) Project manager.

OWEB; Morrow SWCD

6) Project authorization.

OWEB

7) Project implementation responsibility.

Morrow SWCD

8) Funding source.

OWEB

9) Limiting factors or ecological processes project is designed to address.

Rangeland health;

10) Accomplishments and/or failures. Goals met or if not, what problems were encountered.

Goals met.

11) Relation to other activities in the subbasin.

Similar projects occur in the subbasin.

12) Program extension beyond subbasin (provincial & basin-wide).

Similar projects occur basin-wide.

Part V. Contact Information:

Name: Janet Greenup

Title: District Manager

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Project 15: Morrow County EQIP Direct Seed

1) Project Title.
2) EQIP Direct Seed
3) Project description, location.

Demonstration project, direct seed/annual cropping conversion from winter wheat/summer fallow rotation on cropland. Contracts include 1 year of a non-traditional crop i.e. mustard, canola, lentils, Austrian peas, garbonzo, safflower.

HUC: 170701040902; 3 yr contract 1998-2002 (80 ac)

170701040902; 4 yr contract 2002-2006 (237.2 ac)

170701040902; 4 yr contract 2002-2006 (231.7 ac)

170701040902; 4 yr contract 2002-2006 (12.0 ac)

(note: above contracts are on different tracts)

170702040501; 1998-2004 (80 ac)

170701040402; 1999-2003 (80 ac)

170701040801; 2000-2004 (80 ac)

170701041002; 2000-2004 (80 ac)

170701041001; 2002-2006 (80 ac)

170701040401; 2002-2006 (80 ac)

170701040901; 2002-2006 (250 ac)

170701041102; 2002-2006 (80 ac)

170701041102; 2003-2007 (80 ac)

170701010601; 2002-2008 (165 ac)

170701041002; 2002-2006 (250 ac)

4) Goal(s) or objective(s).

Increase soil tilth, reduce wind and water erosion, increase organic matter.

5) Project beginning, ending or target completion date.

See above

6) Project manager.

NRCS-Heppner FO

7) Project authorization.

USDA federal farm bill

8) Project implementation responsibility.

USDA NRCS, federal farm bill, landowners

9) Funding source.

USDA

10) Limiting factors or ecological processes project is designed to address.

Soil erosion higher than soil tollerance

11) Accomplishments and/or failures. Goals met or if not, what problems were encountered.

Extended drought has not allowed the practice to show benefits.

12) Relation to other activities in the subbasin.

Other landowners are also trying direct seeding without federal cost-share dollars.

13) Program extension beyond subbasin (provincial & basin-wide).

Federal programs extend beyond subbasin

Part V. Contact Information:

Name: NRCS

Title: District Conservationist/ Soil Conservationist

Phone Number: 541-676-5021 x113

E-Mail: connie.holmquist@or.usda.gov

Regular Mail: NRCS; PO Box 127; Heppner, OR 97836

Project 16: Morrow County EQIP Riparian / Range Improvements

1) Project Title.

EQIP Riparian/range improvements

2) Project description, location.

Rangeland, spring dev. HUC 170702041305 1079 acres 2001-2005
Riparian/rangeland improvement HUC 17070104040203 2000-2004
Rangeland, spring, trough, pipe HUC 170701040801 2002-2005
Rangeland, riparian improvement HUC 17070104050100 2002-2006

3) Goal(s) or objective(s).

Improve rangeland for grazing, improve riparian for fish & wildlife

4) Project beginning, ending or target completion date.

See above

5) Project manager.

NRCS

6) Project authorization.
USDA Farm bill
7) Project implementation responsibility.

NRCS, landowners

8) Funding source.

USDA farm bill

9) Limiting factors or ecological processes project is designed to address.
Lack of livestock disbursement, lack of water for livestock/fish & wildlife, lack of cover for fish & wildlife

10) Accomplishments and/or failures. Goals met or if not, what problems were encountered.
Goals met. One riparian project was cancelled due to beaver damage to riparian plantings.

11) Relation to other activities in the subbasin.
Similar projects conducted by SWCD w/OWEB, ODA funds.

12) Program extension beyond subbasin (provincial & basin-wide).

Farm bill extends beyond subbasin

Part V. Contact Information:
Name: NRCS
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Regular Mail: NRCS PO Box 127; Heppner, OR 97836

Project 17: Morrow County Wildlife Watering Facilities

NOTE: I was going to include these with the OWEB, ODA wildlife watering projects and forgot.

1) Project Title.

Wildlife watering facilities

2) Project description, location.
Locations: 170701010602 (date 3/2001 (1 guzzler) CRP);
17070104050100 (date 11/2002 (4 guzzler) EQIP);
170701040302 (date 4/2001 (1 guzzler) CRP);

170701041301 (date 6/2003-not complete (1 guzzler) CRP); 170701040302 (date 4/1999) CRP)

3) Goal(s) or objective(s).

Increase water availability for wildlife.

4) Project beginning, ending or target completion date.

See above.

5) Project manager.

NRCS

6) Project authorization.

USDA

7) Project implementation responsibility.

NRCS, landowners

8) Funding source.

USDA Farm Bill

9) Limiting factors or ecological processes project is designed to address.

Fish & Wildlife benefits, increase water availability for wildlife in uplands

10) Accomplishments and/or failures. Goals met or if not, what problems were encountered.

Goals met

11) Relation to other activities in the subbasin.

Federal farm bill program, relates to other farm programs & SWCD projects

12) Program extension beyond subbasin (provincial & basin-wide).

Farm bill extends beyond basin

Part V. Contact Information:

Name: Connie Holmquist

Title: Soil Conservationist

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Regular Mail: NRCS; PO Box 127; Heppner, OR 97836

Project 18: Morrow County Weed Control Reseeding Project

1) Project Title.

Reseed after weed control

2) Project description, location.

Range and pasturelands were reseeded to grass after an OWEB weed control grant. HUC 170701040902

3) Goal(s) or objective(s).

Improve grass stand after weed control.

4) Project beginning, ending or target completion date.

Begin & end 3/2001

5) Project manager.

Morrow SWCD

6) Project authorization.

ODA SWCD small grant.

7) Project implementation responsibility.

Morrow SWCD/ landowners

8) Funding source.

OWEB/ODA small grant

9) Limiting factors or ecological processes project is designed to address.

Noxious weeds reduce the health and vigor of grass stands.

10) Accomplishments and/or failures. Goals met or if not, what problems were encountered.

Worked with two landowners who completed seeding.

Goals not met: Reseed ~500 acres. Landowners were either uninterested or timing wasn't right.

11) Relation to other activities in the subbasin.

CRP program includes grass seeding.

12) Program extension beyond subbasin (provincial & basin-wide).

N/A

Part V. Contact Information:

Name: Janet Greenup
Title: District Manager
Phone Number: 541-676-5452 x109
E-Mail: janet-greenup@or.nacdnet.org
Regular Mail: Morrow SWCD; PO Box 127; Heppner, OR 97836

Project 19: Morrow County Wildlife Habitat Incentive Program (WHIP)

1) Project Title.

Wildlife Habitat Incentive Program (WHIP)

2) Project description, location.

Increase and/or improve wildlife habitat

Spring dev./tree & shrub planting HUC 170701040501 2002-2007
Wildlife watering facility (guzzler) HUC 170701040902 2002-2007
Conservation cover HUC 170701010501 2001-2006
Conservation cover HUC 170701010501 2001-2006
Tree & shrub planting, guzzler HUC 170701010501 2001-2006
Tree & shrub planting HUC 170701010401 2001-2006

3) Goal(s) or objective(s).

Increase or improve wildlife habitat in the subbasin

4) Project beginning, ending or target completion date.

See above

5) Project manager.

Chet Hadley

6) Project authorization.

USDA Farm bill

7) Project implementation responsibility.

NRCS, landowner

8) Funding source.

USDA farm bill

9) Limiting factors or ecological processes project is designed to address.

Decreased or inadequate habitat for wildlife

10) Accomplishments and/or failures. Goals met or if not, what problems were encountered.

Goals were met.

11) Relation to other activities in the subbasin.

SWCD conducts similar projects

12) Program extension beyond subbasin (provincial & basin-wide).

Farm bill extends beyond subbasin

Part V. Contact Information:

Name: Chet Hadley
Title: Biological Technician
Phone Number: 541-676-5021 x108
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Regular Mail: NRCS; PO Box 127; Heppner, OR 97836

Project 20: Morrow County ODA Small Grant Wildlife Watering Facility

1) Project Title.

Wildlife Watering Facility

2) Project description, location.

Installed 3 bird guzzlers. HUC 170701040301; 170701041002; 170701033601

3) Goal(s) or objective(s).

Increase water availability for wildlife.

4) Project beginning, ending or target completion date.

Begin 2001; Complete 4/2003

5) Project manager.

Morrow SWCD, Janet Greenup

6) Project authorization.

ODA SWCD small grant

7) Project implementation responsibility.

Morrow SWCD, landowners

8) Funding source.

OWEB, ODA, landowner

9) Limiting factors or ecological processes project is designed to address.

Lack of wildlife water in uplands.

10) Accomplishments and/or failures. Goals met or if not, what problems were encountered.

Accomplishments and goals met.

11) Relation to other activities in the subbasin.

Watering facilities were also a component in general CRP, EQIP and the Wildlife Habitat Incentive Program (WHIP).

12) Program extension beyond subbasin (provincial & basin-wide).
Federal programs extend beyond the subbasin.

Part V. Contact Information:
Name: **Janet Greenup**
Title: **District Manager**
Phone Number: **541-676-5452 x109**
E-mail: **janet-greenup@or.nacdnet.org**
Regular Mail: **Morrow SWCD; P.O. Box 127; Heppner, OR 97836**

Project 21: OREGON DEQ ADMINISTERS THE US ENVIRONMENTAL PROTECTION AGENCY CLEAN WATER ACT SECTION 319 PROGRAM. GRANTS THROUGH THIS PROGRAM HAVE PROVIDED FOR RIPARIAN RESTORATION, UPLAND BEST MANAGEMENT PRACTICES. I ASSUME THE PROJECT MANAGERS ARE RESPONDING TO THIS QUESTIONAIRRE: UMATILLA COUNTY SWCD (CONSERVATION TILLAGE – 5 PROJECTS), CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION (BUCKAROO CREEK, MEACHAM CREEK RESTORATION PLANNING), OREGON WATER COALITION (ECHO MEADOWS RECHARGE PROJECDT).

CONTACT INFO FOR UMATILLA BASIN AND WILLOW CREEK TMDLS:
Don Butcher
Department of Environmental Quality
700 SE Emigrant, Ste. 330
Pendleton, OR 97801

(541)278-4603
butcher.don@deq.state.or.us

22) Umatilla National Forest response by Del Groat
Forest Service project activity has been limited in this watershed in the last five years. I've been unable to dig up complete information to satisfy this request. A change in computer programs for writing and storage was made during this time frame. Documentation was either archived or not brought forward for already completed projects. Most of our restoration work within the watershed was completed prior to 1998. In the interest in getting back to you ASAP, I will leave this section blank.

23) Stewards of the Umatilla River Environment (S.U.R.E.)
1) What is the title of the project?

Stewards of the Umatilla River Environment (S.U.R.E.)

2) Briefly describe the project, including its location.

S.U.R.E. is made up of volunteers who perform habitat enhancement projects in the 2 and ½ mile reach of the Umatilla River in Pendleton.

3) Briefly describe the goals or objectives of the project.

Goals are improvement of fish and wildlife habitat in the riparian corridor through Pendleton and public education about the local river ecosystem.

4) When did the program begin? When did it end or what is its target date for completion?

The program began in the spring of 2001. It has a tentative end in 2011.

5) Who is the manager or lead entity?

Betty Klepper is the Coordinator.

6) How was the project authorized?

It was not authorized.

7) Who is responsible for the project's implementation?

The Coordinator (a retired plant scientist) and several volunteers with specialized expertise in bird identification, weed control, and so on develop and implement the program.

8) What is the funding source?

Funds are provided by private donations of cash and by in-kind donations of services and rentals. The Umatilla Basin Watershed Council and the Umatilla County Soil and Water Conservation Service co-sponsored and provided Xeroxing and office services for a "Proper Functioning Condition" Workshop. SOLV provides free materials and safety assistance for cleanups under its Adopt-a-River program.

9) What limiting factors or ecological processes is the activity designed to address?

Enhancement of habitat along the river in Pendleton would include planting of native riparian trees for shade and wildlife cover on areas of the river where trees will not interfere with Corps of Engineers structures and their function in keeping flood waters contained. Additionally planting of native shrubs like choke cherry and elderberry will improve fall food supplies for birds. Nesting boxes have already been provided for wood ducks and song birds since old tree snags are scarce along that part of the river.

10) Summarize the accomplishments and/or failures of the activity. Have the projects' goals (both long and short term) been met? If not what problems were encountered?

S. U. R. E. is a ten-year project. Volunteers have removed in the first three years a total of more than three tons of trash from the river, removed three species (of the ten present) of noxious weed species from the two and one-half mile area, planted a demonstration garden for beautification of some horticultural species that will withstand the hot, dry levee environment, and installed 12 song-bird nesting boxes and 15 wood duck nesting boxes. S.U.R.E. sponsored a "Proper Functioning Condition" workshop in June 2002 for local farmers and agency employees to raise consciousness about the positive impacts of management change in improving riparian habitat. S.U.R.E has solicited local writers for newspaper articles (48 so far) about the birds, fish, insects, mammals, plants and ecosystem of the Umatilla River. In coordination with the Pendleton Chamber of Commerce, bird lists of the 129 species of birds observed on the river over the past three years and a map of the best fishing holes in town have been developed using information from local experts. S.U.R.E. coordinated with the Arts Center of Pendleton and the Childrens' Museum of Eastern Oregon to produce a special project to paint a public mural about the river ecosystem on one of the Entrances to the Pendleton River Parkway (essentially a levee-top walkway) and develop an interactive exhibit, "Rollin' on the River" for children ten and under. S.U.R.E. volunteers wrote and published a bird book for local fifth-grade classes describing 24 birds that live in the riparian areas in town. Plans are underway to write next year a book on plants of the Umatilla River in Pendleton, again written for the fifth grade classes. The long-term goal is to have a fifth-grade "River School" using the local river ecosystem for fifth-grade science enrichment. The long-term goal of planting native trees and shrubs is not yet ready to implement.

11) How does this project relate to other activities in the subbasin?

There are no formal relationships with other activities.

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to larger scale (provincial and basin-wide)

The newspaper articles, bird lists, bird books for fifth-graders and other educational activities have wide-spread impact on raising the consciousness of local citizens.

Contact information:

Name: Betty Klepper
Title: Coordinator, S.U.R.E.
Phone Number: 541-276-8416
email: klepperb@uci.net
Regular mail: P. O. Box 33, Pendleton, OR 97801

24) North & South Fork Umatilla River Structure Repair

1) What is the title of the project?
   North and South Fork Umatilla River Structure Repair

2) Briefly (two or three sentences) describe the project, including its location (electronic versions of maps of the project or program are also appreciated).
   The project repaired fish habitat structures that were damaged in the flood events of 1996-1997.

3) Briefly, describe the goal(s) or objective(s) of the project (be as quantitative as possible).

The structures were originally constructed to improve habitat for the reintroduced salmon and steelhead using the river. The repair was initiated to continue to provide this improved habitat to the aquatic species.

4) When did the project begin? When did it end or what is its target date for completion?
   The project was started in July of 1998 and completed in 2 weeks time.

5) Who is the manager or lead entity for the project?
   Umatilla National Forest

6) How was the project authorized?
   Flood repair monies.

7) Who is responsible for the project's implementation?
   Umatilla National Forest

8) What is the funding source?
   Emergency flood repair funds.

9) What limiting factors or ecological processes is the activity designed to address?
   Maintain productive habitat for the local fishery.

10) Summarize the accomplishments and/or failures of the activity. Have the projects goals (both short-term and long-term) been met? If not, what problems were encountered?
   Significant damage was sustained by the original structures during the flood events. The repair consisted of placing the rocks in a keyed together structure not a cabled arrangement as originally constructed.

11) How does this project relate to other activities in the subbasin?

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to a larger scale (provincial and basin-wide).

25) Butter Creek Range and Riparian Enhancement Project

1) What is the title of the project?

Butter Creek Range and Riparian Enhancement Project

2) Briefly (two or three sentences) describe the project, including its location

The Butter Creek Range and Riparian Projects promotes the restoration of upland and riparian areas through grazing management, stream bank stabilization and wildlife enhancements.

Upper Butter Creek Watershed
HUC 1707010328
HUC 1707010329
HUC 1707010330

3) Briefly, describe the goal(s) or objectives(s) of the project (be quantitative as possible).

- Improve water quality within the project area by addressing the impact livestock have on the upland and riparian area.
- Provide landowners with grazing management tools to improve their individual range conditions.

4) When did the program begin? When did it end or what is its target date for

completion?

The Butter Creek project started in 1999 with funding provided by Natural Resources Conservation Service (NRCS), U.S. EPA-RGI Region 10 and Oregon Watershed Enhancement Board. The project continues through 2004 with funding from EPA and Oregon Watershed Enhancement Board.

5) Who is the manager or lead entity for the project?

The program is administered through the Umatilla County Soil and Water Conservation District.

6) How was the project authorized?

N/A

7) Who is responsible for the project's implementation?

Umatilla County Soil & Water Conservation District and Natural Resources Conservation Service - Pendleton

8) What is the funding source?

Natural Resources Conservation Service – EQIP Priority Area
Environmental Protection Agency – Regional Geographic Initiative Region 10
Pheasants Forever – Sage Basin Chapter
Oregon Watershed Enhancement Board

9) What limiting factors or ecological processes is the activity designed to address?

Based on 1997-98 sediment monitoring data Butter Creek contributed 9% of the annual Total Suspended Solids to the Umatilla River and 11% in 1999-2000. Butter Creek watershed is designated as needing a 9% reduction in upland erosion and 82% reduction in stream bank erosion to meet the TMDL target for in stream sediment concentration. Butter Creek is listed on ODEQ 303 list for bacteria during the period of April to October.

10) Summarize the accomplishments and/or failures of the activity. Have the projects' goals (both short-term and long term) been met? If not what problems were encountered?

- 23 miles of riparian and cross fencing
- 28 upland spring developments
- 5 off stream watering systems
- 100,000 acres in improved grazing management systems
- 1 Improved Animal Feeding Operation
- 3 Stream bank stabilization projects
- 1 stream channel reconstruction assessment conducted by USFS

The projects goals have been met to begin implementing grazing management practices that will have a long-term benefit to the watershed. Surrounding landowners continue to join the project.

11) How does this project relate to other activities in the subbasin?

Butter Creek Range and Riparian Enhancement Project established in 1998 as an SWCD priority project area and NRCS Environmental Quality Incentive Program Geographic Priority Area.

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to larger scale (provincial and basin-wide)

26) Umatilla County SWCD Direct Seed Incentive Program
1) What is the title of the project?

Soil and Water Conservation District Direct Seeding Incentive Program

2) Briefly (two or three sentences) describe the project, including its location

The Umatilla County Soil & Water Conservation District provided a $ 10 per acre incentive to 63 growers in the Umatilla & Walla Walla basin for the implementation of "Direct Seeding" residue management methods.

3) Briefly, describe the goal(s) or objectives(s) of the project (be quantitative as possible). A major limiting factor in water quality for the Umatilla Basin is sedimentation. No-till farming has long been recommended and practiced as a best agricultural management practice (BMP) in the PNW dry land farming towards reducing surface runoff and erosion, improving soil quality, increasing water infiltration, and reduce evaporation and keep higher soil moisture. Implementation of Direct Seeding and intensive rotations will greatly reduce the amount of sediment produced from agricultural activities. The adoption of direct seeding in the basins has been slow due to a lack of demonstrated effectiveness, long-term financial sustainability and high initial cost of equipment.

4) When did the program begin? When did it end or what is its target date for

completion?

The Direct Seeding project started in 1997 with funding provided by U.S. EPA and ODEQ. The project continues through 2004 with funding form EPA and Oregon Watershed Enhancement Board.

5) Who is the manager or lead entity for the project?

The program is administered through the Umatilla County Soil and Water Conservation District with assistance from OSU Extension and Natural Resources Conservation Service.

6) How was the project authorized?

N/A

7) Who is responsible for the project's implementation?

Umatilla County Soil & Water Conservation District, OSU Extension – Pendleton, Natural Resources Conservation Service - Pendleton

8) What is the funding source?

Environmental Protection Agency
Oregon Department of Environmental Quality
Oregon Watershed Enhancement Board

9) What limiting factors or ecological processes is the activity designed to address?

Excessive sedimentation adversely affects stream water quality and fish habitat by degrading and reducing spawning habitat (Alexander and Hansen, 1986; Chapman and McLeod, 1987). Low in stream flow and the related high temperature in summer time have been recognized as a critical impairment of salmon as well as other endangered fish species habitats in Pacific Northwest (PNW). Approximately One third and one eighth of the reported impairment of water body in PNW are suffering thermal modification and elevated sedimentation/siltation, respectively. Low flow reduces the available rearing habitat, hinders the movement of juveniles, and affects adult migration. and the related high summer temperature directly affects the entire aquatic ecosystem including fish survival, growth, and reproduction (Sinokrot and Stefan, 1993). High stream temperatures have reduced or eliminated a large percentage of habitats in agricultural watersheds during summer and fall throughout the PNW and presently, many streams have been placed on the 303 (d) list due to temperature and sediment related problems.

The farming practice of Direct Seeding is part of a residue management system that increases amounts of crop residue left in the field which can reduces the amount of upland erosion. The dominant erosion processes in the sub basin are surface erosion by sheet wash, rills, gullies and bank erosion (ODEQ 2000). Neither EPA nor the State of Oregon has numeric water quality standards for suspended solids or streambed fines. Umatilla Basin fisheries however determined through basin-specific knowledge and literature review that 30 NTU in stream turbidity standard will protect aquatic species (ODEQ 2000) The 30 NTU target was correlated to TSS data to derive watershed concentrations/loading capacities. Streams or watersheds in excess of this value were placed on the 303(d) list for standards violation (Umatilla).

10) Summarize the accomplishments and/or failures of the activity. Have the projects' goals (both short-term and long term) been met? If not what problems were encountered?

- Starting in 1997 the Direct Seeding program has paid incentives on 19,498 acres. The number of direct seed drill owned by operators has grown from one to sixteen.
- The number of acres to the sub basin under conservation tillage increased to 92,190 acres (NRCS Crop Residue Survey 2002).
- 42 of the 50 cooperators participating in the program are still utilizing direct seeding on all or a portion of their farm acres.
- Soil loss during this time reduced from 785 tons per acres to 92.5 tons per year

11) How does this project relate to other activities in the subbasin?

Direct Seeding is listed as an effective Best Management Practice in the Umatilla and Walla Walla Agricultural Water Quality Management Plans. Direct seeding is identified as a Best Management Practice to reduce sedimentation in the Umatilla Basin TMDL.

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to larger scale (provincial and basin-wide)

Several active programs, to promote the practice of direct seeding, are located throughout the Columbia and Snake Basins.

27) North and South Fork Umatilla River Structure Repair

1) What is the title of the project?

   North and South Fork Umatilla River Structure Repair

2) Briefly (two or three sentences) describe the project, including its location (electronic versions of maps of the project or program are also appreciated).

   The project repaired fish habitat structures that were damaged in the flood events of 1996-1997.

3) Briefly, describe the goal(s) or objective(s) of the project (be as quantitative as possible).

   The structures were originally constructed to improve habitat for the reintroduced salmon and steelhead using the river. The repair was initiated to continue to provide this improved habitat to the aquatic species.

4) When did the project begin? When did it end or what is its target date for completion?

   The project was started in July of 1998 and completed in 2 weeks time.

5) Who is the manager or lead entity for the project?
   Umatilla National Forest

6) How was the project authorized?
   Flood repair monies.

7) Who is responsible for the project's implementation?
   Umatilla National Forest

8) What is the funding source?
   Emergency flood repair funds.

9) What limiting factors or ecological processes is the activity designed to address?
   Maintain productive habitat for the local fishery.

10) Summarize the accomplishments and/or failures of the activity. Have the projects goals (both short-term and long-term) been met? If not, what problems were encountered?
    Significant damage was sustained by the original structures during the flood events. The repair consisted of placing the rocks in a keyed together structure not a cabled arrangement as originally constructed.

11) How does this project relate to other activities in the subbasin?

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to a larger scale (provincial and basin-wide).

28) Oregon Water Resources Department – Pendleton office

1) What is the title of the project? Umatilla Basin Project

2) Briefly describe the project, including the location. The project is a fish restoration project that pumps water from the Columbia River to three irrigation districts in lieu of them diverting their normal supply of water from the Umatilla River and McKay Reservoir. Using this Columbia River water, the district(s) forego their diversion from the Umatilla River and McKay Reservoir, thus leaving water in the Umatilla River for fishery enhancement.

3) Briefly describe the goal(s) or objective(s) of the project (be as quantitative as possible). The goal was to restore and enhance the fishery in the Umatilla Basin. The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) probably has a quantitative goal of how many fish they want to return and the different species.

4) When did the project begin? When did it end or what is its target date for completion? The actual federal legislation was passed on October 1988 as Public

Law 100-57. Phase I became operational in 1993 and Phase II in 1995. In 1999 Phases I and II were 100% operational.

5) Who is the manager or lead entity for the project? The lead is the U.S. Bureau of Reclamation (BOR) with many cooperators and partners such as: Stanfield Irrigation District; West Extension Irrigation District; Hermiston Irrigation District; Oregon Water Resources Department; Oregon Department of Fish and Wildlife (ODFW); CTUIR; and Bonneville Power Administration, to name a few.

6) How was the project authorized? The project was authorized by Congress in 1988.

7) Who is responsible for the project's implementationProject implementation is largely done by BOR with assistance from OWRD, ODFW, and CTUIR.

8) What is the funding source? The initial funding was authorized by Congress. The various entities noted above have assisted in funding the ongoing implementation in one way or another, either as direct or in-direct costs.

9) What limiting factors or ecological processes is the activity designed to address? The project is designed to augment flows in the Umatilla River when flows are not adequate for fish migration.

10) Summarize the accomplishments and/or failures of the activity. Have the projects' goals (both short-term and long term) been met? If not what problems were encountered? From what I understand, the goals projected for number of fish returning to the Umatilla River as a result of the Umatilla Basin Project have not been met. In particular I believe the fall chinook returns have fallen well short of the stated goal. It would be best to contact ODFW and CTUIR to get an accurate response to this question.

11) How does this project relate to other activities in the subbasin? OWRD has been involved in numerous other activities in the subbasin as part of the Oregon Plan for Salmon and Watersheds. These include numerous fish restoration projects such as: irrigation dam diversion replacement; leasing of water rights instream, riparian improvement projects, surface water to ground water transfers that eliminate the need for fish screening; and regulating water users to protect instream flows for fish. Other agencies and entities in the basin can add the considerable number of projects they have been involved with

12) As applicable, describe the extent to which these programs and activities extend beyond the subbasin to larger scale (provincial and basin-wide) The restoration and improvement on the numbers of fish returning to the Umatilla benefit those outside the basin. It would be best to get a more precise statement from the ODFW and CTUIR.

Mike, should we mention Phase III?

<u>Part V. Contact Information:</u>

Name: Mike Ladd
Title: Region Manager
Phone Number: 541-278-5456
E-mail: Michael.F.Ladd@wrd.state.or.us
Regular Mail: Oregon Water Resources Department
116 SE Dorion
Pendleton,OR 97801

List of Respondents:
J. R. Cook, County Planner, Umatilla County Department of Resource Services and Development, 216 S.E. 4th Street, Pendleton, Oregon 97801, Ph: (541) 278-6252 – hard copy only, includes most sections of relevant ordinances for Part I in response.

Carla McLane, Planning Director, Morrow County, P.O. Box 40, Irrigon, Oregon 97882, Ph: (541) 922-4624 – sent hard copy and electronic copies (saved as McLaneMorrowCounty2 (WP) and McLaneMorrowCounty2.doc (Word)) and includes a copy of relevant section (saved as McLaneMorrowCounty1.doc).

Karen King, Regulatory Specialist for City of Pendleton, 1501 SE Byers Ave., Pendleton, OR 97801, Ph: (541) 276-3078, karen@ci.pendleton.or.us – electronic copies (saved as CityofPendletonHazMatSumforSubbasinPlan.wpd and CityofPendletonWTPSumforSubbasinPland.wpd)

Ray Denny, Umatilla County Soil and Water Conservation District, 1229 SE Third St, Pendleton, OR 97801, Ph: (541) 276-8170 – electronic copy (saved as InventoryQuestionnaireExampleRayDenny.doc).

Janet Greenup, Morrow County Soil and Water Conservation District Manager, P.O. Box 127, Heppner, Oregon 97836, Ph: (541) 676-5452, Fax: 541 (676-9624) – electronic copy (saved as CRPacresforMorrowCounty.doc,
MorrowCountyExistingRestorationandConsProjectsCRP.doc,
MorrowCountyExistingRestorationandConsProjectsbaile.doc,
MorrowCountyExistingRestorationandConsProjectsDEQ.doc,

MorrowCountyExistingRestandConsProjectsMeas.doc,
MorrowCountyExistingRestandConsProjectsOwebFeed.doc,
MorrowCountyExistingRestandConsProjectsWMA.doc,
MorrowCountyExistingRestandConsProjectswilson.doc,
MorrowCountyExistingRestandConsProjectsWeeds.doc)

Mike Lambert, CTUIR
electronic copy (Files saved as:
Umat Sub Plan Inventory – CTUIR Fish Hab.doc for Legal Protections and Existing Plans
Inv Quest CTUIR Fish Hab Instream.doc for Instream and Bank Stabilization project
Inv Quest CTUIR Fish Hab Riparian.doc for Riparian enhancement project)

Tim Bailey, ODFW, Northeast Region. 73471 Mytinger Lane, Pendleton, OR 97801. Ph: (541) 276-2344, Fax: (541) 276-4414 – electronic copy (saved as Fish Hab_Projects Inventory T. Baily edits.doc)

2004 DRAFT

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Umatilla River Summer Steelhead
Species or Hatchery Stock:	Umatilla River Summer Steelhead stock 091
Agency/Operator:	Oregon Dept. of Fish & Wildlife/CTUIR
Watershed and Region:	Umatilla/Columbia/Oregon
Date Submitted:	2004
Date Last Updated:	May 13, 2004

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program. Umatilla River Summer Steelhead Program

1.2) Species and population (or stock) under propagation, and ESA status.
Endemic Umatilla River Summer Steelhead (Oncorhynchus mykiss) (stock 091). Listed as "Threatened" under the federal ESA.

1.3) Responsible organization and individuals

Name (and title): Scott Patterson – Hatchery Coordinator
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 107 Twentieth Street, La Grande, OR 97850
Telephone: 541-963-2138
Fax: 541-963-6670
Email: Scott.D.Patterson@state.or.us

Name (and title): Gary James – Fisheries Program Manager
Agency or Tribe: Confederated Tribes of the Umatilla Indian Reservation
Address: P.O. Box 638, Pendleton, OR 97801
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Email: garyjames@ctuir.com

Name (and title): Tim Bailey – District Fish Biologist
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 73471 Mytinger Lane, Pendleton, OR 97801
Telephone: 541-276-2344
Fax: 541-276-4414
Email: umatfish@oregontrail.net

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Confederated Tribes of the Umatilla Indian Reservation – Co-managers – Operators of acclimation and adult collection facilities.

Bonneville Power Administration – Funding for– Hatchery, acclimation, adult collection and monitoring and evaluation.

1.4) Funding source, staffing level, and annual hatchery program operational costs

Umatilla Hatchery is 100% funded by the Bonneville Power Administration. Oregon Department of Fish & Wildlife operates the facility, and staff consists of one F&W Manager 1, one F&W Technician 2, four F&W Technician 1's, one Trades/Maintenance Worker 2, one half-time F&W Technician 1, and one Trades/Maintenance Worker 1. Fiscal Year 2004 Umatilla Hatchery operations budget is $817,305

1.5) Location(s) of hatchery and associated facilities.

Adult Collection-- Summer steelhead broodstock are collected at the Three Mile Falls Dam adult trapping facility located approximately 4 miles upstream from the mouth of the Umatilla River, near the town of Umatilla, in Umatilla County, Oregon. The regional mark processing center site code for Three Mile Falls Dam is 5F33427 H27 24.

Holding and Spawning-- Summer steelhead broodstock are transferred to Minthorn Springs (Minthorn) for holding and spawning. Minthorn is located approximately 4 miles east of Mission in Umatilla County, Oregon. The facility is located on Minthorn Springs Creek. The creek is approximately one mile long with the facility located near the mouth at approximately Umatilla RM 64. The regional mark processing center site code for this facility is 5F33414 H14 22.

Incubation and rearing (from green egg to smolt-- Green eggs are transferred to Umatilla Hatchery for incubation and rearing. Umatilla Hatchery is located along the Columbia River approximately two miles west of Irrigon in Morrow County, Oregon. The regional mark processing center site code for Umatilla Hatchery is 5F33449 H49 21.

Acclimation to release--Juvenile summer steelhead are transferred to the Minthorn and Pendleton acclimation facilities for acclimation and release. Minthorn is discussed under "Holding and Spawning". The Pendleton facility is located on the Umatilla River at RM 56 in Umatilla County, Oregon.

1.6) Type of program.

Integrated Harvest Program-- The Umatilla River Summer Steelhead Program integrates supplementation and harvest augmentation. Endemic broodstock is used for the hatchery program.

1.7) Purpose (Goal) of program.

The goals of the Umatilla River Summer Steelhead Program are threefold: 1) Enhance production through supplementation of naturally producing populations; 2) Provide sustainable tribal and non-tribal harvest opportunities (augmentation); and 3) Maintain the genetic character of the natural population (CTUIR and ODFW, 1989).

1.8) Justification for the program.

The Umatilla River hatchery summer steelhead program is intended to both augment and supplement the natural population. The hatchery program uses endemic broodstock, all hatchery releases are adipose fin clipped and juvenile releases are made in natural production areas and at the upper fishery boundary. The intent is to provide additional fish for harvest and to increase production of the natural population, while maintaining the genetic character of the natural population.

1.9) List of program "Performance Standards"

The Performance Standards for the program are currently under revision in the Sub-Basin planning process and will submitted when the process is completed.

1.10) List of program "Performance Indicators", designated by "benefits" and "risks"

The performance indicators are currently under revision in the Sub-Basin planning process and will be submitted when the process is completed.

1.10.1) "Performance Indicators" addressing benefits.

1.10.2) "Performance Indicators" addressing risks.

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

Annual broodstock collection includes 100 wild adults (50 pairs), and 20 hatchery adults (10 pairs).

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		0
Unfed Fry		0
Fry		0
Fingerling		0
Yearling	Minthorn (RM 62)	50,000
	Pendleton (RM56)	50,000
	Boston Canyon Creek (RM2)	50,000

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

- Estimated smolt-to-adult survival: Master Plan goal is 2.7%. The average smolt-to-adult survival from brood years1991-97 is 0.422%. (Table 1)

- Total adult production: Subbasin Summary goal is 4,000 naturally produced and 1,500 hatchery adult returns to Three Mile Dam. Since 1988, hatchery adult returns to Three Mile Dam have ranged from 166 to 1,860, and naturally produced adult returns have ranged from 725 to 3,659 (Table 2).

- Adult escapement to natural production areas: Since 1988, hatchery adult escapement to natural production areas have ranged from 102 to 1,301 and naturally produced adults have ranged from 623 to 2144 (Table 3).

1.13) Date program started (years in operation), or is expected to start.

The current summer steelhead program (100% rearing at Umatilla Hatchery) began in 1991 with smolt releases in 1992. However, hatchery steelhead smolts have been released into the Umatilla River Basin since 1967 (Table 4).

1.14) Expected duration of program.

This is an on-going program.

1.16) **Watersheds targeted by program.**

The Umatilla Summer Steelhead Program targets
hatchery releases in the mainstem of the Umatilla River and Meacham Creek..

1.16)1. **Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.**

No formal alternative actions have been developed by co-managers for this program, however possible alternatives include.

Because of water shortages at Umatilla Hatchery the original production plan has been revised to reflect available water. The original production goals have also been modified to reflect additional information gained on adult fish return success, habitat utilization and harvest. The steelhead production goal has been reduced from the adult return target of 9,670 to 5,500 (4,000 natural and 1,500 hatchery).

- Develop a water supply system at Umatilla Hatchery to provide 15,000 gpm of water needed to meet production goals. This would allow the hatchery to produce the original goal of 210,000 steelhead smolts.
- Develop additional acclimation sites lower in basin to provide terminal homing sites allowing for potential increased harvest of hatchery produced steelhead.
- Modify Umatilla Hatchery to convert Oregon ponds to Michigan ponds.
- Modify Bonifer pond to allow for better release of steelhead smolts after acclimation. Acclimation at the site has been discontinued due to the inability to effectively release all of

the fish from the pond. Fish are currently being direct stream released at the site.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

4d rule research permit applications have been submitted to NMFS for the following:

- Outmigration and Survival Study

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

Adult age class structure: See Table 5
Sex ratio: See Table 3
Size range:
Migrational timing: See Table 6
Spawning range:
Spawn timing: See Table 6
Juvenile life history strategy, including smolt emigration timing: See Table 6

- **Identify the ESA-listed population(s) that will be directly affected by the program.**
-
- Umatilla River Summer Steelhead (stock 091) – included as part of the Mid-Columbia ESU - listed as "Threatened" under the federal ESA.

- **Identify the ESA-listed population(s) that may be incidentally affected by the program.**

- Umatilla River bull trout are included as part of the Columbia distinct population segment listed as Threatened under the federal ESA.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- **Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds.**

Chilcote (Unpublished draft) identifies the wild Umatilla summer steelhead critical population threshold at 110, and the viable population threshold at 333. Since 1988, wild adults available for spawning have exceeded 600 (Table 2&3).

The U.S Fish and Wildlife Service bull trout recovery plan for the Umatilla/Walla Walla Recovery Unit (2002) list recovery criteria for the Umatilla River. Recovery criteria for the Umatilla River core area are to maintain 500 to 1,000 spawning adults annually for at least two generations(i.e.,10 to 14 years) The redd count average for the last four years(1999-2002)in the North Fork Umatilla River equates to a population estimate of 281 spawning adults.

- **Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.**

The progeny to parent ratio for natural spawning hatchery and natural steelhead compared to Umatilla hatchery steelhead from 1990 through 1999 is presented in Table 1. The progeny to parent ratio of natural spawning hatchery and natural steelhead has been below replacement in eight of the last ten years. In contrast, hatchery progeny to parent ratio was above one for all of the last ten years.

Adult returns to Three Mile Dam and smolt outmigrant estimates of naturally produced steelhead are the primary measurement of productivity used (Table 2). Other measures of productivity (monitoring and enumeration of redd counts, and juvenile abundance est imates) have been examined without acceptable results.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

The number and percent of adult steelhead available to spawn of wild and hatchery origin since 1988 is presented in Table 3. Total natural adult return numbers to Three Falls Mile Dam have ranged from 725 in 1990-91 to 3,659 in 2001-02 (Table 2).

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

The percent of adults available to spawn that were of hatchery origin has ranged from 6.9% of the total run in 1988, to a high of 58.9% in 1997 with a mean of 27.2% (1988-1998; Table 7).

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take</u>

- **Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take**.

- The Umatilla Summer Steelhead program currently collects 100 unmarked steelhead to provide the egg needs for the hatchery program .

Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Tables 13 and 14 provide the numbers of Umatilla summer steelhead collected and spawned for broodstock needs for the program.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).
- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

- Outmigration and Survival Study - As per the 4d rule research application, we will reduce numbers collected by adjusting the sample times and avoid sampling when large numbers of natural steelhead are passing through the sampling facility. To reduce the number of mortalities from fish jumping out of the sample tank or from other areas, we will apply covers and screens to prevent escape and monitor the facility closely. Monitoring information is mostly obtained through remote interrogation of tags, without any handling.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

1) CTUIR. 1994. Wildlife Mitigation Plan (Draft) May 1996, Columbia Basin Salmon Policy. 1995 pg 9-10, and Water Assessment Report;
2) NMFS - Salmon & Steelhead Enhancement Plan for the Washington and Columbia River Conservation areas.Vol 1. chpt 4, 37pgs;
3) Reeve, R. 1988. Umatilla River Drainage Anadromous Fish Habitat Improvement Plan;
4)CTUIR/ODFW. 1990. Umatilla Hatchery Master Plan;
5) OWRD. 1988. Umatilla Basin Report;
6) BOR. 1988. Umatilla basin Project Planning Report,
7) Umatilla County - Comprehensive Plan. 1983, chpt 8;
8) USNF - Umatilla National Forest Land & Resource Management Plan. 1990, chpt 2, pg 13.

and Final EIS. 1990, chpt III, pgs 59-62;
9) CTUIR/ODFW. 1990. Umatilla River Subbasin Salmon and Steelhead Production Plan;
10) Boyce, R. 1986. A Comprehensive Plan for Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin; 11)USFWS & NMFS. 1982. Umatilla R. Planning Aid Report.
11) USBR and BPA. 1989. Umatilla Basin Project. Initial project workplan presented to the NWPPC, May 1989.

This HGMP is consistent with these plans and commitments.

3.3) Relationship to harvest objectives.

Steelhead harvest guidelines were developed by state and tribal comanagers as part of the Umatilla Hatchery Master Plan (CTUIR and ODFW, 1989). This plan identified hatchery broodstock, spawning escapement, and tag collection for evaluation as priorities, and specified numbers of fish allocated to these uses at varying run sizes. The plan was designed to allow harvest of fish returning in excess of these needs. However, this plan is no longer current as a result of several adaptations in program management. Broodstock and evaluation needs are only about half what was originally projected, and non-tribal sport fishing regulations have changed to exclude the harvest of natural steelhead. No formal harvest plan was drafted since then because the shift in fishing regulations was expected to adequately protect natural fish, and provide sport fisheries and additional spawners from hatchery fish. Reliable run prediction models have been developed for Umatilla River steelhead, and in the event of low projected returns, formal management processes are in place to modify collections and harvest prior to their entry into the Umatilla River.

3.3.1 Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available..

A fishery for wild and hatchery summer steelhead existed prior to the implementation of the Master Plan. Beginning in 1992, only hatchery (adipose clipped) summer steelhead can be harvested with a two fish per day limit. For the return years of 192-93 through 2000-01, the average number of hatchery summer steelhead harvested in the Umatilla River non-tribal fishery was 89 fish per year. For the same return years the number of natural summer steelhead caught and released ranged from 37 in 1993-94 to 733 in 2000-01 (Table 12)
Tribal members are allowed to harvest both natural and hatchery summer steelhead in the Umatilla River. The average number of natural summer steelhead harvested in the tribal fishery per return year from 1992-2001 is 3.8. The average number of hatchery summer steelhead harvested in the tribal fishery per year from 1992-2001 is 43.6.
Umatilla hatchery produced summer steelhead contributed to out -of -basin tribal and non-tribal fisheries. The average number of steelhead caught in the combined commercial and subsistence tribal fisheries was 43 fish from brood years 1991-1997 . The average harvest in the Columbia River sport fishery was 46 for brood years 1991-97.

Information available on the incidental catch and harvest of juvenile steelhead during Umatilla River steelhead, spring Chinook, and trout fisheries is given in Table 11.
(See also Tables 8-10)

3.4) Relationship to habitat protection and recovery strategies.

The Umatilla Summer Steelhead Program is a part of an overall Umatilla Basin Salmon and Steelhead Restoration Program. In addition to on-going passage and hatchery operations, restoration efforts include ongoing projects that enhance stream and riparian habitat as well as monitor and evaluate the hatchery and natural components of the restoration program. Factors limiting the natural production of steelhead in the Umatilla River Basin include channelization, low or no summer flows, warm water temperatures, sediment, and poor habitat diversity caused by urban and rural development/land management practices. Ocean conditions and the mortalities and stress from the operation of hydropower projects on the mainstem Columbia River are important factors outside the basin. There continues to be degradation to fish habitat in these areas that hampers improvement efforts.

3.5) Ecological interactions.

- Interactions with species that could negatively impact program: a) bird predation during peak smolt migration periods each Spring; and b) Northern Pikeminnow and smallmouth bass - predation during smolt migration periods.

- Interactions with species that could be negatively impacted by program: Hatchery steelhead smolts that residualize and become resident fish have been documented in Boston Canyon Creek, lower Meacham Creek, and the middle and lower mainstem Umatilla River. These hatchery smolts are much larger than wild juvenile *O mykiss* of the same age, and compete with wild juvenile *O mykiss*, bull trout, Pacific lamprey, coho and Chinook salmon, Margined Sculpin, Mountain whitefish and other non-game fish for limited summer and winter rearing habitat.

- Interactions with species that could positively impact program: Carcasses from salmon and hatchery steelhead kelts or pre-spawn mortalities add to the Umatilla River subbasin's nutrient recharge cycle. Increased angler effort in the coho and fall Chinook salmon fisheries increases awareness of the Umatilla steelhead program which could potentially lead to increased harvest of hatchery steelhead.

- Interactions with species that could be positively impacted by program: Hatchery steelhead smolts could add to the food base for bull trout.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Umatilla Hatchery--The water source for the Umatilla Hatchery comes from the Columbia River through a Ranney well system. The system was initially designed and constructed to produce a maximum of 15,000 gpm of water. However, actual water capacity is 5,500 gpm, and several wells have been subject to failure (Jack Hurst, ODFW, Umatilla Hatchery) Water from the well system averages 12.2°C (54°F). Water quality exceeds BPA requirements (BPA 1987) for all hatchery uses. Water is withdrawn under certificate #72181, permit G 10870, and, certificate #72182, permit #G 11210. Water discharged is monitored under the general NPDES 0300 J permits.

Three Mile Falls Dam--The water source for the Three Mile Falls Dam adult facility is pumped directly from the Umatilla River. The Denil steep-pass utilizes 2,900 gpm and the holding pond uses 1,450 gpm. Both the steep-pass and holding pond pumps run continuously. The fish lock system uses 630 gpm, but is used only during handling operations (approximately two hours per day). The water source is the same as used by the natural population. Water temperatures at Three Mile Falls Dam range from approximately 0°C (32°F) in winter to over 21°C (70°F) during the summer. Sediment loads vary dramatically during the return season (late August through early June) and during the migration season (March – July). High sediment loads are experienced annually during high flow conditions.

Minthorn Juvenile Acclimation and Adult Holding Facility -- Minthorn receives its water from Minthorn Springs Creek, which is formed from the inflow of several springs located immediately south of the Umatilla River. Water through the brood holding area is supplied by gravity and ranges from approximately 500 to 2,100 gpm. The water supply to the raceways is pumped from the creek with a single-pass pass water-pumping rate of approximately 800 gpm per each of two raceways. During the summer steelhead adult holding period (mid-September to late May), average monthly water temperatures range from approximately 7 to 13°C (45 to 55°F). During the juvenile acclimation period (April), temperatures range from 6.5 to 14°C (44 to 57°F), with an average of 9°C (48^{o}F). High sediment loads are experienced in some years during high flow conditions.

Pendleton Acclimation Facility-- Water for the Pendleton juvenile acclimation and release facility is pumped directly from the Umatilla River. Water flow is approximately 1,600 gpm per pond. During the juvenile acclimation period (April), daily temperatures range from approximately 4.5 to 13.0^{o}C (40.0 to 55^{o}C). High sediment loads are experienced in some years during high flow conditions.

Natural Production-- Natural spawners use the water available in the streams of the Umatilla River Basin. Water quality is relatively high in the headwater streams where steelhead spawn and rear. The spawning streams contrast greatly to the lower Umatilla River and lower tributaries where sediment loads are high in the spring and summer water temperatures are often lethal to Salmonids (Contor et al. 1998). Water quality in this desert basin contrasts to the hatchery, as there are often large daily fluctuations in water temperature. During the winter and spring, rain-on-snow events interspersed with cold periods often produce large fluctuations in stream flow. During spawning and incubation, the streams are often high and turbid.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Minthorn/Pendleton Acclimation--Acclimation facility intake screens conform to NMFS screening guidelines to minimize the risk of entrainment of juvenile listed fish.

Umatilla Hatchery—Rearing water source is 100% well water and operating under NPDES general permit # 300 J. .

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods)

Three Mile Falls Dam--Broodstock collection is conducted solely at the Three Mile Falls Dam east bank adult trapping facility. The facility consists of a vertical slot fish ladder, Denil steeppass, adult holding pond (raceway), and fish handling and sorting complex. The construction and operation of the facility has no effect on the critical habitat for summer steelhead. The dimensions of the holding pond are 14' wide by 36' long by 3.5' deep (approximately 1,800 cubic feet). The holding pond has a jump screen located at the upper end and jumpout panels located at both upper corners to prevent adults from jumping out of the pond. The holding pond is located above the 100 year flood level. The water supply for the holding pond is pumped directly from the Umatilla River at a rate of 1,450 gpm. A low water discharge alarm is located on the pond supply line to signal any loss of flow to the holding pond. No backup pumps or emergency generator system are located at the site. In case of water loss to the pond, two options are available to on-site personnel. During power outages or other short term losses of flow, the outlet gate from the pond can be closed to maintain water depth. For pump failures or other long term losses of water supply, adults can be dipnetted out of the pond and returned to the river.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adults collected are anesthetized with CO_2, prior to handling. Broodstock are transported in a 370-gallon fish transport tank, which is mounted on a dual axle trailer and is pulled by a pick-up truck. The trailer is equipped with compressed oxygen aeration and a re-circulation system.

5.3) Broodstock holding and spawning facilities.

Minthorn Acclimation/Adult Holding--Since 1988, all summer steelhead spawning has occurred at Minthorn. The facility includes a concrete channel that functions as a fish ladder/trap, inlet/outlet water control structure, and summer steelhead broodstock holding area. The brood holding area is approximately 25 feet long by 8 feet wide. Water through the pond is supplied by gravity from Minthorn Springs Creek. Depth is controlled by dam boards and is usually held at 4 feet. The pond has vertical bar screens with 1 ½ inch spacing at both the influent and effluent ends and is surrounded by a chain link fence topped with barbed wire. The fence provides security and prevents fish from jumping out or escaping due to flood events. Floating covers are placed over approximately one third of the pond to help alleviate disturbances to the fish and to help prevent fish from jumping. The top of the concrete walls and bottom of the chain link fence are overlapped with rubber matting so that if the fish do jump, injuries will be minimized. The fence has three gates for accessing the pond for unloading adults and spawning. Adjacent to the pond is a concrete slab used during the spawning operation. The entire facility is covered with a roof to provide protection for fish, eggs and personnel. In an extreme emergency, the fish can be released into Minthorn Springs Creek by pulling the effluent screen and dam boards and letting the fish swim out volitionally.

Beginning in early February and continuing through the end of the spawning season, the fish are treated five days per week with hydrogen peroxide to help control prespawning losses due to fungus. A one-hour flow through treatment at approximately 100 ppm active ingredient is used. ODFW pathology personnel are available to address disease concerns.

The location of the facility blocks approximately one mile of habitat that might be utilized for spawning and rearing. This habitat is limited; however, as flows are as low as 500 gpm and temperatures often exceed 20^{o} C (68^{o}F) during the period from June to September.

5.4) Incubation facilities.

Umatilla Hatchery--Fertilized eggs are transported from Minthorn to Umatilla Hatchery in five-gallon buckets with chilled water. Umatilla hatchery incubation equipment consists of four separate units of Marisource incubators (Heath tray type). Water can be used directly from wells or mixed with chilled water. Three units can be supplied with well water at 12.2^{o}C (54^{o}F) or mixed with chilled water 7.2^{o}C (45^{o} F) for any combination of temperatures from 7.2-12.2^{o}C (45-54^{o} F) provided that 300 gpm of chilled water is not exceeded. The fourth unit can be mixed with water chilled to 3.3^{o}C (38^{o} F) to achieve any combination of temperatures from 3.3-12.2^{o}C (38–54^{o} F) provided that 60 gpm of chilled water is not exceeded. Numerous systems continually monitor temperature, mechanical systems, electrical systems, and flow. Alarms sound if any system fails or is out of criteria. Continual monitoring of systems and preventative maintenance is used to prevent system failure. An emergency gas powered pump installed in the aeration tower structure supplies water for incubation in the event of aeration lift pump failure. In the event of total system failure resulting in total loss of water, eggs may be transported to Irrigon hatchery (if they are still operational and have necessary space).

Pathogen free water is used for incubation at Umatilla Hatchery for all programs. This is a direct preventive measure at minimizing the risk of introducing pathogens into the hatchery program, thus minimizing the risks to fish in the natural environment after these fish are released. Sanitary measures are taken at Umatilla Hatchery to prevent transmission of pathogens from one stock to another by disinfecting equipment in Iodophor.

5.5) Rearing facilities.

Umatilla Hatchery--Umatilla Hatchery has three different types of rearing units. There are eight 21' Canadian style early rearing tanks located in the main building adjacent to incubation. Water is pumped to the aeration tower and gravity fed to the tanks. Steelhead are started in these tanks in early July. The fish are moved outside to Oregon ponds when densities reach approximately 80 pounds in each tank. Umatilla Hatchery has 10 Oregon ponds. Rearing dimensions are 91'X18.75'X3.67'. These ponds are designed for serial reuse in-groups of 2 ponds, upper and lower. They also can be supplied with fresh water individually, if necessary. Steelhead are reared in these ponds until fish are equally divided, (un-graded) into three Michigan ponds in late October, at 50,000 each. Umatilla Hatchery has 24 Michigan style ponds, with rearing dimensions of 91'X9'X2.75'. Water is supplied to these ponds in reuse groups of three ponds each. Each pond has a submersible pump that supplies 950 gpm of water to oxygen contact columns, located at the head of each pond. Oxygen is introduced and unwanted saturated gas is removed from incoming water at this point. Each pond has its own oxygen supply line. Supplemental oxygen is either delivered from oxygen generators, (pressure swing absorption units) or from a bulk liquid tank on site. Steelhead are reared at enhanced densities to utilize well available water efficiently. Two groups (50K ea.) are transferred in the spring to acclimation ponds on the Umatilla River, at Pendleton and Minthorn. One group of 50,000 fish is direct stream released at Bonifer Springs, on Meacham Creek Rm-2, at the time of acclimation releases. All ponds have a high-low water level alarm, and for Michigan ponds, pump failure and oxygen flow alarms. In the event of total system failure, fish could be moved to nearby Irrigon Hatchery if pond space is available and all logistics were in place prior to the time of failure. Monitoring and maintenance of the water supply system, and forecasting for contingencies, are the best means for dealing with the possibility of rearing pond system failure.

Pathogen free water is used for rearing the fish at the Umatilla Hatchery for all production. This is a direct preventive measure at minimizing the risk of introducing pathogens into hatchery phase of this program, thus minimizing the risks to fish in the natural environment after these fish are released. Sanitary measures are taken at Umatilla Hatchery to prevent transmission of pathogens from one stock to another by disinfecting equipment in Iodophor. In addition, a fish health program is in place to monitor and evaluate the health status of summer steelhead juveniles reared at Umatilla Hatchery.

5.6) Acclimation/release facilities.

Minthorn acclimation/release Facilities -- The Minthorn acclimation/release facilities include two-10 hp pumps, standby generator, two raceways (each 120 x 12 x 4 feet), and outlet pipe for releasing fish. The pumps and generator are located in the upper level of an enclosed pump house well above the 100-year flood levels. Water is pumped from the creek to each of the raceways. The outlets of the ponds have both vertical bar screens with one-quarter inch spacing and woven wire screens with one quarter inch openings to keep fish from escaping. The ponds are covered with netting to prevent bird predation. In case of power failure, a standby generator provides emergency power to the pump(s). In addition, there is a backup pump and both ponds are equipped with high-level and low-level float alarms. In the event of a power or pump failure or pond level alarm, an audio message is sent to a security company who then notifies specified individuals of an alarm condition at the facility. Fish are released from the facility by pulling the dam boards, lowering the pond and crowding out the fish. The fish then exit the pond through an underground pipe to Minthorn Springs Creek. In an extreme emergency, the fish can be released in this way. The ponds are thoroughly cleaned and disinfected prior to fish being placed into them, and ODFW pathology personnel are available to address disease concerns.

The location of the Minthorn facility blocks approximately one mile of habitat that might be utilized for spawning and rearing. This habitat is limited; however, as flows are as low as 500 gpm and temperatures often exceed 20^{o} C (68^{o}F) during the period June to September.

The Pendleton Acclimation Facility -- Facility includes a water intake structure with automatic screen cleaner, pump station, standby generator, water head box/distribution system, storage building, four acclimation ponds (approximately 13,000 cubic feet each; one of which is used for acclimating summer steelhead), settling pond for pond cleaning, and water outlet and fish release structure. Water is supplied by gravity flow to the pump station where is pumped into the head distribution box. Water is then supplied by gravity from the head distribution box to the individual ponds. Water flow is approximately 1,600 gpm per pond. The operation of the facility has no effect on the critical habitat for summer steelhead.

Direct Stream releases--One third of production (50K**)**, are direct stream released. @ Bonifer Rm-2 Meacham Creek.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Umatilla Hatchery-- There have been no operational difficulties or disasters at Umatilla that have led to significant fish mortality.

Minthorn Acclimation Facility-- Theft has been a problem in some years, but added security facilities (mostly screening) have been added and this problem seems to have been eliminated. The last two years we have experienced high mortality presumably due to the use of hydrogen peroxide instead of formalin resulting in more fungus. We have stepped up our treatment regime to hopefully alleviate this problem. We have gone from three treatments per week to five. So far, it seems to be helping.

Pendleton Acclimation Facility-- There have been no operational difficulties or disasters at that have led to significant fish mortality.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

These items are covered in Sections 5.3 through 5.6.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Releases of summer steelhead since 1981 have been from endemic Umatilla River stock . Endemic Umatilla River summer steelhead was also released in 1975. From 1967 through 1970, Skamania and Oxbow stocks of summer steelhead were released in the Umatilla River Basin. (See section 10.3)

6.2) Supporting information.

6.2.1) History.

Summer steelhead releases of Skamania and Oxbow stocks were made in the Umatilla River basin from 1967 through 1970 (section 10.3). In 1975, one release of Umatilla stock steelhead occurred and fish releases every year since 1981 have been from endemic Umatilla stock.
Since 1982-83, all broodstock for the program have been trapped at Three Mile Falls Dam. Brood were collected at the west bank ladder from 1982-83 to 1986-87 and at the east bank ladder from 1987-88 to the present.

From 1982-83 to 1989-90, only unmarked adults were collected for broodstock. Beginning in 1990-91, first generation hatchery adults have also been incorporated into the broodstock to ensure meeting broodstock goals. Unmarked adults collected are assumed to be endemic Umatilla stock, but could include wild strays from other basins. Hatchery adults collected for brood are assumed to be first generation Umatilla stock. Only hatchery steelhead with coded wire tags indicating Umatilla origin are used for spawning.

6.2.2) Annual size.

The number of summer steelhead broodstock collected for holding/spawning since 1982-1983 has varied from 52 during the 1983-84 run year to 225 during the 1991-92 run year (Table 13, 14). Historically, the ratio of males to females has varied. The collection goal for the 2003-04 run year is 120 adults (50 pairs of unmarked adults), and an additional 10 pairs of coded-wire tagged hatchery fish. The collection goal in following years is anticipated to be similar.

6.2.3) Past and proposed level of natural fish in broodstock.

From 1982 to 1990, only unmarked summer steelhead were collected for broodstock (Table 14). Beginning in 1990, first generation hatchery fish were also collected to ensure meeting broodstock goals. The proportion of hatchery fish collected has ranged from 2.3% of the total number collected in 1992-93 to 51.0% in 1990-91. The collection goal for the 2003-04 run year is 120 adults (50 pairs of unmarked adults), and an additional 10 pairs of coded-wire tagged hatchery fish. The collection goal in following years is anticipated to be similar.

6.2.4) Genetic or ecological differences.

The broodstock for this program is collected entirely from the Umatilla River. Broodstock consists of both natural steelhead (50 pairs), and 10 pairs of hatchery steelhead verified to be of Umatilla River origin.

6.2.5) Reasons for choosing.

The endemic stock was selected because of their sufficient abundance and based on the tenet that they would have the best local adaptations and highest likelihood of natural production success in the Umatilla Basin. Umatilla Basin natural steelhead survived more than 100 years of human impact in a desert system including dams, dewatering of migration corridors, roads, logging, grazing, and urban agricultural development.

6.3 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

The risk of among population genetic diversity loss will be reduced by selecting the indigenous summer steelhead population for use as broodstock in this program. Twenty hatchery steelhead (10 pairs) containing coded-wire-tags (cwt) are also selected for broodstock in the event there is a shortage of natural fish. The cwt's are read prior spawning to ensure only program fish are used.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

All fish collected for broodstock purposes are adults.

7.2) **Collection or sampling design.**

The broodstock collection goals are to: 1) Collect healthy, naturally produced, endemic, Umatilla River, summer steelhead; however, hatchery fish are also collected to ensure meeting program goals; 2) Collect a cross section of the run based on arrival time at the Three Mile Falls Dam collection facility; 3) Collect males and females at a one to one ratio, and 4) Collect one-salt and two-salt adults at the same ratio as observed in the run.

Over the last decade, all adults that returned to the Umatilla River have been trapped at Three Mile Falls Dam. All brood have been collected at the east bank adult facility and are collected from September through early May. Beginning in December 1999, adults returning to Three Mile Dam have been trapped one week and allowed to volitionally migrate one week. Brood are collected by selecting 10% of the unmarked return by week in order to collect a representative cross-section of the total run as brood. When adults are trapped on alternate weeks, the 10% rate will still be followed. See BZ or PB. The percent of one salt and two salt adult returns is monitored continuously throughout the season and a similar proportion of one salt and two salt adults are selected for brood. Determinations of one salt and two salt adults are based on a fork length of less than or greater than 26 inches. The male: female ratio in the brood is not necessarily representative of the ratio in the total return. Fifty percent of the unmarked brood are of each sex, whereas females have comprised between 65-70%, but up to 75???% of the total run in recent years.

Adults returning to Three Mile Dam ascend a vertical slot fish way ladder, but are precluded from swimming upstream by use of a barrier gate at the top of the ladder. Adults then ascend a Denil steep-pass and fall into an adult holding pond where they are trapped. Disposition of the fish trapped generally occurs daily in order to minimize upstream passage delays. During periods when few adults are being trapped, adults may be held up to 72 hours. During handling operations, all adults are anesthetized with CO_2 to minimize stress. Mortality of listed steelhead can occur during the holding and handling operations at Three Mile Dam. Over the last eight years, average annual mortality at the facility has been 0.22% with a range of 0.00%-0.62%.

7.3) Identity.

There is one population of summer steelhead in the Umatilla Basin above Three Mile Dam. All unmarked adults that enter the trap at Three Mile Falls Dam are assumed to be of Umatilla origin (but could include unmarked strays), and may be selected for broodstock. Twenty CWT hatchery fish (10 pairs) are also selected for broodstock to ensure the broodstock goals are met. Coded wire tags are read prior to spawning in order to preclude the use of any stray hatchery fish.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

The broodstock goal is to collect 120 adults. 50 wild and 10 hatchery females, and 50 wild, and 50 hatchery origin males.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available: (See Tables 13, 14)

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

All hatchery fish returning to Three Mile Dam in excess of the 20 CWT fish needed for broodstock and those needed for CWT recovery (an additional 100 fish) are released upstream. These fish are available for both harvest and natural production. If the 20 CWT fish collected for broodstock are not used, they are sacrificed for CWT recovery.

7.6) Fish transportation and holding methods.

Umatilla steelhead brood stock are collected at the Three Mile Dam adult collection facility, they then are transported to the Minthorn holding facility for holding and spawning. Adults collected are anesthetized with CO2, prior to handling. Broodstock are transported in a 370-gallon fish transport tank, which is mounted on a dual axle trailer and is pulled by a pick-up truck. The trailer is equipped with compressed oxygen aeration and a re-circulation system. Transit time is approximately one hour. Water temperatures are monitored in the tank and at the release site to ensure there is less than a 10-degree water temperature difference at release.

Since 1988, all summer steelhead holding/spawning has occurred at Minthorn. Adults are held in a concrete pond with a total volume of 800 cubic feet (see section 5.2 for more details). Historically, holding densities have ranged from approximately 3.6 to 7.3 cubic feet per adult and flows have varied from approximately 2.2 to 19.0 gpm per adult. The broodstock goal for FY2004 is 120 adults, which will result in a maximum density of approximately 6.7 cubic feet per adult and a flow of 4.2 to 17.5 gpm per adult. The variation is a result of lower flows in Minthorn Springs Creek in the fall and late spring and because 1,600 gpm is diverted into the acclimation ponds during April when juveniles are being acclimated.

Total mortality of fish held at Minthorn has ranged from 1.5 to 45.0% and has averaged 19.3%. Mortality of unmarked fish has ranged from 0.9 to 41.4% and has averaged 18.3%. In some years, however, a portion of the males were live spawned and held through the end of the spawning season. Had these fish been killed at the time of spawning, mortality numbers would have been lower. Prespawn mortalities are built into the broodstock collection goals. At the end of the spawning season all remaining hatchery fish are sacrificed for coded wire tag recovery and all unmarked fish are released back into the Umatilla River.

7.7) Describe fish health maintenance and sanitation procedures applied.

Minthorn Adult Holding--At Minthorn adult facility, hydrogen peroxide is dripped into the inflowing water to achieve a maximum concentration of 100 ppm. The treatment is applied for one hour to control fungus and parasites five times per week.

Progeny-- Eggs are water hardened in 75ppm iodophor solution for up to 60 minutes to control vertical transmission of pathogens including IHNV.

7.8) Disposition of carcasses.

All summer steelhead broodstock carcasses are placed in a tribal landfill and buried.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Use of Endemic Brood--All broodstock are collected from fish returning to the Umatilla River at Three Mile Dam. 85% of the brood are unmarked natural adults. 15% are adipose fin clipped hatchery adults. Of the hatchery fish collected all are CWT so that origin of fish can be determined. Hatchery fish from out-of-basin are not used. These broodstock collection criteria should minimize domestication and associated deleterious genetic effects.

Broodstock are collected from a representative cross section of the run in order to mimic the natural population.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Minthorn Holding--From early April to late May, broodstock are sorted weekly for maturation. Fish are anesthetized with MS-222 and ripe fish are held in live totes until all fish have been sorted. Beginning in 2004, hatchery females have also been collected for broodstock to ensure meeting the program goals. All ripe females (marked and unmarked) will be spawned on any given spawn day. Marked and unmarked males (of natural origin), at a proposed rate of one male for every ripe female, are selected randomly throughout the broodstock population. Only hatchery reared fish with coded wire tags indicating Umatilla stock are used.

8.2) Males.

The goal is not to re-use males, but historically, this has sometimes been unavoidable. Obtaining adequate quantity and quality of milt from the males is often difficult, and in a limited number of instances, re-use of .mature males has been necessary. Before any hatchery males are spawned, coded wire tags are recovered and read on the spot to ensure the fish is of Umatilla River origin. If it is not from Umatilla Hatchery, the fish is discarded and another fish is selected. Backup males have not been used, primarily because matrix schemes are utilized (see section 8.3 for details).

8.3) Fertilization.

Minthorn-- A 3 x 3 spawning matrix is utilized whenever possible and matings are random, except hatchery fish are not crossed with hatchery fish. All crosses are either wild x wild or wild by hatchery. When only two females are available, a 2 x 2 matrix is used and when only one female is available, the eggs have been fertilized with the milt from a single male. Each 1 x 1, 2 x 2 or 3 x 3 cross is considered a single-family group.

Females are killed and bled by severing the caudal peduncle. The undersides of the fish are cleansed with a solution of Argentyne and are then wiped with a clean towel. The eggs from each female are stripped into a colander to remove excess ovarian fluid. When a 3 x 3 matrix is used, the eggs from each female are mixed and divided equally into three cups. If a 2 x 2 matrix is used, the eggs are mixed and divided equally into two cups. Males are generally killed for spawning, cleansed with Argentyne, and the milt is stripped into individual cups. When a 3 x 3 matrix is used, the milt from a single male is used to fertilize one third of the eggs from each female. If a 2 x 2 matrix is used, the milt from each male is used to fertilize one half the eggs from each female. After the milt is added, well water from Umatilla Hatchery is added and the eggs and sperm are mixed and allowed to stand for approximately one minute or longer. The fertilized eggs from each cup (one family group) are then poured into a colander and combined. The eggs are then poured into a bucket with Umatilla Hatchery well water, rinsed, poured back into the colander, and then are placed into a solution of Argentyne and allowed to water harden for one hour. At the end of the hour, the eggs are again poured into a colander and then into a bucket of fresh well water with a watertight lid for transport to Umatilla Hatchery. Colanders, spawning knives and other equipment are disinfected with Argentyne between each family group.

The cwt from all hatchery fish is read before fertilization to ensure they are of Umatilla river origin. If they are not, the fish is discarded and another fish is spawned in its place.

At the time the males and females are stripped, milt and ovarian fluid samples are taken to test for replicating viral agents. After spawning, pyloric caeca, kidney and spleen samples are also taken to test for bacterial kidney disease and other culturable pathogens. Samples of the lower intestine are examined for *Ceratomyxa Shasta*.

Fish health procedures used for disease prevention include: 1) Draining ovarian fluid from eggs by use of colander; 2) Water hardening in Iodophor @ 75ppm for one hour and then for 15 minutes at the hatchery upon arrival to the facility; and 3) Annual fish health monitoring of Umatilla summer steelhead brood stock to detect any virus or replicating agents or bacterial pathogens that could place the listed fish at risk. For results from this monitoring see BPA annual reports 1992-1997 (Fish Health Monitoring & Evaluation, Keefe, Hayes, Focher & Groberg, et al.)

8.4) Cryopreserved gametes.

There has been no cryopreservation of Umatilla River summer steelhead gametes.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

This is covered in Section 8.3.

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

The number of eggs taken since 1983 has varied from a low of 100,000 eggs in 1984 to a high of 602,000 in 1991 (Table 16). During those years, smolt production goals for the Umatilla River varied significantly. Since 1993, eggs takes have been between 181,000 to 255,000 eggs. The production goal for FY2004 is 201,000 green eggs, which will produce 150,000 smolts. The survival objective from green egg to ponding is 75% (Table 16).

9.1.2) Cause for, and disposition of surplus egg takes.

The Umatilla Summer Steelhead Program does not collect eggs in excess of program needs.

9.1.3) Loading densities applied during incubation.

Umatilla Hatchery --Incubation consists of four isolated units or sections of Marisource (Heath tray type) incubators as described in section 5.4. Loading densities are 7,800 eggs/tray.

9.1.4) Incubation conditions.

Umatilla Hatchery --Oxygen saturation levels average 10 ppm influent and 9 ppm effluent. Water flows are regulated to a minimum of 4 gal. /min, with individual egg take temperatures ranging from 38^0F to 54^0F.

9.1.5) Ponding.

Umatilla Hatchery --Steelhead are ponded the first week of July at 950 temperature units, 3,500 fish/pound, and 100% button-up.

9.1.6) Fish health maintenance and monitoring.

Umatilla Hatchery --Eggs brought to Umatilla Hatchery are disinfected in 75 ppm iodophor for 15 minutes. Fungus is controlled with formalin treatments at a concentration of 1,667 ppm (1:600). Treatments are scheduled seven times per week for 15 minutes. Little mortality has been attributed to yolk-sac malformation. After eyeing, dead eggs are hand picked.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Umatilla Hatchery --Eggs will be incubated using well water only to minimize the risk of catastrophic loss due to siltation.

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1991-02), or for years dependable data are available..

Umatilla Hatchery --The fry to smolt survival objective is 94%. A total of 158,000 fry are ponded to produce 150,000 smolts. Grading of fish was suspended in BY 2002, therefore no pre-smolts are programmed, and 100% reared are released as smolts. Table 16 shows egg take and survival of summer steelhead brood years 1992-2003.

9.2.2) Density and loading criteria (goals and actual levels).

Umatilla Hatchery --Swim-up fry are transferred from heath incubators to Canadian troughs in July at approximately 3,500/lb. They are ponded in one Oregon raceway in August at approximately 450 fish/lb. They are equally split into three Michigan raceways in the fall. Density and loading for Michigan and Oregon raceways (1991-1997 brood years) are presented in (Table 17).

9.2.3) Fish rearing conditions

Umatilla Hatchery --The maximum and minimum dissolved oxygen concentrations in Michigan and Oregon raceway's influent and effluent were 14.5 and 5.7, and 10.6 and 5.7 PPM, respectively. (Table 15).

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Umatilla Hatchery average growth for Summer Steelhead (Brood year 2001)

Month	Fish/lb	Conversion

July	737	1.2
August	143	1.0
September	57	1.4
October	29	1.3
November	17	1.05
December	10.0	1.0
January	6.8	1.18
February	5.7	1.26
March	4.9	1.46
April	5.0	1.0

Length, weight, and condition factor are evaluated during monthly, pre-release, and release monitoring (Table 18).

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

No energy reserve parameters are monitored or evaluated. Growth rates were determined *Umatilla Hatchery* --from monthly length-weight monitoring. Mean growth rates for recent broods (1995-98 broods) were 0.70 mm/d (SD=0.06) for length and 0.51 g/d (SD=0.08) for weight.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs./gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Bio-Oregon moist diet is fed exclusively. Approximately 36,000 pounds are fed annually, at a conversion rate of 1.39.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Monthly monitoring follows specific protocols in the Umatilla Fish Health Monitoring and Evaluation work statement. All raceways of each species and stock at Umatilla Hatchery are monitored monthly for pathogens and parasites. Five moribund or dead fish per raceway are tested for systemic and gill bacteria.

Other Infections - Juvenile fish are treated for bacterial infections if necessary with

oxytetracycline under an Investigational New Animal Drug Permit (INAD).
Sanitation procedures - Statewide fish health management policy (September 12, 2003) provides guidelines for preventative and therapeutic fish health strategies that will be followed in this program.

Table 9.2.7 Disease history (1999-2003) of Umatilla River summer steelhead adults spawned at Minthorn adult facility and juveniles[a] reared at Umatilla Hatchery.

Disease or Organism	Adults	Juveniles
IHN Virus	Yes	No
EIBS Virus	No	No
Aeromonas salmonicida	No	No
Aeromonas/Pseudomonas	Yes	Yes
Flavobacterium psychrophilum	No	Yes
Fl. columnare	No	No
Renibacterium salmoninarum	No	No
Yersinia ruckeri	Yes	Yes
Carnobacterium sp.	No	No
Ichthyobodo	No	No
Gyrodactylus	No	No
Ichthyophthirius multifilis	No	No
Epistylis	No	No
Scyphidia	No	No
Trichodinids	No	No
Gill Copepods	Yes	No
Coagulated Yolk Disease	No	Yes
External Fungi	Yes[b]	Yes
Internal Fungi	No	Yes
Myxobolus cerebralis	No	No
Ceratomyxa shasta	Yes	No

[a] "Yes" indicates detection of the pathogen but in many cases no disease or fish loss was associated with presence of the pathogen. "No" indicates the pathogen has not been detected in that stock.
[b]There have been more pre-spawning mortality problems since the elimination of formalin use for fungus control.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Umatilla Hatchery --Visual estimates of smoltification (parr, intermediate smolt, smolt) in combination with condition factor (see Section 9.2.4) are used to evaluate smolt readiness. Data from previous evaluations are presented in Table 19. Descaling and smoltification observations are presented in Table 19.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

None are used.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation. (

Fish will be reared to a size, and released at a time, to encourage out-migration, and eliminating residualiztion. All fish will be marked 100%. Strict health monitoring, prevention, and treatment protocols will be used.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs	0			
Unfed Fry	0			
Fry	0			
Fingerling	0			
Yearling	50,000 and 50,000 50,000	4.5/LB 4.5/LB	Late April Late May	Minthorn & Pendleton Bonifer (Direct Stream)

10.2) Specific location(s) of proposed release(s). This information is included in Section 1.5.

Stream, river, or watercourse: Umatilla River
Release point: Minthorn Springs (RM 63.8)
Major watershed: Umatilla River
Basin or Region: Mid-Columbia River

Stream, river, or watercourse: Meacham Creek
Release point: (RM 2) – Direct Stream
Major watershed: Umatilla River
Basin or Region: Mid-Columbia River

Stream, river, or watercourse: Umatilla River
Release point: Pendleton Acclimation (RM 56.0)
Major watershed: Umatilla River
Basin or Region: Mid-Columbia River

10.3) Actual numbers and sizes of fish released by age class through the program.

Release year	Hatchery	Number Released	Age at Release	Release Location	Date of Release	Type of Release	Number per Pound	Stock
1967	Gnat Creek	109,805				Direct	75.0	Skamania
1967	Oak Springs	238,020				Direct	117.0	Idaho (Oxbow)
1967	Wallowa	142,240				Direct	240.0	Idaho (Oxbow)
1968	Gnat Creek	23,100				Direct	66.0	Skamania
1968	Gnat Creek	150,000	Eggs			Direct	Eggs	Skamania
1969	Oak Springs	174,341				Direct	145.0	Skamania
1970	Carson	39,489				Direct	8.0-9.0	Skamania
1975	Wizard Falls	11,094				Direct	9.0	Umatilla River
1981	Oak Springs	17,558	Yearling	Upper Uma. R.		Direct	6.0-9.0	Umatilla River
1981	Oak Springs	9,400	Subyearling	Upper Uma. R.		Direct	145.0	Umatilla River
1982	Oak Springs	59,494	Yearling	Upper Uma. R.		Direct	7.0-8.0	Umatilla River
1982	Oak Springs	67,940	Subyearling	Upper Uma. R.		Direct	124.0	Umatilla River
1983	Oak Springs	60,500	Yearling	Upper Uma. R.		Direct	11.0	Umatilla River
1983	Oak Springs	52,700	Subyearling	Upper Uma. R.		Direct	62.0	Umatilla River
1984	Oak Springs	57,939	Yearling	Bonifer	May	Forced	6.5	Umatilla River
1985	Oak Springs	22,000	Yearling /b	Bonifer	Spring	Forced	135.0	Umatilla River
1985	Oak Springs	53,850	Yearling	Bonifer	May	Forced	7.0	Umatilla River
1986	Oak Springs	39,134	Yearling /b	Bonifer	Spring	Forced	150.0	Umatilla River
1986	Oak Springs	54,137	Yearling	Bonifer	May	Forced/Vol.	8.4	Umatilla River
1987	Oak Springs	1,485	Yearling	Meacham Cr. (RM 11)	May	Direct	5.5	Umatilla River
1988	Oak Springs	30,549	Yearling	Minthorn	April	Forced	7.4	Umatilla River
1988	Oak Springs	30,757	Yearling	Nr. Minthorn	April	Direct	6.5	Umatilla River
1988	Oak Springs	33,984	Yearling	Umatilla RM 23	May	Direct	10.3	Umatilla River

Release year	Hatchery	Number Released	Age at Release	Release Location	Date of Release	Type of Release	Number per Pound	Stock
1988	Oak Springs	10,033	Subyearling	Umatilla RM 89	December	Direct	57.5	Umatilla River
1988	Irrigon	24,618	Unfed fry	S. F. Uma. R.	June	Direct	3200.0	Umatilla River
1989	Oak Springs	29,852	Yearling	Minthorn	May	Forced	6.6	Umatilla River
1989	Oak Springs	29,586	Yearling	Nr. Minthorn	May	Direct	5.6	Umatilla River
1989	Oak Springs	22,274	Yearling	Bonifer	April/May	Forced	5.5	Umatilla River
1990	Oak Springs	59,747	Yearling	Bonifer	May	Forced	5.9-7.7	Umatilla River
1990	Oak Springs	29,446	Yearling	Nr. Bonifer	May	Direct	5.5	Umatilla River
1991	Oak Springs	42,610	Yearling	Bonifer	May	Forced	6.2-7.5	Umatilla River
1991	Oak Springs	29,325	Yearling	Nr. Bonifer	May	Direct	8.7	Umatilla River
1991	Oak Springs	3,998	Yearling	Umatilla RM 3	April	Direct	12.5	Umatilla River
1992	Umatilla	19,977	Yearling	Bonifer	March	Forced	5.8	Umatilla River
1992	Umatilla	47,458	Yearling	Minthorn	March	Forced	5.8	Umatilla River
1992	Umatilla	64,550	Yearling	Meacham Cr. (RM 0.5)	April	Direct	5.0	Umatilla River
1992	Umatilla	67,419	Yearling	Meacham Cr. (RM 0.5)	April/May	Direct	5.5	Umatilla River
1992	Umatilla	5,443	Yearling	Umatilla RM 3	April	Direct	5.8	Umatilla River
1993	Umatilla	44,824	Yearling	Bonifer	April	Forced	4.5	Umatilla River
1993	Umatilla	47,979	Yearling	Minthorn	April	Forced	5.6	Umatilla River
1993	Umatilla	65,465	Yearling	Bonifer	May	Forced	6.1	Umatilla River
1994	Umatilla	51,403	Yearling	Bonifer	April	Forced	4.9	Umatilla River
1994	Umatilla	49,598	Yearling	Minthorn	April	Forced	5.1	Umatilla River
1994	Umatilla	52,097	Yearling	Bonifer	May	Forced	5.2	Umatilla River
1994	Umatilla	1,732	Yearling	Umatilla RM 27.3	April	Direct	5.7	Umatilla River

Release year	Hatchery	Number Released	Age at Release	Release Location	Date of Release	Type of Release	Number per Pound	Stock
1995	Umatilla	48,539	Yearling	Bonifer	April	Forced	5.6	Umatilla River
1995	Umatilla	49,983	Yearling	Minthorn	April	Forced	4.7	Umatilla River
1995	Umatilla	47,941	Yearling	Bonifer	May	Forced	5.5	Umatilla River
1996	Umatilla	47,543	Yearling	Minthorn	April	Forced	5.1	Umatilla River
1996	Umatilla	49,377	Yearling	Bonifer	April	Forced	5.3	Umatilla River
1996	Umatilla	49,783	Yearling	Thornhollow	May	Forced	5.1	Umatilla River
1997	Umatilla	46,788	Yearling	Minthorn	April	Volitional	4.6	Umatilla River
1997	Umatilla	41,555	Yearling	Bonifer	April	Volitional	5.4	Umatilla River
1997	Umatilla	48,944	Yearling	Bonifer	May	Volitional	4.9	Umatilla River
1998	Umatilla	49,084	Yearling	Minthorn	April	Volitional	4.7	Umatilla River
1998	Umatilla	41,088	Yearling	Bonifer	April	Volitional	5.9	Umatilla River
1998	Umatilla	47,313	Yearling	Bonifer	Apr/May	Volitional	5.5	Umatilla River
1999	Umatilla	41,843	Yearling	Minthorn	April	Volitional	4.9	Umatilla River
1999	Umatilla	44,226	Yearling	Bonifer	April	Volitional	5.5	Umatilla River
1999	Umatilla	35,564	Yearling	Bonifer	April/May	Volitional	5.9	Umatilla River
1999	Umatilla	9,878	Subyearling	Umatilla RM 2.8	November	Direct	43.9	Umatilla River
2000	Umatilla	51,659	Yearling	Minthorn	March/April	Volitional	4.8	Umatilla River
2000	Umatilla	52,736	Yearling	Minthorn	April	Volitional	4.7	Umatilla River
2000	Umatilla	49,343	Yearling	Bonifer	April	Volitional	6.4	Umatilla River
2001	Umatilla	50,829	Yearling	Minthorn	March/April	Volitional	4.8	Umatilla River
2001	Umatilla	48,291	Yearling	Bonifer	March/April	Volitional	5.4	Umatilla River
2001	Umatilla	41,403	Yearling	Minthorn	April	Volitional	4.7	Umatilla River
2002	Umatilla	54,917	Yearling	Bonifer	April	Volitional	5.1	Umatilla River

Release year	Hatchery	Number Released	Age at Release	Release Location	Date of Release	Type of Release	Number per Pound	Stock
2002	Umatilla	47,521	Yearling	Minthorn	April	Volitional	4.5	Umatilla River
2002	Umatilla	54,366	Yearling	Pendleton	April	Volitional	4.2	Umatilla River
2002	Umatilla	608	Yearling	Pendleton	April	Direct	3.6	Umatilla River
2002	Umatilla	1,218	Yearling	Minthorn	April	Direct	4.2	Umatilla River
2003	Umatilla	41,369	Yearling	Bonifer	April	Volitional	4.8	Umatilla River
2003	Umatilla	42,805	Yearling	Minthorn	April	Volitional	4.0	Umatilla River
2003	Umatilla	42,783	Yearling	Pendleton	April	Volitional	4.4	Umatilla River

10.4) Actual dates of release and description of release protocols. Table (section 10.3 - above) details historical hatchery steelhead releases in the Umatilla River. Since 1984, all releases have been in the spring (March to early June), other than a small release of Subyearlings in December, 1988 & 1999. Since 1993, all yearling steelhead have been acclimated prior to release, other than a small group of fish released directly into the Umatilla River in 1991 and 1992 as part of a passage evaluation study, and from 1998 – 2000 as part of reach-specific survival tests. Acclimated fish were force released from 1993 to 1996, while all releases since 1997 have been volitional beginning the last week of holding. After one week of volitional release, the remaining fish were forced out. Future releases will also be volitional whenever possible. (Table 20)

10.5) Fish transportation procedures, if applicable. .

Juvenile summer steelhead are transported to Pendleton/Minthorn, using 2,000 and 5,000 gallon fish transport trucks.

10.6) Acclimation procedures.

Minthorn Acclimation --Historically, the proposed acclimation period has been four weeks. Beginning in FY2004, however, two groups of fish will be acclimated for three to four weeks while one group will be released directly into Meacham Creek (adjacent to Bonifer Pond) at RM 2. The fish are fed Biomoist Feed twice each day at rate of approximately 0.5 to 1.0% BWD. Mortalities are removed daily and ODFW pathology personnel are available to address specific disease concerns. Temperature and dissolved oxygen measurements are taken daily during acclimation, and on the day of release, ODFW personnel sample the fish for descaling, weight and fork length.

Beginning in 1997, summer steelhead have been allowed to release volitionally for the final week of holding before the remaining fish are forced out. At Minthorn, one of three effluent screens in each of the two ponds is removed and the fish are allowed to swim over a V-notched dam board and through an underground pipe directly into Minthorn Springs Creek. One to two days before the remaining fish are released; they are taken off feed to reduce stress. The ponds are lowered and the fish are slowly crowded out. The fish are released over a two day period (one pond /day) and late in the day.

Pendleton Acclimation --At Pendleton, the effluent screen is pulled and the fish are allowed to volitionally swim over a notched dam board and down the outlet channel directly into the Umatilla River. The fish are taken off feed one to two days prior to the remaining fish being released. The effluent dam boards are removed and the pond is lowered. The fish are then crowded out of the pond using a seine.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All hatchery steelhead released into the Umatilla River are adipose fin clipped. Program goals are evaluated by annually tagging 40 percent of each release group with coded wire tags (20,000 fish in each group of 50,000) The CWT fish are also given a left ventral fin clip. (table 20)

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

The production goal for FY 2004 and subsequent years is 150,000 smolts. Numbers released from 1993 through 2003 have been between 122,000 and 159,000 (section 10.3). Beginning in brood year 2000, all fish raised in this program have been and will continue to be released into the Umatilla River sub basin.

10.9) Fish health certification procedures applied pre-release.

All monitoring will be consistent with the ODFW fish health policy. Current Umatilla Hatchery Monitoring and Evaluation work statements provide the following protocol: Within four weeks prior to release grab-sampled fish of each species and stock are examined as follows:
-Kidney for *R. salmoninarum* by ELISA from 30 fish per raceway (spring Chinook)
-Gill tissue and body scrapings by microscopy from a minimum of five fish
-Gill/kidney/spleen tissue pools (5 fish per pool) from 10 fish per raceway for culturable viruses.

10.10) Emergency release procedures in response to flooding or water system failure.

Minthorn Acclimation --The Minthorn acclimation/release facility includes two-10 hp pumps (one primary and one backup), standby generator, two raceways, and outlet pipe for releasing fish. The pumps and generator are located in the upper level of an enclosed pump house well above the 100-year flood levels. Water is pumped from the creek to each of the raceways. In case of power failure, a standby generator provides emergency power to the pump(s). In addition, if the primary pump fails, the backup pump will automatically start. Both ponds are also equipped with high-level and low-level float alarms. In the event of a power or pump failure or pond level alarm, an audio message is sent to a security company who then notifies specified individuals of an alarm condition at the facility. Fish are released from the facility by pulling the dam boards, lowering the pond and crowding out the fish. The fish then exit the pond through an underground pipe to Minthorn Springs Creek. In an extreme emergency, the fish can be released in this way.

Pendleton Acclimation --The Pendleton acclimation/release facility includes three vertical turbine pumps (two primary and one backup), standby generator, four acclimation ponds (one of which is used for acclimating summer steelhead), and outlet pipes on each pond for releasing fish. In case of power failure, a standby generator provides emergency power to the pump(s). If one of the two primary pumps fails, the backup pump will automatically start. In the event of a power or pump failure, a phone dialer will begin calling up to 10 telephone numbers (stating there is an alarm condition at the facility) until the alarm is acknowledged. Fish are released from the facility by pulling the dam boards, lowering the pond and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Two-thirds of production is acclimated. Acclimated fish are released volitionally for one week and the fish remaining are then forced out. This will help to prevent negative impacts from predators focusing fish released at the same time in large groups. Outmigration of hatchery reared smolts is being monitored to help in detection of ecological problems during this life history stage.

TABLES AND FIGURES:

Table 1. Smolt-to-adult survival, return rate, number of adults produced, out-of basin exploitation and in-basin exploitation for steelhead reared at Umatilla Hatchery and released in the Umatilla River, 1991-97 broods. Out-of-basin data was downloaded from the central database in October 2001. Returns are incomplete for the 1997 brood.

Brood year	Race-way	Release Date	Release[a] site	Release size (fish/lb)	No.[b] CWT recov-eries	Smolt-to-adult sur-vival (%)	Umatilla[c] River return (%)	No. adults pro-duced	Out-of-[d] basin exploit-ation(%)	In-[e] basin exploit-ation(%)
				Small - grade						
91	M5A	5/01/92	MC	5.5	3	0.030	0.030	20	0.0	0.0
92	M5A	5/13/93	BS	6.1	9	0.073	0.073	48	0.0	0.0
93	M5A	5/12/94	BS	5.2	3	0.036	0.031	19	15.8	31.6
94	M5A	5/12/95	BS	5.5	14	0.211	0.202	101	4.0	5.0
95	M5A	5/09/96	TH	5.1	10	0.129	0.129	64	0.0	0.0
96	M8A	5/15/97	BS	4.9	1	0.014	0.014	7	0.0	100
97	M8A	5/04/98	BS	5.5	10	0.167	0.167	79	0.0	15.2
				4.7	50	0.094	0.92	338	2.1	8.9
				Large - grade						
91	M5B	4/30/92	MC	5.0	2	0.020	0.000	13	100	0.0
92	M5B	4/16/93	MN	5.6	46	0.502	0.406	241	19.1	5.4
93	M5B	4/14/94	MN	5.1	36	0.710	0.520	352	26.1	12.5
94	M5B	4/13/95	MN	4.7	79	1.523	1.144	761	24.8	8.9
95	M5B	4/12/96	MN	5.1	50	0.711	0.650	338	8.6	10.9
96	M8B	4/11/97	MN	4.6	42	0.569	0.543	266	4.5	10.5
97	M8B	4/17/98	MN	4.7	27	0.454	0.397	223	12.6	7.2
				4.4	282	0.641	0.523	2,194	18.7	9.4
				Large - grade						
91	M5C	3/29/92	BS+MN	5.8	27	0.279	0.221	188	20.7	3.2
92	M5C	4/18/93	BS	4.5	67	0.665	0.562	298	15.4	7.1
93	M5C	4/11/94	BS	4.9	39	0.885	0.613	455	30.8	10.1
94	M5C	4/11/95	BS	5.6	59	1.051	0.890	510	15.3	7.1
95	M5C	4/24/96	BS	5.3	21	0.281	0.235	139	16.6	7.2
96	M8C	4/10/97	BS	5.4	22	0.322	0.308	134	4.5	9.0
97	M8C	4/16/98	BS	5.9	15	0.221	0.163	91	26.4	14.3
				4.7	250	0.529	0.427	1,815	19.6	7.9
All broods and size grades:				4.6	582	0.422	0.348	4,347	17.8	8.7

[a] *MC = Meacham Creek near Bonifer Springs acclimation site, BS = Bonifer Springs acclimation site, TH = Thornhollow acclimation site, MN = Minthorn acclimation site.*
[b] *Number of coded-wire tags recovered.*
[c] *Return = number of fish counted at Three Mile Falls Dam plus harvest beolow Three Mile Falls Dam.*
[d] *Percent of adult production harvested outside of the Umatilla River basin.*
[e] *Percent of adult production harvested in the Umatilla River basin by non-tribal and tribal sport anglers*

Table 2. Summer Steelhead Annual Run Counts to Three Mile Falls Dam

Year	Hatchery	Wild	Total
1966-67		1778	1778
1967-68		930	930
1968-69		1917	1917
1969-70		2298	2298
1970-71			
1971-72			
1972-73		2057	2057
1973-74		2640	2640
1974-75		2171	2171
1975-76		2534	2534
1976-77		1258	1258
1977-78		3080	3080
1978-79			
1979-80		2367	2367
1980-81		1298	1298
1981-82		768	768
1982-83		1264	1264
1983-84		2314	2314
1984-85		3197	3197
1985-86		2885	2885
1986-87		3444	3444
1987-88	166	2316	2482
1988-89	371	2104	2475
1989-90	246	1422	1668
1990-91	387	725	1112
1991-92	523	2246	2769
1992-93	616	1297	1913
1993-94	345	945	1290
1994-95	656	875	1531
1995-96	785	1296	2081
1996-97	1463	1014	2477
1997-98	903	862	1765
1998-99	751	1135	1886
1999-00	739	2153	2892
2000-01	1089	2573	3662
2001-02	1860	3659	5519
2002-03	960	2120	3080

Table 3. Disposition and Spawning Ground Data of Natural and Hatchery Summer Steelhead (STS) Returning to the Umatilla River above Three Mile Falls Dam, 1988-1999.

RUN YEAR (Fall/Spring)	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Natural STS Enumerated at TMD	2315	2104	1422	724	2247	1298	945	875	1299	1014	862	1134
Hatchery STS Enumerated at TMD	165	370	245	387	522	616	345	656	782	1463	903	740
Natural and Hatchery STS Enumerated at TMD	2480	2474	1667	1111	2769	1914	1290	1531	2081	2477	1765	1874
Natural STS Sacrificed or Mortalities at TMD	20	12	40	2	3	4	0	0	8	5	2	1
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	69	51	33	73	95	70	74
Natural STS Taken for Brood Stock	151	158	92	99	237	129	93	86	107	100	86	110
Natural STS Spawned	31F	42F	25F	78	172	95	79	59	63	75	68	76
Hatchery STS Taken for Brood Stock	0	0	0	103	95	91	42	68	26	10	30	15
Hatchery STS Spawned	0	0	0	49	0	3	17	22	21	3	21	4
Natural Females Released above TMD	1436	1232			1193	875	642	602	863	689	550	716
Natural Males Released above TMD	708	702			814	290	210	187	321	220	224	308
Natural STS Released above TMD	2144	1934	1290	623	2007	1165	852	789	1184	909	774	1024
Hatchery Females Released above TMD	114	216			161	266	186	274	371	666	476	425
Hatchery Males Released above TMD	46	137			154	190	66	281	312	692	327	236
Hatchery STS Released above TMD	160	353	102	234	315	456	252	555	683	1358	803	661
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39
Natural STS Harvested above TMD-ODFW								0	0	0	0	0
Hatchery STS Harvested above TMD-ODFW						22	5	21	25	24	12	47
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548	713
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221	306
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769	1019
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454	382
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305	193
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759	575
Total STS Available for Spawning	2304	2287	1392	857	2322	1569	1074	1298	1803	2210	1528	1594
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002	1095
STS Redds Observed in Index Reaches	138	77	H W.	H W	135	H W.	64	74	119	138	126	218
Total STS Redds Observed	275	128	H W.	H W	300	H W.	224	126	150	149	217	270
Index Reaches Miles Surveyed	18.5	20	H W.	H W	21.4	H W.	21.4	21.4	21.4	21.4	21.4	21.4
Redds Per Mile in Index Reaches	7.5	3.9	H W.	H W	6.3	H W.	3.0	3.5	5.6	6.4	5.9	10.2
Total Miles Surveyed in Umatilla River	61.0	50.2	H W.	H W	67.2	H W.	65.8	35.0	34.4	24.6	38.0	35.0
Redds Per Mile in all Areas	4.5	2.5	H W.	H W	4.5	H W.	3.4	3.6	4.4	6.1	5.7	7.7

Harvest not determined and not subtracted from estimates of spawners, 1988-1982. H. W. = high water.
Assumes that harvest steelhead were 50% females and 50% males. No adjustments made for hook and release mortality.
Index reaches are in Squaw, NF Meacham, Buckaroo, Camp, and Boston Canyon Creeks and the SF Umatilla River.

Table 4. Hatchery releases of summer steelhead in the Umatilla River Basin.

Year of Release	Hatchery	Number Released	Age at Release	Location	Date of Release	Type of Release	No./lb	Stock

1967	Gnat Creek	109,805				Direct	75.0	Skamania
1967	Oak Springs	238,020				Direct	117.0	Idaho (Oxbow)
1967	Wallowa	142,240				Direct	240.0	Idaho (Oxbow)
1968	Gnat Creek	23,100				Direct	66.0	Skamania
1968	Gnat Creek	150,000	Eggs			Direct	Eggs	Skamania
1969	Oak Springs	174,341				Direct	145.0	Skamania
1970	Carson	39,489				Direct	8.0-9.0	Skamania
1975	Wizard Falls	11,094				Direct	9.0	Umatilla River
1981	Oak Springs	17,558	Yearling	Upper Umat. R.		Direct	6.0-9.0	Umatilla River
1981	Oak Springs	9,400		Upper Umat. R.		Direct	145.0	Umatilla River
1982	Oak Springs	59,494	Yearling	Upper Umat. R.		Direct	7.0-8.0	Umatilla River
1982	Oak Springs	67,940		Upper Umat. R.		Direct	124.0	Umatilla River
1983	Oak Springs	60,500	Yearling	Upper Umat. R.		Direct	11.0	Umatilla River
1983	Oak Springs	52,700		Upper Umat. R.		Direct	62.0	Umatilla River
1984	Oak Springs	57,939	Yearling	Bonifer	May	Forced	6.5	Umatilla River
1985	Oak Springs	22,000	Yearling /b	Bonifer	March	Forced	135.0	Umatilla River
1985	Oak Springs	53,850	Yearling	Bonifer	May	Forced	7.0	Umatilla River
1986	Oak Springs	39,134	Yearling /b	Bonifer	Spring	Forced	150.0	Umatilla River
1986	Oak Springs	54,137	Yearling	Bonifer	May	Forced	8.4	Umatilla River
1987	Oak Springs	1,485	Yearling	Meacham Cr.(RM 11)	May	Direct	5.5	Umatilla River
1988	Oak Springs	30,549	Yearling	Minthorn	April	Forced	6.5-7.4	Umatilla River
1988	Oak Springs	30,757	Yearling	Near Minthorn	April	Direct	6.5	Umatilla River
1988	Oak Springs	33,984	Yearling	Umatilla RM 23	May	Direct	10.3	Umatilla River
1988	Oak Springs	10,033	Subyearling	Umatilla RM 89	December	Direct	57.5	Umatilla River
1988	Irrigon	24,618	Unfed fry	S. F. Umat. R.	June	Direct	3200.0	Umatilla River
1989	Oak Springs	29,852	Yearling	Minthorn	May	Forced	6.6	Umatilla River
1989	Oak Springs	29,586	Yearling	Near. Minthorn	May	Direct	5.6	Umatilla River
1989	Oak Springs	22,274	Yearling	Bonifer	April/May	Forced	5.5	Umatilla River
1990	Oak Springs	59,747	Yearling	Bonifer	May	Forced	5.9-7.7	Umatilla River
1990	Oak Springs	29,446	Yearling	Near Bonifer	May	Direct	5.5	Umatilla River
1991	Oak Springs	42,610	Yearling	Bonifer	May	Forced	6.2-7.5	Umatilla River
1991	Oak Springs	29,325	Yearling	Near Bonifer	May	Direct	8.7	Umatilla River
1991	Oak Springs	3,998	Yearling	Umatilla RM 3	April	Direct	12.5	Umatilla River
1992	Umatilla	19,977	Yearling	Bonifer	March	Forced	5.8	Umatilla River
1992	Umatilla	47,458	Yearling	Minthorn	March	Forced	5.8	Umatilla River
1992	Umatilla	64,550	Yearling	Meacham Cr.(RM 0.5)	April	Direct	5.0	Umatilla River
1992	Umatilla	67,419	Yearling	Meacham Cr.(RM 0.5)	April/May	Direct	5.5	Umatilla River
1992	Umatilla	5,443	Yearling	Umatilla RM 3	April	Direct	5.8	Umatilla River
1993	Umatilla	44,824	Yearling	Bonifer	April	Forced	4.5	Umatilla River
1993	Umatilla	47,979	Yearling	Minthorn	April	Forced	5.6	Umatilla River
1993	Umatilla	65,465	Yearling	Bonifer	May	Forced	6.1	Umatilla River
1994	Umatilla	51,403	Yearling	Minthorn	April	Forced	4.9	Umatilla River
1994	Umatilla	49,598	Yearling	Bonifer	April	Forced	5.1	Umatilla River
1994	Umatilla	52,097	Yearling	Bonifer	May	Forced	5.2	Umatilla River
1994	Umatilla	1,732	Yearling	Umatilla RM 27.3	April	Direct	5.7	Umatilla River
1995	Umatilla	48,539	Yearling	Bonifer	April	Forced	5.6	Umatilla River
1995	Umatilla	49,983	Yearling	Minthorn	April	Forced	4.7	Umatilla River
1995	Umatilla	47,941	Yearling	Bonifer	May	Forced	5.5	Umatilla River
1996	Umatilla	47,543	Yearling	Minthorn	April	Forced	5.1	Umatilla River
1996	Umatilla	49,377	Yearling	Bonifer	April	Forced	5.3	Umatilla River
1996	Umatilla	49,783	Yearling	Thornhollow	May	Forced	5.1	Umatilla River
1997	Umatilla	46,788	Yearling	Minthorn	April	Volitional	4.6	Umatilla River
1997	Umatilla	41,555	Yearling	Bonifer	April	Volitional	5.4	Umatilla River
1997	Umatilla	48,944	Yearling	Bonifer	May	Volitional	4.9	Umatilla River
1998	Umatilla	49,084	Yearling	Minthorn	April	Volitional	4.7	Umatilla River
1998	Umatilla	41,088	Yearling	Bonifer	April	Volitional	5.9	Umatilla River
1998	Umatilla	47,313	Yearling	Bonifer	May	Volitional	5.5	Umatilla River
1999	Umatilla	41,843	Yearling	Minthorn	April	Volitional	4.9	Umatilla River
1999	Umatilla	44,226	Yearling	Bonifer	April	Volitional	5.5	Umatilla River
1999	Umatilla	35,564	Yearling	Bonifer	April/May	Volitional	5.9	Umatilla River

Table 5. Age summary of natural summer steelhead from the Umatilla River.

Return Year		Age 1.1	Age 1.2	Age 2.1	Age 2.2	Age 2.3	Age 3.1	Age 3.2	Age 4.1	Total
1994	n=	0	2	24	26	0	5	6	0	63

	%=	0	3.2	38.1	41.3	0	7.9	9.5	0	100
1995	n=	0	0	19	17	0	9	11	0	56
	%	0	0	33.9	30.4	0	16.1	19.6	0	100
1996	n=	0	0	28	8	0	7	1	0	44
	%	0	0	63.6	18.2	0	15.9	2.3	0	100
1997	n=	0	0	19	17	0	5	10	0	51
	%	0	0	37.3	33.3	0	9.8	19.6	0	100
1998	n=	1	1	33	11	1	4	0	1	52
	%	1.9	1.9	63.5	21.2	1.9	7.7	0	1.9	100

Juvenile years of freshwater growth from scales of adult steelhead returning to the Umatilla River.

Return Year		Age 1	Age 2	Age 3	Age 4	Total
1994	n=	2	50	11	0	63
	%=	3.2	79.4	17.4	0	100
1995	n=	0	36	20	0	56
	%	0	64.3	35.7	0	100
1996	n=	0	36	8	0	44
	%	0	81.8	18.2	0	100
1997	n=	0	37	15	0	51
	%	0	70.6	29.4	0	100
1998	n=	2	45	4	1	52
	%	3.8	86.5	7.7	1.9	99.9

Table 6. Life History table of steelhead

Mouth of the Umatilla to the mouth of McKay Creek (RM 0-50.5)

Life History Stage	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding												
Spawning												
Incubation												
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x	x		

Mouth of McKay Creek to the mouth of Meacham Creek (RM 50.5-79) and mid-basin streams

Life History Stage	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

Mouth of Meacham Creek to the forks (RM 79-89 and headwater streams)

Life History Stage	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**

Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

Table 7. The Number and Percent of Steelhead (STS) Available to Spawn Naturally that were of Hatchery Origin; Umatilla River, 1988-1999.

BROOD YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002
Percent Spawners of Hatchery Origin	6.9	15.4	7.3	27.3	13.6	26.1	21.1	39.6	34.3	58.9	49.7
Percent Females Spawners of Hatchery Origin	7.4	14.9			11.9	21.7	21.3	29.7	28.2	48.0	45.3

Harvest not estimated 1988-1992. 1993-1999, Harvest estimate subtracted from total, assumes harvest of 50% females and 50% males
No adjustments made for catch and release mortality.

Table 8. Descriptive statistics for the steelhead fishery in the Umatilla River, run years 1993-94 through 1998-99. Catch statistics were based on creel surveys conducted in the lower river (Umatilla mouth to Three Mile

Falls Dam) and upper river (Barnhart Bluffs to lower boundary of the CTUIR).

Statistic[a]	Fish origin[b] or creel area	Run year 93-94	94-95	95-96	96-97	97-98	98-99	Mean
Run size	WSTS	945	875	1296	1014	862	1133	1021
	HSTS	359	696	819	1529	994	739	856
Run composition (%)	WSTS	72	56	61	40	46	61	56
	HSTS	28	44	39	60	54	39	44
Catch composition (%)	WSTS	59	67	70	59	62	65	64
	HSTS	41	33	30	41	38	35	36
Number caught	WSTS	37	172	161	168	239	250	171
	HSTS	26	85	69	115	146	132	96
Percent of run caught	WSTS	3.9	19.6	12.4	16.6	27.7	22.1	17.1
	HSTS	7.2	12.2	8.4	7.5	14.7	17.9	11.3
Percent of run harvested	HSTS	5.3	8.7	7.3	5.9	10.4	13.7	8.6
Composition of lower river catch (%)	WSTS	49	67	64	59	49	50	56
	HSTS	51	33	36	41	51	50	44
Composition of upper river catch (%)	WSTS	71	66	75	60	78	75	71
	HSTS	29	34	25	40	22	25	29
Location of WSTS catch (%)	Lower Rr.	46	70	44	71	44	30	51
	Upper Rr.	54	30	56	29	56	70	49
Location of HSTS catch (%)	Lower Rr.	69	68	56	72	74	56	66
	Upper Rr.	31	32	44	28	26	44	34
Percent of WSTS run caught	Lower Rr.	1.8	13.7	5.4	11.9	12.2	6.6	8.6
	Upper Rr.	2.1	5.9	7.0	4.7	15.5	15.4	8.4
Percent of HSTS run caught	Lower Rr.	5.0	8.3	4.7	5.4	10.9	10.0	7.4
	Upper Rr.	2.2	3.9	3.7	2.1	3.8	7.8	3.9
Percent of HSTS run harvested	Lower Rr.	3.9	5.7	4.2	4.3	9.2	7.3	5.8
	Upper Rr.	1.4	3.0	3.1	1.6	1.2	6.4	2.8

[a] *Hatchery steelhead run = number counted at Three Mile Falls Dam plus harvest below Three Mile Falls Dam; Wild steelhead run = number counted at Three Mile Falls Dam.*
[b] *WSTS = wild steelhead; HSTS = hatchery steelhead; Lower Rr. = lower river creel area; Upper Rr. = upper river creel area.*

Table 9. Summary of Estimated Tribal of Summer Steelhead from 1993 through 1988.

Year	Summer Steelhead Caught by Tribal Anglers
1993-94	30 (5)*
1994-95	25 (5)
1995-96	25 (5)
1996-97	39
1997-98	33
1998-99	39 (5)*
Total	191 (20)*

* Wild Fish in parentheses, estimated for 1993 and 1999.

Table 10. Summary of Estimated Harvest Outside of the Umatilla River Basin for Hatchery Summer Steelhead Adults Returning from Releases in the Umatilla River (based on coded wire tag recoveries).

Year of Release	Estimated Summer Steelhead Harvested Out of Basin		
	Canada and Idaho Catch	Columbia River Catch (Nets)	Columbia River Sport Catch
1988	3	88	15
1989	0	0	6
1990	0	136	74
1991	0	119	63
1992	0	48	4
1993	2	30	56
1994	0	42	157
1995	0	100	75
1996	0	17	11
Total	7	580	461

Table 11. Catch and harvest of fin-clipped "trout" (juvenile hatchery steelhead) and unclipped "trout" (rainbow trout and juvenile native steelhead) during steelhead and spring Chinook salmon fisheries in the upper Umatilla River, 1999.

Steelhead Fishery (Barnhart Bluffs to CTUIR West Boundary)
January 1 – April 15, 1999

Fish Caught	Estimated catch	Estimated harvest	Hrs / fish	Estimated hours of steelhead angling
Clipped "trout"	114	0	77.2	8,805
Unclipped "trout"	340	0	25.9	
Unclipped:Clipped "Trout" Catch Ratio = 3:1				

Spring Chinook Fishery (Three Mile Falls Dam to CTUIR West Boundary)
May 29 – June 20, 1999

Fish Caught	Estimated catch	Estimated harvest	Hrs / fish	
SALMON ANGLERS				Estimated hours of salmon angling
Clipped "trout"	79	44	37.5	2966
Unclipped "trout"	169	94	17.6	
TROUT ANGLERS				Estimated hours of trout angling
Clipped "trout"	325	169	9.0	2932
Unclipped "trout"	1,737	903	1.7	
TOTAL				
Clipped "trout"	404	213	--	
Unclipped "trout"	1,906	997	--	
Unclipped to Clipped "Trout" Catch Ratio = 5:1				

Table 12. Summary of steelhead catch statistics, 1992-2001 run years. Data is combined from lower river (Umatilla mouth to Three Mile Falls Dam) and upper river (Barnhart Bluffs to lower boundary of the Confederated Tribes of the Umatilla Indian reservation near Highway 11).

Year	No. anglers	Hours fished	No. hatchery steelhead harvested	No. hatchery steelhead released	No. natural steelhead released	Catch rate (fish/h)
1992-93	543	5,293	37	NA	140[a]	0.040
1993-94	577	4,504	19	7	37	0.014
1994-95	1,070	6,172	61	24	172	0.042
1995-96	880	4,560	60	10	162	0.051
1996-97	1,409	6,916	90	25	169	0.048
1997-98	898	6,676	101	43	238	0.057
1998-99	1,179	9,097	101	31	272	0.044
1999-00	1,154	8,545	78	22	454	0.065
2000-01	1,455	7,283	90	24	181	0.041
2001-02	1,624	12,057	204	56	733	0.082

[a] *Includes an undetermined number of hatchery steelhead released.*

Table 13. Umatilla River summer steelhead broodstock collection

Run Year	Number Collected								
	Marked			Unmarked			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
82-83	0	0	0	unk	unk	161	unk	unk	161
83-84	0	0	0	20	32	52	20	32	52
84-85	0	0	0	25	79	104	25	79	104
85-86	0	0	0	11	58	69	11	58	69
86-87	0	0	0	57	91	148	57	91	148
87-88	0	0	0	73	78	151	73	78	151
88-89	0	0	0	72	88	160	72	88	160
89-90	0	0	0	49	57	106	49	57	106
90-91	47	56	103	46	53	99	93	109	202
91-92	49	46	95	109	116	225	109	116	225
92-93	1	2	3	64	61	125	65	63	128
93-94	18	25	43	47	45	92	65	70	135
94-95	35	33	68	38	48	86	73	81	154
95-96	16	12	28	56	49	105	72	61	133
96-97	12	1	13	48	49	97	60	50	110
97-98	19	11	30	42	44	86	61	55	116
98-99	17	0	17	52	59	111	69	59	128
99-00	14	1	15	60	55	115	74	56	130
00-01	10	0	10	55	50	105	65	50	115
01-02	10	0	10	50	50	100	60	50	110
02-03	10	0	10	48	51	99	58	51	109

Table 14. Umatilla River summer steelhead broodstock spawning

Run Year	Number Spawned									Eggs Taken	Mean Fecundity
	Marked			Unmarked			Total				
	Males	Females	Total	Males	Females	Total	Males	Females	Total		

82-83	0	0	0	unk	33	unk	unk	33	unk	132,000	4,000
83-84	0	0	0	unk	21	unk	unk	21	unk	100,000	4,762
84-85	0	0	0	unk	33	unk	unk	33	unk	150,000	4,545
85-86	0	0	0	unk	30	unk	unk	30	unk	166,000	5,533
86-87	0	0	0	30	37	67	30	37	67	239,760	6,480
87-88	0	0	0	31	31	62	31	31	62	121,980	5,545
88-89	0	0	0	42	42	84	42	42	84	214,712	5,803
89-90	0	0	0	28	25	53	28	25	53	130,274	5,922
90-91	11	31	42	52	33	85	63	64	127	410,356	6,412
91-92	0	0	0	86	86	172	86	86	172	476,871	5,545
92-93	1	2	3	48	47	95	49	49	98	255,441	5,213
93-94	0	17	17	48	31	79	48	48	96	234,432	4,884
94-95	9	13	22	31	28	59	40	41	81	223,525	5,452
95-96	13	8	21	31	32	63	44	40	84	215,408	5,385
96-97	2	1	3	37	38	75	39	39	78	209,639	5,375
97-98	13	8	21	30	38	68	43	46	89	228,622	5,080
98-99	4	0	4	35	41	76	39	41	80	224,716	5,481
99-00	8	0	8	34	42	76	42	42	84	200,825	4,782
00-01	0	0	0	41	41	82	41	41	82	226,685	5,529
01-02	4	0	4	32	36	68	36	36	72	180,955	5,027
02-03	2	0	2	29	30	59	31	30	61	184,827	6,161

Table 15. Water quality comparisons between Michigan and Oregon raceways during production 1992-1998.

		Inlet			Outlet		
Parameter	Pass	N	Means	Min-Max	N	Means	Min-Max
Temperature (°C)	A	113	12.4	10.4-15.2	113	12.4	10.4-15.1
	B	93	12.5	10.6-15.0	93	12.5	10.6-15.0
	C	87	12.5	10.2-14.9	86	12.5	10.3-15.2
pH	A	108	7.78	6.83-8.63	108	7.68	6.79-8.30
	B	88	7.71	7.08-8.30	88	7.63	6.73-8.18
	C	82	7.64	6.85-8.24	81	7.60	6.73-8.14
Oxygen (mg/L)	A	110	12.1	8.7-17.9	110	9.13	5.7-11.9
	B	90	12.7	8.7-19.5	90	9.51	6.2-12.9
	C	82	13.0	9.3-17.6	81	9.79	7.2-14.5
Unionized Ammonia (μg/l)	A				88	0.56	0.03-2.56
	B				70	1.12	0.12-7.48
	C				65	1.49	0.23-11.75

Table 16. Egg take and survival of summer steelhead (brood years 1992-1998) reared at Umatilla Hatchery during 1992-1998.

Brood	Number of eggs taken	Egg-to-fry survival	Egg-to-smolt survival[a]

Year	or received	(%)	(%)
1991	340,674	79	68
1992	423,810	81	73
1993	255,000	74	75
1994	234,000	85	83
1995	223,525	87	77
1996	224,000	82	72
1997	209,639	82	76
1998	228,622	63	54
1999	224,716	76	74
2000	200,825	79	76
2001	226,685	75	71
2002	180,955	73	69
2003	184,827	75	

[a] *Survival estimate is based on green egg-to-smolt stage.*

Table 17. Rearing conditions immediately before transfer for summer steelhead in Michigan raceways at Umatilla Fish Hatchery during 1991-2001.

Brood year	Maximum density (lb/ft^3)	Maximum loading (lb/gal/min)	Maximum total number reared per gpm in system
1991	5.4-6.7	11.8-14.6	210
1992	4.0-4.5	8.9-9.9	167
1993	3.8-4.6	8.4-10.1	161
1994	4.0-4.2	9.7-10.2	154
1995	4.1-4.3	9.8-10.4	154
1996	3.4-3.9	8.1-9.3	145
1997	3.7-3.8	8.7-9.1	145
1998	2.1-3.5	5.1-8.2	128
1999	5.03	11.9	163
2000	3.82	9.0	149
2001	5.30	12.6	166

Table 18. Mean length, weight, and condition factor at release for summer steelhead reared in first, second, and third pass Michigan raceways from Umatilla Hatchery, 1991-1997 broods (standard error in parentheses).

Brood			Length(mm)		Weight(g)		Condition factor	
year	Date	Pass	N	Mean(SE)	N	Mean(SE)	N	Mean(SE)
1991	4/29/92	A	323	194.3(1.4)	100	91.0(3.2)	100	1.13(0.01)
	3/29/92	B	328	200.0(1.1)	101	90.2(2.4)	101	1.09(0.01)
	3/29/92	C	316	186.9(1.0)	99	76.7(2.1)	99	1.12(0.01)
1992	5/13/93	A	298	199.6(1.1)	110	74.8(2.1)	110	0.93(0.01)
	4/16/93	B	308	198.2(1.2)	98	80.9(2.7)	98	1.01(0.01)
	4/18/93	C	324	220.1(1.0)	108	102.4(2.5)	108	0.93(0.01)
1993	4/14/94	A	320	205.9(1.2)	103	86.7(2.5)	103	0.97(0.01)
	3/16/94	B	312	198.3(1.2)	125	88.7(2.4)	125	1.05(0.01)
	3/17/94	C	315	214.2(1.1)	106	93.8(2.3)	106	0.94(0.01)
(Table 18 Cont.)								
1994	5/12/95	A	315	206.3(1.1)	128	82.6(2.2)	128	0.90(0.01)
	3/14/95	B	300	209.7(1.0)	101	96.2(2.7)	101	1.00(0.01)
	3/15/95	C	316	205.9(0.8)	117	81.4(1.8)	117	0.90(0.01)
1995	5/9/96	A	303	207.9(1.1)	100	87.3(2.4)	100	0.99(0.01)
	4/12/96	B	312	206.8(1.3)	102	89.9(2.9)	102	0.98(0.01)
	4/24-26/96a	C						
1996	5/15/97	A	301	208.3(1.0)	99	93.3(2.3)	99	0.99(0.01)
	4/11/97	B	502	208.1(0.9)	381	99.5(1.5)	380	1.08(0.01)
	4/10/97	C	304	203.5(1.1)	202	84.8(1.7)	202	0.95(0.01)
1997	5/4/98	A	255	187.0(1.7)	106	71.9(2.9)	106	1.04(0.01)
	4/17/98	B	302	209.3(1.7)	208	95.5(3.1)	208	1.01(0.01)
	4/17/98	C	289	202.3(1.3)	198	77.0(1.7)	198	0.94(0.01)
1998	5/4/99	A	323	194.7(1.1)	100	76.4(2.6)	100	0.98(0.01)
	4/14/99	B	347	207.3(1.1)	102	91.9(2.9)	102	1.04(0.01)

	4/15/99	C	316	207.7(1.1)	105	83.2(2.5)	105	0.96(0.01)
1999	4/11/00	B	69	194.3(2.6)	67	70.6(3.0)	67	0.93(<0.01)
	4/4/00	C	610	206.4(0.9)	214	93.8(2.4)	214	1.05(<0.01)
	4/26/00	A	325	201.7(1.7)	210	96.5(3.0)	210	1.08(<0.01)
2000	4/3/01	C	303	207.3(0.9)	101	94.7(2.5)	101	1.03(0.01)
	4/6/01	B	310	207.9(0.9)	101	84.7(1.7)	101	0.93(0.01)
	4/26/01	A	319	205.9(1.3)	111	96.9(3.1)	111	1.03(0.01)
2001	4/9/02	C	316	211.1(1.0)	99	88.2(2.4)	99	0.93(<0.01)
	4/30/02	B	311	222.7(1.3)	105	108.0(3.0)	105	1.00(0.01)
	4/29/02	A	333	210.3(1.2)	197	100.1(2.3)	197	1.03(0.01)
2002	3/26/03	A	300	212.4(1.5)	98	103.2(4.0)	98	1.08(0.01)
	3/27/03	B	297	216.5(1.5)	97	93.8(3.4)	97	0.95(0.01)
	3/27/03	C	608	217.8(1.1)	199	112.1(2.9)	199	1.00(0.01)

Table 19. Mean proportion of descaled, partially descaled, and undamaged summer steelhead reared in Michigan raceways at Umatilla Fish Hatchery for brood years 1991-2003.

Brood	Sample		Smolting			Descaling		
Year	date	Pass	Smolt	Intermediate	Parr	Descaled	Partial	None
1991		A				0.01	0.43	0.56
		B				0.05	0.39	0.61
1992		A				0.08	0.30	0.62
		B				0.03	0.56	0.41
		C				0.02	0.58	0.40
1993		A				0.05	0.13	0.82
		B				0.01	0.50	0.49
		C				0.11	0.33	0.56
1994		A				0.13	0.39	0.48
		B				0.00	0.21	0.79
		C				0.09	0.42	0.50
1995		A				0.03	0.70	0.28
		B				0.01	0.31	0.69
1996		A				0.12	0.48	0.41
		B				0.02	0.35	0.63
		C				0.32	0.57	0.11
1997		A				0.00	0.04	0.96
		B				0.04	0.32	0.64
		C				0.05	0.34	0.61
1998		A				0.03	0.12	0.85
		B				0.00	0.06	0.94
		C				0.01	0.15	0.84
1999	2/28/2000	B	0.02	0.97	0.01	0.03	0.81	0.16
		C	0.04	0.96	0.00	0.05	0.74	0.21
	4/5/2000	A	0.01	0.96	0.03	0.01	0.14	0.85
2000	3/5/2001	A	0.00	1.00	0.00	0.00	0.00	1.00
		B	0.00	0.99	0.01	0.00	0.00	1.00
		C	0.00	1.00	0.00	0.00	0.00	1.00
2001	2/25/2002	B	0.00	1.00	0.00	0.00	0.03	0.97
		C	0.00	1.00	0.00	0.00	0.00	1.00
		A	0.00	1.00	0.00	0.00	0.00	1.00
	3/20/2002	A	0.01	0.99	0.00	0.01	0.01	0.98
	4/8/2002	B	0.11	0.89	0.00	0.00	0.00	1.00
2002	3/26/03	A	0.07	0.93	0.00	0.00	0.00	1.00
	3/27/03	B	0.07	0.93	0.00	0.00	0.00	1.00
	3/27/03	C	0.12	0.89	0.00	0.00	0.00	1.00

Table 20. Release data for summer steelhead reared at Umatilla Hatchery and released in the Umatilla River (RM= river mile; acclimation facilities: BS - Bonifer Springs acclimation facility; MC - Meacham Creek; MI - Minthorn Springs acclimation facility, RM=63.8; TH - Thornhollow acclimation facility, RM=73.5)

Brood year, CWT code	Last date of release	Race-way	Number released	Number CWT	Number brand/paint or PIT-tag	Fish per pound	Release location (RM)
1991							
075840	5/01/1992	M5A	22,288	10,105		5.5	MC
075838	5/01/1992	M5A	22,469	10,562		5.5	MC
075839	5/01/1992	M5A	22,662	10,275		5.5	MC
075841	4/30/1992	M5B	22,262	10,108		5.0	MC
075842	4/30/1992	M5B	21,365	9,498		5.0	MC
075843	4/30/1992	M5B	20,923	9,747		5.0	MC
074127	3/29/1992	M5C	22,059	10,203		5.8	BS & MN
073862	3/29/1992	M5C	22,902	10,594		5.8	BS & MN
073759	3/29/1992	M5C	22,474	10,394		5.8	BS & MN
Total			199,404	91,486		5.4	
1992							
076052	5/13/1993	M5A	65,465	13,117	9,055	6.1	BS
076053	5/13/1993	M5A		11,410		6.1	BS
076054	5/13/1993	M5A		9,907		6.1	BS
076055	4/16/1993	M5B	47,979	10,031	9,641	5.6	MN
076056	4/16/1993	M5B		9,418		5.6	MN
076057	4/16/1993	M5B		9,643		5.6	MN
076058	4/18/1993	M5C	44,824	10,194	8,863	4.5	BS
076059	4/18/1993	M5C		9,792		4.5	BS
076060	4/18/1993	M5C		9,440		4.5	BS
Total			158,268	92,952	27,559	5.5	
1993							
070139	5/12/1994	M5A	26,411	8,595	7,700	5.2	BS
070140	5/12/1994	M5A	25,686	8,400		5.2	BS
070141	4/14/1994	M5B	24,692	9,952	7,827	5.1	MN
070142	4/14/1994	M5B	24,906	9,965		5.1	MN
070143	4/11/1994	M5C	26,481	10,470	7,718	4.9	BS
070144	4/11/1994	M5C	24,922	9,651		4.9	BS
Total			153,098	57,034	23,346	5.1	
1994							
070655	5/12/1995	M8A	47,941	19,782	8,908	5.5	BS
070656	4/13/1995	M8B	49,983	18,812	8,134	4.7	MN
070657	4/11/1995	M8C	48,539	19,290	7,771	5.6	BS
Total			146,463	57,884	24,813	5.3	
1995							
071034	5/9/1996	M8A	49,783	20,633	8,896	5.1	TH
071035	4/12/1996	M8B	47,543	19,742	8,615	5.1	MN
071036	4/24/1996	M8C	49,377	21,205	8,827	5.3	BS
Total			146,703	61,580	26,338	5.3	

[a] *All fish were adipose clipped and all CWT fish were also left ventral fin-clipped*

Appendix Table A-7 (continued)

Brood year, CWT code	Release date	Race-way	Number released	Number CWT	Number brand/paint or PIT-tag[a]	Fish per pound	Release location (RM)
1996							
091837[b]	5/15/1997	M8A	48,944	20,065	8,655	4.9	BS
091836	4/11/1997	M8B	46,788	19,103		4.6	MN
091835[c]	4/10/1997	M8C	41,555	19,531		5.4	BS
Total			137,287	58,699	8,655	4.9	
1997							
092339	5/4/1998	M8A	47,313	19,468	242	5.5	BS
092340	4/17/1998	M8B	49,084	20,646	244	4.7	MN
092341	4/16/1998	M8C	41,088	20,800	250	5.9	BS
Total			137,485	60,914	736	5.3	
1998							
092527	5/4/1999	M8A	35,564	19,088	288	5.9	BS
092526	4/14/1999	M8B	41,843	20,787	210	4.9	MN
092525	4/13/1999	M8C	44,226	20,450	198	5.5	BS
1999							
092344	4/28/2000	M8A	52,736	21,965	1,356	4.7	64.5
070947	4/11/2000	M8B	49,343	21,552	252	6.4	2.0
070535	4/4/2000	M8C	51,659	20,980	233	4.8	64.5
Total			153,738	64,497	1,841	5.3	
2000							
093225	4/26/2001	M8A	41,403	21,556	1,744	4.7	64.5
093224	4/6/2001	M8B	48,291	20,944	296	5.4	2.0
093223	4/4/2001	M8C	50,829	21,065	282	4.8	64.5
Total			140,523	63,565	2,322	5.0	
2001							
093412	4/30/2002	M8A	47,521	20,422	1,077	4.5	64.5
093411	4/30/2002	M8B	54,366	21,241	568	4.2	56
093410	4/9/2002	M8C	54,917	21,274	268	5.1	2.0
Total			156,804	62,937	1,913	4.6	
2002							
093641	4/30/2003	M8A	42,783	20,240	278	4.4	56
093640	4/28/2003	M8B	41,369	19,217	285	4.8	2.0
093639	4/29/2003	M8C	42,805	18,702	288	4.0	6

2004 DRAFT

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Umatilla Spring Chinook
Species or Hatchery Stock:	Umatilla/Carson Stock Spring Chinook 091
Agency/Operator:	Oregon Department of Fish and Wildlife/ Confederated Tribes of the Umatilla Indian Reservation
Watershed and Region:	Umatilla / Columbia / Oregon
Date Submitted:	2004
Date Last Updated:	May 13, 2004

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.
Umatilla Spring Chinook

1.2) Species and population (or stock) under propagation, and ESA status.
Umatilla Spring Chinook (Carson stock) *Oncorhynchus tshawytscha*

1.3) Responsible organization and individuals

.**Name (and title):** Scott Patterson – Hatchery Coordinator
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 107 Twentieth Street, La Grande, OR 97850
Telephone: 541-963-2138
Fax: 541-963-6670
Email: Scott.D.Patterson@state.or.us

Name (and title): Gary James – Fisheries Program Manager
Agency or Tribe: Confederated Tribes of the Umatilla Indian Reservation
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Fax: 541-276-4348
Email: garyjames@ctuir.com

Agency or Tribe Name (and title): Tim Bailey – District Fish Biologist
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 73471 Mytinger Lane, Pendleton, OR 97801
Telephone: 541-276-2344
Fax: 541-276-4414
Email: umatfish@oregontrail.net

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Confederated Tribes of the Umatilla Indian Reservation-- Co-managers – Operators of acclimation and adult collection facilities

Bonneville Power Administration -- Funding – acclimation and adult collection, passage, hatchery, habitat, monitoring and evaluation.

U.S. Fish and Wildlife Service-- Little White Salmon National Fish Hatchery-

1.4) Funding source, staffing level, and annual hatchery program operational costs

Umatilla Hatchery is 100% funded by the Bonneville Power Administration. Oregon Department of Fish & Wildlife operates the facility, and staff consists of one F&W Manager 1, one F&W Technician 2, four F&W Technician 1's, one Trades/Maintenance Worker 2, one half-time F&W Technician 1, and one Trades/Maintenance Worker 1. Fiscal Year 2004 Umatilla Hatchery operations budget is $817,305

Little White Salmon National Fish Hatchery supports a variety of programs with funding from the U.S. Army Corps of engineers, NMFS-Mitchell Act, Bonneville Power Administration and U.S. Fish and Wildlife Service maintenance funding. The Little White Salmon NFH has a staff of thirteen full time employees and an annual budget of $1.08 million in Fiscal Year 2003. The budget for the Umatilla Basin spring chinook program was $71,485 during fiscal year 2003 and funded by the Bonneville Power Administration.

1.5) Location(s) of hatchery and associated facilities.

Adult Collection--: Spring chinook will be collected at Three Mile Falls Dam adult trapping facility. If broodstock needs can not be met at Three mile Dam, other locations where Carson stock is available, such as Ringold Springs hatchery or Little White Salmon NFH, may be used for broodstock collection. Three Mile Falls Dam adult trapping facility is located approximately 4 miles upstream from the mouth of the Umatilla River, near the town of Umatilla, in Umatilla County, Oregon. The regional mark processing center site code for Three Mile Falls Dam is 5F33427 H27 24.

Little White Salmon NFH is located on the Little White Salmon River at river kilometer 2, approximately 19 kilometers east of Stevenson, Washington. The hatchery is situated just above Drano Lake, a water body where the Little White Salmon River joins the Columbia River at river kilometer 261. This position is approximately 45° 42' 30" North Latitude and 121° 37' 30" West Longitude. Site elevation is about 27 meters above sea level.

Ringold Springs hatchery --is located on Ringold Spings near its confluence with the Columbia River at Columbia River mile 354 in Franklin County, Washington..

Holding and Spawning-- Spring chinook broodstock are transferred to the South Fork Walla Walla facility for holding and spawning. The South Fork Walla Walla facility is located at approximately RM 7 on the South Fork of the Walla Walla River, East of Milton-Freewater in Umatilla County, Oregon.

Incubation and rearing (from green egg to smolt-- Green eggs are transferred to Umatilla and eyed eggs to Little White Salmon hatcheries for incubation and rearing. Umatilla Hatchery is located along the Columbia River approximately two miles west of Irrigon in Morrow County, Oregon. The regional mark processing center site code for Umatilla Hatchery is 5F33449 H49 21.

Little White Salmon NFH is located on the Little White Salmon River at river kilometer 2, approximately 19 kilometers east of Stevenson, Washington. The hatchery is situated just above Drano Lake, a water body where the Little White Salmon River joins the Columbia River at river kilometer 261. This position is approximately 45° 42' 30" North Latitude and 121° 37' 30" West Longitude. Site elevation is about 27 meters above sea level.

Acclimation to release-- Juvenile Spring chinook are transferred to Imeques-C-mem-ini-kem for acclimation and release. The Imeques C-mem-ini-kem facility is located on the Umatilla River at RM 79.5 in Umatilla County, Oregon.

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1.6) Type of program.

The Umatilla River spring Chinook program is a re-introduction program.

1.7) Purpose (Goal) of program.

The goal of the program is to re-introduce spring chinook to the Umatilla River, to provide harvest, while rebuilding and maintaining adequate hatchery and natural production.

1.8) Justification for the program.

The indigenous Umatilla River spring chinook were extirpated from the Umatilla River in the mid-1900's. The program was started using Carson stock spring chinook as the donor stock, which is available at numerous locations in the Columbia Basin. Broodstock to meet the program needs are currently collected at Three Mile Falls Dam. All juveniles released are adipose fin clipped.

1.9) List of program "Performance Standards".

The Performance Standards for the program are currently under revision in the Sub-Basin planning process and will submitted when the process is completed

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

The Performance Indicators for the program are currently under revision in the Sub-Basin planning process and will submitted when the process is completed

1.10.1) "Performance Indicators" addressing benefits.

1.10.2) "Performance Indicators" addressing risks.

1.11) Expected size of program.

The current Umatilla River spring chinook yearling production goal is 810,000 smolts. Of this goal 600,000 are reared at Umatilla Hatchery and 210,000 smolts are reared at Little

White Salmon NFH.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

Broodstock needs are 280 females and 280 males and 28 jacks. Broodstock are collected from April through June.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location. (*Use standardized life stage definitions by species presented in* Attachment 2).

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Imeques C-mem-ini-kem RM 79.5 Umatilla River	810,000 Yearling smolts

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

See – (Tables 1-4).
.

1.13) Date program started (years in operation), or is expected to start.

The first releases of spring chinook in the Umatilla River were made in 1986, the first releases from Umatilla Hatchery were made in 1992. (Table 5)

1.14) Expected duration of program.

The program is ongoing.

1.15) Watersheds targeted by program.
Umatilla River sub-basin.

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

Managers are currently reassessing hatchery performance goals in the subbasin planning process. When this process is completed, the revised goals and alternative actions will be submitted.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

4d rule research permit applications have been submitted to NMFS for the following:

- Outmigration and Survival Study

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

Adult age class structure: See table 19
Sex ratio: See table 15
Size range: See table 15
Migrational timing: See table 20
Spawning range:
Spawn timing: See table 20
Juvenile life history strategy, including smolt emigration timing: See table 20

- **Identify the ESA-listed population(s) that will be directly affected by the program.**

- **Identify the ESA-listed population(s) that may be incidentally affected by the program.**

Umatilla River Summer Steelhead (stock 091) – included as part of the Mid-Columbia ESU - listed as "Threatened" under the federal ESA. Umatilla River bull trout are included as part of the Columbia distinct population segment listed as Threatened under the federal ESA.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

Describe the status of the listed natural population(s) relative to "critical" and "viable"

population thresholds

Chilcote (Unpublished draft) identifies the wild Umatilla summer steelhead critical population threshold at 110, and the viable population threshold at 333. Since 1988, wild adults available for spawning have exceeded 600. (See table 6)

- **Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.** The progeny to parent ratio for natural spawning hatchery and natural steelhead compared to Umatilla hatchery steelhead from 1990 through 1999 is presented in Table 7. The progeny to parent ratio of natural spawning hatchery and natural steelhead has been below replacement in eight of the last ten years. In contrast, hatchery progeny to parent ratio was above one for all of the last ten years.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.
The number and percent of adult steelhead available to spawn of wild and hatchery origin since 1988 is presented in Table 6. Total natural adult return numbers to Three Falls Mile Dam have ranged from 725 in 1990-91 to 3,659 in 2001-02 (Table 16).

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.
The percent of adults available to spawn that were of hatchery origin has ranged from 6.9% of the total run in 1988, to a high of 58.9% in 1997 with a mean of 27.2% (1988-1998; Table 17).

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take</u>

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

- **- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.**

  Outmigration and Survival Study - As per the 4d rule research application; we will reduce numbers collected by adjusting the sample times and avoid sampling when large numbers of natural steelhead are passing through the sampling facility. To reduce the number of mortalities from fish jumping out of the sample tank or from other areas, we will apply covers and screens to prevent escape and monitor the facility closely. Monitoring information is mostly obtained through remote interrogation of tags, without any handling.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.
1) CTUIR. 1994. Wildlife Mitigation Plan (Draft) May 1996, Columbia Basin Salmon Policy. 1995 pg 9-10, and Water Assessment Report;
2) NMFS - Salmon & Steelhead Enhancement Plan for the Washington and Columbia River Conservation areas.Vol 1. chpt 4, 37pgs;
3) Reeve, R. 1988. Umatilla River Drainage Anadromous Fish Habitat Improvement Plan;
4)CTUIR/ODFW. 1990. Umatilla Hatchery Master Plan;
5) OWRD. 1988. Umatilla Basin Report;
6) BOR. 1988. Umatilla basin Project Planning Report,
7) Umatilla County - Comprehensive Plan. 1983, chpt 8;
8) USNF - Umatilla National Forest Land & Resource Management Plan. 1990, chpt 2, pg 13. and Final EIS. 1990, chpt III, pgs 59-62;
9) CTUIR/ODFW. 1990. Umatilla River Subbasin Salmon and Steelhead Production Plan;
10) Boyce, R. 1986. A Comprehensive Plan for Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin; 11)USFWS & NMFS. 1982. Umatilla R. Planning Aid Report.
11) USBR and BPA. 1989. Umatilla Basin Project. Initial project workplan presented to the NWPPC, May 1989.

This HGMP is consistent with these plans and commitments.

3.3) Relationship to harvest objectives.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available

Spring chinook fisheries have occurred nine of the past twelve years in the Umatilla River. The spring chinook fishery generates the highest level of participation and harvest to both tribal and non-tribal fishers in the Umatilla River compared with all the other salmonid runs. Managers have set a harvest goal of 10% of the run to the mouth of the Umatilla River for both the tribal and non-tribal fishery. (Tables 1, 3, & 6)

3.4) Relationship to habitat protection and recovery strategies.

The Umatilla spring chinook Program is a part of an overall Umatilla Basin Salmon and Steelhead Restoration Program. In addition to on-going passage and hatchery operations, restoration efforts include ongoing projects that enhance stream and riparian habitat as well as monitor and evaluate the hatchery and natural components of the restoration program.

Factors limiting the natural production of spring chinook in the Umatilla River Basin include channelization, low or no summer flows, warm water temperatures, sediment, and poor habitat diversity caused by urban and rural development/land management practices. Ocean conditions and the mortalities and stress from the operation of hydropower projects on the mainstem Columbia River are important factors outside the basin. There continues to be degradation to fish habitat in these areas that hampers improvement efforts.

3.5) Ecological interactions.

- Interactions with species that could negatively impact program: a) bird predation during peak smolt migration periods each Spring; and b) Northern Pikeminnow and smallmouth bass - predation during smolt migration periods.

- Interactions with species that could positively impact program: Carcasses from spring chinook add to the Umatilla River subbasin's nutrient recharge cycle. Increased angler effort in the spring Chinook salmon fisheries increases awareness of the Umatilla steelhead program which could potentially lead to increased harvest of hatchery steelhead.

- Interactions with species that could be positively impacted by program: Hatchery and naturally produced spring chinook smolts could add to the food base for bull trout.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Umatilla Hatchery--The water source for the Umatilla Hatchery comes from the Columbia River through a Ranney well system, and four separate wells. The system was initially designed and constructed to produce a maximum of 15,000 gpm of water. However, actual water capacity at UH is 5,500 gpm, and several wells have been subject to failure (Jack Hurst, ODFW, Umatilla Hatchery) Water from the well system averages 12.2°C (54°F). Water quality exceeds BPA requirements (BPA 1987) for all hatchery uses. Water is withdrawn under certificate #72181, permit G 10870, and, certificate #72182, permit #G 11210. Water discharged is monitored under the general NPDES 0300 J permits.

Three Mile Falls Dam-- The water source for the Three Mile Falls Dam adult facility is pumped directly from the Umatilla River. The Denil steep-pass utilizes 2,900 gpm and the holding pond uses 1,450 gpm. Both the steep-pass and holding pond pumps run continuously. The fish lock system uses 630 gpm, but is used only during handling operations (approximately two hours per day). The water source is the same as used by the natural population.

Water temperatures at Three Mile Falls Dam range from approximately 0°C (32°F) in winter to over 21°C (70°F) during the summer. Sediment loads vary dramatically during the return season (late August through early June) and during the migration season (March – July). High sediment loads are experienced annually during high flow conditions.

Natural Production-- Natural spawners use the water available in the streams of the Umatilla River Basin. Water quality is relatively high in the headwater streams where steelhead spawn and rear. The spawning streams contrast greatly to the lower Umatilla River and lower tributaries where sediment loads are high in the spring and summer water temperatures are often lethal to Salmonids (Contor et al. 1998). Water quality in this desert basin contrasts to the hatchery, as there are often large daily fluctuations in water temperature. During the winter and spring, rain-on-snow events interspersed with cold periods often produce large fluctuations in stream flow. During spawning and incubation, the streams are often high and turbid.

Little White Salmon Hatchery-- Water rights for the **Little White Salmon NFH** total 33,868 gpm from the Little White Salmon River, a small well and springs. Water use for fish production ranges from11, 221 gpm to 28,232 gpm. The river supplies most of this water flow. The water intake structure was rebuilt in 1994 and modified in 2001. A water re-use system was constructed in 1967 for egg incubation, but has not been operated for several years.

The re-use system was originally used to supplement water supplies for incubation in low water years, but has not been needed since the well was upgraded. Use of the reused water is avoided whenever possible due to disease transmission concerns. An independent hatchery audit (Montgomery Watson 1997) measuring hatchery operations against IHOT standards (IHOT 1995) reported a remedial action was needed to provide disease-free water for incubation and early rearing (4,700 gpm). The estimated cost was $2.7 million. Such a system would also benefit the incubation of fall Chinook and coho salmon.

The Complex=s water intake structure was examined during the independent audit (Montgomery Watson 1997). The structure was in compliance when measured against NMFS=s screening criteria for approach velocity and screen openings. The hatchery monitors water discharges and is in compliance with the NPDES permit.

Imeques Acclimation-- Imeques is fed by gravity directly from the Umatilla River. Flows are held constant at approximately 1,600 gpm per each of four acclimation ponds. During the juvenile acclimation period (mid-November to mid-April), average monthly temperatures range from approximately 3.6 to 6.7 C (38.5 to 44^{o}F).

4.3) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Imeques Acclimination--Acclimation facility intake screens conform to NMFS screening guidelines to minimize the risk of entrainment of juvenile listed fish.

Umatilla Hatchery-- Umatilla Hatchery uses 100% well water.

Little White Salmon Hatchery--As stated above in section 4.1, the hatchery intake structure is above an impassable barrier dam which prevents listed anadromous species from having access to the main water supply. The hatchery's effluent discharge is well within its NPDES permit and is further diluted by the Little White Salmon River further reducing any possible negative impacts.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Broodstock collection is conducted solely at the Three Mile Falls Dam east bank adult trapping facility. The facility consists of a vertical slot fish ladder, Denil steeppass, adult holding pond (raceway), and fish handling and sorting complex. The construction and operation of the facility has no effect on the critical habitat for summer steelhead.
The dimensions of the holding pond are 14' wide by 36' long by 3.5' deep (approximately 1,800 cubic feet). The holding pond has a jump screen located at the upper end and jumpout panels located at both upper corners to prevent adults from jumping out of the pond. The

holding pond is located above the 100 year flood level.

The water supply for the holding pond is pumped directly from the Umatilla River at a rate of 1,450 gpm. A low water discharge alarm is located on the pond supply line to signal any loss of flow to the holding pond. No backup pumps or emergency generator system are located at the site. In case of water loss to the pond, two options are available to on-site personnel. During power outages or other short term losses of flow, the outlet gate from the pond can be closed to maintain water depth. For pump failures or other long term losses of water supply, adults can be dip netted out of the pond and returned to the river.

5.2) Fish transportation equipment

Umatilla Spring Chinook Adults collected are anesthetized with CO2, prior to handling. Broodstock are transported in a 370-gallon fish transport tank, which is mounted on a dual axle trailer and is pulled by a pick-up truck. The trailer is equipped with compressed oxygen aeration and a re-circulation system.

5.3) Broodstock holding and spawning facilities.

South Fork Walla Walla-- Since 2000, all spring Chinook spawning has occurred at South Fork Walla Walla. The facility includes a water intake system with automatic screen cleaning, pump station having a nominal pumping capacity of 8,700 gpm, ozone effluent water treatment system, settling pond, five adult holding ponds, (each 90 x 10 x 5 foot effective water depth; (4,500 f^3), mechanical fish crowder, standby generator, chemical storage and spawning buildings and two homes for night watch personnel. The spawning building includes a fish lift, electroshock anesthesia system, sorting and spawning facilities, wet and dry storage rooms, walk-in cooler/freezer, and restroom and office space.

5.4) Incubation facilities.

Umatilla Hatchery-- Fertilized eggs are transported from South Fork Walla Walla to Umatilla Hatchery in five-gallon buckets with chilled water. Umatilla hatchery incubation equipment consists of four separate units of Marisource incubators (Heath tray type). Water can be used directly from wells or mixed with chilled water. Three units can be supplied with well water at 12.2^{o}C (54^{o}F) or mixed with chilled water 7.2^{o}C (45^o F) for any combination of temperatures from 7.2-12.2^{o}C (45-54^o F) provided that 300 gpm of chilled water is not exceeded. The fourth unit can be mixed with water chilled to 3.3^{o}C (38^o F) to achieve any combination of temperatures from 3.3-12.2^{o}C (38–54^o F) provided that 60 gpm of chilled water is not exceeded. Numerous systems continually monitor temperature, mechanical systems, electrical systems, and flow. Alarms sound if any system fails or is out of criteria. Continual monitoring of systems and preventative maintenance is used to prevent system failure. An emergency gas powered pump installed in the aeration tower structure supplies water for incubation in the event of aeration lift pump failure. In the event of total system failure resulting in total loss of water, eggs may be transported to Irrigon hatchery (if they are still operational and have necessary space).

Pathogen free water is used for incubation at Umatilla Hatchery for all programs. This is a direct preventive measure at minimizing the risk of introducing pathogens into the hatchery program, thus minimizing the risks to fish in the natural environment after these fish are released. Sanitary measures are taken at Umatilla Hatchery to prevent transmission of pathogens from one stock to another by disinfecting equipment in Iodophor.

Little White Salmon Hatchery--Eyed eggs are received at Little White for their portion of the Umatilla River program. Incubation at Little White Salmon Hatchery is done in the nursery building about 0.5 km from the spawning facility using up to 36 of 132 stacks of vertical incubators with flows set initially to 3 gpm and raised to 5 gpm at hatching. Water for incubation is primarily from springs and a well, with screened river water available if needed. The eggs are treated with 1,667 ppm formalin for fifteen minutes between three and five times a week to control fungus. The formalin is delivered using a newly constructed delivery system which ensures proper dilutions and timing. The installation of egg isolation units has been proposed to prevent potential disease transmission from eggs transported from outside the facility to Little White Salmon stocks.

5.5) Rearing facilities.

Umatilla Hatchery-- Umatilla Hatchery has three different types of rearing units. There are eight 21' Canadian style early rearing tanks located in the main building adjacent to incubation. Water is pumped to the aeration tower and gravity fed to the tanks. Spring Chinook are started in these tanks in mid-May. The fish are moved outside tone Oregon pond when densities reach approximately 80 pounds in each tank. Umatilla Hatchery has 10 Oregon ponds. Rearing dimensions are 91'X18.75'X3.67'. These ponds are designed for serial reuse in-groups of 2 ponds, upper and lower. They also can be supplied with fresh water individually, if necessary. Spring Chinook are reared in these ponds until fish are 100% AD clipped and 120,000 Coded Wire tagged, into 12 Michigan ponds in early August. Umatilla Hatchery has 24 Michigan style ponds, with rearing dimensions of 91'X9'X2.75'. Water is supplied to these ponds in reuse groups of three ponds each. Each pond has a submersible pump that supplies 950 gpm of water to oxygen contact columns, located at the head of each pond. Oxygen is introduced and unwanted saturated gas is removed from incoming water at this point. Each pond has its own oxygen supply line. Supplemental oxygen is either delivered from oxygen generators, (pressure swing absorption units) or from a bulk liquid tank on site. Chinook are reared at enhanced densities to utilize well available water efficiently. Three Michigan ponds (50K ea.) are transferred in November to Imeques acclimation. The remainder is transferred to Imeques in mid-January, and all are released by mid-March. All ponds have a high-low water level alarm, and for Michigan ponds, pump failure and oxygen flow alarms. In the event of total system failure, fish could be moved to nearby Irrigon Hatchery if pond space is available and all logistics were in place prior to the time of failure. Monitoring and maintenance of the water supply system, and forecasting for contingencies, are the best means for dealing with the possibility of rearing pond system failure.

Pathogen free water is used for rearing the fish at the Umatilla Hatchery for all production. This is a direct preventive measure at minimizing the risk of introducing pathogens into hatchery phase of this program, thus minimizing the risks to fish in the natural environment after these fish are released. Sanitary measures are taken at Umatilla Hatchery to prevent transmission of pathogens from one stock to another by disinfecting equipment in Iodophor.

In addition, a fish health program is in place to monitor and evaluate the health status of summer steelhead juveniles reared at Umatilla Hatchery.

Little White Salmon Hatchery--Rearing is performed at Little White Salmon in newly constructed (2001-2002) 10' X 110' X 3.5' mocha colored raceways with maximum flows of approximately 800 gpm, as well as in nine 8' X 80' concrete raceways (flows up to 470 gpm) and two new 10' X 210' X 3.5' colored concrete raceways (flows up to 2,000 gpm). Baffles are being evaluated in the new raceways to determine their usefulness with these fish

5.6) Acclimation/release facilities.

Imeques Acclimation-- The Imeques acclimation/release facility includes a water intake structure with automatic screen cleaner, water head box/distribution system, storage building, four acclimation ponds (approximately 13,000 cubic feet each) and water outlet and fish release structure. Water is supplied by gravity flow (approximately 1,600 gpm per pond). The ponds are covered with netting to prevent bird predation. In case of power failure, or low water level alarm, a phone dialer will begin calling four telephone numbers repeatedly until someone acknowledges the alarm. Fish are released from the facility by pulling the pond outlet screen and dam boards, lowering the pond, and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way. The ponds are thoroughly cleaned prior to fish being received, and ODFW pathology personnel are available to address disease concerns.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Umatilla Hatchery--There have been no operational difficulties or disasters at Umatilla that have led to significant fish mortality.

Little White Salmon Hatchery--There have been no operational difficulties or disasters at Little White Salmon that have led to significant fish mortality.

Imeques Acclimation—A early release in December 1998 occurred due to extreme icing. No significant mortality occurred however. See (section 5.6)

Bonifer Ponds--In 1986, one group of spring chinook juveniles was acclimated at Bonifer from July through October. This group suffered significant losses (~25%) due to disease (Columnaris) and excessive aquatic vegetation. In 1988, another group of spring chinook was acclimated at Bonifer from September through November. This group also suffered significant juvenile losses (98%) due to low dissolved oxygen levels and disease (Ich).

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Umatilla Hatchery--This is covered in section 5.5

Little White Salmon Hatchery--Hatchery has low water alarm probes positioned in several locations to prevent fish losses due to water system failures. The alarm system is equipped with radio pagers and an automatic phone dialer in case of emergency. Fish disease transmission is managed in accordance with the US Fish and Wildlife Service=s fish health policy and IHOT recommendations.

South Fork Walla Walla -- Since 2000, all spring chinook spawning has occurred at South Fork Walla Walla. The facility includes a water intake system with automatic screen cleaning, pump station having a nominal pumping capacity of 8,700 gpm, five adult holding ponds, standby generator, and two homes for night watch personnel. In the event of power failure, an audio alarm will sound; the standby generator will start automatically, and in turn, the primary pump will restart. If for some reason the primary pump does not start or fails for any reason, one of two backup pumps will start automatically. The audio alarm will alert the facility night watch personnel who will respond to the emergency. If one of the pumps will not run, the effluent standpipes to the individual ponds can be quickly raised, maintaining existing water levels in the ponds. This will keep the fish alive for a period of time. The project maintenance supervisor and technicians are also on call 24 hours per day for emergency response.

Imeques Acclimation--The Imeques acclimation/release facility includes a gravity flow water intake structure with automatic screen cleaner. Water (approximately 1,600 gpm per each of four acclimation ponds) is supplied by gravity to a headbox/water distribution structure where it is gravity fed to the ponds. The ponds are covered with netting to prevent bird predation. In case of power failure, or low water level alarm, a phone dialer will begin calling four telephone numbers repeatedly until someone acknowledges the alarm. Fish are released from the facility by pulling the pond outlet screen and dam boards, lowering the pond, and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Carson stock spring Chinook are used for the Umatilla River program. From brood years 1984 to 1999, Carson stock adults were collected from various sources (Carson National Fish Hatchery, Lookingglass Hatchery, Big Canyon Hatchery, Ringgold Hatchery, Little White Salmon Hatchery, and from adult returns to the Umatilla River. Since 2000, all spring Chinook broodstock have been collected from the Umatilla River.

6.2) Supporting information.

6.2.1) History.

From brood years 1984 to 1999, Carson stock spring Chinook broodstock from various sources (Carson National Fish Hatchery, Lookingglass Hatchery, Big Canyon Hatchery, Ringold Hatchery, Little White Salmon Hatchery, and from adult returns to the Umatilla River), were used for the Umatilla River program. Since 2000, however; all spring Chinook broodstock have been collected from the Umatilla River.

6.2.2) Annual size.

The number of spring Chinook broodstock collected for holding/spawning since 2000, when all broodstock have been collected from Umatilla River adult returns, has varied from 586 in both 2002 and 2003 to 630 in 2001(Table 9). The collection goal for 2004 is 560 adults (230 pairs), and 28 jacks. The collection goal in following years is anticipated to be similar.

6.2.3) Past and proposed level of natural fish in broodstock.

All fish collected are from reestablished Carson stock of hatchery origin.

6.2.4) Genetic or ecological differences.

Since 2000, broodstock for this program has been collected entirely from the Umatilla River (Carson stock). Broodstock consists of both marked and unmarked fish.

6.2.5) Reasons for choosing.

Carson stock was selected for reestablishment of Spring Chinook salmon in the Umatilla River, due to its existence in adjacent watersheds.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

The risk of among population genetic diversity loss will be reduced by selecting the indigenous Chinook salmon population for use as broodstock in the program.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

All fish collected for broodstock are adults and jacks.

7.2) Collection or sampling design.

Include information on the location, time, and method of capture (e.g. weir trap, beach seine, etc.) Describe capture efficiency and measures to reduce sources of bias that could lead to a non-representative sample of the desired broodstock source.

Preston?

7.3) Identity.

Carson stock spring chinook are used for the Umatilla River program. From brood years 1984 to 1999, Carson stock adults were collected from various sources (Carson National Fish Hatchery, Lookingglass Hatchery, Big Canyon Hatchery, Ringold Hatchery, Little White Salmon Hatchery, and from adult returns to the Umatilla River). Since 2000, all spring chinook broodstock have been collected from the Umatilla River.

7.4) Proposed number to be collected:

The number of spring chinook broodstock collected for holding/spawning since 2000, when all broodstock have been collected from Umatilla River adult returns, has varied from 586 in both 2002 and 2003 to 630 in 2001(Table 9). The collection goal for 2004 is 560 adults (230 pairs), and 28 jacks. The collection goal in following years is anticipated to be similar.

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

The broodstock goal is to collect 280 adult males, 280 adult females, and 28 jacks.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults Females	Males	Jacks	Eggs	Juveniles
1997	320	276	0	1,029,237	671,683
1998	110	82	8	455,953	Unknown
1999	327	304	32	942,988	689,265
2000	320	286	13	1,120,995	878,971
2001	365	235	30	1,175,281	787,373
2002	322	238	26	1,017,113	869,466
2003	253	306	27	1,051,246	

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.
Describe procedures for remaining within programmed broodstock collection or allowable upstream hatchery fish escapement levels, including culling.

Broodstock are collected at a rate not to exceed program needs.

7.6) Fish transportation and holding methods.

Umatilla spring Chinook brood stock are collected at the Three Mile Dam adult collection facility, they then are transported to the South Fork Walla Walla holding facility for holding and spawning. Adults collected are anesthetized with CO2, prior to handling. Broodstock are transported in a 370-gallon fish transport tank, which is mounted on a dual axle trailer and is pulled by a pick-up truck. The trailer is equipped with compressed oxygen aeration and a re-circulation system. Transit time is approximately one hour. Water temperatures are monitored in the tank and at the release site to ensure there is less than a 10-degree water temperature difference at release.

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7.7) Describe fish health maintenance and sanitation procedures applied.

South Fork Walla Walla -- Collection--Adults retained for broodstock are injected with oxytetracycline (10mg/kg) and erythromycin (20mg/Kg) at the collection facility and at South Fork.

Holding--At South Fork Walla Walla adult facility, formalin is dripped into the inflowing water to achieve a maximum concentration of 167 ppm. The treatment is applied for one hour to control fungus and parasites three times per week.

Spawning--All hatchery-spawned females are screened for *R. salmoninarum* using enzyme-linked immunosorbent assay (ELISA) techniques. Examination of a minimum of 20 adults for systemic bacteria and *R. salmoninarum* by ELISA. Testing of a minimum of 60 spawned fish for culturable viruses using ovarian fluid and caeca/kidney/spleen in 5 fish sample pools.

Progeny-- Eggs are water hardened in 75ppm iodophor solution for up to 60 minutes to control vertical transmission of pathogens including IHNV. Vertical transmission of BKD (*R. Salmoninarum*) is also a concern. Eggs are culled based on ELISA titers. The overall goal is to only use eggs from females with OD values <0.200.

7.8) Disposition of carcasses.

All spring Chinook broodstock carcasses are buried in the regional landfill.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

(e.g. "The risk of fish disease amplification will be minimized by following Co-manager Fish Health Policy sanitation and fish health maintenance and monitoring guidelines").

??? Brian Zimmerman

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

From mid August to mid-September, all broodstock are sorted once per week for maturation. Fish are anesthetized with MS-222 or electro shocked. Ripe fish are held in live totes until a minimum of one or two family groups (a family group consists of four females and four males) have been sorted before they are killed and spawned. All ripe females are spawned on any given spawn day until the egg goals are met. Males, including jacks, and at a proposed rate of one male for every ripe female, are selected randomly throughout the broodstock population.

8.2) Males.

Males, including jacks, and at a proposed rate of one male for every ripe female, are selected randomly throughout the broodstock population. Whenever possible, one male is used to fertilize the eggs from one female.

8.3) Fertilization.

A 1:1 spawning ratio is utilized whenever possible and matings are random. Females are killed and bled by severing the caudal peduncle. The undersides of the fish are cleansed with a solution of Argentyne and are then wiped with a clean towel. The eggs from each female are stripped into a colander to remove excess ovarian fluid and then placed into individual buckets. Males are killed, cleansed with Argentyne, and the milt is stripped directly into the eggs (one male per female). After the milt is added, well water from Umatilla Hatchery is added and the eggs and sperm are mixed and allowed to stand for approximately one minute or longer. The fertilized eggs from each bucket are then poured into a colander and combined. The eggs are then poured into a bucket with Umatilla Hatchery well water, rinsed, poured back into the colander, and then are placed into a solution of Argentyne and allowed to water harden for one hour. At the end of the hour, the eggs are again poured into a colander and then into a bucket of fresh well water with a watertight lid for transport to Umatilla Hatchery. Colanders, spawning knives and other equipment are disinfected with Argentyne between each family group. At the time the males and females are stripped, milt and ovarian fluid samples are taken to test for replicating viral agents. After spawning, pyloric caeca, kidney and spleen samples are also taken to test for bacterial kidney disease and other culturable pathogens. Samples of the lower intestine are examined for *Ceratomyxa Shasta*. Fish health procedures used for disease prevention include: 1.) Eggs are water hardened in 75ppm iodophor solution for up to 60 minutes to control vertical transmission of pathogens including IHNV. 2.)Vertical transmission of BKD (*R. Salmoninarum*) is also a concern. Eggs are culled based on gross observation of infected females, and ELISA titers. The overall goal is to only use eggs from females with OD values <0.200. 3) Draining ovarian fluid from eggs by use of colander; 4.)15 minute disinfection in iodophore at the hatchery upon arrival to the facility; and 5) Annual fish health monitoring of Umatilla spring Chinook brood stock to detect any virus or replicating agents or bacterial pathogens. For results from this monitoring see BPA annual reports 1992-1997 (Fish Health Monitoring & Evaluation, Keefe, Hayes, Focher & Groberg, et al.)

8.4) Cryopreserved gametes.

None used--

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

(*e.g. "A factorial mating scheme will be applied to reduce the risk of loss of within population genetic diversity for the small chum salmon population that is the subject of this supplementation program"*.).

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding

Umatilla hatchery has used Carson stock from several hatcheries in the Columbia river basin prior to 1997. Since brood year '97, the sole egg source for Umatilla and little White Salmon, has been Umatilla stock. (Table 9 & 10)

9.1.2) Cause for, and disposition of surplus egg takes.

The Umatilla Spring Chinook Program does not collect eggs in excess of program needs.

9.1.3) Loading densities applied during incubation

Umatilla Hatchery--Hatchery incubation consists of four isolated units or sections of Marisource (Heath tray type) incubators as described in section 5.4.1 Loading densities do not exceed 8,000 eggs/tray green, and 7,300 eggs/tray eyed stage.

Little White Salmon Hatchery--Eyed eggs are placed Heath tray's, at 5,000 eggs/tray at 5 gpm. (section 5.4.2)

9.1.4) Incubation conditions.

Umatilla Hatchery--Oxygen saturation levels average 10 ppm influent and 9 ppm effluent. Water flows are regulated to a minimum of 4 gal. /min, with individual egg take temperatures ranging from 38^0F to 54^0F.

Little White Salmon Hatchery--Water temperature is monitored using temperature loggers taking readings every 30 minutes. Temperatures during incubation range from 43°F to 50°F with typical temperatures around 47°F. Dissolved oxygen levels are not regularly monitored, but have been tested and found to be at, or near saturation. All water for incubation is passed through a 70 micron drumscreen to filter out solids.

9.1.4.5) Egg Transfers

Umatilla Hatchery—Transfer of eyed eggs to Little White Salmon for their portion of the program, occurs in mid-to late October.

9.1.5) Ponding

Umatilla Hatchery--Spring Chinook are ponded mid-May at 1,850 temperature units @ approximately 1,375 fish to the pound, and 100% button-up.

Little White Salmon Hatchery--Fish are transferred to the nursery tanks from egg trays when most individuals have absorbed their yolk sac (at around 1,700 Temperature Units, TUs). At this time, eggs destined for an individual tank are emptied into a transport vessel, moved to the appropriate tank and released directly into the tank (i.e. swim up and ponding are forced) in December and early January. The fish are held in the tanks and fed using automatic feeders until they are large enough to be moved into the raceways and/or the next take of fry needs the tank space. At this time the fish are loaded by net into a 400 gallon transport tank and moved to the 8' X 80' raceways. Average length at initial ponding is 33 mm.

9.1.6) Fish health maintenance and monitoring.

Umatilla Hatchery--Eggs brought to Umatilla Hatchery are disinfected in 75 ppm iodophor for 15 minutes. Fungus is controlled with formalin treatments at a concentration of 1,667 ppm (1:600). Treatments are scheduled seven times per week for 15 minutes. Little mortality has been attributed to yolk-sac malformation. After eyeing, dead eggs are hand picked.

Little White Salmon Hatchery--The current treatment to control fungus on the eggs, at Little White Salmon, is a 1,667 ppm drip of formalin for 15 minutes three to five times a week. The first health exam of newly hatched fish occurs when approximately 50% are beyond the yolk sac stage and begin feeding. Sixty fish are sampled and tested for virus. Regular fish health checks are done on a monthly basis by the fish health specialist from the Lower Columbia River Fish Health Center as per the fish health policy in 713 FW.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Umatilla Hatchery--Eggs will be incubated using well water only to minimize the risk of catastrophic loss due to siltation.

Little White Salmon Hatchery--There are no known listed fish that will be affected by incubation procedures.

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Umatilla Hatchery--Table 9

Little White Salmon Hatchery-- Table 10

9.2.2) Density and loading criteria (goals and actual levels).

Umatilla Hatchery--Current production goals are to have a final density of 5 pound/ft3 and loading of 12 lbs/gpm, with exchange rates of 3.4X/hour.

Little White Salmon Hatchery--Current production goals are to have a final density index of below 0.25 and a flow index of no higher than 1.5 (ref. Fish Hatchery Management, Piper et.al., 1982). Maximum density and loading criteria are for maximum loadings of 4.5 lbs/gpm or 0.87 lbs/ft^3.

9.2.3) Fish rearing conditions

Umatilla Hatchery-- The current program is finally reared exclusively in Michigan style ponds. (Refer to section 5.5) Fish are fed at least once every hour by mechanical feeder.

Ponds are self-cleaning, with the assistance of baffles and high exchange rates. All waste is settled out behind lower pond screen, and is pumped to hatchery settling ponds once per day. Mortality's are removed once per day. Dissolved oxygen is monitored daily, as well as, oxygen delivery systems, and oxygen delivery rates. Water flow rates are monitored weekly and range in temperature from 52^0F to 61^0F. Dissolved oxygen levels are maintained at or above 8ppm. Ammonia and total gas saturation levels have not been a problem. All of our monitoring is recorded as performed. (Table 7, 11)

Little White Salmon--Fingerling spring Chinook are held in the 8' X 80' raceways until mid-May when they are moved to the new colored raceways described in Section 5.5 and Section 9.2.9. Temperature readings are monitored using data loggers taking readings every 30 minutes. Temperatures in the raceways range from 38°F to 49°F during the year. Mortalities are removed daily and raceways are cleaned with a broom while effluent water is drained to a pollution control structure. Cleaning is performed as needed but no less than once a week. Dissolved oxygen, carbon dioxide and total gas pressure have never been problems and are not recorded on a regular basis. Fish are reared on river water for most of their rearing cycle.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Umatilla Hatchery average growth for Spring Chinook. (Brood year 2002)

Month	Fish/lb	Conversion
May	474	1.0
June	245	1.1
July	125	1.2
August	70	1.5
September	45	1.3
October	27	1.3
November	19	1.3
December	14	1.25
January	13.7	1.4

End of Month Growth Parameters for LWS NFH Spring Chinook Brood Year 2000.

Month	Length	#/lb	Condition Factor C	Conversion For Month	Density Index	Flow Index

Month	Length	#/lb	Condition Factor C	Conversion For Month	Density Index	Flow Index
December ,2000	1.417	976		1.53	0.09	0.63
January, 2001	1.724	542		1.18	0.10	0.59
February	1.977	359		1.65	0.13	0.89
March	2.414	197		0.97	0.20	0.90
April	2.827	123		1.01	0.28	0.93
May	3.308	76.7		0.83	0.30	0.98
June	3.547	62.2		1.39	0.34	1.13
July	3.949	45.1		1.27	0.17	0.53
August	4.309	34.7		1.22	0.20	0.64
September	4.746	26.0		1.16	0.24	0.77
October	4.822	24.8		3.86	0.25	0.80
November	4.866	24.1		3.26	0.20	0.95
December	4.953	22.9		1.52	0.22	1.13
January, 2002	5.043	21.7		1.71	0.23	1.17
February	5.154	20.3		1.55	0.24	1.22
March	5.416	17.5		1.03	0.26	1.35

Data from Lot History, Production for Brood Year 2000 spring Chinook.

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available

Umatilla and Little White Salmon Hatcheries--Energy reserve information is not available.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Umatilla Hatchery-- Spring Chinook are fed Bio-Oregon feed, starter, Bio-moist grower, and Bio-moist feed. Fish are fed hourly up to 12 times per day, by mechanical feeders at rates of

1.8%-6% body weight.

Little White Salmon Hatchery—Fish are fed Bio-Moist starter, grower and feed following manufacturer recommendations (generally between 3.5% and 0.5% of body weight per day). They are fed between two and nine times daily depending on fish size. Overall conversions are around 1.1.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Umatilla Hatchery-- Monthly monitoring follows specific protocols in the Umatilla Fish Health Monitoring and Evaluation work statement. All raceways of each species and stock at Umatilla Hatchery are monitored monthly for pathogens and parasites. Five moribund or dead fish per raceway are tested for systemic and gill bacteria. Five Chinook per raceway are examined for *R. salmoninarum* by the DFAT or ELISA. BKD **–** Erythromycin prophylactic feed treatments are scheduled, with one feeding at Umatilla. The target dose is 100 mg erythromycin per kilogram fish.
Other Infections - Juvenile fish are treated for bacterial infections if necessary with oxytetracycline under an Investigational New Animal Drug Permit (INAD).
Sanitation procedures - Statewide fish health management policy (September 12, 2003) provides guidelines for preventative and therapeutic fish health strategies that will be followed in this program.

Little White Salmon Hatchery--The Lower Columbia River Fish Health Center (LCRFHC) in Underwood, WA provides fish health care for the Little White Salmon NFH as described in the published policy 713 FW in the Fish and Wildlife Service Manual. In addition to this policy, the 1995 annual report "Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries", chapter 5, by the Integrated Hatchery Operations Team provides further fish health guidelines as approved by state, federal, and tribal agencies. The directives of these two documents exceed the requirements of the Washington State and Tribal fish health agencies which follow the directives in the Washington Co-Managers Salmonid Disease Control Policy of 1998.

The documents mentioned above provide guidance for preventing or minimizing diseases within and outside of the hatchery. In general, movements of live fish into or out of the hatchery must be approved by the Production Advisory Committee (PAC) and be noted on the Brood Document for the hatchery. If a fish transfer or release is not on the Brood Document, permits from the Washington Department of Fish & Wildlife, the USFWS, and any other states through which the fish travel must be obtained and approved by co-managers. Fish health exam and certification must be done prior to any releases or transfers from the hatchery to minimize risks from possible disease transmittance.

A pathologist from the LCRFHC visits at least once per month to examine fish at the hatchery. From each stock of juveniles, fish are randomly sampled to ascertain general health. Based on pathological signs, age of fish, concerns of hatchery personnel, and the history of the facility, the examining pathologist determines the appropriate tests. This usually includes an external and internal examination of skin, gills, and internal organs.

Kidneys (and other tissues, if necessary) will be checked for the common bacterial pathogens by culture and by a specific test for bacterial kidney disease (BKD). Blood is checked for signs of anemia or other infections, including viral anemia. Additional tests for virus or parasites are done if warranted.

A diagnostic exam is done on an as-needed basis determined by the pathologist or requested by hatchery personnel. Sick, dying, and/or fish with unusual behavior are examined for disease with appropriate diagnostic tests. A pathologist will normally check symptomatic fish during a monthly examination.

Spring Chinook are given prophylactic medicated feedings once in July at a rate of 100 mg erythromycin/kg fish/day for 21 days. Administration of erythromycin in mid-summer appears to control outbreaks of bacterial kidney disease later in the rearing cycle (LCRFHC fish health reports). The dosage and duration can be variable depending on that brood year's susceptibility to drug-induced toxicity. As of 2001, there is a temporary INAD 4333 that allows feeding of Aquamycin 100 (erythromycin thiocyanate in a wheat flour base) and prescription by a veterinarian is not required

At two to four weeks prior to a release or transfer from the hatchery, 60 fish from the stock of concern are tested for the presence of listed pathogens. These pathogens, defined in USFWS policy 713 FW include infectious hematopoietic necrosis virus (IHNV), infectious pancreatic necrosis virus (IPNV), viral hemorrhagic septicemia virus (VHSV), *Renibacterium salmoninarum*, *Aeromonas salmonicida*, *Yersinia ruckeri*, and *Myxobolus cerebralis*.

Table 9.2.7.1 Disease history (1999-2003) of Umatilla River spring chinook adults spawned at South Fork Walla Walla adult facility and juveniles reared at Umatilla Hatchery[a].

Disease or Organism	Adults	Juveniles
IHN Virus	Yes	No
EIBS Virus	No	No
Aeromonas salmonicida	Yes	No
Aeromonas/Pseudomonas	Yes	Yes
Flavobacterium psychrophilum	No	Yes
Fl. columnare	No	No
Renibacterium salmoninarum	Yes	Yes[b]
Yersinia ruckeri	Yes	Yes
Carnobacterium sp.	No	No
Ichthyobodo	No	No
Gyrodactylus	No	Yes
Ichthyophthirius multifilis	No	No
Epistylis	No	No
Scyphidia	No	No
Trichodinids	No	No
Gill Copepods	Yes	No
Coagulated Yolk Disease	No	Yes
External Fungi	Yes	Yes
Internal Fungi	No	Yes

Myxobolus cerebralis	No	No
Ceratomyxa shasta	Yes	No

[a] "Yes" indicates detection of the pathogen but in many cases no disease or fish loss was associated with presence of the pathogen. "No" indicates the pathogen has not been detected in that stock.
[b] There have been no cases of clinical BKD in the last 5 years rearing this stock at Umatilla Hatchery (brood years 1997-2001).

Table 9.2.7.2Umatilla spring Chinook Disease history (2000-2004) of juveniles[a,b] at Little White Salmon NFH.

Disease or Organism	Adults	Juveniles
IHN Virus		Yes
EIBS Virus		Yes
Aeromonas salmonicida		No
Aeromonas/Pseudomonas		No
Flavobacterium psychrophilum		No
Fl. columnare		No
Renibacterium salmoninarum		Yes
Yersinia ruckeri		No
Carnobacterium sp.		No
Ichthyobodo		Yes
Gyrodactylus		Yes
Ichthyophthirius multifilis		Yes
Epistylis		Yes
Scyphidia		Yes
Trichodinids		Yes
Gill Copepods		No
Coagulated Yolk Disease		Yes
External Fungi		Yes
Internal Fungi		No
Myxobolus cerebralis		No
Ceratomyxa shasta		na[c]

[a] "Yes" indicates detection of the pathogen but in many cases no disease or fish loss was associated with presence of the pathogen. "No" indicates the pathogen has not been detected in that stock.
[b] Data represents juveniles at Little White Salmon NFH for BY 1999-2002. Fish were examined by USFWS/LCRFHC from Jan. 2000 to transfer of BY 2002 in Feb 2004.
[c] Didn't look for *C. Shasta* in juveniles.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Umatilla Hatchery-- Smolts are transferred to acclimation from Umatilla Hatchery. (Tables 12 & 13)

Little White Salmon Hatchery--Fish are given a 24 hour saltwater challenge before release and observed for survival and outward signs of smoltification, i.e. loss of parr marks, etc. Survival is typically at or near 100%.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program

Umatilla Hatchery-- Baffles are used in Michigan ponds, to assist in self cleaning, reducing the need for human contact with the fish.

Little White Salmon Hatchery--New raceways are now being used that are made of colored concrete to better simulate the river bottom where the fish are released. The new raceways are also equipped with baffles to minimize the amount of cleaning necessary and to give the fish a variety of conditions within the raceway to choose from.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

Umatilla Hatchery-- Fish will be reared to a size, and released at a time, to encourage out-migration. All fish will be marked 100%. Strict health monitoring, prevention, and treatment protocols will be used.

Little White Salmon Hatchery-- These fish are not listed. There are no listed fish under propagation at this facility at this time.

<u>SECTION 10. RELEASE</u>

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels. *(Use standardized life stage definitions by species presented in* ***Attachment 2****. "Location" is watershed planted (e.g. "Elwha River").)*

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Fry				
Yearling (Little White Salmon Hatchery)	210,000	15	Mid-April	Imeques acclimation RM 80
Yearling (Umatilla Hatchery)	600,000	12	Mid-March	Imeques Acclimation RM 80

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Umatilla River
Release point: Imeques Acclimation (RM 79.5)
Major watershed: Umatilla River
Basin or Region: Mid-Columbia River

10.3) Actual numbers and sizes of fish released by age class through the program.

Juvenile spring Chinook have been released in the Umatilla River basin since 1986. Release numbers have varied between 225,883 (yearling spring releases) in 1997 to 1,836,737 (yearling spring and subyearling fall and spring releases) in 1994. The production goal since 1998 has been 810,000 yearling spring releases and it is anticipated that future releases will be similar.

Release year	Eggs/ Unfed Fry	Avg size	Fall Rel.	Avg size	Subyearling Spring Rel.	Avg size	Yearling	Avg size
1992			234,345	13.8	1,250,210	34.7	304,283	10.6
1993			460,809	19.9	667,367	27.6	491,816	11.5
1994			378,225	8.7	839,377	30.4	610,245	10.5
1995			0		0		673,331	11.1
1996			0		0		378,561	8.9
1997			0		0		225,883	9.1
1998			114,370	18.1	0		827,612	12.7
1999			0		0		659,607	14.0
2000			0		0		816,184	12.7

Release year	Eggs/ Unfed Fry	Avg size	Fall Rel.	Avg size	Subyearling Spring Rel.	Avg size	Yearling	Avg size
2001			0		0		782,733	11.4
2002			0		0		876,121	13.9
2003			0		0		782,106	13.8
Average			89,448	12.8	229,746	31.4	619,040	11.9

10.4) Actual dates of release and description of release protocols.

Historically, fish releases have occurred both in the spring and fall . With two exceptions, all releases since 1995 have been in the spring (March and April). One group of fish was released in February, 2002, and one group was emergency released in December, 1998. From 1986 to 1994, releases were made directly into the Umatilla River or were acclimated and force released at the end of the holding period. From 1995 to 1999, all fish were acclimated and force released. Beginning in 2000, all groups of fish have been acclimated and have been allowed to volitionally release for the last few days to week of holding before being forced out. It is anticipated that future releases will also be volitional. (Table 14)

10.5) Fish transportation procedures, if applicable.

Umatilla Hatchery--Chinook smolts are loaded with water using a fish pump. Fish are separated from the water and transferred into insulated liberation tankers ranging in capacity from 2,000 to 5,000-gallons. Fish are loaded at maximum rate of 1.0 lbs/gallon. Transport time from Umatilla Hatchery to acclimation sites is less than two hours. Supplemental oxygen and aeration is provided and temperature is monitored during transport.

Little White Salmon Hatchery—Same as above.

10.6) Acclimation procedures (*methods applied and length of time*).

Juvenile spring Chinook are transported to Imeques using 3,000 and 5,000 gallon fish transport trucks. The proposed acclimation period is three to four weeks. The fish are fed Bio-moist Feed twice each day at rate of approximately 0.5 to 1.0% BWD. Mortalities are removed daily and ODFW pathology personnel are available to address specific disease concerns. Temperature and dissolved oxygen measurements are taken daily during acclimation, and on the day of release, ODFW personnel sample the fish for weight and fork length. Since 2000, the fish have been allowed to release volitionally for the final few days to week of holding before the remaining fish are forced out. The effluent pond screen is removed and the fish are allowed to swim over a notched dam board and through an underground pipe directly into the Umatilla River. One to two days before the remaining fish are released; they are taken off feed to reduce stress. The ponds are lowered and the fish are slowly crowded out using a seine.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

Historically, spring Chinook releases were either unmarked, adipose clipped and CWT, or adipose right ventral or left ventral clipped and CWT. Since 2002 releases, all spring Chinook have been either adipose clipped and not CWT or adipose right ventral or left ventral clipped and CWT(ventral clips are alternated yearly). It is anticipated that all future releases will be marked the same.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

There is no plan for surplus smolt production. Fish surplus to programmed needs would be released at an earlier life stage or culled as eggs.

10.9) Fish health certification procedures applied pre-release.

Umatilla Hatchery-- All monitoring will be consistent with the ODFW fish health policy. Current Umatilla Hatchery Monitoring and Evaluation work statements provide the following protocol: Within four weeks prior to release grab-sampled fish of each species and stock are examined as follows:
-Kidney for *R. salmoninarum* by ELISA from 30 fish per raceway (spring chinook)
-Gill tissue and body scrapings by microscopy from a minimum of five fish
-Gill/kidney/spleen tissue pools (5 fish per pool) from 10 fish per raceway for culturable viruses.

Little White Salmon Hatchery-- For production groups at Little White Salmon NFH pre-transfer examinations will be conducted by Lower Columbia River Fish Health Center (LCRFHC) staff following standard protocols. (See section 9.2.7)

10.10) Emergency release procedures in response to flooding or water system failure.

Imeques Acclimation-- The Imeques acclimation/release facility includes a gravity flow water intake structure with automatic screen cleaner. Water (approximately 1,600 gpm per each of four acclimation ponds) is supplied by gravity to a headbox/water distribution structure where it is gravity fed to the ponds. The ponds are covered with netting to prevent bird predation. In case of power failure, or low water level alarm, a phone dialer will begin calling four telephone numbers repeatedly until someone acknowledges the alarm. Fish are released from the facility by pulling the pond outlet screen and dam boards, lowering the pond, and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Brian ??

TABLES AND FIGURES:

Table 1. Smolt-to-adult survival, return rate, number of adults produced, out-of basin exploitation and in-basin exploitation for yearling spring chinook salmon reared at Umatilla, Bonneville, Carson, and Little White Salmon hatcheries and released in the Umatilla River, 1991-96 broods. Out-of-basin data was downloaded from the central database in October 2001.

Brood year	Hatch-[a] ery	Release date	Release[b] site	Release size (fish/lb)	No.[c] CWT recov-eries	Smolt-to-adult sur-vival (%)	Umatilla[d] River return (%)	No. adults pro-duced	Out-of-[e] basin exploit-ation(%)	In-[f] basin exploit-ation(%)
March releases										
91	UFH	3/23/93	RM80	8.3	12	0.037	0.036	78	0.0	0.0
91	BFH	3/22/93	RM80	14.5	29	0.196	0.180	179	7.8	0.0
92	UFH	3/21/94	RM80	8.5	17	0.059	0.058	121	1.7	10.7
92	BFH	3/25/94	RM80	12.0	190	0.552	0.521	2,237	2.7	17.0
93	UFH	3/13/95	RM80	7.9	22	0.030	0.028	83	4.8	0.0
93	BFH	3/13/95	RM80	13.9	40	0.301	0.280	225	7.1	2.7
94	UFH	3/13/96	IC	9.0	3	0.003	0.003	12	0.0	0.0
95	UFH	3/26/97	IC	9.1	482	1.009	0.935	2,279	0.8	7.1
96	UFH	3/08/98	IC	11.7	584	0.734	0.730	2,809	0.1	12.9
96	LWSFH	3/08/98	RM80	15.6	21	0.221	0.223	339	0.0	3.2
April releases										
93	BFH	4/14/95	RM80	11.4	91	0.559	0.545	419	1.9	3.3
93	BFH	4/21/95	RM80	10.4	164	0.612	0.602	1,518	1.1	3.9
96	LWSFH	4/14/99	RM80	11.6	14	0.138	0.138	238	0.0	16.0
96	CNFH	4/14/99	RM80	16.3	46	0.490	0.490	488	0.0	12.1

[a] *UFH = Umatilla Fish Hatchery, BFH = Bonneville Fish Hatchery, LWSFH = Little White Salmon Fish Hatchery, CNFH = Carson National Fish Hatchery.*
[b] *RM = river mile, IC = Imeques acclimation site.*
[c] *Number of coded-wire tags recovered.*
[d] *Return = number of fish counted at Three Mile Falls Dam plus harvest beolow Three Mile Falls Dam.*
[e] *Percent of adult production harvested outside of of the Umatilla River basin.*
[f] *Percent of adult production harvested in the Umatilla River basin by non-tribal and tribal sport anglers.*

Table 2

Spring Chinook Annual Run Counts To Three Mile Dam			
Year	Adults	Jacks	Total
1988	13	0	13
1989	66	97	163
1990	2158	32	2190
1991	1291	39	1330
1992	460	4	464
1993	1205	16	1221
1994	263	8	271
1995	388	108	496
1996	2152	121	2273
1997	2194	4	2198
1998	409	20	429
1999	1764	210	1974
2000	4215	124	4339
2001	4382	185	4567
2002	5058	188	5246
2003	3607	135	3742

Table 3. Smolt-to-adult survival, return rate, number of adults produced, out-of basin exploitation and in-basin exploitation for yearling spring chinook salmon reared in Michigan and Oregon raceways at Umatilla Hatchery and released in the Umatilla River, 1993-94 and 1996 broods. Returns are incomplete for the 1996 brood.

BY[a]	Rear-[b] ing system	Release date	Rel-[c] ease site	Rel-ease size (fish/lb)	No.[d] CWT recov-eries	Smolt-to-adult sur-vival (%)	Umatilla[e] River return (%)	No. adults pro-duced	No.[f] adults/gal/h	Out-of-[g] basin exploit-ation(%)	In-[h] basin exploit-ation(%)
93	M	3/13/95	RM80	7.8	7	0.032	0.032	29	2.8	0.0	0.0
93	O	3/13/95	RM80	8.0	15	0.029	0.026	54	1.3	7.4	0.0
94	M	3/13/96	IC	9.6	1	0.003	0.003	4	0.3	0.0	0.0
94	O	3/13/96	IC	9.0	2	0.003	0.003	4	0.2	0.0	0.0
96	M	3/08/98	IC	11.3	219	0.637	0.629	993	63.6	0.0	10.2
96	O	3/08/98	IC	9.1	365	0.801	0.800	1,816	43.6	0.1	14.4

[a] *BY = brood year*
[b] *M = Michigan raceways, O = Oregon raceways.*
[c] *RM = river mile, IC = Imeques acclimation site.*
[d] *Number of coded-wire tags recovered.*
[e] *Return = number of fish counted at Three Mile Falls Dam plus harvest below Three Mile Falls Dam.*
[f] *Number of adults produced per water use at Umatilla Hatchery (gallons/h).*
[g] *Percent of adult production harvested outside of the Umatilla River basin.*
[h] *Percent of adult production harvested in the Umatilla River basin by non-tribal and tribal sport anglers*

Table 4. Number of hatchery and natural spring chinook salmon that returned to the eastbank fish ladder, Three Mile Falls Dam, Umatilla River, 2000-2002.

	Hatchery				Natural					
	Male		Female		Male		Female		Total	
Age[a]	Number	%	Number	%	Number	%	Number	%	Number	%
					2000					
Subjack	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Jack	118	95.2	0	0.0	6	4.8	0	0.0	124	2.9
Adult	1667	39.6	2197	52.2	178	4.[illegible]	168	4.0	4210	97.1
Total	1785	41.2	2197	50.7	184	4.[illegible]	168	3.9	4334	100.0
					2001					
Subjack	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Jack	161	85.2	0	0.0	28	14.8	0	0.0	189	4.1
Adult	1629	37.2	2535	57.9	83	1.9	129	2.9	4376	95.9
Total	1790	39.2	2535	55.5	111	2.4	129	2.8	4565	100.0
					2002					
Subjack	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Jack	171	94.0	0	0.0	11	6.0	0	0.0	182	3.5
Adult	1842	36.4	3051	60.3	61	1.[illegible]	107	2.1	5061	96.5
Total	2013	38.4	3051	58.2	72	1.4	107	2.0	5243	100.0

[a] *Age designation based on fork length: subjacks <381 mm, jacks 382-610 mm and adults > 610 mm. Length-age relationships were determined by known coded wire tag returns.*

Hatchery and natural was not distinguished prior to 1996.

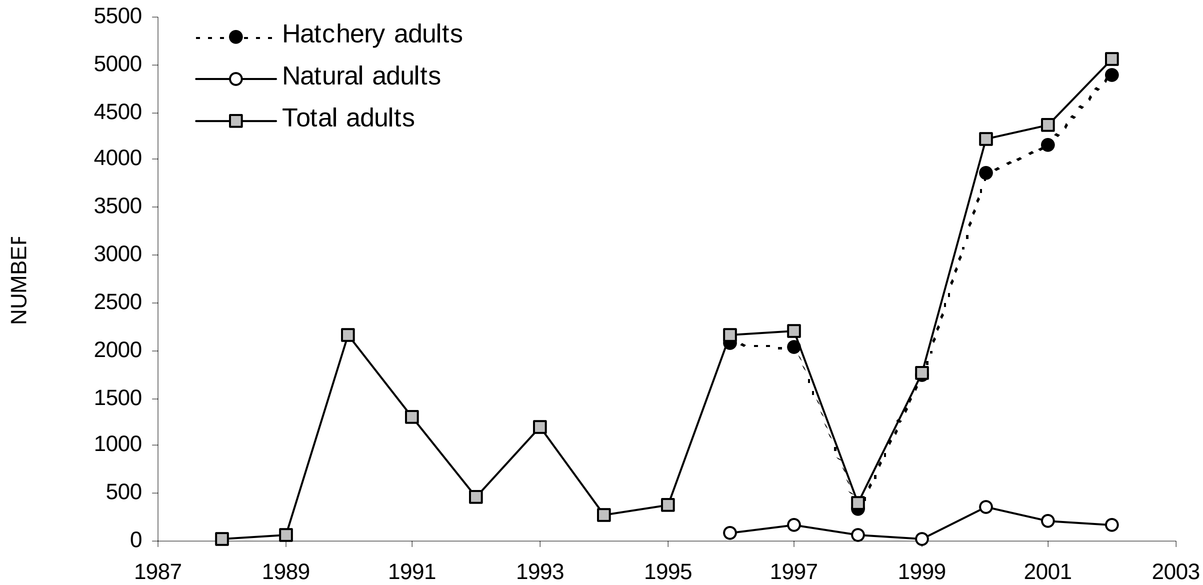

Figure 1. Number of adult spring chinook salmon that returned to Three Mile Falls Dam (1988-2002)

Table 5. Hatchery releases of spring chinook in the Umatilla River Basin.

Year of Release	Hatchery	No. Released	No./lb.	Stock

Table 5 cont.

Year of Release	Hatchery	No. Released	No./lb.	Stock
1986	Carson	99,970	22.8	Carson
1986	Irrigon	300,438	87.0	Carson
1986	Irrigon	75,000	15.0	Carson
1987	Carson	99,897	10.4	Carson
1987	Oxbow	169,100	199.0	Carson
1988	Bonneville	1,196	21.4	Carson /a
1988	Carson	99,895	20.6	Carson
1988	Bonneville	297,377	8.3-10.3	Carson /a
1988	Bonneville	75,767	11.1	Carson /a
1989	Bonneville	325,520	10.6-12.0	Carson /a
1990	Carson	99,775	18.6	Carson
1990	Bonneville	390,208	9.0-13.4	Carson /a
1991	Carson	96,733	16.9-20.6	Carson
1991	Bonneville	196,657	10.1-11.8	Carson /a
1991	Bonneville	159,624	16.5-16.8	Carson /b
1992	Carson	90,982	18.7	Carson
1992	Carson	5,272	18.7	Carson
1992	Bonneville	208,029	8.5-9.2	Carson /a
1992	Umatilla	955,752	35.4	Carson
1992	Irrigon	294,458	32.5	Carson
1992	Bonneville	132,929	11.3	Carson
1992	Umatilla	101,416	19.4	Carson
1993	Bonneville	186,948	14.5	Carson
1993	Umatilla	208,782	8.3	Carson
1993	Carson	85,134	20.3	Carson
1993	Carson	10,952	20.0-20.5	Carson
1993	Umatilla	667,367	27.6	Carson
1993	Umatilla	460,809	19.9	Carson
1994	Umatilla	205,143	8.4	Carson
1994	Bonneville	152,854	11.5	Carson
1994	Bonneville	252,248	12.3	Carson
1994	Umatilla	8,890	8.1-8.3	Carson
1994	Umatilla	839,377	30.4	Carson
1994	Umatilla	378,225	8.7	Carson
1995	Bonneville	247,871	10.3	Carson
1995	Umatilla	275,804	7.9	Carson
1995	Bonneville	74,735	14.4	Carson
1995	Bonneville	74,921	11.4	Carson
1996	Umatilla	378,561	8.9	Carson /c
1997	Umatilla	225,883	9.1	Carson /d
1998	Umatilla	382,714	11.6	Carson /e
1998	Umatilla	114,370	18.1	Carson /f
1998	Little White Salmon	172,999	15.6	Carson /e
1998	Little White Salmon	172,258	11.6	Carson /e
1998	Carson	99,641	16.3	Carson
1999	Umatilla	253,831	13.7	Carson /f
1999	Little White Salmon	302,015	12.7-16.1	Carson /f
1999	Carson	103,761	13.2	Carson

2000	Umatilla	254,101	13.3	Carson /g
2000	Umatilla	103,621	12.2	Carson /g
2000	Little White Salmon	173,545	13.1	Carson /h
2000	Little White Salmon	185,069	11.1	Carson /h
2000	Carson	99,848	14.4	Carson
2001	Umatilla	91,727	14.8	Carson /f
2001	Umatilla	244,794	10.4	Carson /f
2001	Little White Salmon	165,310	13.0	Carson /f
2001	Little White Salmon	180,919	11.3	Carson /f
2001	CNFH	99,983	13.9	Carson
2002	Umatilla	107,717	13.8	Carson /f
2002	Umatilla	104,089	12.0	Carson /f
2002	Umatilla	148,048	13.7	Carson /f
2002	Umatilla	152,026	12.3	Carson /f
2002	Willard NFH	143,516	17.0	Carson /f
2002	Willard NFH	220,725	14.9	Carson /f
2003	Umatilla	104,679	13.0	Carson /f
2003	Umatilla	102,217	12.1	Carson /f
2003	Umatilla	148,748	12.2	Carson /f
2003	Umatilla	103,656	11.6	Carson /f
2003	Little White Salmon	322,806	16.9	Carson /f

/a Carson via Lookingglass broodstock
/b Carson via Lookingglass, Umatilla River and Big Canyon broodstock
/c Carson via Lookingglass (Wallowa H.) and Ringold (Lyons Ferry H.) broodstock
/d Carson via Ringold (Lyons Ferry H.) and Little White Salmon broodstock
/e Carson via Little White Salmon broodstock
/f Carson via Umatilla River broodstock
/g Carson via Ringold (Lyons Ferry H.) and Umatilla River broodstock
/h Carson via Ringold (Little White Salmon H.) broodstock

Table 6. Statistical summary of spring chinook salmon sport fishery in the Umatilla River, 1990-2002. There was no sport fishery during years not listed.

Year	Survey area[a]	Ang -ling days	No. days sam- pled	No. ang- lers	Hours fished	No. kept	No. released	Run size	Catch rate (fish/h)
1990	Ryan Creek to Forks	12	11	80	1,248	20	0	2,190	0.016
1991	Ryan Creek to Forks	12	12	235	1,544	23	0	1,330	0.015
1993	Yoakum Bridge to wCTUIR	16	12	39	317	0	0	1,220	0.000
	Ryan Creek to Forks	16	12	145	1,211	18	0		0.015

1996	Rieth Bridge to wCTUIR	20	15	428	2,471	205	0	2,273	0.083
	Ryan Creek to Forks	20	12	67	429	1	0		0.002
1997	TMFD to Yoakam Bridge	23	10	58	812	19	0	2,196	0.023
	Yoakam Bridge to wCTUIR	23	13	337	2,529	12	0		0.005
1999	TMFD to Yoakam Bridge	23	4	18	21	0	0	1,974	0.000
	Yoakam Bridge to wCTUIR	23	16	222	531	4	2		0.011
2000	Mouth to TMFD	76	39	1,103	9,198	443	82	4,777	0.057
	Yoakum Bridge to wCTUIR	76	12	214	4,274	141[b]	9		0.035
2001	Mouth to TMFD	76	41	1,404	10,872	463	13	5,028	0.043
	Yoakum Bridge to wCTUIR	76	24	324	4,053	80	2		0.020
2002	Mouth to TMFD	40	27	924	10,326	645	11	5,884	0.064
	Yoakum Bridge to wCTUIR	53	17	222	7,227	110	6		0.016

[a] *wCTUIR = west boundary of Confederated Tribes of the Umatilla Indian Reservation (RM); Forks = confluence of Umatilla River north and south forks (river mile 89.5); TMFD = Three Mile Falls Dam (river mile 3.7).*
[b] *Includes an estimated 57 fish caught prior to the initiation of creel surveys.*

HGMP: Umatilla River spring chinook salmon

Table 7. Water quality comparisons between Michigan and Oregon raceways during production 1992-1998.

		Inlet			Outlet		
Parameter	Pass	N	Means	Min-Max	N	Means	Min-Max
Temperature	A	89	13.9	11.4-16.3	89	13.9	11.4-16.1
(°C)	B	89	13.9	11.4-16.4	89	14.0	11.4-16.6
	C	57	13.9	11.2-16.1	57	14.0	11.2-16.3
pH	A	83	7.84	6.64-8.70	83	7.80	6.65-8.65
	B	83	7.82	6.67-8.65	83	7.80	6.66-8.65
	C	51	7.79	6.63-8.17	51	7.76	6.65-8.20
Oxygen	A	85	11.10	7.9-13.7	84	9.70	7.3-11.8
(mg/L)	B	85	10.96	8.8-13.7	85	9.68	7.9-11.8
	C	54	10.69	8.5-14.0	53	9.49	7.3-11.7
Unionized	A				62	0.33	0.02-1.35
Ammonia	B				62	0.55	0.02-2.56
(µg/l)	C				30	0.58	0.03-1.42

Table 8. Spring Chinook salmon abundance by life stage reared at Umatilla (UFH), Little White Salmon (LWSH),

Carson (CNFH), and Willard Fish Hatcheries for 1991-2002 broods. 0+ = subyearling, 1+ = yearling. Additional egg sources from Ringgold (RIN) and Lyons Ferry (LF) hatcheries.

Brood year	Number of Umatilla River females spawned	Rearing and release strategies	Egg source	Number of eggs taken	Number Of eyed eggs received	Number of fry	Number of smolts released
			Umatilla Fish Hatchery				
1991		1+, spring	CNFH		332,000	322,704	208,880
1992		1+, spring	CNFH		319,000	227,447	205,400
1993		1+, spring					286,243
1994		1+, spring	RIN/LF		602,000	432,236	381,122
1995		1+, spring	CNFH/LF/LWSH		227,000	218,296	226,909
1996		1+,spring	CNFH/LF/UFH		487,612	391,065	383,449
1997		1+, spring	UFH				254,324
1998	96	1+, spring	UFH	455,953	82,000	441,628	360,056
1999	276	1+, spring	UFH	942,988		362,104	338,723
2000	300	1+, spring	UFH	1,120,995		526,628	513,913
2001	282	1+, spring	UFH	1,175,281		477,691	460,048
			Little White Salmon Fish Hatchery				
1997		1+, spring	UFH	396,000			379,693
1998		1+, spring	RIN	307,624			294,267
1999		1+, spring	UFH	398,784			355,776
2001		1+, spring	UFH	364,752			346,664
			Carson National Fish Hatchery				
1997		1+, spring	CNFH			102,462	103,838
1998		1+, spring	CNFH			100,067	99,916
1999		1+, spring	CNFH			100,309	100,111
			Willard Fish Hatchery				
2000		1+, spring	UFH			401,065	394,348

Table 9. Egg take and survival of Umatilla River stock Spring Chinook (brood years 1997-2002) reared at Umatilla Hatchery during 1998-2003.

Brood Year	Number of eggs taken or received	Egg-to-fry survival (%)	Egg-to-smolt survival[a] (%)
1997	1,029,237	81	78
1998	455,953	97	82
1999	942,988	81	78
2000	1,120,955	84	82
2001	1,175,281	81	80
2002	986,145	86	86

[a] *Survival estimate is based on green egg-to-smolt stage.*

Table 10. Little White Salmon Survival for Spring Chinook brood years (1996-2001) Brood years 1997, and 1999-2001 are eggs from Umatilla Stock.

BROOD YEAR	EGGS TAKEN	% SURVIVAL TO EYED	EYED EGGS RECEIVED	% SURVIVAL TO POND	% SURVIVAL POND TO RELEASE
1996	382,382	94.10	0	99.41	97.26
1997	0	N/A	396,000	99.07	97.79
1998	507,844	91.83	0	90.04	97.27
1999	0	N/A	398,784	91.81	97.13
2000	0	N/A	401,065	99.88	98.39
2001	0	N/A	373,062	97.77	94.79
Average	445,113	92.97	392,228	96.33	97.11

Table 11. Rearing conditions immediately before transfer for spring chinook salmon at Umatilla Fish Hatchery in Oregon raceways during 1991-2000.

Brood year	System	Maximum density (lb/ft^3)	Maximum loading (lb/gal/min)	Total number reared per gpm in system
1991	Oregon	1.0	5.0	83
1992	Oregon	1.0	4.8-5.0	84
1993	Oregon	0.9-1.1	4.6-5.4	74
1994	Michigan	2.4-2.7	5.9-6.6	115
	Oregon	1.2-1.3	5.6-6.2	94
1995	Oregon	1.0	4.8-4.9	92
1996	Michigan	2.0	4.9	164
	Oregon	0.9	4.2	91
1997	Michigan	3.5	8.4	157
	Oregon	0.7-1.3	3.2-6.2	46
1998	Michigan	1.73	4.2	159
	Oregon	0.75	3.6	84
1999	Michigan	1.70	4.1	143
	Oregon	0.77	3.7	90
2000	Michigan	1.76	4.2	163
	Oregon	0.68	3.3	84

Table 12. Mean length, weight, and condition factor at transfer for yearling spring chinook salmon reared in Michigan or Oregon raceways at Umatilla Hatchery, 1991-97 broods (standard error in parentheses).

Brood year	System	Length (mm)	Weight (g)	Condition factor
1991[a]	Oregon	158.8(0.0)	50.5(0.0)	1.20(<0.01)
1992	Oregon	163.0(0.7)	55.2(1.3)	1.23(0.01)
1993[b]	Michigan	166.9	57.8	1.24
	Oregon	171.0	56.9	1.16
1994[b]	Michigan	160.9	46.4	1.11
	Oregon	167.7	53.0	1.12
1995[b]	Oregon	149.2	45.9	1.35
1996	Michigan	147.1(0.4)	39.9(0.5)	1.21(<0.01)
	Oregon	145.9(0.3)	40.0(0.5)	1.25(<0.01)
1997	Michigan	131.8(0.4)	28.3(0.4)	1.22(<0.01)
	Oregon(10/15/1998)	108.3(0.3)	15.7(0.2)	1.21(<0.01)
	Oregon(1/20/1999)	137.9(0.4)	33.4(0.5)	1.23(<0.01)
1998	Michigan	133.7(0.6)	31.8(0.8)	1.29(0.01)
	Oregon (11/1/99)	122.2(0.4)	26.3(0.5)	1.41(0.01)
	Oregon (1/4/00)	135.6(0.5)	32.4(0.7)	1.3(0.01)
1999	Michigan	137.1(0.6)	32.8(0.9)	1.27(0.01)
	Oregon (11/8/00)	134.1(0.6)	32.3(0.7)	1.28(0.01)
	Oregon (1/8/01)	139.7(0.5)	35.7(0.7)	1.29(0.01)
2000	Michigan	133.7(0.6)	30.4(0.8)	1.25(0.01)
	Oregon (11/2/01)	117.2(0.4)	21.3(0.4)	1.30(0.01)
	Oregon (1/7/02	136.5(0.5)	33.5(0.8)	1.28(0.01)

[a] *Brood years 1991-92 were not acclimated and were released directly into the Umatilla River.*
[b] *Fish from the 1993 through 1995 brood years were measured at release after acclimation, standard errors were not determined.*

Table 13. Percent descaled, partially descaled, and undamaged yearling spring chinook salmon reared in Michigan and Oregon raceways at Umatilla Hatchery, brood years 1991-2000.

		Smolting			Descaling		
Brood year	System[a]	Smolt	Interme-diate	Parr	Descaled[b]	Partially descaled[c]	Undam-aged[d]
1991	Oregon				1.0	1.0	99.0
1992	Oregon				1.0	18.0	81.0
1993	Michigan				3.0	24.0	74.0
	Oregon				0.0	15.0	85.0
1994	Michigan				13.0	54.0	33.0
	Oregon				1.0	12.0	87.0
1995	Oregon				1.0	13.0	86.0
1996	Michigan				0.0	17.0	83.0
	Oregon				1.0	24.0	76.0
1997	Michigan				3.0	53.0	44.0
	Oregon(10/15/1998)				0.0	0.0	100.0
	Oregon(1/20/1999)				1.0	87.0	12.0
1998	Michigan	0.0	100.0	0.0	0.0	0.0	100.0
	Oregon(11/1/1999)	0.0	98.0	2.0	0.0	0.0	100.0
	Oregon(1/4/2000)	0.0	100.0	0.0	0.0	0.0	100.0
1999	Michigan	0.0	100.0	0.0	0.0	0.0	100.0
	Oregon(11/8/2000)	0.0	100.0	0.0	0.0	0.0	100.0
	Oregon(1/8/2001)	0.0	100.0	0.0	0.0	0.0	100.0
2000	Michigan	0.0	100.0	0.0	0.0	0.0	100.0
	Oregon(11/2/2001)	0.0	100.0	0.0	0.0	0.0	100.0
	Oregon(1/7/2002)	0.0	100.0	0.0	0.0	0.0	100.0

[a] *Data are mean of A and B passes.*
[b] *More than 20 % descaling on either side of the fish.*
[c] *Descaling = 3 to 20 % on either side of the fish.*
[d] *Less than 3 % descaling on either side of the fish.*

Table 14. Release data for yearling spring Chinook salmon reared at Bonneville, Umatilla, Little White Salmon, and Carson hatcheries and released in the Umatilla River (IC=Imeques acclimation facility).

Brood year, CWT code	Release date	Race-way	Number released[a]	Number CWT	Number brand/paint or PIT-tag[b]	Fish per pound	Release location (RM)
			Bonneville Hatchery				
1991							
071455	3/23/1993	B1	92,728	19,951		14.8	80
071456	3/22/1993	B2	94,220	20,022		14.3	80
Total			186,948	39,973		14.5	
1992							
070250	3/25/1994	B6	99,616	26,716		11.7	80
070251	3/25/1994	B5	101,830	26,305		11.7	80
075944	3/25/1994	B8	103,980	20,109	4,818	12.5	80
075945	3/25/1994	B7	99,676	20,219	5,200	12.2	80
Total			405,102	93,349	10,018	12.0	
1993							
070649	4/21/1995	B7	123,257	22,189	5,137	10.5	80
070650	4/21/1995	B8	124,614	24,088	4,878	10.2	80
070660	3/13/1995	B5	74,735	23,607		13.9	80
070661	4/14/1995	B6	74,921	28,765		11.4	80
Total			397,527	98,649	10,015	11.2	
			Umatilla Hatchery				
1991							
075739	3/23/1993	O5B	50,312	21,499	5,300	8.2	80
075740	3/23/1993	O4B	50,109	20,880	4,934	8.1	80
075741	3/24/1993	O4A	54,347	21,157	5,548	8.3	80
075742	3/24/1993	O5A	54,014	20,307	5,242	8.6	80
Total			208,782	83,843	21,085	8.3	
1992							
070217	3/21/1994	O5A	51,210	20,070	5,082	8.5	80
070218	3/21/1994	O5B	49,375	19,920	5,142	8.1	80
070219	3/21/1994	O4B	52,620	20,971	5,151	8.8	80
070220	3/22/1994	O4A	51,938	20,982	5,419	8.4	80
Total			205,143	81,943	20,797	8.5	

[a] *All fish from even numbered brood years were LV fin-clipped and fish from odd numbered brood years were RV fin-clipped. All coded-wire-tagged fish were adipose fin-clipped.*
[b] *Fish from 1991-93 broods were branded.*

Table 14 (continued)

Brood year, CWT code	Release date	Race-way	Number released[a]	Number CWT	Number brand/paint or PIT-tag[b]	Fish per pound	Release location (RM)
1993							
071453	3/13/95	M5A	50,007	20,315	4,910	8.3	80
071454	3/13/95	M5B	40,685	15,661	4,436	8.9	80
subtotal			90,692	35,976	10,015	7.8	
070651	3/13/95	O4A	49,001	18,864	5,176	9.1	80
070652	3/13/95	O4B	44,077	19,052	4,975	8.2	80
070653	3/13/95	O5B	44,188	18,175	5,133	9.0	80
070654	3/13/95	O5A	47,846	19,091	5,063	8.7	80
subtotal			185,112	75,182	20,347	8.0	
Total			275,804	111,158	29,673	7.9	
1994							
071027	3/13/96	M6A	49,032	19,622	5,083	9.0	IC
071028	3/13/96	M6B	45,887	18,844	4,682	10.8	IC
071029	3/13/96	M6C	49,121	19,258	5,275	9.0	IC
subtotal			144,040	57,724	15,040	9.6	
071030	3/13/96	O4A	60,599	19,961	4,531	7.5	IC
071031	3/13/96	O5A	60,137	20,066	5,026	8.8	IC
071032	3/13/96	O5B	57,076	19,874	5,092	8.7	IC
071033	3/13/96	O4B	56,709	19,583	4,232	9.5	IC
subtotal			234,521	79,484	18,881	8.6	
Total			378,561	137,208	33,921	9.0	
1995							
091730[a]	3/26/97	O4A	57,668	19,842	3,724	9.3	IC
091750	3/26/97	O4B	56,901	20,289		9.3	IC
091749	3/26/97	O5A	56,764	19,818		8.9	IC
091751	3/26/97	O5B	54,550	20,597		8.9	IC
Total			225,883	80,546		9.1	
1996							
092256	3/8/98	M2A	52,159	23,162	248	11.2	IC
092257	3/8/98	M2B	51,972	22,788	243	11.2	IC
092258	3/8/98	M2C	51,743	22,450	240	11.5	IC
subtotal			155,874	68,400	731	11.3	
092259	3/8/98	O5A	60,277	23,247	237	11.8	IC
092260	3/8/98	O4A	59,744	22,759	247	11.9	IC
092261	3/8/98	O5B	53,502	23,248	233	11.9	IC
092262	3/8/98	O4B	53,317	23,778	244	12.0	IC
subtotal			226,840	93,032	961	11.9	
Total			382,714	161,432	1,692	11.7	

[a] *All fish from even numbered brood years were LV fin-clipped and fish from odd numbered brood years were RV fin-clipped. All coded-wire tagged fish were adipose fin-clipped.*
[b] *Fish from 1991-94 broods were branded; 1995 brood was paint-marked (3,724) green on the anal fin. Mark represents tag codes 091730, 091750, and 091751; 1996 brood was PIT-tagged.*

Table 14 (continued)

Brood year, CWT code	Release date	Race-way	Number released[a]	Number CWT	Number brand/paint or PIT-tag[b]	Fish per pound	Release location (RM)
1997							
092414	12/20/1998	O4A	61,849	21,795	243	18.1	IC
092416	12/20/1998	O4B	52,521	21,969	240	18.1	IC
subtotal			114,350	43,754	483	18.1	
092347	3/08/1999	M2A	49,190	20,832	240	13.9	IC
092411	3/08/1999	M2B	48,901	21,741	247	13.4	IC
092412	3/08/1999	M2C	51,017	21,833	240	14.4	IC
subtotal			149,108	64,405	727	13.9	
092413	3/08/1999	O5A	53,403	21,602	241	14.0	IC
092415	3/08/1999	O5B	51,319	21,740	233	12.8	IC
subtotal			104,722	43,342	474	13.4	
Total			368,180	151,501	1,684	15.1	
1998							
076040	3/9/2000	O4A	53,256	22,483	266	12.1	IC
076039	3/9/2000	O4B	50,365	21,070	263	12.1	IC
subtotal			103,621	43,553	529	12.1	
076138	3/9/2000	M1A	47,489	21,112	253	13.1	IC
076051	3/9/2000	M1B	49,189	22,102	249	12.7	IC
076050	3/9/2000	M1C	52,426	22,115	263	13.5	IC
subtotal			149,104	65,329	765	13.1	
076049	3/9/2000	O5A	53,621	22,137	291	13.5	IC
076041	3/9/2000	O5B	51,376	21,848	279	13.5	IC
subtotal			104,997	43,985	570	13.5	
Total			357,722	152,867	1,864	12.9	
1999							
093154	3/9/2001	O4A	58,418	19,879	294	10.4	IC
093152	3/9/2001	O4B	52,671	21,113	299	10.4	IC
subtotal			111,089	40,992	593	10.4	
093158	3/9/2001	M1A	29,130	11,063	280	10.4	IC
093157	3/9/2001	M1B	52,986	20,203	290	10.4	IC
093155	3/9/2001	M1C	51,589	22,086	293	10.4	IC
subtotal			133,705	53,352	863	10.4	
093156	3/9/2001	O5A	42,762	21,195	298	14.8	IC
093153	3/9/2001	O5B	48,965	20,991	295	14.8	IC
subtotal			91,727	42,186	593	14.8	
Total			336,521	136,530	2,049	11.7	

Table 14 (continued)

Brood year, CWT code	Last date of release	Race-way	Number released[a]	Number CWT	Number brand/paint or PIT-tag[b]	Fish per pound	Release location (RM)
2000							
093360	3/9/2002	O4A	53,961	21,450	297	13.8	IC
093361	3/9/2002	O4B	53,756	20,616	299	13.8	IC
subtotal			107,717	42,066	596	13.8	
092657	2/7/2002	M1A	49,095	6,503	298	13.7	IC
092658	2/7/2002	M1B	49,159	6,582	297	13.7	IC
092659	2/7/2002	M1C	49,794	6,458	297	13.7	IC
subtotal			148,048	19,543	892	13.7	
093362	3/9/2002	M2A	50,412	21,020	294	12.3	IC
093363	3/9/2002	M2B	50,804	20,401	298	12.3	IC
093401	3/9/2002	M2C	50,810	20,835	299	12.3	IC
subtotal			152,026	62,256	891	12.3	
093358	3/9/2002	O5A	54,045	21,187	299	12.0	IC
093359	3/9/2002	O5B	50,144	20,657	298	12.0	IC
subtotal			104,089	41,844	597	12.0	
Total			511,880	165,709	2,976		
2001							
093606	3/6/2003	O4A	52,399	21,197	298	13.0	IC
093603	3/6/2003	O4B	52,280	20,620	298	13.0	IC
subtotal			104,679	41,817	596	13.0	IC
093609	3/6/2003	M2A	49,631	20,984	298	12.1	IC
093608	3/6/2003	M2B	49,843	20,061	295	12.2	IC
093607	3/6/2003	M2C	49,972	20,849	295	12.2	IC
subtotal			149,446	61,894	888	12.2	
	3/6/2003	M1A	49,617			11.7	IC
	3/6/2003	M1B	53,341			11.6	IC
subtotal			102,958			11.6	
093605	3/6/2003	O5A	49,850	21,415	299	12.1	IC
093604	3/6/2003	O5B	52,367	20,895	300	12.1	IC
subtotal			102,217	42,310	599	12.1	
Total			459,300	146,021	2,083		

Table 14 (continued)

Brood year, CWT code	Last date of release	Race-way	Number released[a]	Number CWT	Number brand/paint or PIT-tag[b]	Fish per pound	Release location (RM)
Little White Salmon Hatchery							
1996							
071420	3/08/1998	39-43	172,999	19,403	235	15.6	80
075743	4/14/1998	34-38	172,258	19,255	244	11.6	80
Total			345,257	38,658	479	13.6	
1997							
076037	3/08/1999	39-43	177,655	17,707	248	16.1	IC
076038	4/14/1999	35-38	124,360	17,993	218	12.7	IC
Total			302,015	35,700	466	14.7	
1998							
053645	3/9/2000	39-43	173,545	19,712	297	13.1	IC
053647	4/12/2000	34-38	185,069	19,597	270	11.1	IC
			358,614	39,309	567	12.1	
1999							
054660	3/16/2001	39-43	165,310	18,266	289	13.0	IC
054659	4/11/2001	34-38	180,919	18,133	286	11.3	IC
Total			346,229	36,399	575	12.1	
2001							
054657	4/15/2003	8-10	199,991	16,334		17.0	IC
054658	4/15/2003	11-12	122,815	17,404	291	16.8	IC
Total			322,806	33,738		16.9	
Willard National Fish Hatchery							
2000							
054662	3/14/2002	41-46	143,516	15,993	289	14.6	IC
054761	4/11/2002	47-50,21-22	220,725	23,849	283	14.0	IC
Total			364,241	39,841	572	14.3	
Carson Hatchery							
1996							
076036	4/14/1998	37-40	99,641	18,721	241	16.3	80
1997							
075746	4/14/1999	37-40	103,761	19,593	248	13.3	IC
1998							
054655	4/12/2000	37-40	99,848	19,444	297	14.4	IC
1999							
054661	4/17/2001	37-40	99,983	18,398	288	13.9	IC

[a] All fish from even numbered brood years through 1996 were LV fin-clipped and fish from odd numbered brood years were RV fin-clipped. All coded-wire tagged fish were adipose fin-clipped. CWT fish from the 1997 brood at Little White Salmon and Carson hatcheries were adipose and LV fin-clipped. Non-CWT fish from the 1997 brood at Umatilla Hatchery were unmarked. [b] 1996 brood was PIT-tagged.

Table 15. Disposition and Spawning Ground Data of Natural and Hatchery Summer Steelhead (STS) Returning to the
Umatilla River above Three Mile Falls Dam, 1988-1999.

RUN YEAR (Fall/Spring)	1987 1988	1988 1989	1989 1990	1990 1991	1991 1992	1992 1993	1993 1994	1994 1995	1995 1996	1996 1997	1997 1998	1998 1999
Natural STS Enumerated at TMD	2315	2104	1422	724	2247	1298	945	875	1299	1014	862	1134
Hatchery STS Enumerated at TMD	165	370	245	387	522	616	345	656	782	1463	903	740
Natural and Hatchery STS Enumerated at TMD	2480	2474	1667	1111	2769	1914	1290	1531	2081	2477	1765	1874
Natural STS Sacrificed or Mortalities at TMD	20	12	40	2	3	4	0	0	8	5	2	1
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	69	51	33	73	95	70	74
Natural STS Taken for Brood Stock	151	158	92	99	237	129	93	86	107	100	86	110
Natural STS Spawned	31F	42F	25F	78	172	95	79	59	63	75	68	76
Hatchery STS Taken for Brood Stock	0	0	0	103	95	91	42	68	26	10	30	15
Hatchery STS Spawned	0	0	0	49	0	3	17	22	21	3	21	4
Natural Females Released above TMD	1436	1232			1193	875	642	602	863	689	550	716
Natural Males Released above TMD	708	702			814	290	210	187	321	220	224	308
Natural STS Released above TMD	2144	1934	1290	623	2007	1165	852	789	1184	909	774	1024
Hatchery Females Released above TMD	114	216			161	266	186	274	371	666	476	425
Hatchery Males Released above TMD	46	137			154	190	66	281	312	692	327	236
Hatchery STS Released above TMD	160	353	102	234	315	456	252	555	683	1358	803	661
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39
Natural STS Harvested above TMD-ODFW								0	0	0	0	0
Hatchery STS Harvested above TMD-ODFW						22	5	21	25	24	12	47
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548	713
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221	306
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769	1019
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454	382
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305	193
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759	575
Total STS Available for Spawning	2304	2287	1392	857	2322	1569	1074	1298	1803	2210	1528	1594
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002	1095
STS Redds Observed in Index Reaches	138	77	H W.	H W	135	H W.	64	74	119	138	126	218
Total STS Redds Observed	275	128	H W.	H W	300	H W.	224	126	150	149	217	270
Index Reaches Miles Surveyed	18.5	20	H W.	H W	21.4	H W.	21.4	21.4	21.4	21.4	21.4	21.4
Redds Per Mile in Index Reaches	7.5	3.9	H W.	H W	6.3	H W.	3.0	3.5	5.6	6.4	5.9	10.2
Total Miles Surveyed in Umatilla River	61.0	50.2	H W.	H W	67.2	H W.	65.8	35.0	34.4	24.6	38.0	35.0
Redds Per Mile in all Areas	4.5	2.5	H W.	H W	4.5	H W.	3.4	3.6	4.4	6.1	5.7	7.7

Harvest not determined and not subtracted from estimates of spawners, 1988-1982. H. W. = high water.
Assumes that harvest steelhead were 50% females and 50% males. No adjustments made for hook and release mortality.
Index reaches are in Squaw, NF Meacham, Buckaroo, Camp, and Boston Canyon Creeks and the SF Umatilla River

Table 16. Smolt-to-adult survival, return rate, number of adults produced, out-of basin exploitation and in-basin exploitation for steelhead reared at Umatilla Hatchery and released in the Umatilla River, 1991-97 broods. Out-of-basin
data was downloaded from the central database in October 2001. Returns are incomplete for the 1997 brood.

Brood year	Race-way	Release date	Release[a] site	Release size (fish/lb)	No.[b] CWT recov-eries	Smolt-to-adult sur-vival (%)	Umatilla[c] River return (%)	No. adults pro-duced	Out-of-[d] basin exploit-ation(%)	In-[e] basin exploit-ation(%)
					Small - grade					
91	M5A	5/01/92	MC	5.5	3	0.030	0.030	20	0.0	0.0
92	M5A	5/13/93	BS	6.1	9	0.073	0.073	48	0.0	0.0
93	M5A	5/12/94	BS	5.2	3	0.036	0.031	19	15.8	31.6
94	M5A	5/12/95	BS	5.5	14	0.211	0.202	101	4.0	5.0
95	M5A	5/09/96	TH	5.1	10	0.129	0.129	64	0.0	0.0
96	M8A	5/15/97	BS	4.9	1	0.014	0.014	7	0.0	100
97	M8A	5/04/98	BS	5.5	10	0.167	0.167	79	0.0	15.2
				4.7	50	0.094	0.92	338	2.1	8.9
					Large - grade					
91	M5B	4/30/92	MC	5.0	2	0.020	0.000	13	100	0.0
92	M5B	4/16/93	MN	5.6	46	0.502	0.406	241	19.1	5.4
93	M5B	4/14/94	MN	5.1	36	0.710	0.520	352	26.1	12.5
94	M5B	4/13/95	MN	4.7	79	1.523	1.144	761	24.8	8.9
95	M5B	4/12/96	MN	5.1	50	0.711	0.650	338	8.6	10.9
96	M8B	4/11/97	MN	4.6	42	0.569	0.543	266	4.5	10.5
97	M8B	4/17/98	MN	4.7	27	0.454	0.397	223	12.6	7.2
				4.4	282	0.641	0.523	2,194	18.7	9.4
					Large - grade					
91	M5C	3/29/92	BS+MN	5.8	27	0.279	0.221	188	20.7	3.2
92	M5C	4/18/93	BS	4.5	67	0.665	0.562	298	15.4	7.1
93	M5C	4/11/94	BS	4.9	39	0.885	0.613	455	30.8	10.1
94	M5C	4/11/95	BS	5.6	59	1.051	0.890	510	15.3	7.1
95	M5C	4/24/96	BS	5.3	21	0.281	0.235	139	16.6	7.2
96	M8C	4/10/97	BS	5.4	22	0.322	0.308	134	4.5	9.0
97	M8C	4/16/98	BS	5.9	15	0.221	0.163	91	26.4	14.3
				4.7	250	0.529	0.427	1,815	19.6	7.9
	All broods and size grades:			4.6	582	0.422	0.348	4,347	17.8	8.7

[a] *MC = Meacham Creek near Bonifer Springs acclimation site, BS = Bonifer Springs acclimation site, TH = Thornhollow acclimation site, MN = Minthorn acclimation site.*
[b] *Number of coded-wire tags recovered.*
[c] *Return = number of fish counted at Three Mile Falls Dam plus harvest beolow Three Mile Falls Dam.*
[d] *Percent of adult production harvested outside of the Umatilla River basin.*
[e] *Percent of adult production harvested in the Umatilla River basin by non-tribal and tribal sport anglers*

Table 17
Summer Steelhead Annual Run Counts

Year	Hatchery	Wild	Total
1966-67		1778	1778
1967-68		930	930
1968-69		1917	1917
1969-70		2298	2298
1970-71			
1971-72			
1972-73		2057	2057
1973-74		2640	2640
1974-75		2171	2171
1975-76		2534	2534
1976-77		1258	1258
1977-78		3080	3080
1978-79			
1979-80		2367	2367
1980-81		1298	1298
1981-82		768	768
1982-83		1264	1264
1983-84		2314	2314
1984-85		3197	3197
1985-86		2885	2885
1986-87		3444	3444
1987-88	166	2316	2482
1988-89	371	2104	2475
1989-90	246	1422	1668
1990-91	387	725	1112
1991-92	523	2246	2769
1992-93	616	1297	1913
1993-94	345	945	1290
1994-95	656	875	1531
1995-96	785	1296	2081
1996-97	1463	1014	2477
1997-98	903	862	1765
1998-99	751	1135	1886
1999-00	739	2153	2892
2000-01	1089	2573	3662
2001-02	1860	3659	5519
2002-03	960	2120	3080

Table 18. The Number and Percent of Steelhead (STS) Available to Spawn Naturally that were of Hatchery Origin; Umatilla River, 1988-1999.

BROOD YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002
Percent Spawners of Hatchery Origin	6.9	15.4	7.3	27.3	13.6	26.1	21.1	39.6	34.3	58.9	49.7
Percent Females Spawners of Hatchery Origin	7.4	14.9			11.9	21.7	21.3	29.7	28.2	48.0	45.3

Harvest not estimated 1988-1992. 1993-1999, Harvest estimate subtracted from total, assumes harvest of 50% females and 50% males

No adjustments made for catch and release mortality.

Table 19. Age summary of natural summer steelhead from the Umatilla River.

Return Year		Age 1.1	Age 1.2	Age 2.1	Age 2.2	Age 2.3	Age 3.1	Age 3.2	Age 4.1	Total
1994	n=	0	2	24	26	0	5	6	0	63
	%=	0	3.2	38.1	41.3	0	7.9	9.5	0	100
1995	n=	0	0	19	17	0	9	11	0	56
	%	0	0	33.9	30.4	0	16.1	19.6	0	100
1996	n=	0	0	28	8	0	7	1	0	44
	%	0	0	63.6	18.2	0	15.9	2.3	0	100
1997	n=	0	0	19	17	0	5	10	0	51
	%	0	0	37.3	33.3	0	9.8	19.6	0	100
1998	n=	1	1	33	11	1	4	0	1	52
	%	1.9	1.9	63.5	21.2	1.9	7.7	0	1.9	100

Juvenile years of freshwater growth from scales of adult steelhead returning to the Umatilla River.

Return Year		Age 1	Age 2	Age 3	Age 4	Total
1994	n=	2	50	11	0	63
	%=	3.2	79.4	17.4	0	100
1995	n=	0	36	20	0	56
	%	0	64.3	35.7	0	100
1996	n=	0	36	8	0	44
	%	0	81.8	18.2	0	100
1997	n=	0	37	15	0	51
	%	0	70.6	29.4	0	100
1998	n=	2	45	4	1	52
	%	3.8	86.5	7.7	1.9	99.9

Table 20. Life History table of steelhead

Mouth of the Umatilla to the mouth of McKay Creek (RM 0-50.5)

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding												
Spawning												
Incubation												
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x	x		

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Mouth of McKay Creek to the mouth of Meacham Creek (RM 50.5-79) and mid-basin streams

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

Mouth of Meacham Creek to the forks (RM 79-89 and headwater streams)

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

2004 DRAFT

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Umatilla River Fall Chinook
Species or Hatchery Stock:	Umatilla River Fall Chinook stock 091
Agency/Operator:	Oregon Department of Fish & Wildlife/ Confederated Tribes of the Umatilla Indian Reservation
Watershed and Region:	Umatilla/Columbia/Oregon
Date Submitted:	2004
Date Last Updated:	May 13, 2004

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program. Umatilla River Fall Chinook Program

1.2) Species and population (or stock) under propagation, and ESA status.
Fall Chinook (Oncorhynchus tshawytscha) Upriver Bright (stock 091).

1.3) Responsible organization and individuals

Name (and title): Scott Patterson – Hatchery Coordinator
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 107 Twentieth Street, La Grande, OR 97850
Telephone: 541-963-2138
Fax: 541-963-6670
Email: Scott.D.Patterson@state.or.us

Name (and title): Gary James – Fisheries Program Manager
Agency or Tribe: Confederated Tribes of the Umatilla Indian Reservation
Address: P.O. Box 638, Pendleton, OR 97801
Telephone: 541-276-4109
Fax: 541-276-4348
Email: garyjames@ctuir.com

Name (and title): Tim Bailey – District Fish Biologist
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 73471 Mytinger Lane, Pendleton, OR 97801
Telephone: 541-276-2344
Fax: 541-276-4414
Email: umatfish@oregontrail.net

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

1. *Confederated Tribes of the Umatilla Indian Reservation* – Co-managers – Operators of acclimation and adult collection facilities.
2. *Bonneville Power Administration* – Funding for– Hatchery, acclimation, adult collection and monitoring and evaluation.
3. *Washington Department of Fish & Wildlife Priest Rapids Hatchery*—Broodstock and egg source for sub-yearling program.

1.4) Funding source, staffing level, and annual hatchery program operational costs

Umatilla Hatchery is 100% funded by the Bonneville Power Administration. Oregon Department of Fish & Wildlife operates the facility, and staff consists of one F&W Manager 1, one F&W Technician 2, four F&W Technician 1's, one Trades/Maintenance Worker 2, one half-time F&W Technician 1, and one Trades/Maintenance Worker 1. Fiscal Year 2004 Umatilla Hatchery operations budget is $817,305

1.5) Location(s) of hatchery and associated facilities.

Adult Collection-- Fall chinook broodstock are collected at the Three Mile Falls Dam adult trapping facility and Priest Rapids Hatchery. The Threemile Dam facility is located approximately 4 miles upstream from the mouth of the Umatilla River, near the town of Umatilla, in Umatilla County, Oregon. The regional mark processing center site code for Three Mile Falls Dam is 5F33427 H27 24. The Priest Rapids Hatchery is located on the Columbia River at RM----, County, Washington.

Holding and Spawning-- Fall chinook collected at Three Mile Dam are held and spawned at the Three Mile holding and spawning facility. Adults collected at Priest Rapids are held and spawned on site.

Incubation and rearing (sub-yearling program)-- Eyed eggs are transferred from Priest Rapids Hatchery, to Umatilla Hatchery for incubation and rearing. Egg source priorities for Umatilla Hatchery sub-yearling program are: Priest Rapids, Bonneville and Little White Salmon hatcheries.
Incubation (Umatilla Hatchery-Yearling Program)—Eggs are incubated at Umatilla Hatchery until the eyed stage, and then transferred to Bonneville hatchery for final incubation and rearing. Umatilla Hatchery is located along the Columbia River approximately two miles west of Irrigon in Morrow County, Oregon. The regional mark processing center site code for Umatilla Hatchery is 5F33449 H49
Final Incubation and Rearing (Bonneville Hatchery-Yearling Program)—Eyed eggs are received from Umatilla Hatchery. Egg source priorities for Bonneville hatchery will be in the preceding order: Three Mile Falls Dam, Bonneville and Little White Salmon hatcheries. Bonneville Hatchery is located on Tanner Creek near its confluence with the Columbia River at Bonneville Dam in Multnomah County, Oregon.

Acclimation to release: Yearling fall chinook from Bonneville hatchery will be transferred and released from the Thornhollow acclimation facility (RM 73.5). Two groups of 150,000 sub-yearling fall chinook from Umatilla hatchery will be transferred to Thornhollow for acclimation and release. Two groups of 150,000 sub-yearling fall chinook from Umatilla hatchery will be released directly into the Umatilla River at Reith (RM 48).

1.7) Type of program.

Re-introduction of Fall Chinook to the Umatilla River.

1.7) Purpose (Goal) of program.

The primary goal of the Umatilla River fall chinook program is to reintroduce fall chinook for harvest in the Umatilla River while rebuilding and maintaining adequate hatchery and natural production.

1.8) Justification for the program.

Fall chinook were extirpated for the Umatilla river in the early 1900's. Reintroduction of fall chinook is intended to provide harvest opportunities while rebuilding and maintaining adequate hatchery and natural production.

1.9) List of program "Performance Standards"

The Performance Standards for the program are currently under revision in the Sub-Basin planning process and will submitted when the process is completed

1.12) List of program "Performance Indicators", designated by "benefits" and "risks"

The Performance Indicators for the program are currently under revision in the Sub-Basin planning process and will submitted when the process is completed

1.10.1) "Performance Indicators" addressing benefits.

1.10.2) "Performance Indicators" addressing risks.

1.13) Expected size of program.

The Umatilla Hatchery Master Plan goal for the Umatilla River was to produce 10,000 hatchery and 11,000 naturally returning fall chinook adults annually. Currently the goal of the program is produce 1.08 million juveniles annually, the production is divided in two programs. The yearling program consists of 480,000 smolts, which are produced at Bonneville Hatchery and the sub-yearlings program consisting of 600,000 smolts, which are produced at Umatilla Hatchery.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

Broodstock needs for the Bonneville hatchery yearling production is 190 females, 190 male and 19 jacks, and will be collected at Three Mile Dam. Broodstock priorities for the Umatilla hatchery sub-yearling program will be in the preceding order: Priest Rapids, Bonneville and Little White Salmon hatcheries. The collecting hatchery will spawn approximately 220 females to provide Umatilla hatchery with 670,000 eyed eggs.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and

location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		0
Unfed Fry		0
Fry		0
Fingerling	Thornhollow(RM73.5)	300,000
	Reith(RM48)	300,000
Yearling	Thornhollow (RM73.5)	480,000

1.14) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

- *Estimated smolt-to-adult survival*--Master Plan goal for the program is 0.3% for the subyearlings and 0.75% for the yearlings. The average smolt-to-adult survival of the Umatilla yearling and subyearling program has ranged from 0.001% to 0.149% (Tables 1&2).

- **Total adult production--** ***The Master Plan goal for fall chinook hatchery return was 10,000. Since 1992, hatchery adult returns to Three Mile Falls Dam have ranged from 6028 to 303, and averaged 2052 (Table 3).***

1.15) Date program started (years in operation), or is expected to start.

The first release of fall chinook in the Umatilla River took place in 1982 using Tule stock, since that time only upriver bright fall chinook stock has been released. The current program of releasing 1.08 million juveniles was started in 2001 (table 4).

1.16) Expected duration of program.

This is an on-going program.

1.17) Watersheds targeted by program.

The Umatilla Fall Chinook Program targets the Umatilla River sub-basin.

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

Managers are currently reassessing hatchery performance goals in the subbasin planning process. When this process is completed, the revised goals and alternative actions will be submitted.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

4d rule research permit applications have been submitted to NMFS for the following: Umatilla River Juvenile Salmonid out migration and survival studies; permit #OR2004-1408

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

:

Adult age class structure: See table 18
Sex ratio: See table 15
Size range:
Migrational timing: See table 20
Spawning range:
Spawn timing: See table 20
Juvenile life history strategy, including smolt emigration timing: See table 20

Identify the ESA-listed population(s) that will be directly affected by the program.

None.

Identify the ESA-listed population(s) that may be incidentally affected by the program.

Umatilla River Summer Steelhead (stock 091) – included as part of the Mid-Columbia ESU - listed as “Threatened” under the federal ESA.
Umatilla River bull trout are included as part of the Columbia distinct population segment listed as Threatened under the federal ESA.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

Describe the status of the listed natural population(s) relative to “critical” and “viable” population thresholds.

Chilcote (Unpublished draft) identifies the wild Umatilla summer steelhead critical population threshold at 110, and the viable population threshold at 333. Since 1988, wild adults available for spawning has exceeded 600 (see Table15).

The U.S Fish and Wildlife Service bull trout recovery plan for the Umatilla/Walla Walla Recovery Unit (2002) list recovery criteria for the Umatilla River. Recovery criteria for the Umatilla River core area are to maintain 500 to 1,000 spawning adults annually for at least two generations(i.e.,10 to 14 years) The redd count average for the last four years(1999-2002)in the North Fork Umatilla River equates to a population estimate of 281 spawning adults.

Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

The progeny to parent ratio for natural spawning hatchery and natural steelhead compared to Umatilla hatchery steelhead from 1990 through 1999 is presented in Table17. The progeny to parent ratio of natural spawning hatchery and natural steelhead has been below replacement in eight of the last ten years. In contrast, hatchery progeny to parent ratio was above one for all of the last ten years.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

The number and percent of adult steelhead available to spawn of wild and hatchery origin since 1988 is presented in Table 6. Total natural adult return numbers to Three Falls Mile Dam have ranged from 725 in 1990-91 to 3,659 in 2001-02 (Table 16).

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

The percent of adults available to spawn that were of hatchery origin has ranged from 6.9% of the total run in 1988, to a high of 58.9% in 1997 with a mean of 27.2% (1988-1998; Table 21).

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

The Umatilla Summer Steelhead program currently collects 100 unmarked steelhead to provide the egg needs for the hatchery program .

Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Table 22 provides the numbers of Umatilla summer steelhead collected and spawned for broodstock needs for the program.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

- Outmigration and Survival Study - As per the 4d rule research application; we will reduce numbers collected by adjusting the sample times and avoid sampling when large numbers of natural steelhead are passing through the sampling facility. To reduce the number of mortalities from fish jumping out of the sample tank or from other areas, we will apply covers and screens to prevent escape and monitor the facility closely. Monitoring information is mostly obtained through remote interrogation of tags, without any handling.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

3.5) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

1) CTUIR. 1994. Wildlife Mitigation Plan (Draft) May 1996, Columbia Basin Salmon Policy. 1995 pg 9-10, and Water Assessment Report;
2) NMFS - Salmon & Steelhead Enhancement Plan for the Washington and Columbia River Conservation areas.Vol 1. chpt 4, 37pgs;
3) Reeve, R. 1988. Umatilla River Drainage Anadromous Fish Habitat Improvement Plan; 4)CTUIR/ODFW. 1990. Umatilla Hatchery Master Plan;
5) OWRD. 1988. Umatilla Basin Report;
6) BOR. 1988. Umatilla basin Project Planning Report,
7) Umatilla County - Comprehensive Plan. 1983, chpt 8;
8) USNF - Umatilla National Forest Land & Resource Management Plan. 1990, chpt 2, pg 13. and Final EIS. 1990, chpt III, pgs 59-62;
9) CTUIR/ODFW. 1990. Umatilla River Subbasin Salmon and Steelhead Production Plan;
10) Boyce, R. 1986. A Comprehensive Plan for Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin; 11)USFWS & NMFS. 1982. Umatilla R. Planning Aid Report.
11) USBR and BPA. 1989. Umatilla Basin Project. Initial project workplan presented to the NWPPC, May 1989.

This HGMP is consistent with these plans and commitments.

3.6) Relationship to harvest objectives.

State and tribal comanagers as part of the Umatilla Hatchery Master Plan developed fall chinook harvest guidelines. Harvest guidelines are designed to support the rebuilding of the fall chinook run, support the monitoring and evaluation program, be consistent with Indian treaty fishing rights. The fall chinook fishery in the lower Umatilla has been limited to a jack only bag limit, due to low adult returns. The fall chinook program primarily contributes to ocean and Columbia River fisheries.

3.3.2 Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available**.**

The fall chinook fishery in the lower Umatilla has been limited to a jack only bag limit, due to low adult returns. The fall chinook program primarily contributes to ocean and Columbia River fisheries. Releases of fall chinook smolts in the Umatilla River contributed an average of 750 fish annually to fisheries from 1993 to 2000. Mean annual fishery contributions were considerably higher (8,872 fish/yr.) from 1985-1992. (Tables 1&2)

3.7) Relationship to habitat protection and recovery strategies.

The Umatilla Fall Chinook Program is a part of an overall Umatilla Basin Salmon and Steelhead Restoration Program. In addition to on-going passage and hatchery operations, restoration efforts include ongoing projects that enhance stream and riparian habitat as well as monitor and evaluate the hatchery and natural components of the restoration program.

Factors limiting the natural production of fall chinook in the Umatilla River Basin include channelization, low or no summer flows, warm water temperatures, sediment, and poor habitat diversity caused by urban and rural development/land management practices. Ocean conditions and the mortalities and stress from the operation of hydropower projects on the mainstem Columbia River are important factors outside the basin. There continues to be degradation to fish habitat in these areas that hampers improvement efforts.

3.6) Ecological interactions.

- Interactions with species that could negatively impact program: a) bird predation during peak smolt migration periods each spring; and b) Northern Pikeminnow and smallmouth bass - predation during smolt migration periods.

- Interactions with species that could positively impact program: Carcasses from fall chinook add to the Umatilla River subbasin's nutrient recharge cycle. Increased angler effort in the fall Chinook salmon fisheries increases awareness of the Umatilla steelhead program which could potentially lead to increased harvest of hatchery steelhead.

- Interactions with species that could be positively impacted by program: Hatchery fall chinook smolts could add to the food base for bull trout.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Umatilla Hatchery--The water source for the Umatilla Hatchery comes from the Columbia River through a Ranney well system, and for separate wells. The system was initially designed and constructed to produce a maximum of 15,000 gpm of water. However, actual water capacity at UH is 5,500 gpm, and several wells have been subject to failure (Jack Hurst, ODFW, Umatilla Hatchery) Water from the well system averages 12.2°C (54°F). Water quality exceeds BPA requirements (BPA 1987) for all hatchery uses.

Water is withdrawn under certificate #72181, permit G 10870, and, certificate #72182, permit #G 11210. Water discharged is monitored under the general NPDES 0300 J permits.

Three Mile Falls Dam-- The water source for the Three Mile Falls Dam adult facility is pumped directly from the Umatilla River. The Denil steep-pass utilizes 2,900 gpm and the holding pond uses 1,450 gpm. Both the steep-pass and holding pond pumps run continuously. The fish lock system uses 630 gpm, but is used only during handling operations (approximately two hours per day). The water source is the same as used by the natural population.

Water temperatures at Three Mile Falls Dam range from approximately 0°C (32°F) in winter to over 21°C (70°F) during the summer. Sediment loads vary dramatically during the return season (late August through early June) and during the migration season (March – July). High sediment loads are experienced annually during high flow conditions.

Bonneville Hatchery--The facility has water rights to 50 CFS of water from Tanner Cr. Water quality is high. Temperatures range from 32 to 55 degrees, September recording the highest temperature and February the lowest.

Limitations are as follows; Tanner Cr. water is dependent on rainfall and snow pack which effects water temperature and available CFS. During high water adult salmon and steelhead can pass above the Tanner Cr. intake to spawn. These fish have been known to carry IHN and have infected programs at Bonneville. Tanner Cr. location subjects itself to very cold weather which results in minus 32 degree temperatures and intake problems resulting from anchor ice and slush build up and potential loss of flow.

A secondary source of water for Bonneville hatchery is a well field located on Robbins Island within the confines of the Bonneville Dam / Corp of Engineers Project. Originally seven wells operated to produce 18,000 GPM. In recent years the well field has become depleted and now can only produce approximately 14,000 GPM. Plans are in effect for funding and surveys to resurrect these wells.

Bonneville Hatchery operates under NPDES permit # 300J which allows treated discharge from aquatic animal facilities which produce at least 20,000 pounds of fish per year, but have less than 300,000 pounds on hand at anyone time.

Bonneville Hatchery intake at this time is not NOAA fisheries screen compliant, but Oregon Dept. Fish and wildlife Fish Passage and Screening section is currently reviewing the work necessary to bring it into compliance.

Priest Rapids Hatchery --

Thornhollow Acclimation-- Water for the Thornhollow facility is pumped directly from the Umatilla River. Flows are held constant at approximately 1,600 gpm per each of two acclimation ponds. During the juvenile acclimation period (mid-February to late May), average monthly temperatures range from approximately 3.6 to 6.7 C (38.5 to 44^{o}F).

Natural Production-- Natural spawners use the water available in the streams of the

Umatilla River Basin. Water quality is relatively high in the headwater streams where steelhead spawn and rear. The spawning streams contrast greatly to the lower Umatilla River and lower tributaries where sediment loads are high in the spring and summer water temperatures are often lethal to Salmonid's (Contor et al. 1998). Water quality in this desert basin contrasts to the hatchery, as there are often large daily fluctuations in water temperature. During the winter and spring, rain-on-snow events interspersed with cold periods often produce large fluctuations in stream flow. During spawning and incubation, the streams are often high and turbid.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Umatilla Hatchery-- Umatilla Hatchery uses 100% well water, and operates under DEQ NPDES discharge permit # 300 J.

Bonneville Hatchery --Intake at this time is not NOAA fisheries screen compliant, but Oregon Dept. Fish and wildlife Fish Passage and Screening section is currently reviewing the work necessary to bring it into compliance. Bonneville Hatchery operates under DEQ NPDES discharge permit # 300 J.

Thornhollow Acclimation— Acclimation facility intake screens conform to NMFS screening guidelines to minimize the risk of entrainment of juvenile listed fish.

Priest Rapids Hatchery--

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Three Mile Falls Dam--Broodstock collection is conducted solely at the Three Mile Falls Dam east bank adult trapping facility. The facility consists of a vertical slot fish ladder, Denil steeppass, adult holding pond (raceway), and fish handling and sorting complex. The construction and operation of the facility has no effect on the critical habitat for summer steelhead. The dimensions of the holding pond are 14' wide by 36' long by 3.5' deep (approximately 1,800 cubic feet). The holding pond has a jump screen located at the upper end and jumpout panels located at both upper corners to prevent adults from jumping out of the pond. The holding pond is located above the 100 year flood level. The water supply for the holding pond is pumped directly from the Umatilla River at a rate of 1,450 gpm. A low water discharge alarm is located on the pond supply line to signal any loss of flow to the holding pond. No backup pumps or emergency generator system are located at the site. In case of water loss to the pond, two options are available to on-site personnel. During power outages or other short term losses of flow, the outlet gate from the pond can be closed to maintain water depth. For pump failures or other long term losses of water supply, adults can be dip netted out of the pond and returned to the river.

Priest Rapids Hatchery--

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Priest Rapids Hatchery--

Three Mile Falls Dam--None used, fish held on site for spawning.

5.3) Broodstock holding and spawning facilities.

Priest Rapids Hatchery--

Three Mile Falls Dam-- Since 1997, all fall chinook spawning for the yearling program has occurred at Three Mile Dam. The facility includes a water intake system with automatic screen cleaning, pump station having a nominal pumping capacity of 8,000 gpm, six adult holding ponds, (each 90 x 10 x 5 foot effective water depth; 4,500 ft^3), mechanical fish crowder, visitor facilities including restrooms, standby generator, chemical storage, bunkhouse and spawning buildings. The bunkhouse includes two bunkrooms, kitchen area, office space, conference room, shop, and restrooms. The spawning building includes a fish lift, electroshock anesthesia system, sorting and spawning facilities, wet and dry storage rooms, walk-in cooler/freezer, and restroom.

5.4) Incubation facilities.

Umatilla Hatchery—Green eggs are transported from Three Mile dam, in five-gallon buckets with chilled water, and eyed eggs from Priest Rapids hatchery in mesh bags with ice. Umatilla hatchery incubation equipment consists of four separate units of Marisource incubators (Heath tray type). Water can be used directly from wells or mixed with chilled water. Three units can be supplied with well water at 12.2°C (54°F) or mixed with chilled water 7.2°C (45° F) for any combination of temperatures from 7.2-12.2°C (45-54° F) provided that 300 gpm of chilled water is not exceeded. The fourth unit can be mixed with water chilled to 3.3°C (38° F) to achieve any combination of temperatures from 3.3-12.2°C (38–54° F) provided that 60 gpm of chilled water is not exceeded. Numerous systems continually monitor temperature, mechanical systems, electrical systems, and flow. Alarms sound if any system fails or is out of criteria. Continual monitoring of systems and preventative maintenance is used to prevent system failure. An emergency gas powered pump installed in the aeration tower structure supplies water for incubation in the event of aeration lift pump failure. In the event of total system failure resulting in total loss of water, eggs may be transported to Irrigon hatchery (if they are still operational and have necessary space).

Pathogen free water is used for incubation at Umatilla Hatchery for all programs. This is a direct preventive measure at minimizing the risk of introducing pathogens into the hatchery program, thus minimizing the risks to fish in the natural environment after these fish are released. Sanitary measures are taken at Umatilla Hatchery to prevent transmission of pathogens from one stock to another by disinfecting equipment in Iodophor.

Bonneville Hatchery-- Incubation facilities consist of 8 rows of 19 double heath vertical incubators / 16 trays using 4 gpm of well water.

Priest Rapids Hatchery--

5.5) Rearing facilities.

Umatilla Hatchery-- Umatilla Hatchery has three different types of rearing units. There are eight 21' Canadian style early rearing tanks located in the main building adjacent to incubation. Water is pumped to the aeration tower and gravity fed to the tanks. Fall Chinook Subyearlings are started in one Oregon pond. Umatilla Hatchery has 10 Oregon ponds. Rearing dimensions are 91'X18.75'X3.67'. These ponds are designed for serial reuse in-groups of 2 ponds, upper and lower. They also can be supplied with fresh water individually, if necessary. When densities reach 3,000 pounds these fish are split into two Oregon ponds, just prior to tagging operations. These fish will then be 100% tagged and marked into four equally sized groups, into four Oregon Ponds. Umatilla Hatchery has 24 Michigan style ponds, with rearing dimensions of 91'X9'X2.75'. Water is supplied to these ponds in reuse groups of three ponds each. Each pond has a submersible pump that supplies 950 gpm of water to oxygen contact columns, located at the head of each pond. Oxygen is introduced and unwanted saturated gas is removed from incoming water at this point. Each pond has its own oxygen supply line. Supplemental oxygen is either delivered from oxygen generators, (pressure swing absorption units) or from a bulk liquid tank on site. Chinook can also be reared in these ponds if optimization of water use is necessary.

All ponds have a high-low water level alarm, and for Michigan ponds, pump failure and oxygen flow alarms. In the event of total system failure, fish could be moved to nearby Irrigon Hatchery if pond space is available and all logistics were in place prior to the time of failure. Monitoring and maintenance of the water supply system, and forecasting for contingencies, are the best means for dealing with the possibility of rearing pond system failure.

Pathogen free water is used for rearing the fish at the Umatilla Hatchery for all production. This is a direct preventive measure at minimizing the risk of introducing pathogens into hatchery phase of this program, thus minimizing the risks to fish in the natural environment after these fish are released. Sanitary measures are taken at Umatilla Hatchery to prevent transmission of pathogens from one stock to another by disinfecting equipment in Iodophor. In addition, a fish health program is in place to monitor and evaluate the health status of Fall Chinook juveniles reared at Umatilla Hatchery.

Bonneville Hatchery--Early rearing occurs in modified Burrows concrete ponds (75' x 16.8 x 30") supplied with well water, Fingerlings are then moved to Standard raceways (80'x 20 x 30") and reared on Tanner Cr. water in 10 concrete ponds.

5.6) Acclimation/release facilities.

Thornhollow— The Thornhollow acclimation/release facility includes a water intake structure with automatic screen cleaner, pump station, standby generator, water headbox/distribution system, storage building, two acclimation ponds (approximately 13,000 cubic feet each) and water outlet and fish release structure. Water is supplied by gravity flow to the pump station where it is pumped into the headbox. From here, water is supplied to the ponds by gravity at approximately 1,600 gpm per pond. The ponds are covered with netting to prevent bird predation. In case of power failure, or low water level alarm, a phone dialer will begin calling four telephone numbers repeatedly until someone acknowledges the alarm. Fish are released from the facility by pulling the pond outlet screen and dam boards, lowering the pond, and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way. The ponds are thoroughly cleaned prior to fish being received, and ODFW pathology personnel are available to address disease concerns.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Umatilla Hatchery—There has been no significant fish loss.

Bonneville Hatchery-- There has been no significant fish loss.

Thornhollow-- There has been no significant fish loss.

Three Mile Facility -- There has been no significant fish loss.

Minthorn Acclimation-- In 1986, one group of fall chinook juveniles was acclimated at Minthorn from July through October. This group suffered significant losses (~78%) due to disease (Columnaris) and pump failure. In 1988, another group of fall chinook was acclimated at Minthorn from September through November. This group also suffered significant juvenile losses (~82%) due to disease (Ich). Since 1988, there have been no significant fish losses.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Umatilla Hatchery--This is covered in section 5.5

Bonneville Hatchery--The hatchery will be staffed full-time, 24 hrs a day, 365 days a year, and equipped with low water alarm system to help prevent catastrophic fish loss resulting from water system failure.

Three Mile Dam --Since 1997, all fall chinook spawning for the yearling program has occurred at Three Mile Dam. The facility includes a water intake system with automatic screen cleaning, pump station having a nominal pumping capacity of 8,000 gpm, six adult holding ponds, standby generator, and bunkhouse building for night watch personnel. In the event of power failure, an audio alarm will sound; the standby generator will start automatically, and in turn, the primary pump will restart. If for some reason the primary pump does not start or fails for any reason, one of two backup pumps will start automatically. In addition, a low water level alarm in the water distribution headbox will sound in case of low flow. The audio alarm will alert the facility night watch personnel who will respond to the emergency. If one of the pumps will not run, the effluent standpipes to the individual ponds can be quickly raised, maintaining existing water levels in the ponds. This will keep the fish alive for a period of time. The project leader, maintenance supervisor, and technicians are also on call 24 hours per day for emergency response.

Thornhollow Acclimation --The Thornhollow acclimation/release facility includes a water intake structure with automatic screen cleaner, pump station, standby generator, water headbox/distribution system, and two acclimation ponds. Water is supplied by gravity flow to the pump station where it is pumped into the headbox. From here, water is supplied to the ponds by gravity at approximately 1,600 gpm per pond. The ponds are covered with netting to prevent bird predation. In case of power failure, or low water level alarm, a phone dialer will begin calling four telephone numbers repeatedly until someone acknowledges the alarm. Fish are released from the facility by pulling the pond outlet screen and dam boards, lowering the pond, and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

List all historical sources of broodstock for the program. Be specific (e.g., natural spawners from Bear Creek, fish returning to the Loon Creek Hatchery trap, etc.).

Umatilla --

Priest Rapids Hatchery--

6.2) Supporting information.

6.2.1) History.

Umatilla—

Priest Rapids Hatchery--

Provide a brief narrative history of the broodstock sources. For listed natural populations, specify its status relative to critical and viable population thresholds (use section 2.2.2 if appropriate). For existing hatchery stocks, include information on how and when they were founded, sources of broodstock since founding, and any purposeful or inadvertent selection applied that changed characteristics of the founding broodstock.

6.2.2) Annual size.

Umatilla—

Priest Rapids Hatchery--

Provide estimates of the proportion of the natural population that will be collected for broodstock. Specify number of each sex, or total number and sex ratio, if known. For broodstocks originating from natural populations, explain how their use will affect their population status relative to critical and viable thresholds.

6.2.3) Past and proposed level of natural fish in broodstock.

Umatilla—

Priest Rapids Hatchery--

If using an existing hatchery stock, include specific information on how many natural fish were incorporated into the broodstock annually.

6.2.4) Genetic or ecological differences.

Umatilla—

Priest Rapids Hatchery--

Describe any known genotypic, phenotypic, or behavioral differences between current or proposed hatchery stocks and natural stocks in the target area.

6.2.5) Reasons for choosing.

Umatilla—

Priest Rapids Hatchery--

Describe any special traits or characteristics for which broodstock was selected.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Umatilla River--Adults are being monitored for hatchery marked versus unmarked hatchery/wild abundance. Brood Year 2003 proposed trapping rate of 100% of the return, up to December 1, or until 380 adults are captured.

Priest Rapids Hatchery--

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Umatilla River—Adults

Priest Rapids Hatchery--Adults

7.2) Collection or sampling design.

Umatilla--Preston??

Priest Rapids Hatchery--

Include information on the location, time, and method of capture (e.g. weir trap, beach seine, etc.) Describe capture efficiency and measures to reduce sources of bias that could lead to a non-representative sample of the desired broodstock source.

7.3) Identity.

Umatilla--Adults

Priest Rapids Hatchery--

Describe method for identifying (a) target population if more than one population may be present; and (b) hatchery origin fish from naturally spawned fish.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

The number of fall chinook broodstock collected for holding/spawning at Three Mile Dam since 1996 has varied from 199 in 1998 to 603 in 2000 (Table 9). The collection goal for 2003 was 380 adults (190 pairs), and 19 jacks. The collection goal in following years is anticipated to be similar.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults			Eggs	Juveniles
	Females	Males	Jacks		
1996	272	267	25	778,028	unknown
1997	186	102	11	641,861	unknown
1998	90	93	16	257,311	unknown
1999	246	189	29	541,821	401,900
2000	290	269	44	1,081,481	unknown
2001	213	246	27	732,205	509,816
2002	262	263	34	678,122	477,306
2003	195	196	18	681,595	unknown

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

??

7.6) Fish transportation and holding methods.

Three mile Dam—No transportation occurs.

Priest Rapids Hatchery-- No transportation occurs.

7.7) Describe fish health maintenance and sanitation procedures applied.

Three Mile Dam --Collection--Adults retained for broodstock are injected with

oxytetracycline (10mg/kg) and erythromycin (20mg/Kg) at the collection site (Three Mile Dam).
Holding--At Three Mile Dam adult facility, hydrogen peroxide is dripped into the inflowing water to achieve a maximum concentration of 100 ppm. The treatment is applied for one hour to control fungus and parasites three times per week.

Priest Rapids Hatchery--

7.8) Disposition of carcasses.

Three Mile Dam--

Priest Rapids Hatchery--

Include information for spawned and unspawned carcasses, sale or other disposal methods, and use for stream reseeding.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Three Mile Dam--

Priest Rapids Hatchery--

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Three Mile Dam--

Priest Rapids Hatchery--

Specify how spawners are chosen (e.g. randomly over whole run, randomly from ripe fish on a certain day, selectively chosen, or prioritized based on hatchery or natural origin).

8.2) Males.

Three Mile Dam--

Priest Rapids Hatchery--

Specify expected use of backup males, precocious males (jacks), and repeat spawners.

8.3) Fertilization.

Three Mile Dam—Spawning is accomplished by mating at sex ratio's 1:1.

Priest Rapids Hatchery--

8.4) Cryopreserved gametes.

Three Mile Dam—None used

Priest Rapids Hatchery—None used

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Three Mile Dam--

Priest Rapids Hatchery--

(*e.g. "A factorial mating scheme will be applied to reduce the risk of loss of within population genetic diversity for the small chum salmon population that is the subject of this supplementation program"*.).

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Table 9.1.1. Egg take and survival of Fall Chinook taken from Three Mile Holding Facility (Umatilla R. Stock) and reared @ Bonneville. Brood Years 97-98 & 2001-2003

Brood Year	Number Eggs taken	Green / Eyed Survival %	Eyed/Smolt Survival %
1997	515,281	70	
1998	256,511	69	
a.			
2000	1,081,481	71	*b.*
2001	716,549	82	
2002	678,122	75	

a. Egg's were shipped green to Bonneville in BY 1999.
b. 171,000 fry incorporated in Umatilla hatchery sub-yearling program.

9.1.2) Cause for, and disposition of surplus egg takes.

Three Mile Dam Holding/Spawning—In brood year 2000, excess adults were captured and spawned, resulting in 171,000 being incorporated in Umatilla Hatchery sub-yearling program.

Priest Rapids Hatchery—There are no surpluses, eyed eggs are shipped to Umatilla Hatchery.

9.1.3) Loading densities applied during incubation.

Umatilla Hatchery-- *Umatilla Hatchery*--Hatchery incubation consists of four isolated units or sections of Marisource (Heath tray type) incubators as described in section 5.4.1 Loading densities do not exceed 8,000 eggs/tray green, and 7,300 eggs/tray eyed stage.

Bonneville Hatchery-- Eggs are received from Umatilla hatchery eyed; they are put down 5500 eggs per Marisource (Heath) tray with 4 gpm flow.

9.1.4) Incubation conditions.

Umatilla Hatchery-- Oxygen saturation levels average 10 ppm influent and 9 ppm effluent. Water flows are regulated to a minimum of 4 gal. /min, with individual egg take temperatures ranging from 38^0F to 54^0F.

Bonneville Hatchery-- As eggs incubate they are visually monitored until hatching begins, at this time the tray lids are lightly brushed each day to clear dissolving shell. Eggs are incubated in 50 degree well water, with a running total of TU's recorded daily. DO's and silt management is of no concern.

9.1.4.5) Egg Transfers

Umatilla Hatchery—Transfer of eyed eggs to Bonneville Hatchery for the Yearling program, occurs in early January. Transfer is done with Burlap and egg baskets @ 21K/basket.

9.1.5) Ponding.

Umatilla Hatchery—Fall Chinook are ponded mid-February at 1,850 temperature units @ approximately 1,000 fish to the pound, and 100% button-up. (Section 5.5)

Bonneville Hatchery-- Ponding is considered when the fry accumulate between 1800 – 1850 temperature units. At this time a sample of fry is removed from individual trays and viewed under light to determine degree of button up. Degree of button up desired is 99.9%.

9.1.6) Fish health maintenance and monitoring.

Umatilla Hatchery--Eggs brought to Umatilla Hatchery are disinfected in 75 ppm iodophor for 15 minutes. Fungus is controlled with formalin treatments at a concentration of 1,667 ppm (1:600). Treatments are scheduled seven times per week for 15 minutes. Little mortality has been attributed to yolk-sac malformation. After eyeing, dead eggs are hand picked.

Bonneville Hatchery-- Upon arrival, eyed eggs are disinfected in an Argentyne bath at 1/600. No subsequent treatments are performed. Eggs are visually checked for fungus growth activity or other problems that may occur as they complete the incubation process. Before ponding fry are picked to removed dead eggs and malformed fry, loss is enumerated.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Umatilla Hatchery--Eggs will be incubated using well water only to minimize the risk of catastrophic loss due to siltation.

Bonneville Hatchery--Each year incubation trays are inspected, and then repaired to prevent any loss of fry into the water way due to equipment failure.

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.

Table 9.2.1.1 Egg take and survival of Priest Rapids Stock for Umatilla Hatchery Sub-yearling program Fall Chinook (brood years 1997-2002) reared at Umatilla Hatchery during 1998-2003.

Brood Year	Number of eggs taken or received	Egg-to-fry survival (%)	Egg-to-smolt survival[a] (%)
1997	3,847,000	82	69
1998	3,400,000	59	54
1999	4,380,000	72	69
2000	1,268,120 [b]	55	44
2001	670,000 [c]	93	93
2002	670,000 [c]	90	93

[a] *Survival estimate is based on eyed egg-to-smolt stage.*
[b] Total includes 205,000 eyed eggs received.

[c] Eyed Eggs received

Table 9.2.1.2 Bonneville reared Umatilla river stock hatchery survival rates.

Brood Yr.	# / Ponded	Fry to Fingerling	Fingerling Smolt
1997	475,000	N/A	N/A
1998	538,400	99.9	98.8
1999	542,000	99.7	98.5
2000	645625	99.9	87.0
2001	549,652	99.7	97.9
2002	499,549	99.4	93.0
2003	557,081	N/A	N/A

9.2.2) Density and loading criteria (goals and actual levels).

Umatilla Hatchery—Current sub-yearling production goals are to rear in Oregon style ponds with a final density of 0.5 pound/ft3, loading of 2.67 lbs/gpm, and exchange rates of 2.0X/hour.

Bonneville Hatchery—Loading goals for both Modified Burrows and Standard raceways is fry to fingerling--0 to 4 lbs per gpm inflow, and fingerling to smolt-- 6 to 8 lbs per gpm inflow

9.2.3) Fish rearing conditions

Umatilla Hatchery-- The current program is finally reared exclusively in Oregon style ponds. (Refer to section 5.5) Fish are fed at least once every hour by mechanical feeder. Ponds are cleaned once per week, with waste being flushed to settling ponds and water quality monitored under DEQ permit guidelines. Mortalities are removed once per day. Dissolved oxygen is monitored daily. Water flow rates are monitored weekly and range in temperature from 52^0F to 61^0F. Dissolved oxygen levels are maintained at or above 8ppm. Ammonia and total gas saturation levels have not been a problem. All of our monitoring is recorded as performed. (Table 5, 6 & 10)

Bonneville Hatchery-- After ponding, fry are monitored during feeding and cleaning activities. Mortality is removed daily and ponds cleaned up twice a week in the early stages and then once a week in later stages. Water flows are checked weekly. Fish per pound counts are checked once a week during early rearing, and ounce a month later stages. Water flows are adjusted accordingly (Table 11)

9.2.4) Indicate biweekly or monthly fish growth information (*average program*

***performance*), including length, weight, and condition factor data collected during rearing, if available.**

Umatilla Hatchery average growth for Fall Chinook Subyearlings (Brood year 2002)

Month	Fish/lb	Conversion
February	520	1.1
March	150	1.0
April	79	1.25
May	48	1.1

Bonneville Hatchery—Monthly growth rate for Umatilla stock Fall Chinook Yearlings.

Month	Fish/lb
March	625
April	300
May	150
June	85
July	50
August	35
September	28
October	20
November	17
December	13.5
January	12.5
February	11.5
March	10.5

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program erformance*), if available.

Umatilla Hatchery--Not available

Bonneville Hatchery—Not available

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Umatilla Hatchery--Fall Chinook are fed Bio-Oregon feed, starter, Bio-moist grower, and Bio-moist feed. Fish are fed hourly up to 12 times per day, by mechanical feeders at rates of 2.8%-6% body weight.

Bonneville Hatchery—Fall Chinook Yearlings are fed Bio-Oregon Bio-diet starter initially, with Silver Cup feeds fed for the remainder of their rearing. Fish are fed 4 to 8 times per day with conversions ranging fro 1.0 to 1.2 pounds feed /weight gain.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Umatilla Hatchery-- Monthly monitoring follows specific protocols in the Umatilla Fish Health Monitoring and Evaluation work statement. All raceways of each species and stock at Umatilla Hatchery are monitored monthly for pathogens and parasites. Five moribund or dead fish per raceway are tested for systemic and gill bacteria. Five Chinook per raceway are examined for *R. salmoninarum* by the DFAT or ELISA.
Other Infections - Juvenile fish are treated for bacterial infections if necessary with oxytetracycline under an Investigational New Animal Drug Permit (INAD).
Sanitation procedures - Statewide fish health management policy (September 12, 2003) provides guidelines for preventative and therapeutic fish health strategies that will be followed in this program.

Table 9.2.7 Disease history (1999-2003) of Priest Rapids fall chinook adults at Priest Rapids and juveniles reared at Umatilla Hatchery[a].

Disease or Organism	Adults	Juveniles
IHN Virus	No	No
EIBS Virus		No
Aeromonas salmonicida		No
Aeromonas/Pseudomonas		Yes
Flavobacterium psychrophilum		Yes
Fl. columnare	Yes	No
Renibacterium salmoninarum		Yes
Yersinia ruckeri		Yes
Carnobacterium sp.		No
Ichthyobodo		No
Gyrodactylus		No
Ichthyophthirius multifilis		No
Epistylis		No
Scyphidia		No
Trichodinids		No

Gill Copepods		No
Coagulated Yolk Disease		Yes
External Fungi	Yes	Yes
Internal Fungi		No
Myxobolus cerebralis	No	No
Ceratomyxa shasta		No

[a] "Yes" indicates detection of the pathogen but in many cases no disease or fish loss was associated with presence of the pathogen. "No" indicates the pathogen has not been detected in that stock.

Bonneville Hatchery-- While being reared at Bonneville the Umatilla Chinook program received monthly health exams performed by ODFW Pathology. During rearing the program receives two feedings of Aquamycin; in the Spring at 300 f/lb. and in the fall at 20 f/lb. Sanitation procedures prior to ponding, ponds are pressure washed and lightly disinfected with bleach. During the rearing period mortality is removed daily and ponds are cleaned weekly.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Umatilla Hatchery—Table 7 & 8

Bonneville Hatchery—Table 12 & 13

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

Umatilla Hatchery—None used

Bonneville Hatchery—None Used

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

Umatilla Hatchery— Fish will be reared to a size, and released at a time, to encourage out-migration. All fish will be marked 100%. Strict health monitoring, prevention, and treatment protocols will be used.

Bonneville Hatchery— Fish will be reared to a size, and released at a time, to encourage out-migration. All fish will be marked 100%. Strict health monitoring, prevention, and treatment protocols will be used.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Sub-Yearling (Umatilla Hatchery)	300,000	45	Late May	Thornhollow Acclimation
Sub-Yearling (Umatilla Hatchery)	300,000	35	Late May	Direct Stream release @ Reith Umatilla River Mile 48.
Yearling (Bonneville Hatchery)	480,000	10	Mid-April	Thornhollow Acclimation

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Umatilla River
Release point: Thornhollow Acclimation (RM 73.5)
Major watershed: Umatilla River
Basin or Region: Mid-Columbia River

Stream, river, or watercourse: Umatilla River
Release point: Reith Bridge (Rm48) – Direct Stream
Major watershed: Umatilla River
Basin or Region: Mid-Columbia River

10.2) Actual numbers and sizes of fish released by age class through the program.

Release year	Eggs/ Unfed Fry	Avg size	Fall Rel.	Avg size	Subyearling Spring Rel.	Avg size	Yearling	Avg size
1992					3,190,549	60.6	220,440	7.7
1993					2,659,598	63.0	134,837	9.1
1994					2,865,386	65.4	283,453	10.0
1995					2,466,298	63.5	227,088	8.0

Release year	Eggs/ Unfed Fry	Avg size	Fall Rel.	Avg size	Subyearling Spring Rel.	Avg size	Yearling	Avg size
1996					2,960,413	65.8	564,403	6.4
1997					2,580,833	72.1	519,921	10.0
1998					2,777,442	66.7	436,010	9.3
1999					1,842,666	55.9	449,568	9.2
2000					3,020,519	48.5	469,756	10.5
2001					646,996	38.6	400,761	9.5
2002					620,063	39.8	520,564	8.8
2003					624,789	55.4	509,135	11.7
Average					2,188,213	59.8	394,661	9.0

10.4) Actual dates of release and description of release protocols.

Umatilla Hatchery --See Table 9

Bonneville Hatchery –See Table 14

10.5) Fish transportation procedures, if applicable.

Umatilla Hatchery--Chinook sub-yearlings are loaded with water using a fish pump. Fish are separated from the water and transferred into insulated liberation tankers ranging in capacity from 2,000 to 5,000-gallons. Fish are loaded at maximum rate of 1.0 lbs/gallon. Transport time from Umatilla Hatchery to acclimation sites is less than two hours. Supplemental oxygen and aeration is provided and temperature is monitored during transport.

Bonneville Hatchery—Fall Chinook smolts are loaded with water using a fish pump. Fish are separated from the water and transferred into insulated liberation tankers ranging in capacity from 2,000 to 5,000-gallons. Fish are loaded at maximum rate of 1.0 lbs/gallon. Transport time from Bonneville Hatchery to Thornhollow acclimation site is approximately three hours. Supplemental oxygen and aeration is provided and temperature is monitored during transport.

10.6) Acclimation procedures

Thornhollow – The Thornhollow acclimation/release facility includes a water intake structure with automatic screen cleaner, pump station, standby generator, water headbox/distribution system, storage building, two acclimation ponds (approximately 13,000 cubic feet each) and water outlet and fish release structure. Water is supplied by gravity flow to the pump station where it is pumped into the headbox. From here, water is supplied to the ponds by gravity at approximately 1,600 gpm per pond. The ponds are covered with netting to prevent bird predation. In case of power failure, or low water level alarm, a phone dialer will begin calling four telephone numbers repeatedly until someone acknowledges the alarm. Fish are released from the facility by pulling the pond outlet screen and dam boards, lowering the pond, and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way. The ponds are thoroughly cleaned prior to fish being received, and ODFW pathology personnel are available to address disease concerns.

(*methods applied and length of time***).**

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

Umatilla Hatchery –Marks applied to sub-yearling program Fall Chinook.

Mark	# Marked	% Total Population
AD	600,000	100
CWT	600,000	100

Bonneville Hatchery -- Marks applied to yearling program Fall Chinook.

Mark	# Marked	% Total Population
AD	50,000	10.4
CWT	50,000	10.4
BWT	430,000	89.6

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Umatilla Hatchery --There is no plan for surplus smolt production. Fish surplus to programmed needs would be released at an earlier life stage or culled as eggs.

Bonneville Hatchery --In the early years of this program, ponds were not covered at Bonneville hatchery allowing bird predation to occur. Subsequently eyed egg requests numbers were high to make up for loss and still reach program goals at transfer. Smolts identified as excess were shipped to acclimation sites. In recent years ponds are covered and predation is at a minimum, egg requests numbers have are lower, but excesses still occur, these smolts are shipped to acclimation sites.

10.9) Fish health certification procedures applied pre-release.

Umatilla Hatchery --All monitoring will be consistent with the ODFW fish health policy. Current Umatilla Hatchery Monitoring and Evaluation work statements provide the

following protocol: Within four weeks prior to release grab-sampled fish of each species and stock are examined as follows:
-Gill tissue and body scrapings by microscopy from a minimum of five fish
-Gill/kidney/spleen tissue pools (5 fish per pool) from 10 fish per raceway for culturable viruses.

Bonneville Hatchery -- *All* monitoring will be consistent with the ODFW fish health policy. Current Umatilla Hatchery Monitoring and Evaluation work statements provide the following protocol: Within four weeks prior to release grab-sampled fish of each species and stock are examined as follows:
-Gill tissue and body scrapings by microscopy from a minimum of five fish
-Gill/kidney/spleen tissue pools (5 fish per pool) from 10 fish per raceway for culturable viruses.

10.10) Emergency release procedures in response to flooding or water system failure.

Thornhollow -- The Thornhollow acclimation/release facility includes a water intake structure with automatic screen cleaner, pump station, standby generator, water headbox/distribution system, and two acclimation ponds. Water is supplied by gravity flow to the pump station where it is pumped into the headbox. From here, water is supplied to the ponds by gravity at approximately 1,600 gpm per pond. The ponds are covered with netting to prevent bird predation. In case of power failure, or low water level alarm, a phone dialer will begin calling four telephone numbers repeatedly until someone acknowledges the alarm. Fish are released from the facility by pulling the pond outlet screen and dam boards, lowering the pond, and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Thornhollow –Releases are made high in the basin to minimize straying of adults into the Snake River basin. 100% of subyearling release is CWT so strays into the Snake River can be detected and removed. 50% of subyearling and 100% of yearlings are acclimated to minimize straying of adults. Subyearlings are released during expected natural migration time of subyearlings to encourage outmigration. Subyearlings are released after most natural steelhead smolts have left the subbasin so there is minimal concern with interspecific competition

TABLES AND FIGURES:

Table 1. Smolt-to-adult survival, return rate, number of adults produced, out-of basin exploitation and in-basin exploitation for subyearling fall chinook salmon reared in Michigan and Oregon raceways at Umatilla Hatchery and released in the Umatilla River, 1991-95 broods. Out-of-basin data was downloaded from the central database in October 2001. Returns are incomplete for brood years 1996 and 1997.

BY[a]	Rear-[b] ing sys- tem	Rel- ease date	Rel-[c] ease site	Rel- ease size (fish/lb)	No.[d] CWT recov- eries	Smolt- to- adult sur- vival (%)	Umatilla River return (%)	No. adults pro- duced	No.[e] adults/ gal/h	Out-of-[f] basin exploit- ation(%)	In-[g] basin exploit- ation(%)
91	M	5/18/92	RM42.5	61.8	2	0.001	0.001	19	0.6	0.0	0.0
91	O	5/19/92	RM42.5	63.7	3	0.003	0.002	30	0.7	43.3	0.0
92	M	5/24/93	RM73.5	63.9	67	0.068	0.024	1,138	36.4	58.4	0.0
92	O	5/25/93	RM73.5	59.4	49	0.065	0.024	621	14.9	56.2	0.0
93	M	5/23/94	RM73.5	67.6	76	0.079	0.024	1,494	47.8	53.9	0.0
93	O	5/24/94	RM73.5	61.1	50	0.085	0.018	803	19.3	59.9	0.0
94	M	5/31/95	IC+TH	64.7	1	0.001	0.000	9	0.3	100	0.0
94	O	5/31/95	IC	61.1	4	0.006	0.001	50	1.2	78.0	0.0
95	M	5/30/96	IC+TH	68.4	63	0.055	0.022	1,126	36.1	39.4	1.3
95	O	5/30/96	IC	66.2	73	0.104	0.040	935	22.4	41.7	2.4

[a] *BY = brood year*
[b] *M = Michigan raceways, O = Oregon raceways.*
[c] *RM = river mile, IC = Imeques acclimation site TH=Thornhollow acclimation site.*
[d] *Return = number of fish counted at Three Mile Falls Dam plus harvest below Three Mile Falls Dam.*
[e] *Number of adults produced per water use at Umatilla Hatchery (gallons/h).*
[f] *Number of coded-wire tags recovered.*
[g] *Percent of adult production harvested outside of the Umatilla River basin.*
[h] *Percent of adult production harvested in the Umatilla River basin by non-tribal and tribal sport anglers*

Table 2. Smolt-to-adult survival, return rate, number of adults produced, out-of basin exploitation and in-basin exploitation for yearling fall chinook salmon reared at Bonneville, Umatilla, and Willard hatcheries and released in the Umatilla River, 1991-96 broods. Out-of-basin data was downloaded from the central database in October 2001. Returns are incomplete for brood year 1996.

Brood year	Hatch-ery	Release date	Release[a] site	Release size (fish/lb)	No.[b] CWT recov-eries	Smolt-to-adult sur-vival (%)	Umatilla River return (%)	No. adults pro-duced	Out-of-[c] basin exploit-ation(%)	In-[d] basin exploit-ation(%)
				March releases						
90	BFH	3/17+19/92	RM70+56	7.5	1	0.002	0.002	4	0.0	0.0
91	BFH	3/18/93	RM73.5	8.9	5	0.032	0.010	43	46.5	0.0
92	BFH	3/23/94	RM73.5	10.4	20	0.149	0.068	347	54.2	0.0
95	UFH	3/25/97	IC+TH	7.9	309	0.451	0.16	1167	55.8	0.0
95	WNFH	3/30/97	TH	13.6	8	0.018	0.008	48	58.3	0.0
96	BFH	3/13/98	TH	10.8	15	0.063	0.063	161	0.0	0.0
				April releases						
92	BFH	4/19/94	RM73.5	8.5	4	0.054	0.012	27	0.0	0.0
93	BFH	4/07/95	TH	8.0	13	0.050	0.033	114	27.2	0.0
94	BFH	4/05/96	TH	7.0	10	0.075	0.024	152	63.8	0.0
94	BFH	4/18/96	IC	7.0	9	0.070	0.024	152	59.9	15.1
94	UFH	4/18/96	IC	5.1	1	0.006	0.001	8	25.0	0.0
96	WNFH	4/17/98	TH	7.8	23	0.065	0.051	116	20.7	0.0

[a] *BFH = Bonneville Fish Hatchery, UFH = Umatilla Fish Hatchery, WNFH = Willard National Fish Hatchery.*
[a] *RM = river mile, IC = Imeques acclimation site, TH = Thornhollow acclimation site.*
[b] *Number of coded-wire tags recovered.*
[c] *Return = number of fish counted at Three Mile Falls Dam plus harvest beolow Three Mile Falls Dam.*
[d] *Percent of adult production harvested outside of the Umatilla River basin.*
[e] *Percent of adult production harvested in the Umatilla River basin by non-tribal and tribal sport anglers.*

Table 3
Fall Chinook Annual Run Counts
To Three Mile Dam

Year	Adults	Jacks	Subjacks	Total
1985	6	79		85
1986	28	407		435
1987	53	47	287	387
1988	94	164	1295	1553
1989	279	247	76	602
1990	333	107	621	1061
1991	522	468	274	1264
1992	239	64	0	303
1993	370	27	15	412
1994	688	236	368	1292
1995	603	288	338	1229
1996	646	80	606	1332
1997	354	207	189	750
1998	286	154	230	670
1999	737	137	152	1026
2000	643	437	4948	6028
2001	1146	1158	970	3274
2002	1716	617	1709	4042
2003	1482	638	2150	4270

Table 4. Hatchery releases of fall chinook in the Umatilla River Basin.

Year of Release	Hatchery	No. Released	No. lb.	Stock
1982	Bonneville/SCNFH	3,807,171	79.0-92.0	Tule
1983	Bonneville	100,564	5.9	Bonneville URB
1984	Bonneville	228,412	8.6	Bonneville URB
1984	Bonneville	966,250	85.1	Bonneville URB
1985	Bonneville	3,223,172	92.3	Bonneville URB
1985	Bonneville	198,162	7.8	Bonneville URB
1985	Bonneville	51,000	16.2	Bonneville URB
1986	Irrigon	206,815	4.7-5.0	Bonneville URB
1986	Irrigon	2,029,602	86.0	Bonneville URB
1986	Irrigon	35,574	11.6	Bonneville URB
1987	Irrigon	1,476,830	60.4	Priest Rapids URB
1987	Bonneville	211,506	8.1-8.6	Bonneville URB
1987	Irrigon	2,000	20.0	Priest Rapids URB
1988	Irrigon	1,886,757	68.3	Priest Rapids URB
1988	Irrigon	1,429,250	93.1	Bonneville URB
1988	Irrigon	94,089	8.6-9.8	Priest Rapids URB
1988	Bonneville	200,341	8.8-10.2	Bonneville URB
1989	Bonneville	217,443	8.6	Bonneville URB
1989	Irrigon	2,393,710	66.6	Priest Rapids URB
1989	Irrigon	156,957	10.9-11.1	Priest Rapids URB
1990	Bonneville	255,614	8.2	Bonneville URB
1990	Irrigon	2,425,681	87.5	Bonneville URB
1990	Irrigon	629,800	82.4	Priest Rapids URB
1990	Irrigon	148,510	8.8-9.2	Bonneville URB
1991	Bonneville	194,847	7.8	Bonneville URB
1991	Irrigon	10,462	80.0-194.0	Bonneville URB
1991	Irrigon	3,245,751	80.5-86.0	Bonneville URB
1992	Bonneville	220,440	7.6-7.7	Bonneville URB
1992	Umatilla	2,678,343	62.2	Bonneville URB
1992	Irrigon	504,369	53.4	Umatilla River
1992	Irrigon	5,167	62.8	Umatilla River
1992	Umatilla	2,670	112.0	Bonneville URB
1993	Bonneville	134,837	9.1	Bonneville URB
1993	Umatilla	2,629,917	62.7	Upriver Brights /a
1993	Umatilla	29,681	95.5-142.0	Upriver Brights /a
1994	Bonneville	283,453	8.5-10.4	Bonneville URB
1994	Umatilla	2,843,212	65.2	Upriver Brights /b
1994	Umatilla	22,174	85.0-171.0	Upriver Brights /b
1995	Bonneville	227,088	8.0	Bonneville URB
1995	Umatilla	2,466,298	63.1-64.7	Priest Rapids URB
1996	Bonneville	421,316	7.0-7.1	Bonneville URB
1996	Umatilla	143,087	5.1	Priest Rapids URB
1996	Umatilla	2,960,413	63.9-71.0	Priest Rapids URB
1997	Umatilla	258,953	7.6-8.1	Priest Rapids URB
1997	Willard	260,968	13.6	Upriver Brights /c
1997	Umatilla	2,580,833	66.0-67.3	Upriver Brights /b

Table 4 cont. Hatchery releases of fall chinook in the Umatilla River Basin.

Year of Release	Hatchery	No. Released	No. lb.	Stock
1998	Bonneville	256,910	10.8	Bonneville URB
1998	Willard	179,100	7.8	Upriver Brights /c
1998	Umatilla	2,777,442	64.9-67.7	Priest Rapids URB
1999	Bonneville	449,568	9.0-9.4	Umatilla River
1999	Umatilla	1,842,666	55.9	Upriver Brights /d
2000	Bonneville	235,246	10.9	Umatilla River
2000	Bonneville	234,510	10.1	Umatilla River
2000	Umatilla	975,871	49.0	Priest Rapids URB
2000	Umatilla	2,044,648	48.3	Priest Rapids URB
2001	Bonneville	213,499	9.7	Umatilla River
2001	Bonneville	187,262	9.2	Umatilla River
2001	Umatilla	324,713	45.3	Umatilla River
2001	Umatilla	322,283	33.6	Umatilla River
2002	Bonneville	259,607	9.0	Umatilla River
2002	Bonneville	260,957	8.7	Umatilla River
2002	Umatilla	307,194	40.6	Umatilla River
2002	Umatilla	312,869	39.0	Umatilla River
2003	Bonneville	261,065	13.1	Umatilla River
2003	Bonneville	248,070	10.5	Umatilla River
2003	Umatilla	313,383	54.6	Umatilla River
2003	Umatilla	311,406	56.2	Umatilla River

/a Bonneville, Little White Salmon and Umatilla River broodstock
/b Priest Rapids and Umatilla River broodstock
/c Little White Salmon broodstock
/d Priest Rapids and Little White Salmon broodstock

HGMP: Umatilla River fall chinook salmon subyearlings

Table 5. Water quality in Michigan series used to rear subyearling fall chinook salmon at Umatilla Fish Hatchery from brood years 1995-1997. Years 1996 and 1997 were reared at three different densities.

Parameter measured	Density 200K	300K	400K
		1995	
Temperature head (d-C)		12.4	
Temperature tail (d-C)		12.6	
pH head		8.0	
pH tail		7.9	
Oxygen head (ppm)		12.0	
Oxygen tail (ppm)		9.6	
Nitrogen head (mmHg)		565	
Nitrogen tail (mmHg)		571	
Total pressure-head (mmHg)		743	
Total pressure-tail (mmHg)		716	
Unionized ammonia (ug/l)		0.15	
Alkalinity (mg/l CaCO3)		129	
		1996	
Temperature head (d-C)	12.0	11.6	11.8
Temperature tail (d-C)	11.9	11.8	11.7
pH head	7.7	7.7	7.7
pH tail	7.7	7.7	7.7
Oxygen head (ppm)	10.9	11.3	11.6
Oxygen tail (ppm)	8.8	9.3	9.2
Nitrogen head (mmHg)	553	559	582
Nitrogen tail (mmHg)	542	555	596
Total pressure-head (mmHg)	726	732	752
Total pressure-tail (mmHg)	687	704	732
Unionized ammonia (ug/l)	1.49	1.35	1.77
Alkalinity (mg/l CaCO3)	137	140	143
		1997	
Temperature head (d-C)	11.4	11.5	11.7
Temperature tail (d-C)	11.4	11.5	11.8
pH head	7.6	7.6	7.6
pH tail	7.5	7.6	7.5
Oxygen head (ppm)	11.4	11.3	10.2
Oxygen tail (ppm)	9.2	9.0	7.7
Nitrogen head (mmHg)	580	559	589
Nitrogen tail (mmHg)	595	590	598
Total pressure-head (mmHg)	743	749	741

Total pressure-tail (mmHg)	726	720	710
Unionized ammonia (ug/l)	1.45	2.28	N/A
Alkalinity (mg/l CaCO3)	133	134	139

Table 6 Rearing conditions immediately before transfer for subyearling fall chinook salmon reared in Michigan and Oregon series at Umatilla Hatchery in 1991-2001 brood years.

Brood year	Rearing series	Mean number per raceway	Maximum density (lb/ft^3)	Maximum loading (lb/gal/min)	Number reared per gpm[a]
1991	Michigan		2.0-2.4	5.4-6.6	
	Oregon		0.5-0.7	2.6-3.5	
1992	Michigan		2.0-2.4	5.4-6.6	
	Oregon		0.5-0.7	5.4-6.6	
1993	Michigan		2.2-2.5	4.8-5.5	
	Oregon		0.5-0.8	2.6-3.7	
1994	Michigan		1.5-1.9	3.7-4.5	
	Oregon		0.4-0.6	1.9-2.9	
1995	Michigan		1.5-1.7	3.6-4.0	
	Oregon		0.4-0.7	2.0-3.5	
1996	Michigan	199,540	1.0-1.1	2.3-2.7	617
1996		299,817	1.6-1.7	3.7-3.9	940
1996		366,920	1.7-2.1	4.0-4.9	1,159
1997	Michigan	211,526	1.2-1.4	2.9-3.2	668
1997		308,855	1.6-1.8	3.9-4.3	975
1997		407,367	2.1-2.3	5.0-5.3	1,286
1998	Michigan	187,235	1.1-1.2	2.6-2.7	427
1998		324,797	1.5-1.9	3.7-4.6	651
1998		411,114	1.9-2.6	4.4-6.1	865
1999	Michigan	237,931	2.36	5.6	754
1999		330,938	3.45	8.2	1,049
1999		437,971	4.20	10.0	1,387
2000	Oregon	162,878	0.47	2.2	261
		161,142	0.51	2.5	258

2001	Oregon	153,882	0.51	2.5	246
		156,449	0.70	3.3	250

[a] *Numbers are combined production for three Michigan passes. The 1998 brood was reared in first and second pass raceways only.*

Table 7. Mean length, weight, and condition factor at transfer for subyearling fall chinook salmon reared in Michigan or Oregon raceways at Umatilla Hatchery, 1996-2001 brood years (standard error in parentheses).

Brood year	System	Density (*1000)	Pass	Length (mm)	Weight (g)	Condition factor
1996	Michigan	200	A	75.4	4.9	1.11
			B	77.3	5.3	1.12
			C	79.7	5.9	1.14
		300	A	79.5	5.6	1.06
			B	78.3	5.8	1.16
			C	78.0	5.3	1.08
		400	A	75.5	4.9	1.10
			B	77.9	5.4	1.11
			C	78.1	5.7	1.17
1997	Michigan	200	A	77.9	4.9	1.03
			B	77.3	4.6	0.97
			C	78.5	5.4	1.07
		300	A	77.3	4.8	1.08
			B	79.3	4.4	0.89
			C	77.6	4.7	0.97
		400	A	78.0	4.5	1.00
			B	76.6	3.7	0.82
			C	75.3	4.4	1.00
1998	Michigan	200	A	79.6	5.5	1.07
			B	79.3	5.8	1.20
		300	A	82.5	6.3	1.14
			B	76.9	5.2	1.13
		400	A	75.8	4.6	1.07
			B	77.5	6.4	1.19
1999	Michigan	200	A	88.8	8.1	1.14
			B	86.1	7.3	1.12
			C	87.3	7.7	1.11
		300	A	88.4	8.2	1.17
			B	84.9	7.5	1.20
			C	90.3	8.4	1.12
		400	A	85.1	7.5	1.19
			B	84.0	7.1	1.18
			C	87.0	7.9	1.18
2000	Oregon		A	88.3	7.8	1.20
			B	87.3	7.7	1.20
2001	Oregon		A	87.6	8.0	1.20
			B	87.3	7.5	1.1

Table 8. Mean smoltification and proportion of descaled, partially descaled, and undamaged subyearling fall chinook salmon reared in Michigan and Oregon raceways at Umatilla Hatchery, brood years 1998-2001.

				Smolting			Descaling		
Brood year	System	Density (*1000)	Pass	Smolt	Interme-diate	Parr	Descaled	Partially descaled	Undam-aged
1998	Michigan	200	A				0.00	0.19	0.81
			B				0.00	0.27	0.73
		300	A				0.01	0.27	0.73
			B				0.00	0.18	0.82
		400	A				0.00	0.03	0.97
			B				0.04	0.79	0.17
1999	Michigan	200	A	0.02	0.98	0.00	0.00	0.01	0.99
			B	0.00	1.00	0.00	0.00	0.00	1.00
			C	0.01	0.99	0.01	0.00	0.00	1.00
		300	A	0.00	1.00	0.00	0.00	0.01	0.99
			B	0.00	1.00	0.00	0.00	0.00	1.00
			C	0.00	1.00	0.00	0.00	0.01	0.99
		400	A	0.03	0.97	0.00	0.00	0.00	1.00
			B	0.00	1.00	0.00	0.00	0.04	0.96
			C	0.00	1.00	0.00	0.00	0.00	1.00
2000	Oregon		A	0.00	1.00	0.00	0.00	0.00	1.00
			B	0.00	1.00	0.00	0.00	0.00	1.00
2001	Oregon		A	0.00	1.00	0.00	0.00	0.00	1.00
			B	0.00	1.00	0.00	0.00	0.00	1.00

Table 9. Release data for subyearling fall chinook salmon reared at Umatilla Hatchery and released in the Umatilla River. River mile (RM) 42.5, 48 and 73.5 were direct-stream releases. TH=Thornhollow acclimation facility, RM 73.5; IC=Imeques-C-mem-ini-kem acclimation facility, RM 79.5).

Brood year, CWT code	Date of release	Race-way	Number released[a]	Number brand/paint CWT	Number per or PIT tag[b]	Fish per pound	RM or release location
1991							
071433	5/18/1992	M2A	303,878	29,066	7,445	61.0	42.5
071434	5/18/1992	M3A	306,802	31,224	6,917	65.7	42.5
071435	5/18/1992	M2B	297,331	30,326	9,643	60.9	42.5
071436	5/18/1992	M3B	302,555	30,365	7,049	61.9	42.5
071437	5/18/1992	M2C	223,830	30,508	7,526	55.2	42.5
071438	5/18/1992	M3C	301,831	30,924	7,656	64.5	42.5
subtotal			1,736,227	182,413	46,236	61.8	
071430	5/19/1992	O2A	281,350	32,287	9,174	65.1	42.5
071429	5/20/1992	O3A	286,578	31,892	6,272	70.6	42.5
071432	5/19/1992	O2B	191,257	29,425	8,558	58.3	42.5
071431	5/19/1992	O3B	182,931	28,951	8,863	56.2	42.5
subtotal			942,116	122,555	32,867	63.7	
Total			2,678,343	304,968	79,103	62.2	
1992							
076330	5/24/1993	M2A	292,895	28,964	10,027	63.0	73.5
076331	5/24/1993	M3A	282,125	29,537	10,053	67.0	73.5
070127	5/24/1993	M2B	269,336	27,092	10,150	63.4	73.5
076333	5/24/1993	M3B	273,662	29,718	10,020	60.3	73.5
076334	5/24/1993	M2C	282,175	29,958	9,434	68.0	73.5
076332	5/24/1993	M3C	277,931	29,451	9,894	61.5	73.5
subtotal			1,678,124	174,720	59,578	63.9	
070126	5/25/1993	O2A	268,001	29,594	10,458	59.3	73.5
070125	5/25/1993	O3A	272,496	29,360	9,828	59.4	73.5
076329	5/25/1993	O2B	203,731	30,706	10,278	59.4	73.5
076335	5/25/1993	O3B	207,565	30,462	10,547	59.4	73.5
subtotal			951,793	120,122	41,173	59.4	
Total			2,629,917	294,842	101,361	62.7	
1993							
070663	5/23/1994	M2A	322,867	31,162	10,171	63.0	73.5
070719	5/23/1994	M3A	327,700	31,658	9,725	72.4	73.5
070720	5/23/1994	M2B	314,518	30,528	10,008	65.4	73.5
070723	5/23/1994	M3B	326,408	30,447	10,217	68.2	73.5
070722	5/23/1994	M2C	303,843	30,950	9,769	68.0	73.5
070721	5/23/1994	M3C	306,105	28,474	9,373	68.7	73.5
subtotal			1,901,441	183,219	59,263	67.6	

[a] *All coded-wire tagged fish were adipose fin-clipped. Fish from the 1991-97 broods were also RV-clipped. Beginning with the 1993 brood, all non coded-wire tagged fish were blank-wire tagged.*
[b] *Fish from 1991-95 broods were branded.*

Table 9 (continued)

Brood year, CWT code	Date of release	Race-way	Number released	Number CWT	Number brand/paint or PIT tag[b]	Fish per pound	RM or release location
1993							
070662	5/24/1994	O2A	280,046	31,239	10,158	60.1	73.5
070718	5/24/1994	O3A	279,965	31,040	10,220	64.2	73.5
070716	5/24/1994	O2B	191,321	30,502	10,906	59.1	73.5
070717	5/24/1994	O3B	190,439	32,481	10,260	60.0	73.5
subtotal			941,771	125,262	41,544	61.1	
Total			2,843,212	308,481	103,331	65.2	
1994							
071019	5/31/1995	M2A	286,459	29,353	10,665	62.7	IC
071017	5/31/1995	M3A	271,129	29,736	10,172	67.8	IC
071022	5/31/1995	M2B	280,406	28,472	10,323	63.0	IC
071020	5/31/1995	M3B	275,613	29,460	10,183	65.6	IC
071025	5/31/1995	M2C	274,110	29,784	10,176	66.5	TH
071023	5/31/1995	M3C	287,313	28,623	10,249	63.0	TH
subtotal			1,675,030	175,428	61,768	64.7	
071026	5/31/1995	O1A	245,885	30,106	10,374	58.0	IC
071018	5/31/1995	O3A	241,342	29,132	10,438	65.1	IC
071024	5/31/1995	O1B	151,943	30,204	10,248	62.3	IC
071021	5/31/1995	O3B	152,098	29,327	11,104	58.7	IC
subtotal			791,268	118,769	42,167	61.1	
Total			2,466,298	294,197	103,946	63.4	
1995							
071320	5/30/1996	M2A	303,803	30,015	10,557	69.5	IC
071321	5/30/1996	M3A	299,233	28,997	9,407	68.4	IC
071323	5/30/1996	M2B	300,377	29,914	9,965	62.8	IC
071325	5/30/1996	M3B	300,895	30,220	10,389	67.4	IC
071157	5/31/1996	M2C	393,339	29,852	10,316	72.8	TH
071327	5/31/1996	M3C	460,259	28,476	10,378	69.5	TH
subtotal			2,057,906	177,474	61,012	68.3	
071322	5/30/1996	O2A	266,913	29,646	10,252	57.2	IC
071324	5/30/1996	O3A	272,594	30,243	10,420	66.4	IC
071326	5/30/1996	O2B	181,291	30,238	10,237	56.5	IC
071328	5/30/1996	O3B	181,709	30,455	9,980	60.3	IC
subtotal			902,507	120,582	40,889	60.5	
Total			2,960,413	298,056	101,901	65.8	

Table 9 (continued)

Brood year, CWT code	Date of release	Race-way	Number released	Number CWT	Number brand/paint or PIT tag[c]	Fish per pound	RM or release location
1996							
092129	5/30/1997	M1A	294,417	33,161	8,469	63.6	IC/TH
092130	5/30/1997	M1B	294,043	32,464		62.4	IC/TH
092132	5/29/1997	M1C	304,993	31,382		66.8	IC
092131	5/30/1997	M2A	395,493	31,844	8,094	67.9	IC/TH
092133	5/29/1997	M2B	394,250	33,273		70.7	IC
092134	5/29/1997	M2C	311,016	33,640		67.6	IC
092126	5/30/1997	M4A	197,028	33,555	9,000	67.2	TH
092127	5/29/1997	M4B	195,031	32,764		70.2	IC
092128	5/29/1997	M4C	194,562	29,732		65.6	IC
Total			2,580,833	291,815	27,238	66.9	
1997							
092404	5/28/1998	M2A	214,521	33,286	520	65.2	TH
092407	6/1/1998	M2B	202,816	33,661	505	66.3	TH
092410	6/1/1998	M2C	215,643	31,820	508	66.7	IC
092403	5/28/1998	M3A	305,038	30,808	493	65.5	TH
092406	6/1/1998	M3B	317,296	30,558	510	67.3	IC
092409	6/1/1998	M3C	302,336	32,219	509	67.1	IC
092402	5/28/1998	M4A	400,614	30,654	504	64.1	TH
092405	5/28/1998	M4B	413,832	30,533	507	67.2	IC
092408	5/28/1998	M4C	405,346	32,322	508	69.8	IC
Total			2,777,442	284,861	4,564	66.7	
1998							
092701	6/3/1999	M2A	201,224	64,881	590	54.5	IC
092663	6/3/1999	M2B	203,951	66,220	592	54.7	IC
092703	6/3/1999	M3A	311,370	65,821	567	54.7	IC
092702	6/3/1999	M3B	305,731	63,127	589	56.7	IC
092705	6/3/1999	M4A	411,966	63,147	589	55.7	IC
092704	6/3/1999	M4B	408,424	63,757	591	57.5	IC
Total			1,842,666	386,953	3,518	55.9	
1999							
093003	5/24/2000	M1A	327,224	67,044	596	48.9	PN
093033	5/24/2000	M1B	371,230	68,834	584	48.0	PN
093036	5/23/2000	M1C	294,359	65,514	591	49.3	TH
093002	5/24/2000	M2A	461,165	66,975	570	48.9	PN
093032	5/24/2000	M2B	422,982	68,418	594	47.6	PN
093035	5/23/2000	M2C	429,765	65,425	595	49.0	TH
093004	5/24/2000	M3A	206,478	60,629	596	48.0	PN
093034	5/24/2000	M3B	255,569	63,593	588	48.3	PN
093037	5/23/2000	M3C	251,747	67,911	591	48.7	TH
Total			3,020,519	594,343	5,288	48.5	

[c] *Fish from 093003, 1996 brood were paint marked on the anal fin, 1997-98 broods were PIT-tagged.*

Table 9 (continued)

Brood year, CWT code	Last date of release	Race-way	Number released	Number CWT	Number brand/paint or PIT tag	Fish per pound	RM or release location
2000							
093255	5/21-24/01	O1A	163,021	158,747	290	45.3	TH
093256	5/21-24/01	O1B	161,692	158,052	292	45.3	TH
093253	5/25/01	O2A	154,438	152,398	289	33.3	48.5
093254	5/24/01	O2B	167,845	165,322	299	33.9	48.5
Total			646,996	634,519	1.16,970	38.6	
2001							
093501	5/17-23/02	O1A	149,453	146,558	288	42.0	TH
093503	5/17-23/02	O1B	157,741	156,097	267	39.3	TH
093502	5/23/02	O2A	149,669	145,816	297	39.0	48.5
093504	5/23/02	O2B	163,200	158,572	299	39.0	48.5
Total			620,063	607,044	1,151	39.8	

HGMP: Umatilla River fall chinook salmon yearlings

Table 10. Water quality comparisons between Michigan and Oregon raceways during production 1992-1995 Table 11. Water quality in first and second pass Michigan and Oregon raceways used to rear yearling fall chinook salmon in 1996-97, 1995 brood. Means without letters are not significantly different at P>0.05.

	Michigan		Oregon	
Parameter measured	N	Mean	N	Mean
Sampling period	Jul 24 - Feb 15		Jul 24 - Feb 15	
Temperature head (°C)	58	13.4	63	13.3
Temperature tail (°C)	58	13.4	63	13.5
pH head	56	7.8	61	7.8
pH tail	56	7.8	61	7.8
Oxygen head (ppm)	56	11.1a	61	10.1b
Oxygen tail (ppm)	56	9.4a	61	8.5b
Nitrogen head (mmHg)	56	590a	61	601b
Nitrogen tail (mmHg)	56	604a	61	619b
Total pressure-head (mmHg)	56	756	61	752
Total pressure-tail (mmHg)	56	747	61	748
Unionized ammonia (µg/l)	26	0.68	30	0.61
Alkalinity (mg/l $CaCO_3$)	28	132	32	134

Table 11. Rearing conditions for yearling fall chinook salmon reared in raceways at Bonneville Fish Hatchery, 1998-2000 broods.

Brood year	Raceway	Maximum density (lb/ft^3)	Maximum loading (lb/gal/min)	Number reared per gpm
		Bonneville Hatchery		
1998	A6-A11	0.82	5.6	71
	A1-A5	0.89	6.1	68
1999	A7-A11	0.81	5.6	65
	A2-A6	0.96	6.6	68
2000	A7-A11	1.08	7.4	74
	A2-A6	1.13	7.7	77

Table 12. Mean length, weight, and condition factor for yearling fall chinook salmon, brood years 1998-2001 reared at Bonneville Fish Hatchery and transferred to Thornhollow Acclimation facility in the Umatilla River.

Brood		Length(mm)		Weight(g)		Condition Factor	
Year	Date	N	Mean(SE)	N	Mean(SE)	N	Mean(SE)
1998	2/15/00	392	148.8(0.8)	103	39.2(1.0)	103	1.18(0.01)
	3/13/00	406	150.4(0.8)	106	40.5(1.2)	106	1.19(0.01)
1999	2/13/01	293	147.3(0.7)	94	37.6(1.1)	94	1.18(0.01)
	3/20/01	298	154.6(0.7)	108	43.8(1.1)	108	1.20(0.01)
2000	2/14/02	299	156.7(0.9)	95	43.3(1.2)	95	1.16(0.01)
	3/18/02	298	157.0(1.3)	98	42.4(1.2)	98	1.11(0.01)
2001	1/30/03	300	148.0(1.2)	99	40.0(1.8)	99	1.21(0.01)
	3/18/03	300	152.6(1.3)	104	41.9(1.6)	104	1.14(0.01)

Table 13. Mean smoltification and proportion of descaled, partially descaled, and undamaged scaling of yearling fall chinook salmon at transfer from Bonneville Fish Hatchery, brood years 1998-2001.

Brood			Smolting			Descaling		
Year	Date	Raceway	Smolt	Intermediate	Parr	Descaled	Partial	None
1998	2/15/00	A6-10	0.11	0.89	0.00	0.00	0.23	0.77
	3/13/00	A1-5	0.18	0.82	0.00	0.09	0.29	0.61

1999	2/13/01	A7-11	0.01	0.99	0.00	0.08	0.40	0.52
	3/20/01	A1-6	0.00	1.00	0.00	0.00	0.18	0.82
2000	2/12/02	A7-11	0.98	0.02	0.00	0.02	0.02	0.96
	3/13/02	A2-6	0.80	0.20	0.00	0.01	0.02	0.97
2001	1/30/03	D8-D12, A2	0.00	1.00	0.00	0.00	0.02	0.98
	3/18/03	A2-A6	0.00	1.00	0.00	0.02	0.00	0.98

Table 14. Release data for yearling fall chinook salmon reared at Bonneville Fish Hatchery and released from Thornhollow acclimation facility into the Umatilla River.

Brood year	CWT code	Release date	Number released	Number CWT	Number brand/paint or PIT-tag[b]	Fish per pound
1998	092925	3/9/00	235,246	26,956	286	10.9
	092926	4/13/00	234,510	28,223	289	10.1
1999	093206	3/16/01	213,499	17,993	271	9.8
	093207	4/19/01	187,262	24,962	295	9.6
2000	093346	3/7/02	259,607	26,355	287	9.0
	093347	4/11/02	260,957	27,838	286	8.7
2001	093627	3/7/03	261,065	27,105	242	13.1
	093628	4/15/03	248,070	28,175	292	10.5

Table 15.
Disposition and Spawning Ground Data of Natural and Hatchery Summer Steelhead (STS) Returning to the Umatilla River above Three Mile Falls Dam, 1988-1999.

RUN YEAR (Fall/Spring)	1987 1988	1988 1989	1989 1990	1990 1991	1991 1992	1992 1993	1993 1994	1994 1995	1995 1996	1996 1997	1997 1998	1998 1999
Natural STS Enumerated at TMD	2315	2104	1422	724	2247	1298	945	875	1299	1014	862	1134
Hatchery STS Enumerated at TMD	165	370	245	387	522	616	345	656	782	1463	903	740
Natural and Hatchery STS Enumerated at TMD	2480	2474	1667	1111	2769	1914	1290	1531	2081	2477	1765	1874
Natural STS Sacrificed or Mortalities at TMD	20	12	40	2	3	4	0	0	8	5	2	1
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	69	51	33	73	95	70	74

Natural STS Taken for Brood Stock	151	158	92	99	237	129	93	86	107	100	86	110
Natural STS Spawned	31F	42F	25F	78	172	95	79	59	63	75	68	76
Hatchery STS Taken for Brood Stock	0	0	0	103	95	91	42	68	26	10	30	15
Hatchery STS Spawned	0	0	0	49	0	3	17	22	21	3	21	4
Natural Females Released above TMD	1436	1232			1193	875	642	602	863	689	550	716
Natural Males Released above TMD	708	702			814	290	210	187	321	220	224	308
Natural STS Released above TMD	2144	1934	1290	623	2007	1165	852	789	1184	909	774	1024
Hatchery Females Released above TMD	114	216			161	266	186	274	371	666	476	425
Hatchery Males Released above TMD	46	137			154	190	66	281	312	692	327	236
Hatchery STS Released above TMD	160	353	102	234	315	456	252	555	683	1358	803	661
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39
Natural STS Harvested above TMD-ODFW								0	0	0	0	0
Hatchery STS Harvested above TMD-ODFW						22	5	21	25	24	12	47
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548	713
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221	306
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769	1019
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454	382
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305	193
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759	575
Total STS Available for Spawning	2304	2287	1392	857	2322	1569	1074	1298	1803	2210	1528	1594
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002	1095
STS Redds Observed in Index Reaches	138	77	H W.	H W	135	H W.	64	74	119	138	126	218
Total STS Redds Observed	275	128	H W.	H W	300	H W.	224	126	150	149	217	270
Index Reaches Miles Surveyed	18.5	20	H W.	H W	21.4	H W.	21.4	21.4	21.4	21.4	21.4	21.4
Redds Per Mile in Index Reaches	7.5	3.9	H W.	H W	6.3	H W.	3.0	3.5	5.6	6.4	5.9	10.2
Total Miles Surveyed in Umatilla River	61.0	50.2	H W.	H W	67.2	H W.	65.8	35.0	34.4	24.6	38.0	35.0
Redds Per Mile in all Areas	4.5	2.5	H W.	H W	4.5	H W.	3.4	3.6	4.4	6.1	5.7	7.7

Harvest not determined and not subtracted from estimates of spawners, 1988-1982. H. W. = high water.
Assumes that harvest steelhead were 50% females and 50% males. No adjustments made for hook and release mortality.
Index reaches are in Squaw, NF Meacham, Buckaroo, Camp, and Boston Canyon Creeks and the SF Umatilla River.

Table 16
Summer Steelhead Annual Run Counts
To Three Mile Falls Dam

Year	Hatchery	Wild	Total
1966-67		1778	1778
1967-68		930	930
1968-69		1917	1917
1969-70		2298	2298

1970-71			
1971-72			
1972-73		2057	2057
1973-74		2640	2640
1974-75		2171	2171
1975-76		2534	2534
1976-77		1258	1258
1977-78		3080	3080
1978-79			
1979-80		2367	2367
1980-81		1298	1298
1981-82		768	768
1982-83		1264	1264
1983-84		2314	2314
1984-85		3197	3197
1985-86		2885	2885
1986-87		3444	3444
1987-88	166	2316	2482
1988-89	371	2104	2475
1989-90	246	1422	1668
1990-91	387	725	1112
1991-92	523	2246	2769
1992-93	616	1297	1913
1993-94	345	945	1290
1994-95	656	875	1531
1995-96	785	1296	2081
1996-97	1463	1014	2477
1997-98	903	862	1765
1998-99	751	1135	1886
1999-00	739	2153	2892
2000-01	1089	2573	3662
2001-02	1860	3659	5519
2002-03	960	2120	3080

Table 17. Total smolt-to-adult survival, parent:progeny, and parent:spawning escapement data for summer steelhead reared at Umatilla Hatchery, brood years 1991-1995.

Brood Escapement year	Race-way	Release location	Release date	Percent smolt-to-adult survival	Adult progeny produced	Spawning escapement	Parent-progeny ratio	Parent- ratio
91	M5A	Meacham Cr	050192	0.01	7	0	0.1	0.0
91	M5B	Meacham Cr	043092	0.02	13	13	0.3	0.3

91	M5C	Bon./Min.	032992	0.21	138	95	3.2	2.2
92	M5A	Bonifer	051393	0.08	52	38	1.4	1.0
92	M5B	Minthorn	041693	0.64	305	253	11.4	8.8
92	M5C	Bonifer	041893	0.63	284	217	11.4	8.1
93	M5A	Bonifer	051294	0.04	18	16	0.5	0.5
93	M5B	Minthorn	041494	0.47	234	195	7.1	5.9
93	M5C	Bonifer	041194	0.64	330	276	10.4	8.7
94	M8A	Bonifer	051295	0.27	131	113	4.2	3.6
94	M8B	Minthorn	041395	0.69	343	249	10.5	7.6
94	M8C	Bonifer	041195	1.20	581	505	18.3	15.9
95	M8A	Thornhollow	050996	0.14	68	58	2.5	2.1
95	M8B	Minthorn	041296	0.68	323	264	12.3	10.2
95	M8C	Bonifer	042496	0.30	149	128	5.5	4.7

Table 18. Age summary of natural summer steelhead from the Umatilla River.

Return Year		Age 1.1	Age 1.2	Age 2.1	Age 2.2	Age 2.3	Age 3.1	Age 3.2	Age 4.1	Total
1994	n=	0	2	24	26	0	5	6	0	63
	%=	0	3.2	38.1	41.3	0	7.9	9.5	0	100
1995	n=	0	0	19	17	0	9	11	0	56
	%	0	0	33.9	30.4	0	16.1	19.6	0	100
1996	n=	0	0	28	8	0	7	1	0	44
	%	0	0	63.6	18.2	0	15.9	2.3	0	100
1997	n=	0	0	19	17	0	5	10	0	51
	%	0	0	37.3	33.3	0	9.8	19.6	0	100
1998	n=	1	1	33	11	1	4	0	1	52
	%	1.9	1.9	63.5	21.2	1.9	7.7	0	1.9	100

Juvenile years of freshwater growth from scales of adult steelhead returning to the Umatilla River.

Return Year		Age 1	Age 2	Age 3	Age 4	Total
1994	n=	2	50	11	0	63
	%=	3.2	79.4	17.4	0	100
1995	n=	0	36	20	0	56
	%	0	64.3	35.7	0	100
1996	n=	0	36	8	0	44
	%	0	81.8	18.2	0	100
1997	n=	0	37	15	0	51
	%	0	70.6	29.4	0	100
1998	n=	2	45	4	1	52
	%	3.8	86.5	7.7	1.9	99.9

Table 20. Life History table of steelhead

Mouth of the Umatilla to the mouth of McKay Creek (RM 0-50.5)

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding												
Spawning												
Incubation												
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x	x		

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Mouth of McKay Creek to the mouth of Meacham Creek (RM 50.5-79) and mid-basin streams

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

Mouth of Meacham Creek to the forks (RM 79-89 and headwater streams)

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

Table 21. The Number and Percent of Steelhead (STS) Available to Spawn Naturally that were of Hatchery Origin; Umatilla River, 1988-1999.

BROOD YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002
Percent Spawners of Hatchery Origin	6.9	15.4	7.3	27.3	13.6	26.1	21.1	39.6	34.3	58.9	49.7
Percent Females Spawners of Hatchery Origin	7.4	14.9			11.9	21.7	21.3	29.7	28.2	48.0	45.3

Harvest not estimated 1988-1992. 1993-1999, Harvest estimate subtracted from total, assumes harvest of 50% females and 50% males
No adjustments made for catch and release mortality.

Table 22. Umatilla River summer steelhead broodstock collection

Run Year	Number Collected								
	Marked			Unmarked			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
82-83	0	0	0	unk	unk	161	unk	unk	161
83-84	0	0	0	20	32	52	20	32	52
84-85	0	0	0	25	79	104	25	79	104
85-86	0	0	0	11	58	69	11	58	69
86-87	0	0	0	57	91	148	57	91	148
87-88	0	0	0	73	78	151	73	78	151
88-89	0	0	0	72	88	160	72	88	160
89-90	0	0	0	49	57	106	49	57	106
90-91	47	56	103	46	53	99	93	109	202
91-92	49	46	95	109	116	225	109	116	225
92-93	1	2	3	64	61	125	65	63	128
93-94	18	25	43	47	45	92	65	70	135
94-95	35	33	68	38	48	86	73	81	154
95-96	16	12	28	56	49	105	72	61	133
96-97	12	1	13	48	49	97	60	50	110
97-98	19	11	30	42	44	86	61	55	116
98-99	17	0	17	52	59	111	69	59	128

2004 DRAFT

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Umatilla River Coho
Species or Hatchery Stock:	Umatilla River Coho,Tanner Creek stock
Agency/Operator:	Oregon Department of Fish & Wildlife /Confederated Tribes of the Umatilla Indian Reservation
Watershed and Region:	Umatilla/Columbia/Oregon
Date Submitted:	2004
Date Last Updated:	May 4, 2004

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Umatilla River Coho Program

1.2) Species and population (or stock) under propagation, and ESA status.

Coho (Oncorhynchus kisutch) Tanner creek stock .

1.3) Responsible organization and individuals

Name (and title): Scott Patterson – Hatchery Coordinator
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 107 Twentieth Street, La Grande, OR 97850
Telephone: 541-963-2138
Fax: 541-963-6670
Email: Scott.D.Patterson@state.or.us

Name (and title): Gary James – Fisheries Program Manager
Agency or Tribe: Confederated Tribes of the Umatilla Indian Reservation
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Telephone: 541-276-4109
Fax: 541-276-4348
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Name (and title): Tim Bailey – District Fish Biologist
Agency or Tribe: Oregon Department of Fish & Wildlife
Address: 73471 Mytinger Lane, Pendleton, OR 97801
Telephone: 541-276-2344
Fax: 541-276-4414
Email: umatfish@oregontrail.net

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Confederated Tribes of the Umatilla Indian Reservation –Co-managers – Operators of acclimation and adult collection facilities.

Mitchell Act Hatcheries (ODFW)—Bonneville, Oxbow, Cascade

Bonneville Power Administration-- Funding for acclimation and monitoring and evaluation.

1.4) Funding source, staffing level, and annual hatchery program operational costs

Funding for the Umatilla Coho program is provided by Mitchell Act. The Umatilla River coho production goal is 1,000,000 smolts; an additional 500,000 smolts are also being released in the Umatilla for a total production of 1,500,000 smolts. Production is divided between two facilities; one million smolts are produced at Cascade Hatchery. Cascade Hatchery is staffed with five full time permanent positions, plus one nine-month seasonal position. The budget for the Cascade Hatchery portion of the production is $350,000. The additional half million smolts are produced at Oxbow Hatchery. Oxbow Hatchery is staffed with 4 permanent full time positions and one nine-month seasonal position. The budget for the Oxbow Hatchery portion of the production is $106,700. Broodstock for the coho program are collected and spawned at Bonneville Hatchery, the hatchery is staffed with fourteen permanent full time positions and 3 seasonal positions.

1.5) Location(s) of hatchery and associated facilities.

Adult Collection-- Coho broodstock are collected and spawned at Bonneville Hatchery, which is located on Tanner creek, near its confluence with the Columbia River in Multnomah County, Oregon.

Holding and Spawning--Coho broodstock are held and spawned at Bonneville hatchery.

Incubation and rearing (from green egg to smolt)-- Green eggs are transferred to Cascade and Oxbow Hatcheries for incubation and rearing. Cascade Hatchery is located on Eagle creek, approximately two and a half miles west of Cascade Locks, the main facility is located in Multnomah County and the intake structure is located in Hood River County, Oregon. Oxbow Hatchery is located on Herman creek and is approximately one mile East of Cascade Locks in Hood River County, Oregon.

Acclimation to release-- Juvenile coho are transferred to the Pendleton acclimation facility for acclimation and release into the Umatilla River. The Pendleton acclimation facility is located on the Umatilla River at RM 56 in Umatilla County, Oregon.

1.8) Type of program.

The Umatilla Coho program is a reintroduction program.

1.9) Purpose (Goal) of program.

The goal of the Umatilla River Coho Program is to provide ocean and in river harvest opportunities.

1.8) Justification for the program.

The Umatilla River hatchery coho program is intended to re-introduce coho to the Umatilla River and to provide harvest opportunities, while rebuilding and maintaining adequate hatchery and natural production.

1.9) List of program "Performance Standards"

The Performance Standards for the program are currently under revision in the Sub-Basin planning process and will submitted when the process is completed.

1.18) List of program "Performance Indicators", designated by "benefits" and "risks"

The Performance indicators for the program are currently under revision in the Sub-Basin planning process and will submitted when the process is completed

1.10.1) "Performance Indicators" addressing benefits.

1.10.2) "Performance Indicators" addressing risks.

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

All broodstock for the program are collected at Bonneville Hatchery.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		0
Unfed Fry		0
Fry		0
Fingerling		0
Yearling	Pendleton (RM56)	1,500,000

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Total adult coho returns to Three Mile Falls Dam since 1987 have ranged from 29 to 22,872 (Table 1).

1.13) Date program started (years in operation), or is expected to start.

The Coho program was initially started in 1966 and was abandoned in 1970. The program resumed in 1987 with approximately 1 million smolts released per year until 1996 when the program was increased to 1.5 million smolts released per year (Table 2).

1.14) Expected duration of program.

This is an on-going program.

1.15) Watersheds targeted by program.

The Umatilla Coho Program targets hatchery releases in the mainstem of the Umatilla River.

1.16) Indicate actions considered for attaining program goals, and reasons why those actions are not being proposed.

Managers are currently reassessing hatchery performance goals in the subbasin planning process. When this process is completed, the revised goals and alternative actions will be submitted. Current actions are mandated by US vs Oregon.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

4d rule research permit applications have been submitted to NMFS for the following:

- The Umatilla River Outmigration and Survival Study operates under permit # OR2004-1408.

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.
:

Adult age class structure: See Table 6
Sex ratio: See Table 5
Size range:
Migrational timing: See Table 7
Spawning range:
Spawn timing: See Table 7
Juvenile life history strategy, including smolt emigration timing: See Table 7

- Identify the ESA-listed population(s) that will be directly affected by the program.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

Umatilla River Summer Steelhead (stock 091) – included as part of the Mid-Columbia ESU - listed as "Threatened" under the federal ESA.
Umatilla River bull trout are included as part of the Columbia distinct population segment listed as Threatened under the federal ESA.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- **Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds.**

Chilcote (Unpublished draft) identifies the wild Umatilla summer steelhead viable population threshold at 333. Since 1988, wild adults available for spawning have exceeded 600.
The U.S Fish and Wildlife Service bull trout recovery plan for the Umatilla/Walla Walla Recovery Unit (2002) list recovery criteria for the Umatilla River. Recovery criteria for the Umatilla River core area are to maintain 500 to 1,000 spawning adults annually for at least two generations (i.e.,10 to 14 years) The redd count average for the last four years (1999-2002) in the North Fork Umatilla River equates to a population estimate of 281 spawning adults.

- **Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.**

Adult returns to Three Mile Dam and smolt outmigrant estimates of naturally produced steelhead are the primary measurement of productivity used (see Table 3). Other measures of productivity (monitoring and enumeration of redd counts, and juvenile abundance estimates) have been examined without acceptable results.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

The number and percent of adult steelhead available to spawn of wild and hatchery origin since 1988 is presented in Table 5. Total natural adult return numbers to Three Falls Mile

Dam have ranged from 725 in 1990-91 to 3,659 in 2001-02 (Table 3).

- **Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.**

The percent of adults available to spawn that were of hatchery origin has ranged from 6.9% of the total run in 1988, to a high of 58.9% in 1997 with a mean of 27.2% (1988-1998; Table 8).

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take

The Umatilla Summer Steelhead program currently collects 100 unmarked steelhead to provide the egg needs for the hatchery program.
Operation of the adult collection and enumeration facility, may lead the incidental of listed fish.

- **Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take**.

The Three Mile Falls Dam adult collection facility is operated on a daily basis from August 16 until December 1st. During this time period the facility is being operated to collect fall chinook and summer steelhead broodstock and to enumerate and record biological data on all returning salmonids including coho. All adults collected are anesthetized with CO2, fish not collected for broodstock are transferred to recovery tanks prior to release back into the Umatilla River. Beginning December 1st the trapping facility is operated for five days open the trapping facility is then closed for nine days. Returning adults are allowed to volitional migrate upstream when the trap is not being operated and adults returns are video enumerated. During this time period the trap is operated to collect summer steelhead and spring chinook broodstock, and to collect biological data. Trapping and transportation of all salmonids is implemented when the passage flow criteria of 150cfs for 30 days after release cannot be met. Adults are transported as high in the basin as possible within a 10-degree water temperature differential. The ladder and trap are not operated from July 15 to August 16. This time period has been given the lowest priority for stored water in McKay Reservoir designated for fish flow augmentation and made available through the Umatilla Basin Water exchange project, which results in the river being dewatered during this time period during most years.

- **Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish**.

Table 10 provides the numbers of Umatilla summer steelhead collected and spawned for broodstock needs for the program.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

- Outmigration and Survival Study - As per the 4d rule research application, we will reduce numbers collected by adjusting the sample times and avoid sampling when large numbers of natural steelhead are passing through the sampling facility. To reduce the number of mortalities from fish jumping out of the sample tank or from other areas, we will apply covers and screens to prevent escape and monitor the facility closely. Monitoring information is mostly obtained through remote interrogation of tags, without any handling.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.8) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

3.9) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

1) CTUIR. 1994. Wildlife Mitigation Plan (Draft) May 1996, Columbia Basin Salmon Policy. 1995 pg 9-10, and Water Assessment Report;
2) NMFS - Salmon & Steelhead Enhancement Plan for the Washington and Columbia River Conservation areas.Vol 1. chpt 4, 37pgs;
3) Reeve, R. 1988. Umatilla River Drainage Anadromous Fish Habitat Improvement Plan; 4)CTUIR/ODFW. 1990. Umatilla Hatchery Master Plan;
5) OWRD. 1988. Umatilla Basin Report;
6) BOR. 1988. Umatilla basin Project Planning Report,
7) Umatilla County - Comprehensive Plan. 1983, chpt 8;
8) USNF - Umatilla National Forest Land & Resource Management Plan. 1990, chpt 2, pg 13. and Final EIS. 1990, chpt III, pgs 59-62;
9) CTUIR/ODFW. 1990. Umatilla River Subbasin Salmon and Steelhead Production Plan;
10) Boyce, R. 1986. A Comprehensive Plan for Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin; 11)USFWS & NMFS. 1982. Umatilla R. Planning

Aid Report.
11) USBR and BPA. 1989. Umatilla Basin Project. Initial project workplan presented to the NWPPC, May 1989.

This HGMP is consistent with these plans and commitments.

3.10) Relationship to harvest objectives.

3.3.3 Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available..

The Umatilla River coho program contributes to fisheries in the Columbia and Umatilla Rivers. Current ocean fisheries only allow for retention of adipose fin clipped fish and 95% of the Umatilla releases are unmarked.

3.11) Relationship to habitat protection and recovery strategies.

The Umatilla coho Program is a part of an overall Umatilla Basin Salmon and Steelhead Restoration Program. In addition to on-going passage and hatchery operations, restoration efforts include ongoing projects that enhance stream and riparian habitat as well as monitor and evaluate the hatchery and natural components of the restoration program.
Factors limiting the natural production of coho in the Umatilla River Basin include channelization, low or no summer flows, warm water temperatures, sediment, and poor habitat diversity caused by urban and rural development/land management practices. Ocean conditions and the mortalities and stress from the operation of hydropower projects on the mainstem Columbia River are important factors outside the basin. There continues to be degradation to fish habitat in these areas that hampers improvement efforts.

3.7) Ecological interactions.

- Interactions with species that could negatively impact program: a) bird predation during peak smolt migration periods each spring; and b) Northern Pikeminnow and smallmouth bass - predation during smolt migration periods.

Interactions with species that could be negatively impacted by program: Large numbers of hatchery coho smolts tend to not migrate out of the system immediately after acclimation and release, potential competing with wild juvenile *O. mykiss.* Naturally produced coho juveniles have the potential to compete with native Umatilla river species(*O. mykiss*, bull trout, margined sculpin, mountain whitefish and other non-game fish)for rearing space.

Interactions with species that could positively impact program: Carcasses from returning coho salmon add to the Umatilla River subbasin's nutrient recharge cycle. Hatchery coho smolts could add to the food base for bull trout.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Cascade Hatchery – Water rights for Cascade Hatchery total 45 CFS from two separate locations on Eagle Creek. The first location is the hatchery intake which accounts for 35 CFS and the second location is the hatchery emergency pump which accounts for the remaining 10 CFS.

During normal operations, all raceways are supplied with single-pass water. During periods of extreme low water flow in Eagle Creek, a re-use pump is activated that recycles approximately 3500 gpm from the rearing pond discharge and mixes it with available water from the main hatchery intake. The recycled water accounts for about one third of the water entering the ponds. Creek flows are rarely encountered that require the use of the re-use pump. The pump was utilized in the summer of 2003 and previous to that in 1983.

Water quality remains high throughout the year with problems only during flood events. Water temperatures range from 32 to 45 during the winter and spring and 45 to 69 degrees Fahrenheit during the fall and summer.

Small mesh screens are placed in the intake from May 1st to Oct 1st of each year. Large mesh screens are used the remainder of the years. Compliance with NMFS screening criteria needs to be addressed when funds are available.

Spring water is also plumbed to the hatch house and is capable of providing up to 100 gpm for incubation purposes. The water quality from the spring is consistently high with temperatures throughout the year ranging from 45 to 49 degrees Fahrenheit. This spring is shared with the US Forest Service for domestic drinking water to campgrounds and public restrooms. The spring also provides drinking water to the hatchery and hatchery residences.

During cleaning operations, pond effluent is diverted to a pollution abatement pond. All hatchery effluent is monitored and reported quarterly under a National Pollutant Discharge Elimination System (0300J) permit. All conditions of the permit are administered within ODFW and regulated by the Oregon Department of Environmental Quality.

Oxbow Hatchery – Hatchery has water rights to 10 CFS of pathogen free spring water and Lower Herman Cr. (LHC) rearing site has a total of total 100 CFS combined use of Herman Cr. water with our Upper Herman Cr. rearing site.

During normal operations at both sites, all raceways are supplied with single-pass water that runs through two ponds in a series.

Water quality is high in both sites throughout the year with some minor problems at the LHC site during winter flood events. The Oxbow site water temperature is a constant 45 degrees and LHC water fluctuates between 38 degrees for a low in the winter and 54 degrees Fahrenheit for a high in the summer. The limitation to Oxbow Hatchery water is that the springs are seasonally tied to the rain water year and consequently can have summer flows as low as 300 gpm. LHC's limitations are that we pass adult fish above our intake to spawn; these fish carry pathogens that are transmitted to the juvenile fish at our rearing sites. Oxbow Hatchery and LHC neither one have NPDES permits because each site raises less than 20K pounds of fish each year.

Bonneville Hatchery -- Bonneville Hatchery has water rights to 50 CFS of water from Tanner Cr. Water quality is high. Temperatures range from 32 to 55 degrees, September recording the highest temperature and February the lowest. Limitations are as follows; Tanner Cr. water is dependent on rainfall and snowpack which effects water temperature and available CFS. During high water adult salmon and steelhead can pass above the Tanner Cr. intake to spawn. These fish have been known to carry IHN and have infected programs at Bonneville. Tanner Cr. location subjects itself to very cold weather which results in minus 32 degree temperatures and intake problems resulting from anchor ice and slush build up and potential loss of flow. A secondary source of water for Bonneville hatchery is a well field located Robbins Island within the confines of the Bonneville Dam / Corp of Engineers Project. Originally seven wells operated to produce 18,000 GPM. In recent years the well field has become depleted and now can only produce approximately 14,000 GPM. Plans are in effect for funding and surveys to resurrect these wells. Bonneville Hatchery operates under NPDES permit # 300J which allows treated
discharge from aquatic animal facilities which produce at least 20,000 pounds of fish per year, but have less than 300,000 pounds on hand at anyone time.

Pendleton Acclimation -- Water for the Pendleton juvenile acclimation and release facility is pumped directly from the Umatilla River. Water flow is approximately 1,600 gpm per pond. During the juvenile acclimation period (April), daily temperatures range from approximately 4.5 to 13.0^{o}C (40.0 to 55^{o}C). High sediment loads are experienced in some years during high flow conditions.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Bonneville Hatchery --Intake at this time is not NOAA fisheries screen compliant, but Oregon Dept. Fish and wildlife Fish Passage and Screening section is currently reviewing the work necessary to bring it into compliance.

Cascade Hatchery -- Eagle Creek is located in the Columbia River Gorge and has numerous waterfalls, impassible by migratory fish. A fish passage facility is not provided at the hatchery intake due to the limited spawning grounds available above the intake. This reduces exposure of natural fish to the hatchery intake screens.

Small mesh screens are placed in the intake from May 1st to Oct 1st of each year. Compliance with NMFS screening criteria needs to be addressed when funds are available.

Oxbow Hatchery -- Oxbow Hatchery spring water is the head waters of Little Herman Cr. and there are no fish that can get into the source water. Also the portion of Little Herman Cr. that runs from the hatchery and meets with Herman Cr. has an impassable falls to adult fish.

LHC intake at this time is not NOAA fisheries screen compliant, but Oregon Dept. of Fish & Wildlife's Fish Passage and Screening section is currently working to bring this intake into compliance.

Pendleton Acclimation -- Acclimation facility intake screens conform to NMFS screening guidelines to minimize the risk of entrainment of juvenile listed fish.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Bonneville Hatchery – Brood stock collection is conducted solely at Bonneville Hatchery. The facility consists of a vertical slot fish ladder, 2 adult holding ponds and a fish handling and sorting complex.
The water supply for the holding pond can be either well water or Tanner Creek. A low water alarm is located in the aeration channel where loss of flow from either source would be indicated.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Bonneville Hatchery – Bonneville Hatchery is equipped with a 1000 gallon fiberglass tank which can be used both for adult and smolt transfers or releases. Two-200 gallon portable tanks are used for onsite transfers.

5.3) Broodstock holding and spawning facilities.

Bonneville Hatchery – The dimensions of the holding pond are 38' wide by 123.25 ' long by 8.0' deep (approximately 32,785 cubic feet).

5.4) Incubation facilities.

Oxbow Hatchery -- Incubation facilities consist of thirteen double Marisource vertical incubator stacks using 4 gpm of spring water.

Cascade Hatchery -- Incubation facilities consist of 44 full stacks of vertical tray incubators (660 usable trays). Dual water supplies are available from Eagle Creek and hatchery spring water.

5.5) Rearing facilities.

Oxbow Hatchery – Early rearing (swim-up fry to 45 f/lb.) occurs at Oxbow Hatchery in concrete ponds (80` x 20` x 30") supplied with spring water, the fish are than moved to LHC and reared (45 f/lb. to 17f/lb.) on Herman Cr. water in two concrete ponds (110` x 36.75` x 2.75") that are in a series

Cascade Hatchery -- Rearing facilities at Cascade Hatchery consist of 30 concrete raceways with a volume of 3,200 cubic feet each.

5.6) Acclimation/release facilities.

Pendleton Acclimation -- Facility includes a water intake structure with automatic screen cleaner, pump station, standby generator, water head box/distribution system, storage building, four acclimation ponds (approximately 13,000 cubic feet each; one of which is used for acclimating summer steelhead), settling pond for pond cleaning, and water outlet and fish release structure. Water is supplied by gravity flow to the pump station where is pumped into the head distribution box. Water is then supplied by gravity from the head distribution box to the individual ponds. Water flow is approximately 1,600 gpm per pond. The operation of the facility has no effect on the critical habitat for summer steelhead.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Oxbow Hatchery – The only significant fish losses that occur are due to diseases: (Cold-water disease and Bacterial Kidney disease) carried by adult fish spawning above the intake and transmitted to fingerlings in the (LHC) rearing ponds.

Cascade Hatchery – Flood events can cause operational difficulties due to debris damage to intake facilities and by causing heavy silt loads in the water supply. Flood events cause increased monitoring of the water supply, rearing ponds and incubation facilities. Normally flood events do not result in significant fish mortality.

Severe cold weather can cause operational difficulties due to ice formation at key water passageways like the hatchery intake, rearing pond headbox and rearing ponds. Severe cold weather requires increased monitoring of the water supply, rearing ponds and incubation facilities. Normally, severe cold weather does not result in significant fish mortality.
Severe snow events can cause operational difficulties due to slush buildup at key water passageways like the hatchery intake, rearing pond head box and rearing ponds. Severe snow events require increased monitoring of the water supply, rearing ponds and incubation facilities. Severe snow events also greatly impair mobility and chances for outside assistance due to closed roads and treacherous conditions. In 1980 and 1996, severe snow events caused significant fish mortality at Cascade Hatchery.

Pendleton Acclimation -- There have been no operational difficulties or disasters at that have led to significant fish mortality.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Oxbow Hatchery – The hatchery will be staffed full-time, 24 hrs a day, 365 days a year, and equipped with low-water alarm system to help prevent catastrophic fish loss resulting from water system failure.

Cascade Hatchery – The hatchery is staffed full-time, 24hrs a day, 365 days a year. The water system is equipped with a low-water alarm system to help prevent catastrophic fish loss resulting from water system failure. Back up pumps are available for incubation and rearing. A 125kw generator is on site and available during power failures. Monthly fish health exams are conducted by ODFW fish health staff and necessary treatments are administered at their direction.

Pendleton Acclimation -- The Pendleton acclimation/release facility includes three vertical turbine pumps (two primary and one backup), standby generator, four acclimation ponds and outlet pipes on each pond for releasing fish. In case of power failure, a standby generator provides emergency power to the pump(s). If one of the two primary pumps fails, the backup pump will automatically start. In the event of a power or pump failure, a phone dialer will begin calling up to 10 telephone numbers (stating there is an alarm condition at the facility) until the alarm is acknowledged. Fish are released from the facility by pulling the dam boards, lowering the pond and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Bonneville Hatchery – The following are Coho transfers into Bonneville by year:

From	*Region*	*Year*
Trask	(coast)	1911, 57
Alsea	(coast)	1922
Coos	(coast)	1925
Ten-mile Lake	(coast)	1930, 34, 35, 40, 43
Lewis River	(Washington)	1933
Yaquina	(Coast)	1939
Klaskanine	(Columbia)	1941, 44, 45, 46, 48, 49
Big Creek	(Columbia)	1942, 54, 58, 60, 61, 71
Oxbow	(Columbia)	1942, 68, 77
Sandy	(Columbia)	1945, 57, 58, 59, 70
Toutle	(Washington)	1955, 56
Eagle Creek	(Clackamas)	1959
Cascade	(Columbia)	1970, 71, 73

6.2) Supporting information.

6.2.1) History

Bonneville Hatchery – Bonneville Hatchery started operations in 1909 on Tanner Creek. Fall Chinook being the major species present, Coho operations were inconsistent, substantial numbers did returned but not each year, causing propagation to be inconsistent.

Their was no concentrated effort to maintain a run of coho. Coho were transferred in from the Oregon coast in 1911. No data are available regarding other transfers between 1912 and 1921, or regarding on site collections of coho prior to 1924. Coho were collected in Tanner Creek in 1924, 1937, 1939, 1945, 1947, 1949, 1951, 1952, 1954, 1955, and 1957 through 2004. Early collections probable included wild Tanner Creek Coho.

6.2.2) Annual size.

Bonneville Hatchery – No natural production will be used as brood stock

6.2.3) Past and proposed level of natural fish in broodstock.

Bonneville Hatchery – No natural fish have been incorporated into the hatchery brood stock.

6.2.4) Genetic or ecological differences.

Bonneville Hatchery – N/A

6.2.5) Reasons for choosing.

Bonneville Hatchery – Endemic to Tanner Cr. and the lower Columbia River stock.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Bonneville Hatchery – All unmarked coho collected at Bonneville are checked for coded wire tag using a hand held detector. When found to be without coded wire tag the adult coho are placed in a 200 gallon portable tank and transported above Bonneville Dam where they are released.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Bonneville Hatchery –Adults

7.2) Collection or sampling design

Bonneville Hatchery – The brood stock collection goal is to collect healthy Tanner Cr. Coho from a cross section of the run based on historic levels per week.
Percentages of adults collected are based on numbers of adults needed to egg collection goals. Collect males and females in sufficient numbers to provide eggs for production and allow for any adult mortality.

7.3) Identity.

Bonneville Hatchery – Hatchery coho returning to Tanner Creek are identified by adipose fin clip. All adipose fin clipped coho are placed through a R8 Detector designed to detect the presence of Coded Wire Tags in large fish. Unmarked coho do stray into the Bonneville trapping facility. These salmon are removed directly after identification and transported above Bonneville Dam then released.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

Bonneville Hatchery – The 2003 brood stock goal is to collected 2353 females and 2502 males of Tanner Cr. origin.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults Females	Males	Jacks	Eggs	Juveniles
1992	5599	7486	1493		
1993	4161	4343	205		
1994	12559	14851	362		
1995	2417	2433	234		
1996	7143	7740	264	9,754,000	
1997	6568	8392	363	9,596,000	
1998	3067	2994	312	6,101,000	
1999	2280	2232	163	4,774,000	
2000	8936	9199	1037	5,441,000	
2001	19657	24870	767	6,946,000	
2002	11778	13873	1888	7,477,000	
2003	15417	19444	457	7,199,000	

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Bonneville Hatchery – Brood stock collected in excess of program are sold to vendor via the State of Oregon bid process.

7.6) Fish transportation and holding methods.

Bonneville Hatchery – There is no transportation of coho adults. Coho return directly to Bonneville's fish ladder via Tanner Cr... Fish ladder is open the fourth week of August. Fish are collected in the sorting channel, moved upstairs where they are sorted male female, jack and enumerated. Electric shock is used as an anesthetic. Coho are placed in one of the two holding ponds, with 5000 gpm flow.
Adult coho at Bonneville hatchery are treated *with* antibiotic erythromycin at a dosage rate of approx. 22 mg/kg body weight for bacterial kidney disease. This prophylactic and / or therapeutic treatment is to be administered by injection .

7.7) Describe fish health maintenance and sanitation procedures applied.

Bonneville Hatchery – The fish health monitoring plan is identical to that developed by the Integrated Hatchery Operations Team for the Columbia Basin anadromous Salmonid hatcheries (see Policies and Procedures for the Columbia Basin Anadromous Salmonid Hatcheries, Annual Report 1994.(Bonneville Power Administration). Annually examine brood stock for the presence of viral reportable pathogens. Number of individuals examined, usually 60 fish, will be great enough to assure a 95% chance of detection of a pathogen present in the population at the 5% level. American Fisheries Society "Fish Health Blue Book" procedures will be followed. Administration of erythromycin (Erythro 200 or Gallimycin 200) at a dosage rate of approximately 22 mg/kg body weight for treatment of bacterial kidney disease in adult coho salmon (stock #14) is performed at Bonneville Hatchery, Cascade Locks, Oregon. Administration of erythromycin (Erythro 200 or Gallimycin 200) at a dosage rate of approximately 22 mg/kg body weight for treatment of bacterial kidney disease and oxytetracycline HCL (Oxytet 100) at approximately 10 mg/kg for furunculosis in adult fall chinook salmon (stock #95). Adult Coho at Bonneville hatchery are treated with hydrogen peroxide at a ratio of 1 / 3500 for 90 minutes. This prophylactic treatment is administered to control fungus in brood stock held for up to 90 days

7.8) Disposition of carcasses.

Bonneville Hatchery – Spawned carcasses are frozen and transported weekly during the spawning (Oct, Nov.) season to a landfill for burial.
Un-spawned Carcasses are sold to private vendors through the State of Oregon bid process. Fish are sold in the round or with eggs skeins removed.
In recent years carcasses have been donated to the Oregon Food share program. Adult mortality are removed daily, enumerated, frozen, and then shipped to the landfill for burial.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for

adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Bonneville Hatchery – Electronic weir is located adjacent the entrance to the Bonneville Fish ladder. It is operated during the spawning season as a means to prevent adults from moving above the ladder entrance.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Bonneville Hatchery – Spawners are chosen by collecting a cross section of the run based on historic run time levels per week .Percentages per week of adults collected is based on numbers of adults needed plus mortality to meet egg collection goals. During coho spawning, new fish are brought in to the spawning room and sorted; male or female, ripe or green, green fish are sent to the holding pond while the ripe fish are spawned. Old fish or fish that have been held through the collection period are then spawned randomly as they are processed.

8.2) Males.

Bonneville Hatchery – No repeat spawners are used.

8.3) Fertilization.

Bonneville Hatchery – Jacks are spawned at a ratio 1-10 females, Spawning ratio is one male to one female

Describe spawning protocols applied, including the fertilization scheme used (such as equal sex ratios and 1:1 individual matings; equal sex ratios and pooled gametes; or factorial matings). Explain any fish health and sanitation procedures used for disease prevention.

8.4) Cryopreserved gametes.

Bonneville Hatchery – None are used.

If used, describe number of donors, year of collection, number of times donors were used *in the past, and expected and observed viability.*

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Bonneville Hatchery –

(*e.g. "A factorial mating scheme will be applied to reduce the risk of loss of within population genetic diversity for the small chum salmon population that is the subject of this supplementation program".*).

SECTION 9. INCUBATION AND REARING -

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Oxbow Hatchery –

Egg & Fry Data

Brood Year	Stock	Green Eggs Received	Eyed Eggs Received	Green-Eyed Survival (%)	Eyed-Ponding Survival (%)	Fry-Fingerling Survival (%)
2002	1402 CO	1,116,500	0	82.5 *	82.0	98.0
2003	1403 CO	722400	160000	75.6 *	92.0	No Data

- *Eggs destroyed due to BKD culling.
- 2002 is the first year we moved the program from egg to smolt at Oxbow Hatchery.

Cascade Hatchery –

Year	Egg Take	Green-Eyed Survival (%)	Eyed-Ponding Survival (%)
1990	5,845,268	94	96.7
1991	6,673,000	89	98.8
1992	4,368,000	86.5	98.8
1993	5,270,000	90.7	98.6
1994	9,901,000	85.3	99.2
1995	5,448,000	90.1	97.2
1996	10,711,000	78	nya
1997	9,596,000	92.2	94.3
1998	7,099,730	91.9	97.7
1999	2,021,152	71.6	97.9
2000	6,313,210	92.4	97.1

2001	6,946,000	92.9	98.1

Comments:

Data above is combined for Cascade and Bonneville Hatcheries. Prior to 1996, broodstock were collected and spawned at Cascade Hatchery. Broodstock were collected and eggs taken at each hatchery 1996, 1998, 1999, 2000. In 1997 and 2001, broodstock collection and egg take only occurred at Bonneville. Green-eyed egg survival figures are weighted averages of the two hatcheries for 1996, 1997, and 2001.

9.1.2) Cause for, and disposition of surplus egg takes.

Oxbow Hatchery – As seen by the asterisk in the above chart, we started culling for BKD disease in 2001. As a result of this we are keeping enough extra eggs (12% ave.) to cover the culling process. The eggs that are culled are destroyed, frozen, and disposed of at a landfill. If surplus negative eggs are still on hand at the eyed stage, a percentage from each spawn group is taken to minimize the impact to one group.

Cascade Hatchery – Cascade Hatchery collects surplus eggs to safeguard production due to an aggressive BKD culling program. Our goal is to raise BKD negative coho. When BKD test results are available, the positive eggs are bagged, frozen and sent to a sanitary landfill. If surplus negative eggs are still on hand at the eyed stage, a percentage from each spawn group is taken to minimize the impact to one group.

9.1.3) Loading densities applied during incubation.

Oxbow Hatchery –

Brood Year	Incubator Type	Number of Units	Flow (gpm)	Loading-Eying	Loading-Hatching
2002	Incubator Trays	165	4	5,000	5,000
2003	Incubator Trays	176	4	5,000	5,000

Cascade Hatchery – Egg size – 84 / oz.; Incubator flows – 5 gpm; 10,500 green eggs per tray; 8,250 eyed eggs per tray.

9.1.4) Incubation conditions.

Oxbow Hatchery – Eggs and fry are observed daily during incubation. We have no silt problems because we use spring water. Temperature units are monitored for development.

Cascade Hatchery – Water temperatures are monitored with thermographs. Silt management is accomplished by visual inspection and rodding of trays when needed. Cumulative temperatures are recorded daily.

9.1.5) Ponding.

Oxbow Hatchery – Button up happens approximately from 1150 to 1250 TU's. A visual check is performed to determine degree of button up. Ponding normally occurs in late January and is a forced ponding. Lengths are not taken at ponding.

Cascade Hatchery – Button up happens approximately from 1150 to 1250 TU's. A visual check is performed to determine degree of button up. Ponding normally occurs in late February through March and is a forced ponding. Once ponded, feeding is held off for up to 4 days for maximum absorption of yolk sac. Lengths are not taken at ponding.

9.1.6) Fish health maintenance and monitoring.

Oxbow Hatchery – Oxbow Hatchery is operated in compliance with ODFW Fish Health Management Policy and the Integrated Hatchery Operations Team (IHOT) fish health guidelines.
Green eggs are water hardened in iodophor, treated with Hydrogen Peroxide for fungus, and incubated at Bonneville Hatchery. They are then shocked and shipped to Oxbow Hatchery.
Eyed eggs are disinfected with iodophor as per label instructions. They are then picked and counted by machine with some hand picking by the crew. Yolk sac malformation is not a problem at Oxbow Hatchery.

Cascade Hatchery – Cascade Hatchery is operated in compliance with ODFW Fish Health Management Policy and the Integrated Hatchery Operations Team (IHOT) fish health guidelines.

Green eggs are water hardened in iodophor as per label. Eyed eggs brought into the facility are disinfected with iodophor as per label. Eggs are treated with formalin three times a week for fungus control using a drip method. Visual monitoring is conducted daily to detect disease or other problems. Eggs are shocked at approximately 450 TU's. Eggs are counted and picked by machine with some hand picking by hatchery crew. Yolk sac malformation is not a problem at Cascade Hatchery.

All family egg groups are numbered and tracked throughout BKD testing and culling phases. An alarm on the water supply and daily monitoring of eggs minimizes risk. Silt is removed by rodding of the trays. Egg mortality is bagged, frozen and sent to a sanitary landfill.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Oxbow Hatchery – Eggs are incubated on spring water so there are no silt problems and each stack of incubators is individually alarmed for low water. Plus as mentioned earlier the hatchery is manned 24 hrs a day 365 day a year.

Cascade Hatchery – All eggs are handled in a manner to reduce any adverse effects. As mentioned previously, the hatchery is staffed at all hours and alarms systems are in place to reduce the risk of loss due to water flow issues.

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Oxbow Hatchery –

Fish Survival Data

YEAR	Fry to Fingerling	Fingerling to Smolt
1994		91.90%
1996		99.40%
1997		95.90%
1998		96.90%
1999		96.50%
2000		102.00%
2001		100.00%
2002*	89.90%	96.90%

* First year the program was moved to Oxbow Hatchery from Cascade Hatchery

Cascade Hatchery –

YEAR	fry to fingerling	fingerling to smolt
1990	92.1 %	99.94%
1991	90.6%	99.89%
1992	91.3%	84.6%
1993	86.0%	99.88%
1994	93.9%	98.75%
1995	70.0%	97.0%
1996	85.3%	96.8%

1997	80.9%	99.25%
1998	90.0%	99.46%
1999	88.8%	99.39%
2000	97.1%	98.05%
2001	88.5%	99.41%

Comments:

Data above is combined for Cascade and Bonneville Hatcheries. Prior to 1996, broodstock were collected and spawned at Cascade Hatchery. Broodstock were collected and eggs taken at each hatchery 1996, 1998, 1999, 2000. In 1997 and 2001, broodstock collection and egg take only occurred at Bonneville. Green-eyed egg survival figures are weighted averages of the two hatcheries for 1996, 1997, and 2001.

9.2.2) Density and loading criteria (goals and actual levels).

Oxbow Hatchery – Rearing standard limits for Coho are dependant upon fish size and water temperature. Using Coho at 50 f/lb and a water temp. of 48 degrees, IHOT recommends 8 lbs./gpm. Using lbs. per cubic foot, IHOT recommends a factor ranging from 0.3 to 1.7 depending on fish size.
Rearing densities at Lower Herman Cr site fall between 1.11 lb /ft^3 and 1.38 lb/ft^3 at release. Loading is 7-8.5 pounds/gpm at transfer.

Cascade Hatchery – Rearing standard limits for coho are dependant upon fish size and water temperature. Using coho at 50 f/lb and a water temp of 48 degrees, IHOT recommends 8 lbs./gpm. Using lbs per cubic foot, IHOT recommends a factor ranging from 0.3 to 1.7 depending on fish size. Rearing densities at Cascade Hatchery fall between 1.43 lb/ ft^3 and 1.57 lb/ ft^3 at release. Pounds per gallon per minute ranged from 13.0 to 16.6 at transfer.

9.2.3) Fish rearing conditions

Oxbow Hatchery – Water temperatures are recorded daily by thermograph, loading densities monitored with monthly sampling, weekly pond cleaning, and daily mortality removal.

Cascade Hatchery – Water temperatures are recorded daily by thermograph, loading densities monitored with monthly sampling, ponds cleaned weekly, and mortality removed daily.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Oxbow Hatchery – Fish/lb MM

	Fish/lb	MM
Oct	25.7	117
Nov	22.8	122
Dec	19.8	127
Jan	16.3	136
Feb	16.8	136

Cascade Hatchery –

Month	Fish/pound
March	829
April	392
May	190
June	115
July	75
August	39
September	26.8
October	22.3
November	20.4
December	19.1
January	17.9
February	16.6
March	16.3

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Oxbow Hatchery – See 9.2.4

Cascade Hatchery – See 9.2.4

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Oxbow Hatchery – Fish are fed a dry diet of Nutra Plus Fry or Clark's Fry throughout the day as needed. When fish are first ponded they are presented with feed every hour. As they grow, rations per interval are increased while frequency decreases. Fish are fed according to a growth program to reach production goals. The % body weight/day ranges from 0.3 to 3.0. Average yearly food conversion is 1.07.

Cascade Hatchery – Fish are hand fed a dry diet of either BioVita, Bio Dry 1000, Nutra Fry or Nutra Plus throughout the day as needed. When the fish are first ponded they are presented with feed every hour. As they grow, rations per interval are increased while frequency decreases. Fish are feed to satiation until 300 F/lb, when they are placed on a growth program to reach production goals. %B.W./day range is from 0.3 to 3.6. Average yearly food conversion is 1.05.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Oxbow Hatchery – The fish health monitoring plan is identical to that developed by the Integrated Hatchery Operations Team for the Columbia Basin anadromous Salmonid hatcheries (see Policies and Procedures for the Columbia Basin Anadromous Salmonid Hatcheries, Annual Report 1994. (Bonneville Power Administration). Conduct examination of juvenile fish at least monthly and more often as necessary. A representative sample of health and moribund fish from each lot of fish will be examined. The number of fish examined will be at the discretion of the fish health specialist. Investigate abnormal levels of fish loss when they occur. Appropriate actions including drug or chemical treatments will be recommended as necessary. If a bacterial pathogen requires treatment with antibiotics a drug sensitivity profile will be generated when possible. Findings and results of fish health monitoring will be recorded on a standard fish health reporting form and maintained in a fish health database. Fish culture practices will be reviewed as necessary with facility personnel. Where and when pertinent, nutrition, water flow and chemistry, loading and density indices, handling, disinfecting procedures, and treatments will be discussed. Daily fish health observation, daily mortality is removed and recorded, diseases are diagnosed and prescribed a treatment by fish pathology through routine inspections, and equipment is disinfected.

Cascade Hatchery – The fish health monitoring plan is identical to that developed by the Integrated Hatchery Operations Team for the Columbia Basin anadromous Salmonid hatcheries (see Policies and Procedures for the Columbia Basin Anadromous Salmonid Hatcheries, Annual Report 1994. (Bonneville Power Administration).

Conduct examination of juvenile fish at least monthly and more often as necessary. A representative sample of health and moribund fish from each lot of fish will be examined. The number of fish examined will be at the discretion of the fish health specialist. Investigate abnormal levels of fish loss when they occur.

Appropriate actions including drug or chemical treatments will be recommended as necessary. If a bacterial pathogen requires treatment with antibiotics a drug sensitivity profile will be generated when possible. Findings and results of fish health monitoring will be recorded on a standard fish health reporting form and maintained in a fish health database. Fish culture practices will be reviewed as necessary with facility personnel. Where and when pertinent, nutrition, water flow and chemistry, loading and density indices, handling, disinfecting procedures, and treatments will be discussed Daily fish health observation, daily mortality removal and tracking, prophylactic Aquamycin treatments for BKD, formalin treatments for fungus control, monthly fish health checks by pathology, equipment disinfection.

Disease Treatment Cont. Oxbow & Cascade Hatchery's--Treatment for pathogens at Umatilla Hatchery vary depending on the life stage of the fish and the disease agent being treated. Green eggs are routinely water hardened in diluted buffered iodophor. Flush treatments of 1:600 formalin for 15 minutes are given to eggs three to five times per week for fungus prevention. Static treatments of juvenile fish with formalin for controlling external parasites such at trichodinids or Chilodonella and for fungus can also occur. Juvenile fish are treated for bacterial infections when needed with oxytetracycline of florfenicol medicated feed according to label, under veterinary prescription or under an Investigational New Animal Drug Permit. Juvenile chinook and coho are given prophylactic medicated feedings at a rate of 100 mg erythromycin/kg fish /day for 21 days. Administration of erythromycin appears to control outbreaks of bacterial kidney disease later in the rearing cycle.

Table 9.2.7 Five year disease history[a] (1999 to present) by fish stock at Bonneville, Oxbow and Cascade Fish Hatcheries. ChF = Fall Chinook Salmon, Co = Coho Salmon. Stock codes are 91 = Umatilla River, 14 = Tanner Creek (Columbia River).

Hatchery Programs (stock code and species)

Disease or Organism	91 ChF	14 Coho
IHN Virus	No	No
EIBS Virus	No	Yes
Aeromonas salmonicida	No	No
Aeromonas/Pseudomonas	Yes	Yes
Flavobacterium psychrophilum	Yes	Yes
Fl. columnare	No	No
Fl. branchiophilum	No	No
Renibacterium. salmoninarum	Yes	Yes
Yersinia ruckeri	No	No
Ichthyobodo	No	Yes
Gyrodactylus	No	No
Ichthyophthirius multifilis	No	No
Gill Ameba	No	No

Trichodinids	Yes	Yes
Chilodonella	No	No
Nanophyetus salmincola	No	No
Coagulated Yolk Disease	Yes	Yes
External Fungi.	Yes	Yes
Internal Fungi	Yes	Yes

[a] Yes indicates detection of the pathogen but in many cases no disease or fish loss was associated with presence of the pathogen. No indicates the pathogen has not been detected in that stock.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Oxbow Hatchery – N/A

Cascade Hatchery – N/A

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

Oxbow Hatchery – Fish are reared under natural water temperatures and light conditions.

Cascade Hatchery – Fish are reared under natural water temperatures and light conditions.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

Oxbow Hatchery – **F**ish will be reared to a size, and released at a time, to encourage out-migration, and eliminating residualiztion. All fish will be marked 100%. Strict health monitoring, prevention, and treatment protocols will be used.

Cascade Hatchery – **F**ish will be reared to a size, and released at a time, to encourage out-migration, and eliminating residualiztion. All fish will be marked 100%. Strict health monitoring, prevention, and treatment protocols will be used.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				
Yearling				

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Umatilla River
Release point: Pendleton Acclimation (RM 56.0)
Major watershed: Umatilla River
Basin or Region: Mid-Columbia River

10.3) Actual numbers and sizes of fish released by age class through the program.

For existing programs, provide fish release number and size data for the past three fish generations, or approximately the past 12 years, if available. Use standardized life stage definitions by species presented in ***Attachment 2****. Cite the data source for this information.*

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988								
1989								
1990								
1991								
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
Average								

Data source: (Link to appended Excel spreadsheet using this structure. Include hyperlink to main database)

10.4) Actual dates of release and description of release protocols.

Provide the recent five year release date ranges by life stage produced (mo/day/yr). Also indicate the rationale for choosing release dates, how fish are released (volitionally, forced, volitionally then forced) and any culling procedures applied for non-migrants.

10.5) Fish transportation procedures, if applicable.

Oxbow Hatchery –Fish are transported by truck in insulated and oxygenated tanks ranging in size from 2,000 to 5,000 gallons, at 1 pound of fish /gallon. Transportation time to Pendleton acclimation is approximately 3 ½ hours.

Cascade Hatchery – Fish are transported by truck in insulated and oxygenated tanks ranging in size from 2,000 to 5,000 gallons, at 1 pound of fish /gallon. Transportation time to Pendleton acclimation is approximately 3 ½ hours.

10.6) Acclimation procedures (*methods applied and length of time***).**

Pendleton Acclimation -- At Pendleton, the effluent screen is pulled and the fish are allowed to volitionally swim over a notched dam board and down the outlet channel directly into the Umatilla River. The fish are taken off feed one to two days prior to the remaining fish being released. The effluent dam boards are removed and the pond is lowered. The fish are then crowded out of the pond using a seine.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

Oxbow Hatchery –All fish marked 100% AD. Two groups of 25,000 ea. Marked and tagged ADCWT.

Cascade Hatchery –All fish marked 100% AD. One groups of 25,000 tagged ADCWT.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Pendleton Acclimation –Excess fish at this point in the program will be released.

10.9) Fish health certification procedures applied pre-release.

Pendleton Acclimation – (Fish Sampled at hatchery prior to transfer)

Oxbow Hatchery – The fish health monitoring plan is identical to that developed by the Integrated Hatchery Operations Team for the Columbia Basin anadromous Salmonid hatcheries (see Policies and Procedures for the Columbia Basin Anadromous Salmonid Hatcheries, Annual Report 1994. (Bonneville Power Administration).

Determine fish health status prior to release or transfer to another facility. The exam may occur during the regular monthly monitoring visit, i.e. within 1 month of release.

Cascade Hatchery – The fish health monitoring plan is identical to that developed by the Integrated Hatchery Operations Team for the Columbia Basin anadromous Salmonid hatcheries (see Policies and Procedures for the Columbia Basin Anadromous Salmonid Hatcheries, Annual Report 1994. (Bonneville Power Administration).

Determine fish health status prior to release or transfer to another facility. The exam may occur during the regular monthly monitoring visit, i.e. within 1 month of release.

10.10) Emergency release procedures in response to flooding or water system failure.

Pendleton Acclimation -- The Pendleton acclimation/release facility includes three vertical turbine pumps (two primary and one backup), standby generator, four acclimation ponds (one of which is used for acclimating summer steelhead), and outlet pipes on each pond for releasing fish. In case of power failure, a standby generator provides emergency power to the pump(s). If one of the two primary pumps fails, the backup pump will automatically start. In the event of a power or pump failure, a phone dialer will begin calling up to 10 telephone numbers (stating there is an alarm condition at the facility) until the alarm is acknowledged. Fish are released from the facility by pulling the dam boards, lowering the pond and crowding out the fish using a seine. The fish then exit the pond through an underground pipe to the Umatilla River. In an extreme emergency, the fish can be released in this way.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Pendleton Acclimation –

Coho are released in area’s that are <u>not</u> primary rearing habitat for Steelhead

TABLES AND FIGURES:

Table 1

Coho Annual Run Counts To Three Mile Falls Dam			
Year	Adults	Jacks	Total
1987	0	29	29
1988	923	761	1684
1989	4108	521	4629
1990	410	512	922
1991	1733	187	1920
1992	355	174	529
1993	1531	18	1549
1994	984	62	1046
1995	946	53	999
1996	618	24	642
1997	670	137	807
1998	3081	192	3273
1999	3702	205	3907
2000	4654	1276	5930
2001	22792	80	22872
2002	3820	971	4791
2003	8319	667	8986

Table 2. Hatchery releases of coho salmon in the Umatilla River.

Year of Release	Hatchery	No. Released	No./lb.	Stock
1966	Little White Salmon	500,000	1312.0	Little White Salmon
1967	Little White Salmon	200,000	1087.0	Little White Salmon
1967	Cascade	500,000	Eggs	Tanner Creek
1968	Little White Salmon	750,000	Eggs	Little White Salmon

1969	Carson	200,040	23.0	Little White Salmon
1987	Cascade	948,549	13.5-14.0	Tanner Creek
1988	Cascade	996,433	16.6	Tanner Creek
1989	Cascade	986,906	15.3-18.2	Tanner Creek
1990	Cascade	988,928	11.2-14.7	Tanner Creek
1991	Cascade	955,629	15.4-17.1	Tanner Creek
1992	Cascade	489,165	15.7	Tanner Creek
1992	Cascade	472,221	15.5	Tanner Creek
1993	Cascade	437,884	17.5	Tanner Creek
1993	Cascade	454,794	17.6	Tanner Creek
1994	Cascade	465,883	17.1	Tanner Creek
1994	Cascade	418,222	18.1	Tanner Creek
1995	Cascade	502,105	14.7	Tanner Cr. & Umatilla R
1995	Cascade	497,449	14.5	Tanner Cr. & Umatilla R
1995	Sandy	191,854	13.9	Tanner Creek
1995	Lower Herman Cr.	322,858	20.3	Tanner Creek
1996	Lower Herman Cr.	465,769	17.9	Tanner Creek
1996	Cascade	500,005	18.0	Tanner Creek
1996	Cascade	511,609	18.6	Tanner Creek
1997	Klaskanine	81,445	18.1	Tanner Creek
1997	Gnat Creek	881,341	15.3	Tanner Cr. & Sandy R.
1997	Lower Herman Cr.	438,153	16.0	Umatilla River
1998	Cascade	1,078,436	16.8	Tanner Creek
1998	Lower Herman Cr.	528,350	16.3	Tanner Creek
1999	Cascade	1,010,608	17.9	Tanner Creek
1999	Lower Herman Cr.	465,314	15.8	Tanner Creek
2000	Cascade	249,792	16.8	Tanner Creek
2000	Cascade	798,210	15.2	Tanner Creek
2000	Lower Herman Cr.	513,288	16.8	Tanner Creek
2001	Cascade	745,497	13.7	Tanner Creek
2001	Cascade	250,323	17.5	Tanner Creek
2001	Lower Herman Cr	478,739	17.5	Tanner Creek
2002	Cascade	249,684	14.7	Tanner Creek
2002	Cascade	185,018	14.0	Tanner Creek
2002	Cascade	644,680	14.2	Tanner Creek
2002	Lower Herman Cr.	542,475	15.6	Tanner Creek
2003	Cascade	249,988	16.3	Tanner Creek
2003	Cascade	591,349	15.0	Tanner Creek
2003	Cascade	188,971	15.4	Tanner Creek
2003	Lower Herman Cr	515,859	15.8	Tanner Creek

Table 3
Summer Steelhead Annual Run Counts

Year	Hatchery	Wild	Total
1966-67		1778	1778
1967-68		930	930
1968-69		1917	1917
1969-70		2298	2298

1970-71			
1971-72			
1972-73		2057	2057
1973-74		2640	2640
1974-75		2171	2171
1975-76		2534	2534
1976-77		1258	1258
1977-78		3080	3080
1978-79			
1979-80		2367	2367
1980-81		1298	1298
1981-82		768	768
1982-83		1264	1264
1983-84		2314	2314
1984-85		3197	3197
1985-86		2885	2885
1986-87		3444	3444
1987-88	166	2316	2482
1988-89	371	2104	2475
1989-90	246	1422	1668
1990-91	387	725	1112
1991-92	523	2246	2769
1992-93	616	1297	1913
1993-94	345	945	1290
1994-95	656	875	1531
1995-96	785	1296	2081
1996-97	1463	1014	2477
1997-98	903	862	1765
1998-99	751	1135	1886
1999-00	739	2153	2892
2000-01	1089	2573	3662
2001-02	1860	3659	5519
2002-03	960	2120	3080

Table 4. Total smolt-to-adult survival, parent:progeny, and parent:spawning escapement data for summer steelhead reared at Umatilla Hatchery, brood years 1991-1995.

Brood year	Race-way	Release location	Release date	Percent smolt-to-adult survival	Adult progeny produced	Spawning escapement	Parent-progeny ratio	Parent-Escapement ratio
91	M5A	Meacham Cr	050192	0.01	7	0	0.1	0.0
91	M5B	Meacham Cr	043092	0.02	13	13	0.3	0.3
91	M5C	Bon./Min.	032992	0.21	138	95	3.2	2.2
92	M5A	Bonifer	051393	0.08	52	38	1.4	1.0
92	M5B	Minthorn	041693	0.64	305	253	11.4	8.8
92	M5C	Bonifer	041893	0.63	284	217	11.4	8.1
93	M5A	Bonifer	051294	0.04	18	16	0.5	0.5
93	M5B	Minthorn	041494	0.47	234	195	7.1	5.9
93	M5C	Bonifer	041194	0.64	330	276	10.4	8.7
94	M8A	Bonifer	051295	0.27	131	113	4.2	3.6
94	M8B	Minthorn	041395	0.69	343	249	10.5	7.6
94	M8C	Bonifer	041195	1.20	581	505	18.3	15.9
95	M8A	Thornhollow	050996	0.14	68	58	2.5	2.1
95	M8B	Minthorn	041296	0.68	323	264	12.3	10.2
95	M8C	Bonifer	042496	0.30	149	128	5.5	4.7

Table 5. Disposition and Spawning Ground Data of Natural and Hatchery Summer Steelhead (STS) Returning to the Umatilla River above Three Mile Falls Dam, 1988-1999.

RUN YEAR (Fall/Spring)	1987 1988	1988 1989	1989 1990	1990 1991	1991 1992	1992 1993	1993 1994	1994 1995	1995 1996	1996 1997	1997 1998	1998 1999
Natural STS Enumerated at TMD	2315	2104	1422	724	2247	1298	945	875	1299	1014	862	1134
Hatchery STS Enumerated at TMD	165	370	245	387	522	616	345	656	782	1463	903	740
Natural and Hatchery STS Enumerated at TMD	2480	2474	1667	1111	2769	1914	1290	1531	2081	2477	1765	1874
Natural STS Sacrificed or Mortalities at TMD	20	12	40	2	3	4	0	0	8	5	2	1
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	69	51	33	73	95	70	74
Natural STS Taken for Brood Stock	151	158	92	99	237	129	93	86	107	100	86	110
Natural STS Spawned	31F	42F	25F	78	172	95	79	59	63	75	68	76
Hatchery STS Taken for Brood Stock	0	0	0	103	95	91	42	68	26	10	30	15
Hatchery STS Spawned	0	0	0	49	0	3	17	22	21	3	21	4
Natural Females Released above TMD	1436	1232			1193	875	642	602	863	689	550	716
Natural Males Released above TMD	708	702			814	290	210	187	321	220	224	308
Natural STS Released above TMD	2144	1934	1290	623	2007	1165	852	789	1184	909	774	1024
Hatchery Females Released above TMD	114	216			161	266	186	274	371	666	476	425
Hatchery Males Released above TMD	46	137			154	190	66	281	312	692	327	236
Hatchery STS Released above TMD	160	353	102	234	315	456	252	555	683	1358	803	661
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39
Natural STS Harvested above TMD-ODFW								0	0	0	0	0
Hatchery STS Harvested above TMD-ODFW						22	5	21	25	24	12	47
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548	713
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221	306
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769	1019
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454	382
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305	193
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759	575
Total STS Available for Spawning	2304	2287	1392	857	2322	1569	1074	1298	1803	2210	1528	1594
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002	1095
STS Redds Observed in Index Reaches	138	77	H W.	H W	135	H W.	64	74	119	138	126	218
Total STS Redds Observed	275	128	H W.	H W	300	H W.	224	126	150	149	217	270
Index Reaches Miles Surveyed	18.5	20	H W.	H W	21.4	H W.	21.4	21.4	21.4	21.4	21.4	21.4
Redds Per Mile in Index Reaches	7.5	3.9	H W.	H W	6.3	H W.	3.0	3.5	5.6	6.4	5.9	10.2
Total Miles Surveyed in Umatilla River	61.0	50.2	H W.	H W	67.2	H W.	65.8	35.0	34.4	24.6	38.0	35.0
Redds Per Mile in all Areas	4.5	2.5	H W.	H W	4.5	H W.	3.4	3.6	4.4	6.1	5.7	7.7

Harvest not determined and not subtracted from estimates of spawners, 1988-1982. H. W. = high water.
Assumes that harvest steelhead were 50% females and 50% males. No adjustments made for hook and release mortality.
Index reaches are in Squaw, NF Meacham, Buckaroo, Camp, and Boston Canyon Creeks and the SF Umatilla River.

/b These fish were transferred to Bonifer in November as subyearlings and were released the following spring as yearlings.

Table 6. Age summary of natural summer steelhead from the Umatilla River.

Return Year		Age 1.1	Age 1.2	Age 2.1	Age 2.2	Age 2.3	Age 3.1	Age 3.2	Age 4.1	Total
1994	n=	0	2	24	26	0	5	6	0	63
	%=	0	3.2	38.1	41.3	0	7.9	9.5	0	100
1995	n=	0	0	19	17	0	9	11	0	56
	%	0	0	33.9	30.4	0	16.1	19.6	0	100
1996	n=	0	0	28	8	0	7	1	0	44
	%	0	0	63.6	18.2	0	15.9	2.3	0	100
1997	n=	0	0	19	17	0	5	10	0	51
	%	0	0	37.3	33.3	0	9.8	19.6	0	100
1998	n=	1	1	33	11	1	4	0	1	52
	%	1.9	1.9	63.5	21.2	1.9	7.7	0	1.9	100

Juvenile years of freshwater growth from scales of adult steelhead returning to the Umatilla River.

Return Year		Age 1	Age 2	Age 3	Age 4	Total
1994	n=	2	50	11	0	63
	%=	3.2	79.4	17.4	0	100
1995	n=	0	36	20	0	56
	%	0	64.3	35.7	0	100
1996	n=	0	36	8	0	44
	%	0	81.8	18.2	0	100
1997	n=	0	37	15	0	51
	%	0	70.6	29.4	0	100
1998	n=	2	45	4	1	52
	%	3.8	86.5	7.7	1.9	99.9

Table 7. Life History table of steelhead

Mouth of the Umatilla to the mouth of McKay Creek (RM 0-50.5)

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding												
Spawning												
Incubation												
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x	x		

Mouth of McKay Creek to the mouth of Meacham Creek (RM 50.5-79) and mid-basin streams

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

Mouth of Meacham Creek to the forks (RM 79-89 and headwater streams)

Life History Stage	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Adult Migration	x	x	x	x	x	x	x	x				
Prespawning Holding					x	x	x	x				
Spawning						x	x	x				
Incubation						x	x	x	x			
Rearing	x	x	x	x	x	x	x	x	x	x	x	x
Juvenile Migration	x	x	x	x	x	x	x	x	x			

Table 8. The Number and Percent of Steelhead (STS) Available to Spawn Naturally that were of Hatchery Origin; Umatilla River, 1988-1999.

BROOD YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural Female STS Available to Spawn	1436	1232			1193	872	639	599	863	689	548
Natural Male STS Available to Spawn	708	702			814	288	208	185	321	220	221
Natural STS Available to Spawn	2144	1934	1290	623	2007	1160	847	784	1184	909	769
Hatchery Female STS Available to Spawn	114	216			161	242	173	253	339	637	454
Hatchery Male STS Available to Spawn	46	137			154	167	54	261	280	664	305
Hatchery STS Available to Spawn	160	353	102	234	315	409	227	514	619	1301	759
Total Female STS Available to Spawn	1550	1448			1354	1114	812	852	1202	1326	1002
Percent Spawners of Hatchery Origin	6.9	15.4	7.3	27.3	13.6	26.1	21.1	39.6	34.3	58.9	49.7
Percent Females Spawners of Hatchery Origin	7.4	14.9			11.9	21.7	21.3	29.7	28.2	48.0	45.3

Harvest not estimated 1988-1992. 1993-1999, Harvest estimate subtracted from total, assumes harvest of 50% females and 50% males

No adjustments made for catch and release mortality.

Table 9. Descriptive statistics for the steelhead fishery in the Umatilla River, run years 1993-94 through 1998-99. Catch statistics were based on creel surveys conducted in the lower river (Umatilla mouth to Three Mile Falls Dam) and upper river (Barnhart Bluffs to lower boundary of the CTUIR).

		Run year						
Statistic[a]	Fish origin[b] or creel area	93-94	94-95	95-96	96-97	97-98	98-99	Mean
Run size	WSTS	945	875	1296	1014	862	1133	1021
	HSTS	359	696	819	1529	994	739	856
Run composition (%)	WSTS	72	56	61	40	46	61	56
	HSTS	28	44	39	60	54	39	44
Catch composition (%)	WSTS	59	67	70	59	62	65	64
	HSTS	41	33	30	41	38	35	36
Number caught	WSTS	37	172	161	168	239	250	171
	HSTS	26	85	69	115	146	132	96
Percent of run caught	WSTS	3.9	19.6	12.4	16.6	27.7	22.1	17.1
	HSTS	7.2	12.2	8.4	7.5	14.7	17.9	11.3
Percent of run harvested	HSTS	5.3	8.7	7.3	5.9	10.4	13.7	8.6
Composition of lower river catch (%)	WSTS	49	67	64	59	49	50	56
	HSTS	51	33	36	41	51	50	44
Composition of upper river catch (%)	WSTS	71	66	75	60	78	75	71
	HSTS	29	34	25	40	22	25	29
Location of WSTS catch (%)	Lower Rr.	46	70	44	71	44	30	51
	Upper Rr.	54	30	56	29	56	70	49
Location of HSTS catch (%)	Lower Rr.	69	68	56	72	74	56	66
	Upper Rr.	31	32	44	28	26	44	34
Percent of WSTS run caught	Lower Rr.	1.8	13.7	5.4	11.9	12.2	6.6	8.6
	Upper Rr.	2.1	5.9	7.0	4.7	15.5	15.4	8.4
Percent of HSTS run caught	Lower Rr.	5.0	8.3	4.7	5.4	10.9	10.0	7.4
	Upper Rr.	2.2	3.9	3.7	2.1	3.8	7.8	3.9
Percent of HSTS run harvested	Lower Rr.	3.9	5.7	4.2	4.3	9.2	7.3	5.8
	Upper Rr.	1.4	3.0	3.1	1.6	1.2	6.4	2.8

[a] *Hatchery steelhead run = number counted at Three Mile Falls Dam plus harvest below Three Mile Falls Dam; Wild steelhead run = number counted at Three Mile Falls Dam.*
[b] *WSTS = wild steelhead; HSTS = hatchery steelhead; Lower Rr. = lower river creel area; Upper Rr. = upper river creel area.*

Table 10. Umatilla River summer steelhead broodstock collection

Run Year	Number Collected								
	Marked			Unmarked			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
82-83	0	0	0	unk	unk	161	unk	unk	161
83-84	0	0	0	20	32	52	20	32	52
84-85	0	0	0	25	79	104	25	79	104
85-86	0	0	0	11	58	69	11	58	69
86-87	0	0	0	57	91	148	57	91	148
87-88	0	0	0	73	78	151	73	78	151
88-89	0	0	0	72	88	160	72	88	160
89-90	0	0	0	49	57	106	49	57	106
90-91	47	56	103	46	53	99	93	109	202
91-92	49	46	95	109	116	225	109	116	225
92-93	1	2	3	64	61	125	65	63	128
93-94	18	25	43	47	45	92	65	70	135
94-95	35	33	68	38	48	86	73	81	154
95-96	16	12	28	56	49	105	72	61	133
96-97	12	1	13	48	49	97	60	50	110
97-98	19	11	30	42	44	86	61	55	116
98-99	17	0	17	52	59	111	69	59	128

Appendix H – Research Monitoring and Evaluation

I. Aquatic RM&E Plan

NOTE: The following represents a draft RM&E plan that is currently under development by the co-management agencies. This product is not yet suitable for ISRP technical review, but was included as a place-holder to describe the objectives, approach, power-analysis and sample design planning that is underway. A formal product, suitable for ISRP technical review, is expected within four weeks following the submittal of the subbasin plan.

Research, Monitoring, and Evaluation Requirements

The qualitative management objectives described in the management plan provide a framework for defining RM&E requirements. Each management objective carries with it a set of assumptions associated with the implementation of actions that can be evaluated in the context of Tier 1 monitoring. In addition, each management objective is based upon a set of biological assumptions regarding the response of species, communities, and ecosystems to implemented actions. Table X depicts the assumptions of each management objective, and a corresponding RM&E objective that should be addressed. These RM&E objectives provide a useful launching pad for sample design, analysis, and evaluation planning.

Management Objective	Assumption	RM&E Objective
Population and Environmental Status		
1: Monitor the status and trends of fish and mussel populations, their habitats and ecosystems throughout the Umatilla Basin.	**1a:** Annual abundance of fish and mussel abundance can be accurately quantified.	**1a:** Assess and monitor the status and trends of fish and mussel abundances.
	1b: The spatial and temporal distribution of adult and juvenile fish and mussels can be assessed throughout the Umatilla Basin.	**1b:** Assess and monitor the distribution and density of spawners on the spawning grounds and juveniles on the rearing grounds.
	1c: The abundance, timing, life history characteristics, and survival of out-migrating fish can be accurately quantified.	**1c:** Assess and monitor the abundance, timing, life history characteristics, and survival of out-migrating fish.
	1e: The spatial distribution and quantitative features of Umatilla Subbasin stream and riparian habitats can be accurately	**1e:** Assess and monitor the distribution, condition and utilization of stream and riparian habitat in the Umatilla Subbasin.

Management Objective	Assumption	RM&E Objective
	quantified.	
	1f: The ecological characteristics of Umatilla Subbasin stream and riparian habitats can be accurately quantified	**1f:** Assess and monitor the ecological characteristics of Umatilla stream and riparian habitats.
Natural Production		
2: Maintain and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of fish and mussels throughout the Umatilla Basin using habitat protection and improvement.	**2a:** Population abundance, life history pathways, and genetic characteristics of fish and mussels are limited in part by the availability of habitat in the Umatilla Subbasin.	**2a:** Assess and monitor the limiting factors for Umatilla fish and mussels.
	2b: Habitat protection and improvement will benefit fish and mussel abundance, productivity, life history and genetic diversity.	**2b:** Assess the impacts of habitat improvement and protection on salmonid production in the Umatilla Subbasin.
	2c: The impacts of habitat protection and improvement can be detected and distinguished from the impacts of ecological interactions.	**2c:** Assess and monitor the ecological interactions of Umatilla steelhead and Chinook.
3: Maintain, augment, and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of steelhead, Chinook, coho, and lamprey throughout the Umatilla Basin using hatchery supplementation and outplanting.	**3a:** Production, abundance, life history and genetic characteristics of steelhead, Chinook, coho, and lamprey are limited in part by spawner escapement and smolt output.	**3a:** Assess and monitor the spawner escapement and natural production of Umatilla steelhead, Chinook, coho, and lamprey.
	3b: Supplementation will not degrade the life history characteristics of naturally reared steelhead, Chinook, coho, and lamprey.	**3b:** Assess and monitor the life history characteristics of naturally reared steelhead, Chinook, coho, and lamprey.
	3c: Residualization rates of hatchery releases will not be greater than those of naturally spawned fishes.	**3c:** Assess and monitor the residualization of hatchery and naturally reared Chinook.
	3d: Hatchery supplementation using endemic broodstock will not negatively impact genetic characteristics of the natural steelhead population.	**3d:** Assess and monitor the genetic characteristics of naturally and hatchery reared steelhead.
	3e: Natural reproductive success of hatchery-reared steelhead will be similar to that of natural-reared steelhead.	**3e:** Assess and monitor the reproductive success of hatchery and naturally reared steelhead.
	3f: Hatchery-reared steelhead will return to natural production areas targeted for supplementation.	**3f:** Assess and monitor hatchery escapement to target areas.

Management Objective	Assumption	RM&E Objective
	3g: Hatchery supplementation will result in increased natural production of steelhead.	**3g:** Assess and monitor the long-term reproductive success of hatchery reared steelhead.
	3h: The ecological relationships of hatchery-reared Steelhead will not negatively impact natural fish populations.	**3h:** Assess and monitor the ecological interactions of hatchery and naturally reared steelhead.
4: Maintain the Birch Creek sub-population as a natural steelhead sanctuary (not supplemented).	**4a:** The summer steelhead supplementation program can be operated to minimize or exclude hatchery steelhead from escaping to Birch Creek.	**4a:** Assess and monitor hatchery steelhead escapement in Birch Creek.
5: Restore and maintain diverse and productive natural populations of Chinook and coho in the Umatilla Subbasin using hatchery reintroductions.	**5a:** Carson stock spring Chinook returning to the Umatilla Subbasin, Upriver Bright stock fall Chinook returning to the Umatilla Basin and Priest Rapids Hatchery, and Bonneville reared coho returning to the Umatilla Subbasin will have the genetic and phenotypic capacity to produce life histories suitable for sustainable natural productivity in the Umatilla Basin.	**5a:** Assess and monitor the natural production of hatchery reared Chinook and coho in the Umatilla Subbasin.
	5b: Hatchery-reared Chinook will return to natural production areas targeted for reintroduction.	**5b:** Assess and monitor the escapement of Chinook to target areas.
	5c: The ecological relationships of hatchery-reared Chinook and coho will not negatively impact natural fish populations.	**5c:** Assess and monitor the ecological interactions of hatchery and naturally reared Chinook and coho.
Hatchery Program		
6: Develop and maintain a local brood source for steelhead and Chinook from returns to the Umatilla River.	**6a:** Adult steelhead and Chinook returns will be adequate to provide brood needs while supporting harvest and natural production.	**6a:** Monitor and assess whether annual broodstock collection targets are met.
	6b: Adequate broodstock survival will be achieved at adult holding facilities.	**6b:** Monitor broodstock survival and disease incidence during holding.
7: Operate hatchery program to achieve subbasin smolt production, smolt to adult return, and hatchery adult return goals from the subbasin plan.	**7a:** The hatchery programs can be operated to achieve subbasin smolt production, smolt-to-adult survival, and adult return goals.	**7a:** Monitor smolt survival, smolt-to-adult survival, adult returns, and harvest and spawning contributions of hatchery-reared steelhead and Chinook to ensure a full accounting of all production strategies.
	7b: Progeny-to-parent ratios for hatchery-produced fish will be considerably higher than those of	**7b:** Monitor and compare progeny-per-parent productivity of hatchery- and naturally-reared

Management Objective	Assumption	RM&E Objective
	natural fish, and provide an adequate hatchery advantage.	steelhead and Chinook.
8: Achieve optimal effectiveness in the operation of the Umatilla Basin steelhead and Chinook hatchery programs while meeting production, population, and conservation objectives for natural- and hatchery-reared fishes.	**8a:** Rearing and release strategies will optimize smolt production, survival, homing, adult return, harvest, and natural spawning of steelhead and Chinook, and minimize residualization and stray rates.	**8a1:** Evaluate if a colder more natural temperature environment in fall will increase smolt-to-adult survival of spring chinook reared at Umatilla Hatchery.
		8a2: Evaluate if smolt-to-adult survival of subyearling fall Chinook can be improved by programmatic changes including larger size-at-release and direct-stream release lower in the basin.
9: Minimize any negative impacts of the Umatilla Basin hatchery program on natural steelhead and Chinook, and non-target populations.	**9a:** Broodstock collection and spawning strategies will optimize life history and genetic diversity of the hatchery steelhead and Chinook populations.	**9a:** Monitor broodstock collection and spawning to assess whether collection and spawning protocols are met.
	9b: Adult returns from the Umatilla subbasin hatchery programs will not stray at rates that exceed 5% of out-of-basin natural steelhead and Chinook populations.	**9b:** Monitor straying of fish from the Umatilla hatchery program to other subbasins and assess straying relative to environmental variables and rearing and release strategies
	9c: The horizontal and vertical transmission of disease from hatchery-reared steelhead and Chinook to natural fish will be minimized by current fish health protocols.	**9c:** Monitor the health of hatchery and natural fish.
Flow and Passage		
10: Maintain and enhance flow for homing and passage of steelhead and Chinook through the lower Umatilla River using flow restoration and enhancement.	**10a:** Flow restoration and enhancement will improve homing of adult steelhead and Chinook to the Umatilla River.	**10a:** Assess and monitor the impact of flow enhancement on homing of steelhead and Chinook to the Umatilla River.
	10b: Flow restoration and enhancement will reduce the need to transport and improve survival of adult and juvenile steelhead and Chinook in the Umatilla River.	**10b:** Assess the impact of flow enhancement on steelhead and Chinook survival and the frequency of fish transport.
11: Maintain and enhance steelhead and Chinook rearing and spawning habitat in the mainstem Umatilla River with flow enhancement and protection.	**11a:** Flow enhancement will increase steelhead and fall Chinook spawning and rearing habitat in the mainstem Umatilla River.	**11a:** Assess and monitor the availability of spawning and rearing habitat in the mainstem Umatilla.

Management Objective	Assumption	RM&E Objective
12: Maintain and enhance passage of adult and juvenile steelhead and Chinook throughout the Umatilla Subbasin with passage protection and restoration.	**12a:** Passage protection and restoration will result in improved migration times and decreased delay.	**12a:** Assess and monitor migration times and delay in the Umatilla mainstem.
	12b: Program actions and facility operations will optimize fish passage at diversion dams.	**12b:** Assess the effects of reduced diversion during water exchange on the relative attraction of smolts to the passage facility and adult fish ladder at TMFD.
Fisheries		
13: Maintain and enhance tribal and non-tribal steelhead, Chinook, coho and lamprey fisheries compatible with production, population, and conservation objectives.	**13a:** Steelhead, Chinook, coho and lamprey will return at a level of abundance adequate to support annual fisheries.	**13a:** Develop models for pre-season estimation of Umatilla River returns to facilitate management of subbasin fisheries.
	13b: Tribal and non-tribal fisheries can be adequately quantified.	**13b1:** Quantify fishing effort, catch, and harvest by gear type for tribal and non-tribal steelhead, Chinook, coho, and lamprey fisheries in the Umatilla River.
		13b2: Quantify harvest of Umatilla steelhead, Chinook, and coho in out-of-subbasin fisheries.
	13c: Management actions can optimize fishery opportunities while meeting production and population performance objectives for steelhead, Chinook, coho, lamprey, and non-target fishes.	**13c:** Assess whether management actions optimize fishery opportunities while meeting production and population objectives
Collaboration and Communication		
14: Maximize effectiveness of Umatilla Subbasin RM&E projects with collaborative study planning and implementation, synthesis of results, and results dissemination.	**14a:** Increased collaboration will result in decreased duplication and an increase in the power and resolution of Umatilla Subbasin RM&E.	**14a:** Conduct collaborative study planning, implementation, synthesis of results, and results dissemination.
15: Maximize management effectiveness of Umatilla Basin fish programs using local and regional protocols in RM&E methodologies that allow exchange of compatible information among local and regional databases and fisheries management entities.	**15a:** Information needed for adaptive management of the Umatilla Subbasin fisheries programs will be maximized by coordination with local regional RM&E efforts.	**15a:** Adopt locally and regionally standardized protocols.

Management Objective	Assumption	RM&E Objective
	15b: Exchanging compatible information to local and regional research and management groups will increase our understanding of out-of-basin impacts to Umatilla fish populations and improve program management.	**15b:** Coordinate with local and regional management groups and integrate information from these groups into assessments of Umatilla Subbasin fisheries program.
16: Maximize our understanding of the impacts of out-of-basin factors on Umatilla smolt-to-adult survival with collaborative assessments, surveys, tagging, data analysis, modeling, and results dissemination.	**16a:** Management of Umatilla Basin fisheries will benefit from cooperative research outside the basin.	**16a:** Conduct collaborative research with out-of-basin research programs that address Umatilla uncertainties.
	16b: Management of Umatilla Basin fisheries will benefit from participation in Columbia Basin research, monitoring, and evaluation forums.	**16b:** Participate in Columbia Basin research, monitoring, and evaluation forums.

Research Agenda

The research agenda was established for focal species using a gap analysis based on EDT, the management objectives, and the working hypotheses. Research agenda items identified for non-focal species were derived from a gap analysis of current information status and future simulation and evaluation requirements for the subbasin. The following items are considered critical Tier 3 uncertainties for the Umatilla Subbasin. Detailed methodologies for implementation of these studies are contained in section 0.

Test the EDT working hypotheses

Status: Partially funded (BPA)

Purpose and Scope:

EDT was developed to provide a spring-board for quantitative decision making in the habitat and fisheries management arena. The model is theoretically well supported, and provides a set of working hypotheses for habitat restoration and off-site mitigation. Although EDT is populated using some real habitat data, much of the environmental data is based on professional judgement, and the response predicted for fish populations is generally theoretical and associative in nature. The fish population component of EDT does not consider the antagonistic, additive, or synergistic effects of restoring multiple species at once, and it does not consider the density dependent complications associated with restoring populations with relatively small numbers of individuals. Therefore EDT could over or underestimate the benefits of habitat restoration in the Umatilla Subbasin. The purpose of this fifteen year project is to test the following null and alternative hypotheses:

Ho: The restoration of habitat, as described in the EDT working hypotheses, will result in salmonid production that is equal to that predicted by EDT.

Ha1: The restoration of habitat, as described in the EDT working hypotheses, will result in salmonid production that is more than that predicted by EDT.

Ha2: The restoration of habitat, as described in the EDT working hypotheses, will result in salmonid production that is less than that predicted by EDT.

The federal management agencies are working closely together to improve Columbia mainstem passage conditions, and to reduce the impacts of marine harvest on endangered salmonids. If the habitat restoration actions described in the working hypotheses are achieved in the Umatilla Subbasin, one might anticipate that Ha1 will be most strongly supported. However, as more and more people relocate to the region, and water resources become increasingly strained, the chances for recovery continue to change. Statistical support of the working hypothesis will help guide the nature and intensity of future habitat protection and restoration actions in the Umatilla Subbasin.

Approach:

Most of the work needed to address this critical uncertainty will take place in the context of long-term monitoring. The experimental approach is to conduct an observational study of the Umatilla Subbasin using collaborative monitoring of fish and their environment; e.g. (Hillman 2003, Jordan et al. 2003, USACOE et al. 2003, ISAB and ISRP 2004). Collectively UMEP will:

- Conduct long-term monitoring and evaluation of stream, watershed, and aquatic conditions
- Conduct long-term monitoring and evaluation of population, environmental, and ecological conditions for all salmonid life stages and rearing types
- Conduct effectiveness monitoring of restoration actions at the watershed scale

These monitoring efforts will take place subbasin-wide for the next fifteen years. A holistic analysis of the relative impacts of habitat restoration, ecological interactions, stochasticity, climate, and out-of-basin effects will be conducted every three to five years using a modified EDT model. Strategy implementation will be assessed under regular Tier 1 monitoring. Action effectiveness will be evaluated using Tier 2 habitat, water quality, and fish population monitoring results. The interaction of project implementation and system response will be evaluated using EDT.

Currently EDT is not fully capable of incorporating the suite of forcing functions that drive salmonid production. There are limitations in the model in terms of regional habitat nuances and population responses (the biological rules) that must be addressed. UMEP will work with Mobrand Biometrics and the University of Washington Columbia Basin Research Center to develop a version of EDT that addresses all sources of focal species production and loss. The biological rules will be updated as new habitat and population response data becomes available.

Once the working hypotheses habitat restoration strategies have been implemented, the predicted (EDT) and realized (M&E) salmonid production levels will be compared. The quantity and rate of predicted and realized responses will be compared using univariate and multivariate statistics. The results of this analysis will be used to better inform EDT on a regional scale, and to better predict the average benefits of habitat restoration work in the Umatilla and Columbia Basins.

Test the assumption that focal species are representative of ecological conditions in the Umatilla Subbasin

Status: Partially funded (BPA)

Purpose and Scope:

Focal species were selected for the purposes of ecosystem restoration planning in the Umatilla. Although single-species restoration is itself a priority in the Subbasin Plan, ecosystem recovery is the ultimate goal of most mitigation actions. The population dynamics of some species (known as keystone species or ecological indicator species) are indicative of ecological change. However, it is unclear if any of the focal species can adequately represent the health of Umatilla rivers and streams in part due to their anadromous life history and the various out of basin factors that affect them. Therefore it is theoretically possible that habitat restoration actions may enable certain aspects of ecological recovery without resulting in increased focal species production. This fifteen year study will test the following null and alternative hypotheses:

> Ho: The restoration of habitat, as described in the EDT working hypotheses, will result in increased focal species production and improved ecological conditions.
>
> Ha1: The restoration of habitat, as described in the EDT working hypotheses, will result in increased focal species production, but no improvement in other ecological conditions.
>
> Ha2: The restoration of habitat, as described in the EDT working hypotheses, will not result in increased focal species production, but will result in improved ecological conditions.

Approach:

Some of the work needed to address this critical uncertainty will take place in the context of long-term monitoring. The experimental approach is to conduct an observational study of the Umatilla Subbasin using collaborative monitoring of fish populations and their environment; e.g. (Hillman 2003, Jordan et al. 2003, USACOE et al. 2003, ISAB and ISRP 2004). Collectively UMEP will:

- Conduct high-resolution monitoring and evaluation of stream, watershed, and aquatic conditions in five priority geographic areas
- Conduct high-resolution monitoring and evaluation of sub-population performance in five priority geographic areas
- Conduct high-resolution monitoring and evaluation of ecological conditions in five priority geographic areas

These monitoring efforts will take place in the five geographic areas for the next fifteen years. UMEP will quantify food web structure, energy flow, and biotic diversity to monitor ecological change in the five priority geographic areas. Change through time will be analyzed using time series, geostatistical, structural, and functional analysis of those systems. Differential change among geographic area will be analyzed using geostatistical models and associative analyses that account for habitat-based variance in production and ecological criteria.

Test the assumption that EMAP surveys can adequately quantify status or change in Umatilla Ecosystems

Status: Partially funded (BPA)

Purpose and Scope:

EMAP surveys were developed as an expansion of EPA's Rapid Bioassessment Protocols program. The intent was to develop a standardized methodology for assessing and evaluating system impairment across large geographic areas. Currently EMAP protocols are being implemented in a number of subbasins in the Columbia with considerable success.

The spatial scale of EMAP sampling design is the subbasin. This spatial scale differs considerably from the habitat restoration unit (the geographic area) addressed in the management plan. At the subbasin scale EMAP requires 50 sampling sites per year, and it is distinctly unclear how this sampling regime can address within-subbasin management questions. It is theoretically plausible that this small number of samples can be spatially allocated in such a way that both within-subbasin and subbasin-wide questions can be answered simultaneously; however, this assumption has yet to be rigorously tested in the Columbia Plateau. This fifteen year study will test the following null and alternative hypotheses:

> Ho: An EMAP sampling design can adequately quantify sub-population change at the geographic area scale.
>
> Ha1: An EMAP sampling design will under or over estimate sub-population change at the geographic area scale.
>
> Ha2: An EMAP sampling design will fail to produce a statistically sound estimate of sub-population change at the geographic area scale.

Approach:

Some of the work needed to address this critical uncertainty will take place in the context of long-term monitoring. The experimental approach is to conduct an observational study of the Umatilla Subbasin using collaborative monitoring of fish and their environment; e.g. (Hillman 2003, Jordan et al. 2003, USACOE et al. 2003, ISAB and ISRP 2004). Collectively UMEP will:

- Conduct monitoring and evaluation of population and environmental status of the Umatilla Subbasin using an EMAP design
- Conduct high-resolution monitoring and evaluation of population and environmental status of five priority geographic areas using contiguous quadrat sampling

These monitoring efforts will take place subbasin-wide for the next fifteen years. For both sampling methodologies species-habitat curves will be generated along with their 95% confidence intervals. The results of EMAP sampling vs. contiguous quadrat sampling of priority geographic areas will be analyzed using associative analysis, time series analysis, and geostatistical expansions of both data types.

Estimate the relative and long-term success of naturally vs. hatchery reared summer steelhead

The reproductive success and genetic characteristics of hatchery fish can be different from those of naturally reared individuals or populations (Reisenbichler and McIntyre 1977). These affects stem in part from the environmental conditioning of hatchery programs, and in part from the artificial selection associated with the hatchery environment. The problem can in theory impact population growth even when endemic stock is used and traditional stock domestication is avoided (Chilcote 2003, Reisenbichler et al. 2003).

The impacts can be elusive because of the short-term production gains associated with supplementing a diminished population, and could in theory limit the recovery of salmon fisheries in the Umatilla Subbasin and elsewhere. Chilcote is quick to point out that the problem is theoretical in nature, and is "not sensitive to likely levels of data error or confounded by ***extraneous*** habitat correlation with" production (our emphasis, Chilcote 2003, p1057).

Umatilla program mangers have long known that much or most of the limits of production in the Umatilla stem from the deterioration of in-basin and Columbia mainstem habitat conditions. The biological objectives of these programs were developed and pursued to overcome the modern limitations of the system. This restorative approach was adopted without regard to short-term decreased productivity of hatchery reared fish, and with considerable attention paid to the overwhelming impacts of habitat degradation that had extirpated all salmon, and greatly diminished *O. mykiss* stocks. The intent of supplementation and reintroduction actions that have resulted in increased adult returns has been to utilize the UFH as an extension of the ecosystem;

to utilize the hatchery advantage to increase numbers of spawners and thereby further seed the available habitat with juveniles.

Unlike many northwest programs, UFH has used endemic STS stock for more than a decade now. Nonetheless, it is not possible under the current RM&E approach to validate the long-term success of hatchery reared fishes, or to estimate the relative reproductive success of hatchery or naturally reared individuals. Due to increasing concern for the welfare of endemic populations, the reproductive success and genetic characteristics of Umatilla STS remains a critical uncertainty. This fifteen year study will test the following null and alternative hypotheses:

> Ho: The relative and long-term success of hatchery reared Umatilla summer steelhead is equal to that of naturally reared specimens.
>
> Ha1: The relative and long-term success of hatchery reared Umatilla summer steelhead is less than that of naturally reared specimens.
>
> Ha2: The relative and long-term success of hatchery reared Umatilla summer steelhead is greater than that of naturally reared specimens.

Approach:

Polymorphic microsatellite loci have been used in a variety of studies to determine parentage and population structure (O'Reilly et al. 1998, Bernatchez and Duchesne 2000, Letcher and King 2001, Eldridge et al. 2002). The technique and its application have been thoroughly reviewed (Wilson and Ferguson 2002). Microsatellite analysis will be used to estimate the relative reproductive success of hatchery and naturally reared STS, the long-term reproductive success of hatchery reared STS, and the genetic characteristics of both stocks. Although TMFD is available as a potential sampling station, CTUIR and ODFW maintain a policy to minimize fish handling and maximize fish production and health. In addition sampling at TMFD does not address the significant contribution of non-anadromous *O. mykiss* to STS populations. Instead a weir will be constructed at the mouth of Iskuulpa Creek. Adult anadromous returns, resident RBT, and juvenile progeny will be sampled and genotyped for 16 microsatellite markers (0).

Estimate Connectivity of Resident Umatilla Salmonid Populations within the Subbasin, and among Neighboring Populations

Status: Partially funded (USFWS)

Purpose and Scope:

The construction of John Day and McNary Dams dramatically altered the routes and conditions resident salmonids must undertake to connect with neighboring populations. These hurdles are amplified by the acute and chronic stressors that resident and fluvial bull trout and mountain whitefish face within each subbasin. The culmination of these chronic stressors, coupled with direct mortality, have resulted in an ESA listing for bull trout, and increasing concern for the status of mountain whitefish.

Population connectivity is a measurement of interbreeding among arbitrary or allopatric populations. Connectivity can increase the average fitness of a population by increasing heterozygosity and genetic diversity. The mouth of the Umatilla River is most directly juxtaposed to the John Day, Walla Walla, Yakima, and Snake River basins. Connectivity between Walla Walla populations and these neighboring populations is unknown. An understanding of connectivity will help guide mainstem management, and will greatly inform the ESA delisting process. Increased connectivity generally results in decreased jeopardy, and is therefore a critical metric of species conservation. The purpose of this five year project will be to test the following null and alternative hypotheses:

> Ho: Gene flow (F) in Columbia Plateau bull trout and mountain whitefish populations is less than 0.1, and connectivity (Nm) is less than 10 immigrants per generation.
>
> Ha: Gene flow (F) in Columbia Plateau bull trout and mountain whitefish populations is greater than 0.1, and connectivity (Nm) is more than 10 immigrants per generation.

Approach:

The Bull Trout Recovery Team advises critical uncertainties research on this species. A collaborative effort is underway to examine the current status and population trajectory of bull trout in the Walla Walla and Umatilla Subbasins. These efforts put personnel on the ground, and provide substantial opportunities for data collection. The co-managers will work with this collaboration and similar efforts in the John Day, Grande Ronde and Yakima Subbasins to develop a regional program for resident fish genetic sampling. Fin clips will be selected from reproductively active male and female bull trout and mountain whitefish in all four subbasins during normal monitoring activities. These samples will be analyzed using micro-satellite markers to determine the number of immigrants to each subbasin per generation for both species.

Estimate the mortality and survival of Umatilla Coho through all in-subbasin life stages

Status: Partially funded (BPA)

Purpose and Scope:

Based on written and verbal tribal history, and the outputs of EDT, the Umatilla River was once a relatively productive coho system. Anthropogenic degradation of the Umatilla, coupled with out-of-basin changes, have left the system without habitat capable of sustainable coho production. The management plan outlines a series of ambitious habitat restoration actions, including the implementation of Phase III flow enhancement. None of these actions, including the culmination of all habitat restoration actions, were shown to result in sustainable coho production of any significance. While EDT clearly outlines the potential limiting factors for coho, it does not outline a plan of action necessary to increase production. To a great extent managers are left in the dark in terms of how best to address coho productivity in the system. To a great extent the rearing habits of coho populations will impact the survival of emerging and rearing fish (Groot and Margolis 1998). This five year study will address the following null and alternative hypotheses:

Ho: Umatilla coho productivity is limited by spawner success.

Ha1: Umatilla coho productivity is limited by egg-to-fry survival.

Ha2: Umatilla coho productivity is limited by fry-to-smolt survival.

Approach:

Some of the work needed to address this critical uncertainty will take place in the context of long-term monitoring. The experimental approach is to conduct an observational study of the Umatilla mainstem using collaborative monitoring of fish populations and their ecosystem; e.g. (Hillman 2003, Jordan et al. 2003, USACOE et al. 2003, ISAB and ISRP 2004). Collectively UMEP will:

- Monitor coho spawner success in the Umatilla mainstem
- Monitor coho redd production in the Umatilla mainstem
- Monitor coho fry-to-smolt survival in the Umatilla Subbasin

Spawner success will be monitoring using redd and carcass surveys in the Umatilla mainstem. Redd production will be estimated by capping a small number of representative redds. Fry-to-smolt survival will be estimated using a mark-recapture survival model derived from SURPH (www.cbr.washington.edu). From these data a life-history model will be developed that is specific to Umatilla coho, and clearly defines the population bottleneck that is limiting productivity. Managers will use this information to develop a restoration plan for Umatilla coho based on habitat restoration, flow enhancement, and hatchery supplementation.

Monitoring Approach by RM&E Objectives

The following is a description of the proposed approach for addressing each management objective and assumption within UMEP. The Performance metrics addressed, RM&E priority, and current status of the RM&E effort are stated. The general approach descriptions are cross-referenced to precise methodologies described in Section 6.

(1a): Assess and monitor the status and trends of abundance of natural and hatchery origin adult salmonids.

Performance metrics: Adult returns to Umatilla, spawner escapement, brood stock collection, run predictions

Status: Ongoing and funded by BPA through operations and maintenance project, and NPMEP/HMEP evaluation activities

Adult returns to TMFD are perhaps the most basic and critical metric of performance in the Umatilla Subbasin. Return rates by spatial and temporal origin for natural and hatchery fishes is needed to estimate smolt to adult survival, total production, spawner life history characteristics, run timing, and the spawner population for brood stock and natural production.

Approach:

Adults will enumerated at TMFD using trapping and video monitoring (0). Every five out of fourteen days trapped fish will be handled and sampled, allowing for the removal of brood stock. For nine out of fourteen days fish will be passively monitored using video and Passive Integrated Transponder tag (PIT-tag) recoveries. Statistical analysis and evaluation will be based on summary statistics and a trend analysis.

(1b): Assess and monitor the distribution and density of spawners on the spawning grounds and juveniles on the rearing grounds; (3a): Assess and monitor the spawner escapement and natural production of Umatilla steelhead; (5a): Assess and monitor the natural production of hatchery reared Chinook in the Umatilla Subbasin; and (5b): Assess and monitor the escapement of Chinook to areas targeted for natural production.

Performance metrics: Spawner escapement; spawner spatial distribution; spawn timing; pre-spawn mortality; carcass impacts; rearing distribution; juvenile production and distribution; progeny-per-parent ratios

Status: Spawner monitoring is ongoing and funded through BPA NPMEP. Juvenile surveys are not funded and not implemented.

The principle subbasin-scale performance measures for each brood year are assessed from total outmigration and returns to TMFD. However, this information is limited in its explanatory power due to the contingencies associated with watershed-scale variability in spawner abundance and juvenile production. Spawners can escape differentially to each watershed due to habitat conditions, in-basin harvest, pre-spawn mortality, and stochasticity. The production of juveniles can vary among watersheds due to spawner abundance, spawner productivity, habitat quality, habitat quantity, egg mortality, fry mortality, or parr mortality. An understanding of spatial and temporal variance in both spawner and juvenile production and productivity is therefore necessary to estimate a variety of performance measures.

Approach:

In-situ sampling will be conducted for each species within their spawning and rearing habitat (0 and 0). The sampling design will follow a modified EMAP protocol. Spawner and carcass surveys will be randomized by tributary. Juvenile surveys will be randomized by reach. Annual estimates of density will be produced for each life-history stage and watershed. A geostatistical analysis will be conducted using population and habitat data to estimate fish-habitat relationships and to produce a geostatistical stock assessment of spawners and juveniles. Associative and trend analyses will be used to monitor changes in spawner and juvenile populations.

(1c): Assess and monitor the abundance, timing, life history characteristics, and in-stream survival of out-migrating Chinook and steelhead.

Performance metrics: Migration parameters, abundance, survival, and life history characteristics (including age, size and condition) of emigrating smolts.

Status: Modify and expand ongoing activities.

An estimate of smolt abundance for natural species in the lower Umatilla River is essential to answering critical uncertainties surrounding natural production capacity and in-basin productivity. In addition, an understanding of migration success and survival is necessary to identify in and out-of-basin bottlenecks (including environmental conditions, flow, fish habitat, hatchery rearing and release strategies, predation, and passage difficulties) and estimate loss by life stage for hatchery and natural species.

Approach: Smolt abundance will be estimated for natural salmonids leaving the Umatilla River using fish collection and trapping efficiency at Three Mile Falls Dam (RM 3.7). The Bootstrap method with 1,000 iterations will be used to derive a variance. Smolt survival and migration parameters (timing, duration and travel speed) will be monitored for hatchery and natural species using PIT tags and remote interrogation at Three Mile Falls and lower Columbia River dams. Survival estimates will be calculated using the Migrant Abundance Method (Burham et al. 1987 and Dauble et al. 1993) and the SURPH 2 model. The binomial test will be used to test for significant differences in detection between comparable release groups of hatchery fish. Environmental variables including water discharge, flow, temperature and water clarity in the lower river will be monitored and ties to smolt survival and/or migration success assessed (regression and correlation analysis). Juvenile life history characteristics including smolt emigration timing, length, age, health, condition and smolt status will be collected. Associative and trend analysis will be used to evaluate outmigration.

(3b): Assess and monitor the life history characteristics of naturally reared steelhead.

Performance metrics: Migration timing, growth rates, age and size

Status: Partially funded, partially ongoing

Radical anthropogenic changes to the Umatilla system have occurred during the past century and are a significant reason for a lack of recovery to near historic run sizes for all Umatilla salmonids. Understanding Umatilla mainstem migration is critical to understanding the overall production of the system. This requires an estimate of the impacts of ecological and environmental conditions throughout the system.

For animals with indeterminate growth the impacts of ecological and environmental conditions converge in the expression of life-history characteristics (Kitchell et al. 1974, Heino and Kaitala 1999). Unlike animals with determinate growth who must meet metabolic requirements or die, salmonids can buffer the impacts of environmental or ecological changes by modifying energy allocation and behavioral regimes (Stockwell and Johnson 1997, Railsback and Rose 1999). If properly monitored changes in mass-energy allocation can be used as ecological indicators that have direct management implications (Brandt and Hartman 1993, Hansen et al. 1993). This monitoring activity requires estimates of age and growth for pre-smolts and smolts.

Without this information it will not be possible to determine whether changes in adult and juvenile production are related to changes in habitat conditions, mainstem or marine survival, or stochasticity. Estimates of migration timing provide additional information about the hydrology of the system a whole, and the behavior of particular brood years, species, or rearing types. This information can be used to quantify the production benefits of various management scenarios including increased or decreased artificial production or increased flow augmentation.

Approach:
A sub-sample of naturally reared juveniles will be PIT-tagged on the spawning grounds for outmigrant detection at TMFD and Columbia Mainstem facilities. Scales of naturally reared juveniles will be sampled during EMAP surveys and lower river trapping.. Age and growth analysis will be conducted for each managed species. Associative models will be used to evaluate growth of hatchery and naturally reared fishes from each release site and watershed.

(1e): Assess the distribution, condition and utilization of essential salmonid habitat in the Umatilla Subbasin; (11a): Assess and monitor the availability of spawning and rearing habitat in the mainstem Umatilla.

Performance metrics: Quantity, quality, and utilization of essential fish habitat

Status: Not funded, not implemented

Salmonids cannot produce naturally without quality habitat. This pivotal assumption is the backbone of the working hypotheses being developed in the subbasin plan, and the numerous off-site mitigation projects operating in the Umatilla Subbasin. At the macro- and micro-scales land use and riparian conditions are strongly related to in-stream conditions (Crispin et al. 1993, Stednick and Kern 1994, Chen et al. 1998). These features directly impact water quality conditions, and can thereby alter salmonid production through behavioral, physiological, and ecological mechanisms (Torgersen et al. 1999, Ebersole 2002). These powerful in-basin impacts are detectable at multiple scales, and do result in decreased survival and production of juveniles (Paulsen and Fisher 2001) and decreased recruitment of spawners (Regetz 2003) at the subbasin scale.

Approach:

The subbasin plan identifies a set of desired future conditions that may increase natural production and harvest opportunities in the Umatilla Subbasin through habitat restoration and protection, flow augmentation, passage restoration, and hatchery supplementation. There are a number of habitat-based RM&E information needs that must be addressed if the benefits of these management actions are to be effectively detected with sufficient power. The availability and distribution of quality essential fish habitat will be used to define the sampling universe of juvenile and spawner surveys. Spatial and numerical relationships among the habitat and salmonid variables will be used to estimate the degradation through time of essential fish habitat associated with both natural and anthropogenic disturbance; to estimate the absolute abundance and distribution of juveniles and spawners using geostatistical expansions; to estimate the effectiveness of habitat restoration and flow augmentation projects; and to estimate the quantitative relationship between habitat and production. Physical, biological, chemical, and ecological habitat conditions will be monitored throughout the subbasin using a variety of techniques (0).

(1f): Assess and monitor the ecological characteristics of Umatilla essential fish habitat; (2c): Assess and monitor the ecological interactions of Umatilla steelhead and Chinook; (3g): Assess and monitor the ecological interactions of hatchery and naturally reared steelhead; and (5c): Assess and monitor the ecological interactions of hatchery and naturally reared Chinook

Performance metrics: Biological conditions of habitat, trophic relationships of fishes, competition, predation natural mortality, and carcass inputs.

Status: Unfunded; not implemented; innovative monitoring approach.

Ecological relationships have direct and indirect impacts on fish productivity through trophic, physiological, and behavioral interactions. Direct interactions are sometimes considered and managed for, but these may be dwarfed by indirect exchanges (Beamesderfer et al. 1996). There are numerous pathways of confounding relationships in a supplemented salmonid community that might impact egg to fry survival (Vander Haegen et al. 1998). In many systems in-stream mortality of smolts may have a far greater impact on smolt production than early life-stage bottlenecks (Fryer and Mundy 1993, Collis et al. 2001). Given the current state of scientific knowledge it is difficult to discern in any one tributary system between the nominal importance of salmonid abundance and the impacts of ecological relationships on salmonid productivity.

The culmination of direct and indirect processes can negate or amplify the benefits of any restoration action. In general there are two ways these relationships can manifest (Carpenter and Kitchell 1993). Top-down and density-dependent interactions can result in predator mortality or in changes in growth due to increased metabolic expenditures or decreased consumption rates. Bottom-up changes in trophic resources or metabolic conditions can result in direct starvation or in changes in decreased growth associated with consumption rates or metabolic efficiency. The complexities of these factors and their importance to fisheries management has been described in detail (Kitchell et al. 1974). Although these principles have been accepted by the scientific community, they have been rarely incorporated in management. This is true for the Umatilla Subbasin, despite the fact that ecological impacts may, under some conditions, be greater than physical or chemical impacts. A greater understanding of the ecological controls on salmonid productivity will have direct management implications. A quantification of predator mortality and competitive interactions will help guide future release strategies and juvenile production objectives. A detailed understanding of inter- and intra-specific competition will allow for the determination of optimal seeding strategies in a multi-species restoration framework. This information could inform multi-species management throughout the Columbia Plateau.

Approach:

Fish communities will be sampled using a modified EMAP design (0). The biological conditions of habitat will be sampled during EMAP surveys of fish communities, and spawner and carcass surveys (0). Trophic interactions will be surveyed using stable isotope monitoring and ecological inference (0). The ecological characteristics of essential salmonid habitat will be analyzed and evaluated using a multi-species spatially explicit model based on MBI's EDT (0).

(1d): Assess and monitor the residualization of hatchery- and naturally-reared steelhead and Chinook.

Performance metrics: Residualization rates

Status: Unfunded; not-implemented

Hatchery fish are usually released at sizes and conditions that differ from their natural counterparts. Sexually mature residualized fish can compete with anadromous returns for mates, and can compete with resident fish or pre-migrant juveniles for ecological resources. In certain cases hatchery practices can be modified to decrease residualization rates if problems are detected.

Approach:

Residualized steelhead and Chinook will be sampled during EMAP surveys (0). Residuals will be classified based on the length-frequency distribution of the juvenile population using outlier analysis. Resident RBT populations will be similarly noted, but are recognized as part of the steelhead population (Currens and Schreck 1995, Kostow 2003).

(2a): Monitor the limiting factors for Umatilla steelhead and Chinook.

Performance metrics: Mortality and survival at all life-stages

Status: Funded as part of ongoing evaluation activities

Limiting factor analysis is the process by which population bottlenecks are determined for managed species. As conditions are improved through mitigation actions, and population bottlenecks are diminished or eliminated, it is essential to re-assess limiting factors to guide future mitigation actions.

Approach:

Limiting factors will be analyzed every five years as part of regular evaluation activities. A multi-species spatially explicit model of the Umatilla Subbasin will be used to estimate mortality in Umatilla, Columbia, and marine life-history stages of all managed salmonids (0).

(2b): Assess the impacts of habitat improvement and protection on salmonid production in the Umatilla Subbasin.

Performance metrics: Habitat conditions, egg, fry, juvenile, and smolt production and survival

Status: Evaluation is funded; habitat monitoring is not funded and not implemented

Considerable resources are invested in habitat improvement measures as part of BPA and State of Oregon off-site mitigation activities. Each habitat improvement project conducts some monitoring and evaluation at the micro-scale to determine successful project implementation. However, for the most part only the cumulative impacts of watershed restoration can be tied directly to increased salmonid production. The connection between Tier 1 habitat project implementation monitoring and Tier 2 effectiveness monitoring must be addressed across the spatial hierarchy of reaches and watersheds.

Approach:

Habitat status (0) and juvenile production (0) information will be collected during EMAP surveys at the reach scale. These data will be expanded to the watershed scale using associative and geostatistical analysis. Long term effectiveness will be evaluated using trend analysis.

(3c): Assess and monitor the genetic characteristics of naturally and hatchery reared steelhead. (3d): Assess and monitor the reproductive success of hatchery and naturally reared steelhead. And (3f): Assess and monitor the long-term reproductive success of hatchery reared steelhead.

The reproductive success and genetic characteristics of hatchery fish can be different from those of naturally reared individuals or populations (Reisenbichler and McIntyre 1977). These affects stem in part from the environmental conditioning of hatchery programs, and in part from the artificial selection associated with the hatchery environment. The problem can in theory impact population growth even when endemic stock is used and traditional stock domestication is avoided (Chilcote 2003, Reisenbichler et al. 2003).

The impacts can be elusive because of the short-term production gains associated with supplementing a diminished population, and could in theory limit the recovery of salmon fisheries in the Umatilla Subbasin and elsewhere. Chilcote is quick to point out that the problem is theoretical in nature, and is “not sensitive to likely levels of data error or confounded by ***extraneous*** habitat correlation with” production (our emphasis, Chilcote 2003, p1057).

Umatilla program mangers have long known that much or most of the limits of production in the Umatilla stem from the deterioration of in-basin and Columbia mainstem habitat conditions. The biological objectives of these programs were developed and pursued to overcome the modern limitations of the system. This restorative approach was adopted without regard to short-term decreased productivity of hatchery reared fish, and with considerable attention paid to the overwhelming impacts of habitat degradation that had extirpated all salmon, and greatly diminished *O. mykiss* stocks. The intent of supplementation and reintroduction actions that have resulted in increased adult returns has been to utilize the UFH as an extension of the ecosystem; to utilize the hatchery advantage to increase numbers of spawners and thereby further seed the available habitat with juveniles.

Unlike many northwest programs, UFH has used endemic STS stock for more than a decade now. Nonetheless, it is not possible under the current RM&E approach to validate the long-term success of hatchery reared fishes, or to estimate the relative reproductive success of hatchery or naturally reared individuals. Due to increasing concern for the welfare of endemic populations, the reproductive success and genetic characteristics of Umatilla STS remains a critical uncertainty.

Approach:

Polymorphic microsatellite loci have been used in a variety of studies to determine parentage and population structure (O'Reilly et al. 1998, Bernatchez and Duchesne 2000, Letcher and King 2001, Eldridge et al. 2002). The technique and its application have been thoroughly reviewed (Wilson and Ferguson 2002). Microsatellite analysis will be used to estimate the relative reproductive success of hatchery and naturally reared STS, the long-term reproductive success of hatchery reared STS, and the genetic characteristics of both stocks. Although TMFD is available as a potential sampling station, CTUIR and ODFW maintain a policy to minimize fish handling and maximize fish production and health. In addition sampling at TMFD does not address the significant contribution of non-anadromous *O. mykiss* to STS populations. Instead a weir will be constructed at the mouth of Iskuulpa Creek. Adult anadromous returns, resident RBT, and juvenile progeny will be sampled and genotyped for 16 microsatellite markers (0).

(3e): Assess and monitor hatchery escapement to target areas

Performance metrics: Spawner escapement, migration timing, and passage efficiency.

Status: Partially funded; partially implemented

Adult movements were monitored in the Umatilla for a number of years using radio telemetry while physical passage improvements were underway, and spawner flow-requirements were being established (Tribal Fisheries Program 1994, Contor et al. 1995, Contor et al. 1996, 1997). Currently passage efficiency is monitored at a number of sites by the Umatilla Operations and Maintenance Project. Two pending critical uncertainties may require additional radio telemetry work. First, managers are concerned that hatchery reared steelhead escapement to areas targeted for natural production. STS demonstrate iteroparity, and do not often leave carcasses to be sampled. This limits the options for monitoring adult escapement to target tributaries. Second, more information on spring Chinook adult migration and summer holding is needed to understand the causes of high prespawn mortality (55%) and better manage fisheries.

Approach:

A small sub-sample of the natural CHS, CHF, and STS run will be radio tagged at the TMFD trap. The migration rates, passage, and destination of each radio tagged fish will be monitored using fixed station, hand-held, fly-over, and drive-by telemetry (0).

(4a): Assess and monitor hatchery steelhead escapement in Birch Creek.

Performance metrics: Endemic spawner escapement

Status: Unfunded; not-implemented

The Birch Creek watershed has been identified as a possible un-supplemented steelhead sanctuary. Adult escapement was monitored for a number of years by CTUIR and ODFW, and hatchery escapement to the watershed was consistently less than 5%. Unless that fraction changes it will not be necessary to weir and protect the system from hatchery escapement, however regular monitoring of the adult population is warranted.

Approach:

A temporary fish weir will be placed at the mouth of Birch Creek for portions of the STS adult run. Adult hatchery and natural escapement will be monitored using hand-held PIT-tag and CWT detectors and external fish marks (elastomer marks and adipose fin clips). The fraction of natural and hatchery escapement will be monitored, and the management of the watershed will be re-evaluated if necessary.

(7a): Monitor smolt production, smolt to adult survival, and hatchery adult returns of Umatilla hatchery programs; (7a) Monitor and assess the achievement of annual broodstock targets; (6b): Monitor and assess whether annual broodstock collection targets are met; (7b:) Monitor broodstock survival and disease incidence during holding; (8a) Monitor broodstock collection and spawning to assess whether collection and spawning protocols are met.

Performance metrics: Egg-to-fry survival, fry-to-smolt survival, smolt production, smolt-to-adult survival; adult production, percent of brood goal collected, brood collection timing, brood survival, and progeny-to-parent ratio

Status: Funded; ongoing

Hatchery production monitoring is critical to determining whether current hatchery strategies are effective and efficient for meeting smolt and adult production goals established to accomplish regional and subbasin management objectives. Quantifying survival of hatchery fish through all life stages is a fundamental tool used by managers to assess what corrective actions may be necessary if production goals are not met. Whether smolt and adult production goals and hatchery program strategies are appropriate for achieving management objectives for harvest, natural production, protection of life history and genetic diversity, and minimizing negative impacts to natural fish populations will be assessed within the context of information obtained by RM&E Objectives 1b, 1c, 1d, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 4a, 5a, 5b, and 5c.

Approach:

Brood collection and mortality and detailed spawning information is monitored by CTUIR hatchery satellite facility staff and documented in BPA annual reports (11.9.1 and 11.9.2). Numbers of fish spawned (11.9.2), egg take (11.9.3), and in-hatchery survival and growth of fish to the smolt stage (11.9.4 and 11.9.5) is monitored by hatchery staff and reported to the ODFW hatchery database. Information associated with smolt releases (11.9.7), survival from smolt to adult (11.9.6), and adult disposition (11.9.6) is conducted by the UHMEP and reported in BPA annual reports and to the ODFW hatchery and PSMFC PTAGIS and RMIS databases.

(7b): Monitor and compare progeny-per-parent productivity of hatchery- and naturally-reared steelhead and Chinook.

***Status*:** Existing monitoring.

***Performance metric*:** Progeny-per-parent ratio (P:P ratio)

***Approach*:**

Determine number of adult progeny produced per brood for both hatchery and natural steelhead and Chinook. Calculate P:P ratios for both natural- and hatchery-reared fish as total number of adult progeny / total number of adult parents that spawned. Numbers of adult parents will be known from spawning records for hatchery fish, but will require estimation for natural steelhead and chinook. . Numbers of natural parents will be estimated annually from redd counts and spawner carcass data. Adult progeny from a brood will return over multiple years. Number of progeny per brood for hatchery-reared fish will be estimated from abundance and age information acquired by CWT recoveries. Number of progeny per brood for naturally-reared steelhead will be estimated by collecting and analyzing scales to apportion returning adults by brood year, then summing the brood-apportioned returns across run years to estimate total numbers of progeny produced by each brood. Number of progeny per brood for natural Chinook will be estimated by apportioning adult returns to their appropriate brood year based on age structure. Natural Chinook returns have been too low to accurately estimate age structure, therefore age structure of donor stock or nearby natural populations will be used as a surrogate.

(8a1): Evaluate if a colder more natural temperature environment in fall will increase smolt-to-adult survival of spring chinook reared at Umatilla Hatchery.

Status: Existing monitoring and evaluation.

Performance metric: Smolt-to-adult survival

Impetus for testing this alternative rearing strategy ("fall-transfer") was based on 1) previous trends in performance of well water- and surface water-reared spring chinook smolts released in the Umatilla Basin, and 2) a desire to provide a logistical means of maximizing smolt production at the water supply limited Umatilla-Irrigon Hatchery complex. Survival of the first few broods of spring chinook reared at the well-water-supplied Umatilla Hatchery was extremely poor while survival of spring chinook reared at the surface water-supplied Bonneville Hatchery was much higher. Differences in fish health between the Bonneville and Umatilla production groups during this time was a significant confounding factor in this hypothesis that was subsequently addressed through more rigorous brood screening and medication protocols for Umatilla production. Regardless of whether the fall-transfer rearing strategy improves smolt-to-adult survival, it is considered desirable for increasing smolt production capacity at Umatilla Hatchery provided there is a net gain in adult production. The fall-transfer maximizes summer water use and reduces total biomass of fish in the hatchery during the critical fall-spring time period. This is particularly important because a large draw-down of the John Day Pool in anticipation of a severe flood event will lower the aquifer at the hatchery and can reduce the water supply to critical levels.

Approach:

Tier 3 treatment vs. control experiment. Treatment is early transfer of smolts to the Imeques acclimation facility in mid-November to experience a colder and more natural temperature profile of the surface water-supplied acclimation facility. Control is normal transfer of smolts to the acclimation facility in mid-January with fish remaining in the relatively warm and constant well water-supplied hatchery environment. Difference in smolt-to-adult survival between treatment and control will be tested using Analysis of Variance (ANOVA) with years and raceways as replicates and a significance level $\alpha = 0.05$.

(8a2):Evaluate if smolt-to-adult survival of subyearling fall chinook can be improved by programmatic changes including larger size-at-release and direct-stream release lower in the basin.

Status: Existing monitoring and evaluation.

Performance metric: Smolt-to-adult survival

High marking costs and low SAS (0.03%) for subyearling fall chinook produced at Umatilla Hatchery provided the impetus for reducing smolt production from 2.67 million to 600 thousand smolts until an alternative rearing/release strategy could be found to improve SAS. A review of the subyearling fall Chinook program in 2000 concluded the current release location was undesirable relative to the bimodal thermal profile of the Umatilla River, and small size-at-release was a less important secondary factor to SAS. River conditions at the time of the subyearling release in late-May are typically characterized by rapidly decreasing flow and increasing water temperature. Water temperature gradually rises from the headwaters down to Pendleton, then is rapidly decreased by cold hypolimnetic water releases from McKay Reservoir, followed by gradual warming through the lower river. River temperature in the warmer reaches are typically between 55-65^{o} F at release time, but may be as high as 65-70^{o} F. Release of treatment fish lower in the river at the beginning of cold water inputs from McKay Reservoir eliminates migration through the warm water reach above Pendleton and reduces overall migration distance. Direct stream release provides treatment fish an additional three weeks of rapid growth at the hatchery which helps them reach a larger size-at-release compared to controls.

Approach:

Tier 3 treatment vs. control experiment. Treatment is larger size-at-release (40-50 fish/lb) and direct-stream release at river mile 48.5 (near the start of cold water inputs from McKay Creek). Control is the past program strategy of a normal size-at-release (60-70 fish/lb) and an acclimated release at river mile 73.5 (Thornhollow acclimation facility). Difference in smolt-to-adult survival between treatment and control will be tested using Analysis of Variance (ANOVA) with years and raceways as replicates and a significance level $\alpha = 0.05$.

(9a): Determine whether steelhead and Chinook broodstock are collected proportionate to the timing of adult returns.

Status: Existing monitoring.

Performance metric: Broodstock collection timing

Approach:

Hatchery operating protocols assume collection of broodstock proportionate to adult return timing will maximize life history and genetic diversity of the hatchery population. The ability of hatchery-reared returns to produce naturally reared offspring that have the genetic and life history capacities to restore productive and self-sustaining natural populations in the Umatilla Basin will be assed by RM&E Objective 1e1. For steelhead, compare percent of broodstock collected to the percent of natural-reared run to Three Mile Falls Dam on a monthly basis. For Chinook, compare percent of broodstock collected to the percent of combined run (hatchery- and natural-reared returns) to Three Mile Falls Dam on a biweekly basis. Test for significant differences in brood collection timing and run timing using a Chi-Square analysis.

(9b): Estimate number of adult returns from the Umatilla Basin steelhead and Chinook hatchery programs that stray to other basins, and examine associations between homing to the Umatilla River and hatchery production strategies, flow augmentation, and environmental variables.

Status: Modify and enhance existing monitoring.

Performance metric: Number of hatchery returns that stray to other basins; percent of hatchery escapement to the mouth of the Umatilla River that stray to upriver basins (upriver stray rate); and percent of hatchery escapement to the mouth of the Umatilla River that reaches TMFD

Approach:

Estimate number of adult strays from out-of-basin CWT recoveries. Compare upriver stray rates of varying hatchery production strategies. Compare pre- and post-flow augmentation upriver stray rates. Assess relationships between homing and variations in flow and temperature in the Umatilla and Columbia rivers using correlation analysis.

(9c): Monitor the health of hatchery and natural fish; ; (7b:) Monitor broodstock survival and disease incidence during holding.

Performance metrics: Pathogen prevalence and levels in hatchery and natural fish.

Approach:

The health of hatchery production fish will be monitored starting with broodstock and continue throughout rearing. Fish for natural fish health monitoring will come from screw trap mortalities and spawning ground survey samples if available. All sampling, diagnostic, and statistical analyses will conform if possible with the Integrated Hatchery Operations Team (IHOT) and the Pacific Northwest Fish Health Protection Committee. All monitoring will be consistent with the ODFW fish health policy and the native fish conservation policy. An important aspect to the overall approach is to make it a priority and goal to only release fish into the Umatilla basin that are known to be have a healthy disease history during rearing to minimize the impact on natural or other hatchery-produced fish. Fish health sampling and monitoring will be conducted under supervision of a fish health specialist, and processed at a qualified fish disease laboratory. Analysis of samples will follow standard protocols defined in the latest edition of the American Fisheries Society "Fish Health Blue Book" (Procedures for the Detection and Identification of Certain Fish Pathogens).

(10a): Assess and monitor the impact of flow enhancement on homing of adult steelhead and chinook to the Umatilla River; (10b) Assess the impact of flow enhancement on steelhead and Chinook survival and the frequency of fish transport.

Performance measure: Run timing, escapement to the Umatilla River, migration timing, abundance and survival of juveniles and adults, in-stream flow and water temperature in the lower river.

Approach: Previous assessments of fall Chinook homing to the Umatilla River by Kissner (1993) and Volkman (1994 and 1995) suggest homing is poorest for the early portion of the run when flows are low, and a minimum attraction flow of 150 cfs in the Umatilla River is needed for homing. Run timing and abundance of Umatilla returns to Three Mile Falls and Lower Granite dams will be compared to assess the impact of flow enhancement on the homing and stray rates of Umatilla River fish. Information will be correlated with environmental conditions in the Umatilla and Columbia rivers (flow and temperature).

The percent of juvenile and adult migrations that pass through the lower river during enhanced flows will be estimated by determining the overlap in migration timing to Three Mile Falls Dam with flow enhancement timing, and adjusting this overlap for the additional time required for fish to migrate through the flow enhanced river reach. Estimates of juvenile and adult migration speeds through the lower Umatilla River are available from adult radio tracking studies conducted from 1994-1996 (Volkman 1994 and 1995, Contor et. al 1996 and 1997) and smolt migration monitoring conducted by the ODFW Umatilla River Juvenile Salmonid Outmigration and Survival Project (BPA # 89-024-01) from 1996 to present.

The impacts of flow enhancement on survival will be difficult to assess. Problems include obtaining sufficient numbers of migrating fish and minimizing handling stress. The evaluation would involve a treatment and control type experiment, where treatment fish would be trapped, PIT tagged and released on location during flow enhancement. Control fish would be trapped, PIT-tagged and subsequently transported to the river mouth during flow enhancement. Ideally, we would not want to trap and handle in-river migrating treatment fish. Therefore, the ability of this test to detect the effect of the trapping and handling procedures on survival is diminished to an unknown degree. Secondly, our performance measure would be PIT-tag detections and not smolt survival. PIT-tag detection rates probably wouldn't be meaningful since the treatment and controls will likely have different arrival times at mainstem Columbia River dams. The experiment would be replicated in season and between years. ANOVA would be used to test for differences in PIT-tag detection rates at lower Columbia River Dams of treatments and controls.

(12a): Assess and monitor migration times and delay in the Umatilla mainstem; (12b): Assess the effect of reduced diversion during water exchange on the relative attraction of smolts to the passage facility and east bank fish ladder of TMFD.

Status: (12a) Partially funded; partially implemented. (12b) Proposed.

Performance Measures: Passage abundance, migration timing and patterns at various flows and levels of operation.

Approach*:* Effectiveness of the juvenile fish bypass and adult passage facilities was evaluated between 1990 and 1994 (Knapp 1995). However, the effects of canal operations and water exchange programs on fish passage and attraction efficiency were not included in this evaluation. Associations between canal diversion, Phase 1 & 2 exchange and smolt attraction efficiency will be assessed and compared at West Extension Canals juvenile passage facility and the east bank fish ladder (regression and correlation analysis). Mark recapture and pit tag technology will be used to evaluate timing and fish passage routes at various flows and levels of operation. Marked fish will be released upstream of Three Mile Falls Dam and fish passing thru the juvenile passage facility and the east bank fish ladder will be remotely interrogated. Interrogation within the juvenile facility will occur at three locations: the canal headgates, the juvenile bypass channel and river return structure (fish outfall).

A major passage restoration is planned for the Umatilla Mainstem (Harza Engineering Company 1999). Experience has shown that not all passage restorations are successful, so action effectiveness monitoring is warranted.

(13a): Develop models for pre-season estimation of Umatilla River returns to facilitate management of subbasin fisheries.

Performance metrics: Run timing; adult returns; run prediction

Status: Funded; ongoing

Broodstock, harvest, and spawner escapement goals are developed as part of the long-term planning process for the Umatilla. However, these targets are always set as objectives, and are adaptively altered as conditions change. Run prediction models provide near-term estimates of run timing and size that can be used to plan for adaptive changes to biological objectives.

Approach: Correlation models have been developed for preseason prediction of chinook and steelhead run size to the Umatilla River. Spring Chinook run size to the Umatilla River is predicted from the previous year's jack counts to the Umatilla River mouth ($r = 0.93$). Regressions for fall Chinook ($r = 0.92$) and steelhead ($r = 0.87$) run size to the Umatilla River are based on both forecasted and actual fall Chinook and steelhead counts at Bonneville Dam (total run for fall Chinook, Up-river A-run for steelhead). Models based on forecasted run strength to Bonneville Dam are computed in June as part of the development of the Umatilla Basin's Annual Operating Plan (AOP). The model is then updated for steelhead in late-September after the Upriver A-run to Bonneville Dam has been counted.

(13b1): Quantify fishing effort, catch, and harvest by gear type for tribal and non-tribal fisheries in the Umatilla River.

Performance metrics: Fisher hours, harvest, and catch

Status: Mostly funded; mostly ongoing

Approach:

Tribal fisheries will be monitored using roving creel surveys, phone surveys, and volunteer fishing journals (0.1). Non-tribal fisheries will be monitored using stratified roving creel surveys (0.2).

(13b2): Quantify harvest of Umatilla steelhead and Chinook in out-of-basin fisheries.

Performance metrics: Out-of-basin harvest

Status: Funded; ongoing

Approach:

In out-of-basin fisheries that are selective for hatchery fish, harvest will be estimated from CWT recoveries reported on the Pacific States Marine Fisheries Commission CWT database. In out-of-basin fisheries that are not selective for hatchery fish, harvest of natural fish will be estimated as the number of hatchery fish harvest times the ratio of natural to hatchery run size (run sizes to the mouth of the Umatilla River).

(13c): Assess whether management actions optimize fishery opportunities while meeting production and population objectives.

Performance Metrics: Fishery opportunity

Status: Funded; ongoing

Approach:

Maintaining and improving fisheries is a primary goal of local and regional fishery managers. However, fisheries should be monitored and adaptively managed to ensure they do not negatively impact management objectives for brood collection, natural spawning, life history and genetic diversity, and non-target populations. We will assess whether fishing regulations optimize fishing opportunities with the constraints of the aforementioned management objectives. We will also assess impacts of hatchery program management (smolt production and release locations) on fishing opportunities.

(14a): Conduct collaborative study planning, implementation, synthesis of results, and results dissemination.

Performance metrics: All

Priority: High

Status: Funded; ongoing

Throughout the fourteen year history of UMEP, CTUIR and ODFW projects have faced challenging staffing complications, communication problems, and coordination gaps. ISRP reviews, NPPC feedback, and lingering data-gaps have made clear that increased collaboration is needed to increase RM&E effectiveness in the subbasin. CTUIR and ODFW will work together to increase in-situ planning, data collection, analysis, evaluation, and results dissemination. The projects will combine office, field, and laboratory equipment requirements wherever possible to increase programmatic integration and inter-agency communication.The projects will combine budgets and funding requests wherever possible, and will begin to produce a collaborative annual report to BPA.

(14a): Conduct collaborative study planning, implementation, synthesis of results, and results dissemination; (15a): Adopt locally and regionally standardized protocols; (15b): Coordinate with local and regional management and research groups, and integrate information from these groups into assessments of Umatilla Subbasin fisheries program; (16a): Conduct collaborative research with out-of-basin research programs that address Umatilla uncertainties; (16b): Participate in Columbia Basin research, monitoring, and evaluation forums.

Performance metrics: All

Status: Funded; ongoing

This RM&E Plan for steelhead and chinook has been developed collaboratively by the Umatilla Basin Natural Production, Juvenile Salmonid Outmigration and Survival, and Hatchery M&E projects. It will serve as a first step toward development of a Comprehensive RM&E Plan for all fish programs in the basin that will be incorporated in the Umatilla Subbasin Plan. This RM&E Plan should be considered preliminary as it may require revision depending on the outcome of the Subbasin Planning Process. ODFW and CTUIR basin co-managers have participated in the development of this RM&E Plan and provided their best forecast of management goals, objectives, and approaches that will be incorporated in the Subbasin Plan. Annual collaborative study planning will be achieved through review of Draft Work Statements and subsequent coordination meeting between M&E project sponsors, managers, and operations staff to define priority of information needs and assist in the development of RM&E objectives, approaches, methods, and activities.

Annual reports will be developed with data and information exchanged between the M&E projects to provide integrated summaries, analyses, and interpretations of data in relation to M&E objectives. In particular, the Hatchery M&E project will redirect it's focus of assessments and reporting from internal hatchery operations toward whether the hatchery program is accomplishing natural production and harvest goals for the basin. Annual reports will be one means of providing recommendations for adaptive management of the fisheries program. Integration of RM&E findings into program management and operations is an ongoing process facilitated primarily by regular meetings of the Umatilla Monitoring and Evaluation Oversight

Committee (UMEOC). The UMEOC meets monthly or as needed and is made up of RM&E staff, fisheries managers, and program operations staff working within the basin. Other forums for integrating RM&E findings into program management and operations include River Operations and Research Review meetings. The River Operations Group meets monthly to discuss fish passage facility and water exchange issues in the basin and is made up of RM&E staff, irrigation district managers, and staff from the U.S. Bureau of Reclamation, Oregon Water Resources Department, and Umatilla Fish Passage Operations Project. Research Reviews are held periodically to provide an interactive forum for formal presentation of RM&E findings and recommendations to basin fisheries managers and program operations staff. These research reviews also provide managers and operations staff an additional opportunity to assist in the development and prioritization of RM&E objectives and activities. Although members of the above mentioned meeting groups are primarily local staff, regional staff also attend when agenda topics require their participation.

We will participate in several regional processes to coordinate Umatilla RM&E activities with regional information needs. These processes include independent reviews/audits of anadromous fish hatchery performance initiated by the Northwest Power and Conservation Council, using performance measures developed by Independent Hatchery Operations Team (IHOT) and Artificial Production Review and Evaluations (APRE). Currently, comanagers are coordinating with NOAA to assess the scope and status of information needs identified in the Biological Opinion. The Umatilla RM&E program will also be coordinated with the CBFWA Regional Monitoring and Evaluation program currently being developed. The ISRP Provincial Review process provides an additional means of identifying regional information needs.

We will incorporate regional sampling protocols into our RM&E activities to provide region-wide data compatibility as these standards become defined. Currently, RM&E activities incorporate regional protocols for PIT-tagging, CWT'ing, and marking developed by the Pacific States Marine Fisheries Commission, and fish health monitoring developed by the Independent Hatchery Operations Team (IHOT). We propose in this RM&E to incorporate E-map sampling protocols into our fish habitat and population status monitoring. We will adopt other regional protocols for data collection as they are developed thru the Artificial Production Review and Evaluations (APRE), IHOT, NOAA Biological Opinion, and CBFWA Regional Monitoring and Evaluation program processes.

We will utilize project specific and region-wide databases that have been developed to centralize data management and access. A CTUIR website will be maintained to house a standardized database for primary data and description of meta-data. Appropriate components of program data and results will be provided to the Pacific States Marine Fisheries Commission (PSMFC) websites, including: StreamNet, PIT Tag Information System (PTAGIS), and the Regional Mark Information System (RMIS). Fish production and release summaries including mark applications will be provided to the Fish Passage Center for incorruption in their web based data. Run size information will be provided to the Columbia River Technical Advisory Committee.

We will obtain information from other basins to compare with Umatilla Basin RM&E study findings. We will compare basin-to-basin status and trends of fish abundance, productivity, and habitat. In particular, we will compare trends in Umatilla steelhead abundance and productivity with the unsupplemented steelhead population in the John Day Basin to address impacts of supplementation. We will also compared Umatilla spring chinook productivity with other natural and supplemented populations in nearby basins to assess the status of the Umatilla restoration program. Trends in abundance of Umatilla steelhead and chinook will also be compared with the Columbia/Snake river basin metapopulation to assess whether the Umatilla populations are following regional trends. As e-map protocols are expanded regionally, we will integrate the regional-scale understanding of fish populations and habitat into the assessment of Umatilla fish programs. Lack of uniformity in sampling protocols has confounded the validity and utility of some previous between-basin comparisons. Collection of comparable data may provide the ability to calibrate past data, thus increasing the validity of between-basin comparisons.

Detailed Methodology

Juvenile Abundance and Distribution Monitoring

An EMAP sampling design will be used to quantify the abundance of salmonid juveniles at the reach scale. The sampling universe for juvenile surveys will be the 331 reaches developed for subbasin planning and in-situ sampling designs (Figure 1). We will use reaches these reaches and watershed delineations to allocate sampling evenly across the subbasin. Sampling intensity will be increased in watersheds that are receiving supplementation. Fifty reaches will be selected for surveys during the first year of study. Out of the fifty randomly selected reaches, two per watershed will be selected as permanent index sites. An additional eleven sites (one per watershed) will be selected for sampling every three years. During subsequent surveys an additional twenty-eight reaches will be selected randomly to maintain a sample size of 50+ reaches per year. Within each reach sampling sites will be distributed randomly where possible, but will conform to land-owner requests and trespassing laws.

Sampling will occur in June through October. The spatial distribution will be kept balanced for every month of survey effort so that temporal patterns within the sampling season can be analyzed. Within each reach micro-habitats will be surveyed using the appropriate methodology. Pools will be snorkeled and trapped. Riffles will be trapped, seined, or electro-fished using multiple-pass depletions depending on conditions. Approximately five to ten percent of the catch will be PIT-tagged for survival and out-migration monitoring (0). The total number and CPUE of all salmonid species and cohabitants will be recorded separately for each sampling methodology.

Juvenile Abundance and Distribution Analysis:

The total abundance and CPUE by reach and sampling methodology for all fish species will be analyzed using associative, geostatistical, time series, and structural analysis. The data will be expanded to the watershed scale using geostatistical stock assessment based on habitat data (Petitgas 2001). Temporal patterns will be de-trended and filtered using seasonal and autoregressive functions. Fish community data will be further analyzed from an ecological perspective using functional analysis (0).

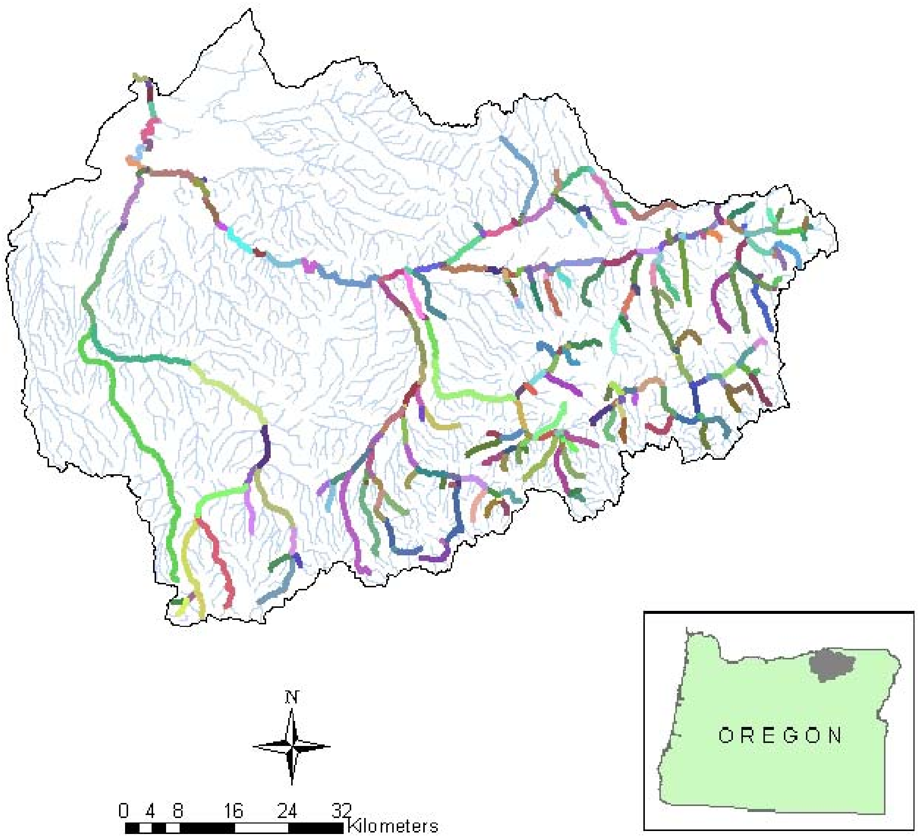


Figure 1. Reach distribution for the Umatilla Subbasin developed for subbasin planning and EMAP sampling design.

Outmigrant Monitoring

Outmigration monitoring is a key M&E activity through which essential components which drive the Subbasin's decision making analysis are derived. Smolt abundance, migration timing, and in-basin survival are all collected through O&S monitoring activities. Smolt yield provides a foundation for relationships such as smolts produced and smolts/spawner, or smolts/spawner regressed by total escapement, which are used to estimate in-basin capacity and productivity. It is also a crucial component required to estimate performance metrics such as smolt-to-adult returns and smolt-to-adult survival for natural species. An understanding of migration success and survival is also necessary to identify in and out-of-basin bottlenecks and estimate loss by life stage for hatchery and natural species. This information can be used to depict trends over time and ultimately assist managers in managing the subbasin.

Existing methodologies include use of mark-recapture techniques to derive in and out-of-basin survival estimates. Smolt abundance is derived from fish collection and expanded by the trap efficiency. We are currently investigating alternate methods to collect outmigrant data in order to improve project operations, estimates, and efficiency, and reduce potential error. Examples of these include moving towards the SURPH model for in-basin survival estimates, changing trap types and locations or applying in-basin survival estimates to upper river abundance to derive a total smolt outmigrant estimate. Options will be analyzed and methodologies finalized for implementation by 2005.

P.I.T. Tagging and Detection

PIT tags have been used to mark hatchery and natural juvenile salmonids in the Umatilla River since 1998. The first remote interrogation system (for 400 kHz tags) was installed at West Extension Canal's juvenile sampling facility off Three Mile Falls Dam in 1999. In 2000, the system was upgraded to a 134 kHz system (to stay aligned with mainstem dam upgrades) and new interrogation software was implemented. Additional upgrades were conducted in 2003, to improve performance and reliability and allow for remote system monitoring.

In the spring of 2001, a second PIT tag interrogation system was installed along the east bank adult fish ladder of Three Mile Falls Dam. Passage evaluation studies conducted in the early 1990's indicated the east bank fish ladder to be a key migration corridor for juvenile salmonids. The temporary system was installed in attempt to supplement juvenile detection data and obtain valuable information on adult returns. With tagging efforts ranging between 14,000-31,000 fish annually since 1999, PIT tag interrogation has provided invaluable data on migration characteristics and in-basin survival of juvenile salmonids. Furthermore, tags implanted between 1998 and 2003 have recently been recovered from adult broodstock during spawning.

Funding is currently being pursued to support installation of improved PIT tag detection capabilities at the east bank fish ladder of Three Mile Falls Dam. Improved detection capabilities would benefit not only juvenile outmigration and survival data, but provide valuable tag information on adult returns (including out-of-basin strays and ESU listed summer steelhead). Furthermore, it will extend interrogation capabilities for juvenile fish beyond operation of the west bank juvenile sampling facility, improve detection efficiency and tag estimates, facilitate data collection, reduce excessive downtime, and ease upload of the current system.

Approximately 6,000 hatchery-reared fish are currently PIT tagged and released annually in the upper Umatilla River between RM 56 and RM 80. An additional 5,000 tagged fish are released in the lower river for use in trap efficiency tests (RM 3.7). Production fish are tagged to monitor hatchery rearing and release strategies. Roughly 300 fish from each release group are tagged at the hatchery or acclimation facility prior to release. Fish are PIT tagged following methods outlined in the PIT Tag Marking Procedures Manual (CBFWA, PIT Tag Steering Committee, 1999. Release groups are sometimes combined to describe comparisons.

Natural fish will be captured and tagged in the headwaters and Umatilla River mainstem using baited minnow traps during abundance surveys (11.1). Approximately 1,000 natural fish are also tagged annually in the lower river during outmigrant sampling for use in trap efficiency tests.

Hatchery and natural smolts leaving the Umatilla River are interrogated for PIT tags at Three Mile Falls Dam (RM 3.7). PIT tag interrogation is conducted at two locations along the dam. Fish traveling along the west bank are interrogated for tags via a 134 kHz stationary PIT tag detection system located within the juvenile bypass facility off West Extension Canal. Fish traveling along the east bank are interrogated by means of temporary PIT tag detection system installed at the viewing window of the adult fish ladder.

Interrogation along the west bank is conducted 24 hr/day, seven days a week, between February and June. This is the primary smolt emigration period for hatchery and natural salmonids. Juvenile fish entering West Extension Canal are directed through the bypass channel, to an inclined plane trap equipped with a separator plate. Small fish (< 400 mm) fall through separator plate into the flume and are diverted to an eight-inch PVC pipe encircled by two hand wrapped antennas. Each antenna is connected to a FS 1001 stationary transceiver which detects and interprets codes from previously tagged fish. Once fish pass through the antennae, they are returned directly to the river via a bypass downwell and pipe extension.

PIT tag data is transferred from the stationary transceivers to a laptop computer via a serial port hub. Files are automatically uploaded to PTAGIS via the Minimon Program and modem. PITTag3 software is used to record codes of implanted tags and track the number of tagged fish Interrogation files are created every 3 hours and completed files are automatically uploaded to the PTAGIS database eight times daily. PIT tag system oversight and maintenance is conducted by Pacific State Marine Fisheries Commission, (PSMFC).

The PIT Tag detection system installed at the east-bank adult fish ladder of Three Mile Falls Dam (TMFD) is operated from September through July. The system consists of two portable transceivers (DA-2001F) equipped with paddle style antennas taped to the viewing window. The antennas are set on high power (80-100%) for maximum reading distance. Detection capability of tags tested through the glass ranges from 2-5 inches. Detection efficiency of tagged juvenile salmonids using the east bank adult ladder is between 0% and 8%. Data from the east bank system is stored in the portable receivers and then manually downloaded into an interrogation file and e-mailed to PTAGIS.

Tagged fish passing by the east and west banks of TMFD are individually differentiated by unique identification codes. Fish passing by the east bank adult fish ladder are identified by (TMA). Fish traversing along the west bank juvenile facility are identified by TMJ (Three Mile Juvenile).

Initial attempts in 2002 to improve detection capabilities at the east bank fish ladder of Three Miles Falls Dam proved too costly (~$194K) at the time to proceed. Subsequent attempts in 2003 also failed due to a large amount of interference from surrounding metalwork. In late 2003, Pacific States Marine Fisheries Commission (PSMFC) was contacted regarding options for improving detection efficiency at the site. Suggested upgrades included installation of three stationary antennas molded into high impact plastic housing and mounted in consecutive succession in the vertical slots (weir walls) of the ladder. The estimated cost was $108K. Funding is currently being pursued to implement recommended upgrades.

Analysis:

Smolt survival is estimated for hatchery and natural salmonids to assess in-basin and out-of-basin loss by species and life-stage. Survival estimates are also generated to evaluate optimal release sites and tactics, rearing strategies, and broods of hatchery reared fish. Mark-recapture methodology utilizing Passive Integrated Transponder (PIT) tags and subsequent detections at Three Mile and downstream Columbia River dams is used to calculate survival.

In-basin survival: In-basin survival is currently estimated using the Migrant Abundance Method (Burham et al. 1987 and Dauble et al. 1993), whereby:

$$S = A/R$$

and

$$A = (TD)/(1/TE)$$

S = survival, A = the outmigrant abundance at RM 3.7, R = the number of tagged fish released at upriver sites (*R*), TD = number of tagged migrants recaptured downstream, and TE = estimated trap efficiency. Since detections are date specific, efficiency estimates used encompass corresponding tag dates. If efficiency estimates do not correspond to the dates tags are detected, trap efficiency data is arbitrarily pooled using the closest daily estimates before and after the detection date.

Confidence intervals (95%) are based on derived population confidence intervals. The binomial test is used to test for significant differences in detection between comparable release groups of hatchery fish.

Alternate methodologies are currently being explored to obtain sound in-basin survival estimates. The SURPH Model (v 2.0) is one of the techniques currently being tested. Preliminary sample size requirements for determining survival probabilities to Three Mile Falls Dam were determined using the SURPH Sample Size program (v 1.2). Observed survival and detection rates from PIT-tagged hatchery and natural salmonids released in the Umatilla River between 1998 and 2003, were used to estimate minimum release groups needed to generate survival probabilities with 90% CI of 2.5%. Estimated minimum release groups ranged in size from 11,714 (natural spring Chinook salmon) to 57,666 (hatchery summer steelhead). All species and their required minimum release size for in-basin survival estimates are presented in Figures TW1 to TW6. Tag numbers needed to estimate in-basin survival would need to be increased by as much as 64 fold over current tag allocations (Table TW1). An increase in tagging would be contingent upon policy decisions by managers, feasibility and funding allocations. We do not currently have the additional funding required to PIT tag high numbers of fish in the Umatilla Subbasin. Additionally, the feasibility and logistics involved in capturing 12,000 to 14,000 natural fish per species to meet in-basin tagging requirements is unrealistic.

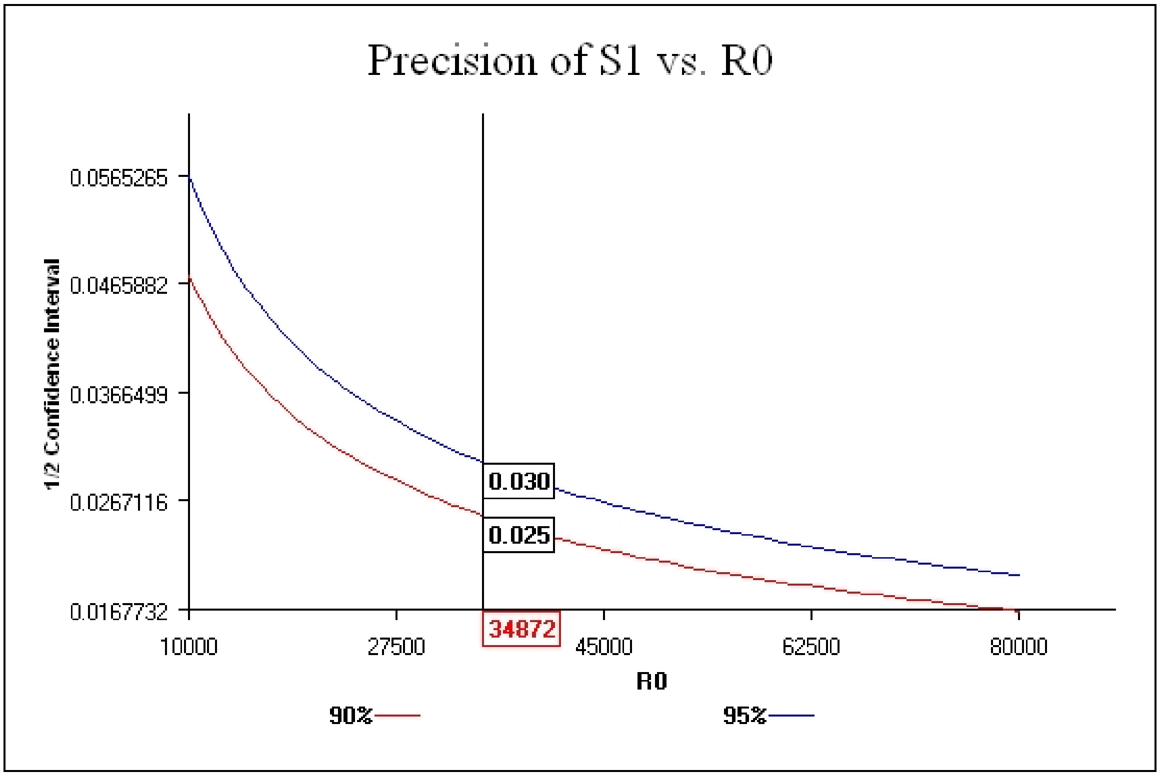


Figure TW1. Hatchery spring chinook salmon tag size needed to obtain a 90% confidence interval at 2.5% for in-basin survival rates.

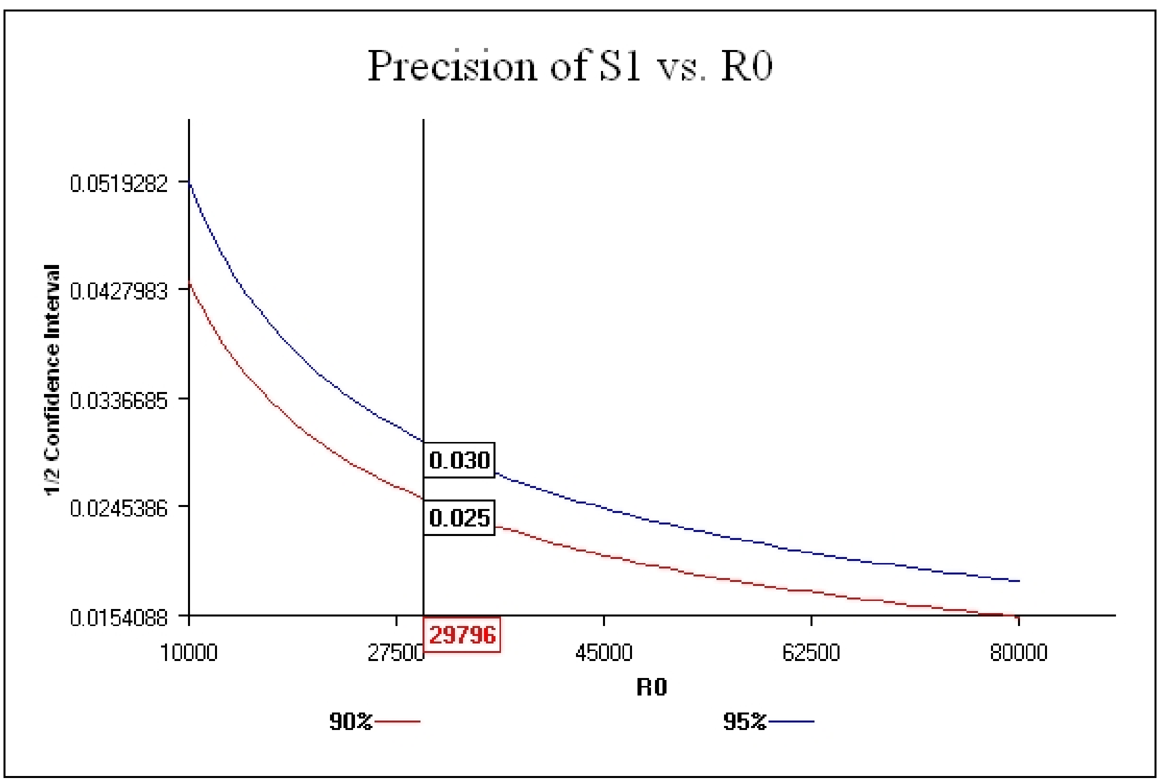


Figure TW2. Hatchery yearling fall chinook salmon tag size needed to obtain a 90% confidence interval at 2.5% for in-basin survival rates.

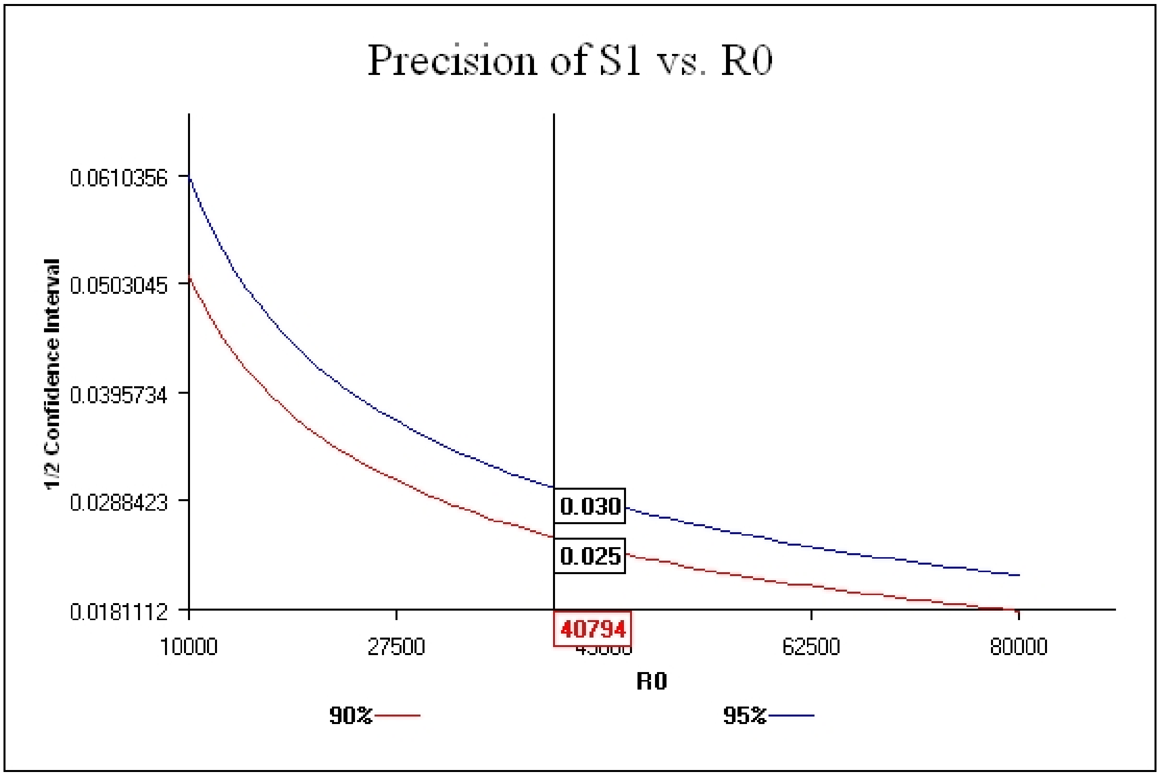


Figure TW3. Hatchery subyearling fall chinook salmon tag size needed to obtain a 90% confidence interval at 2.5% for in-basin survival rates.

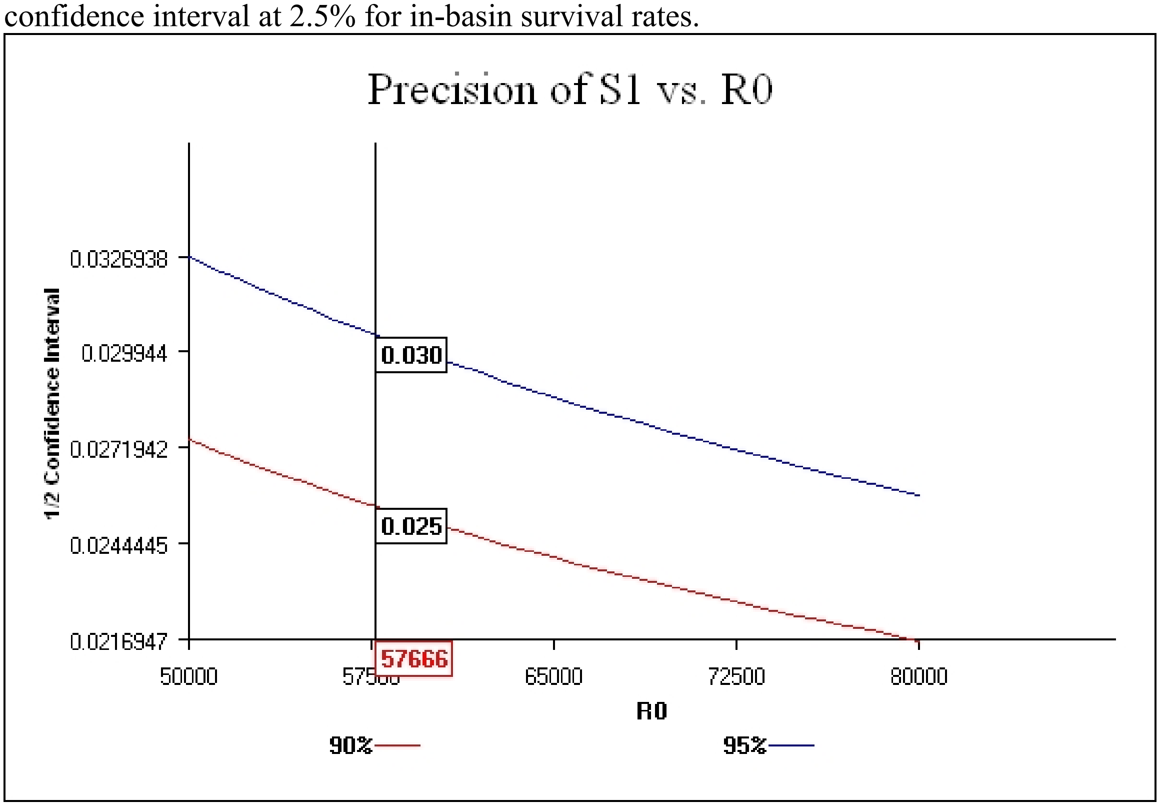


Figure TW4. Hatchery summer steelhead tag size needed to obtain a 90% confidence interval at 2.5% for in-basin survival rates.

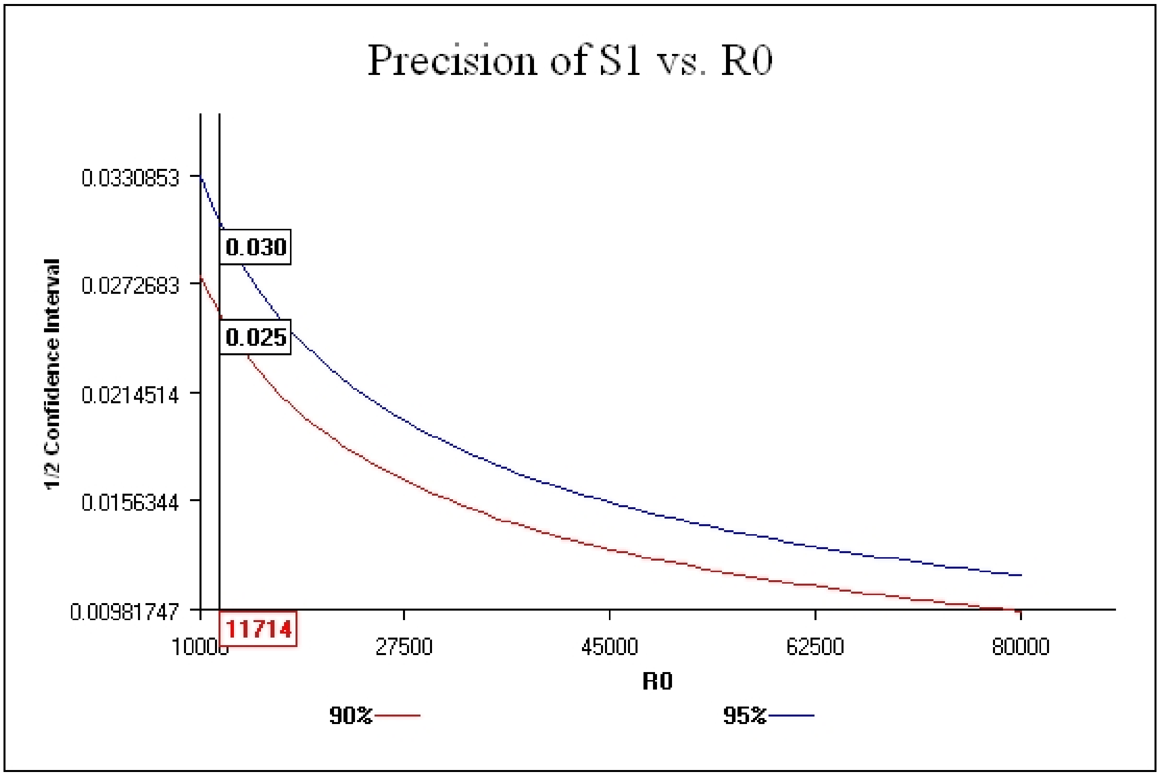


Figure TW5. Natural spring chinook salmon tag size needed to obtain a 90% confidence interval at 2.5% for in-basin survival rates.

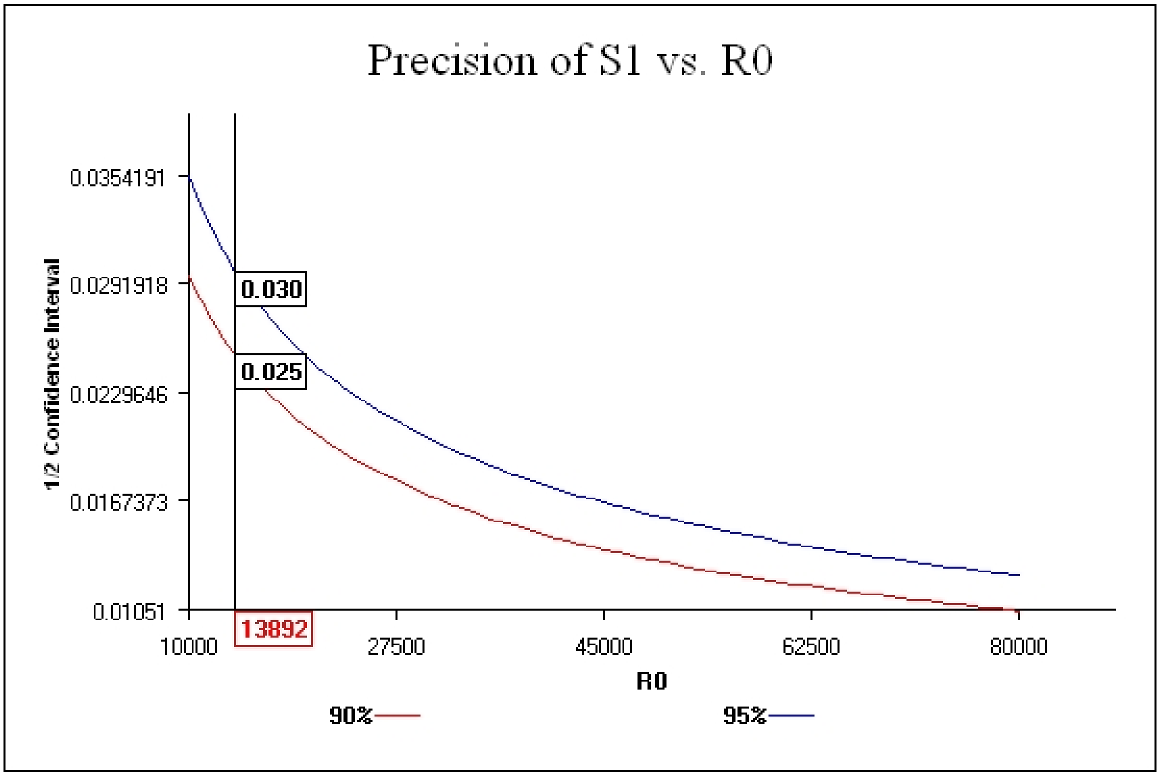


Figure TW6. Natural summer steelhead tag size needed to obtain a 90% confidence interval at 2.5% for in-basin survival rates.

Table TW1. Current and proposed minimum tag sizes needed to obtain in-basin survival rates for hatchery and natural juvenile salmonids using the SURPH 2.0 model.

Species	Current tag size	Proposed tag size
Hatchery spring Chinook	2,500	34,872
Hatchery yearling fall Chinook	600	29,796
Hatchery subyearling fall Chinook	1,200	40,794
Hatchery summer steelhead	900	57,666
Natural spring Chinook	-	11,714
Natural summer steelhead	-	13,892
Total	5,200	188,734

Table TW2. Summary of observed survival and detection rates for hatchery and natural juvenile salmonids released in the Umatilla River.

Species	Survival rate to TMFD	Detection rate at TMFD	Survival rate to JDD*	Detection rate at JDD
Hatchery spring Chinook	0.59	0.25	0.42	0.12
Hatchery yearling fall Chinook	0.63	0.29	--	0.14
Hatchery subyearling Chinook	0.92	0.32	--	0.08
Hatchery summer steelhead	0.78	0.21	0.46	0.05
Natural spring Chinook	0.40	0.35	0.51	0.13

Natural summer steelhead	0.39	0.30	0.54	0.12

*Survival rates to JDD were obtained from Contor 2003.

Testing for significant differences in survival rates will be conducted annually and over five year periods. Smolt survival estimates generated by SURPH include a point estimate and associated variance. ANOVA testing with transformed data will be used to characterize trends over time.

Out-of-subbasin survival: Out-of-subbasin will be estimated using the CRiSP (www.cbr.washington.edu) and SURPH models. Sample Size v. 1.2 (Westhagen et al. 2003) was used to determine the relationship between sample size and power for detecting survival of each brood year of STS, CHS, and CHF using PIT-tags. CTUIR and ODFW PIT-tagged hatchery and wild salmonids in the Umatilla Subbasin during 1999-2001 (Contor 2003). Average detection rates at John Day Dam for STS during 1999-2001 were 0.289 (N=8,718, Table 1). Survival rates varied by rearing type and release group (Table 2). Average STS survival to John Day Dam was 0.54 for all natural STS and 0.45 for all hatchery reared STS. Average survival*detection to Bonneville Dam was 0.379 for all STS (Contor 2003). On average a sample size of 6428 natural and 8007 hatchery reared STS will produce a 90% survival confidence estimate with α=0.05 (Figure 2 and Figure 3). An additional ~2000 naturally reared fish must be tagged so that differences in the survival of natural and hatchery reared STS can be detected with a 95% confidence interval (Figure 4).

Average detection rates at John Day Dam for CHS during 1999-2001 were 0.294 (N=2,980, Table 3). Survival rates of Chinook varied by rearing type and release group (Table 4). Spring and fall Chinook were not differentiated. Average Chinook survival to John Day Dam was 0.55 for natural and 0.39 for naturally reared fish (Contor 2003). Average survival*detection to Bonneville Dam was 0.389 (Contor 2003). On average a sample size of 6516 natural and 9235 hatchery reared Chinook will produce a 90% survival confidence estimate with α=0.05 (Figure 5 and Figure 6). Survival and detection estimates specific to CHF are not available for the Umatilla. It is probably safe to assume that the above Chinook sample sizes should be applied to each species independently. Acquiring this number of natural CHF may be a challenge, but should be possible with sufficient effort. This sampling effort should be sufficient to estimate differences in natural and hatchery reared survival and assign a 90% confidence interval to that estimate (Figure X). Due to the large difference in natural and hatchery survival an additional 4000 hatchery reared Chinook would need to be tagged to assign a 95% confidence interval to that estimate. This additional resolution is probably not cost effective. The variability in outmigration timing is considerable less than the variance in survival. Treatment affects on migration timing were detectable in STS and Chinook populations at sample sizes that were considerably less than those needed for survival monitoring (Contor 2003). Therefore no power analysis was conducted for the assessment of migration timing.

Table 1. PIT-tag detection rates at John Day Dam for Umatilla steelhead. See (Contor 2003) for detection details.

John Day Dam Detection Probability Periods (Steelhead)

1999

Begin Date	End Date	Detection Probability
1/1/1999	4/24/1999	0.22
4/25/1999	4/28/1999	0.21
4/29/1999	5/1/1999	0.12
5/2/1999	5/20/1999	0.29
5/21/1999	5/22/1999	0.35
5/23/1999	5/30/1999	0.39
5/31/1999	6/3/1999	0.33
6/4/1999	6/6/1999	0.43
6/7/1999	6/20/1999	0.29
6/21/1999	6/26/1999	0.42
6/27/1999	6/30/1999	0.25
7/1/1999	12/31/1999	0.10

2000

Begin Date	End Date	Detection Probability
1/1/2000	4/13/2000	0.66
4/14/2000	4/18/2000	0.38
4/19/2000	5/4/2000	0.26
5/5/2000	5/7/2000	0.19
5/8/2000	5/17/2000	0.14
5/18/2000	12/31/2000	0.08

2001

Begin Date	End Date	Detection Probability
1/1/2001	4/30/2001	0.80
5/1/2001	5/17/2001	0.66
5/18/2001	5/19/2001	0.51
5/20/2001	5/24/2001	0.66
5/25/2001	5/25/2001	0.28
5/26/2001	6/21/2001	0.11
6/22/2001	7/29/2001	0.29

2002

Begin Date	End Date	Detection Probability
1/1/2002	4/21/2002	0.45
4/22/2002	4/26/2002	0.20
4/27/2002	4/30/2002	0.09
5/1/2002	5/5/2002	0.23
5/6/2002	5/18/2002	0.11
5/19/2002	5/22/2002	0.20
5/23/2002	5/27/2002	0.05
5/28/2002	5/29/2002	0.19
5/30/2002	6/9/2002	0.06
6/10/2002	6/11/2002	0.20
6/12/2002	6/16/2002	0.31
6/17/2002	7/2/2002	0.10
7/3/2002	12/31/2002	0.39

Table 2. Estimated survival of Umatilla summer steelhead to John Day Dam. See (Contor 2003) for a description of release groups and detection details.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Natural Vs. Hatchery Groups									
STH 1	1999	N	All	All	All	3,855	1,990	0.516	<0.001
STH 2	1999	H	All	All	All	4,251	2,159	0.508	
STH 3	2000	N	All	All	All	1,671	650	0.389	<0.001
STH 4	2000	H	All	All	All	4,786	1,413	0.295	
STH 5	2001	N	All	All	All	2,746	464	0.169	<0.001
STH 6	2001	H	All	All	All	13,157	1,962	0.149	
STH 7	2002	N	All	All	All	446	489	1.096	<0.001
STH 8	2002	H	All	All	All	1,276	1,108	0.869	
STH 9	1999	N	Three Mile Dam	3/1-6/30	All	1,830	1,427	0.780	<0.001
STH 27	1999	H	Three Mile Dam	4/20-6/2	All	1,508	1,102	0.731	
STH 54	2000	N	Imeques Acc. Pond	4/1-5/31	All	822	409	0.498	<0.001
STH 55	2000	H	Bonifer Acc. Pond	4/10-4/12	All	822	207	0.252	
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	281	99	0.354	<0.001
STH 29	2001	H	ODFW Trap and Three Mile Dam	5/1-5/31	All	329	77	0.235	
STH 52	2001	N	CTUIR Mainstem Trap	3/1-5/31	All	813	162	0.200	<0.001
STH 53	2001	H	Bonifer Acc. Pond	4/3-4/7	All	2,047	182	0.089	

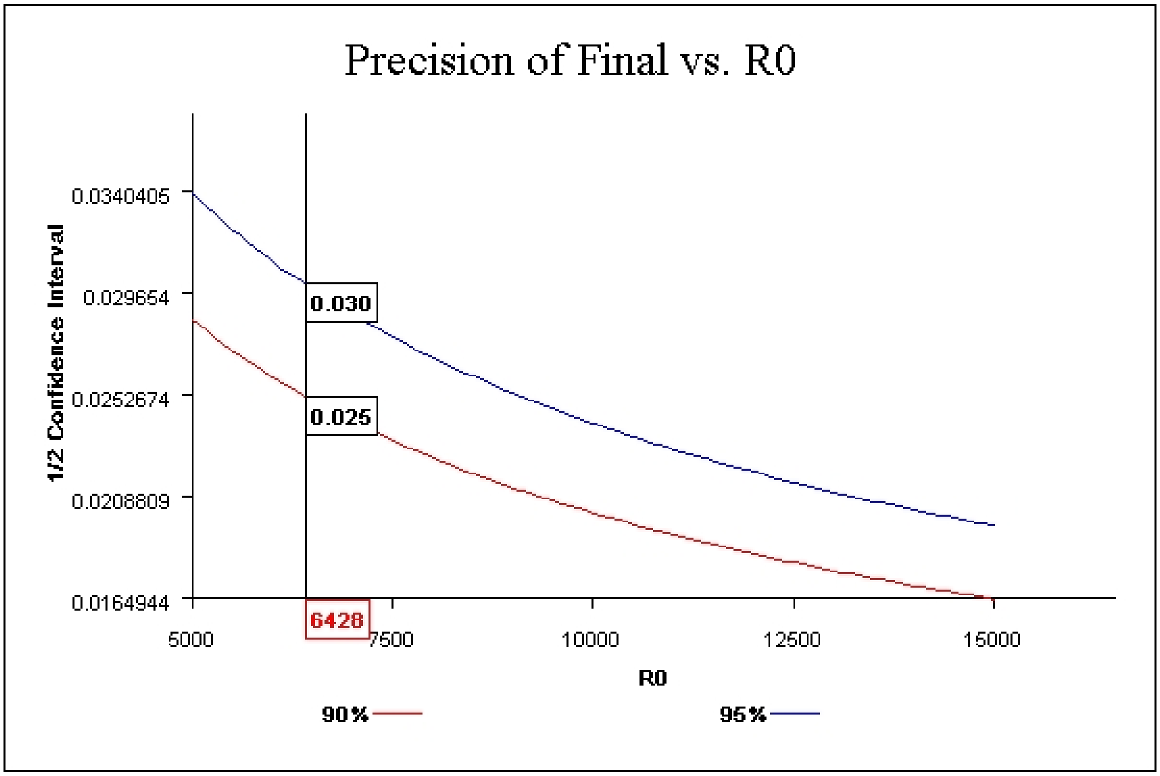


Figure 2. Natural summer steelhead sample size needed to generate a 90% confidence interval for survival rates at John Day and Bonneville Dams using PIT-tags.

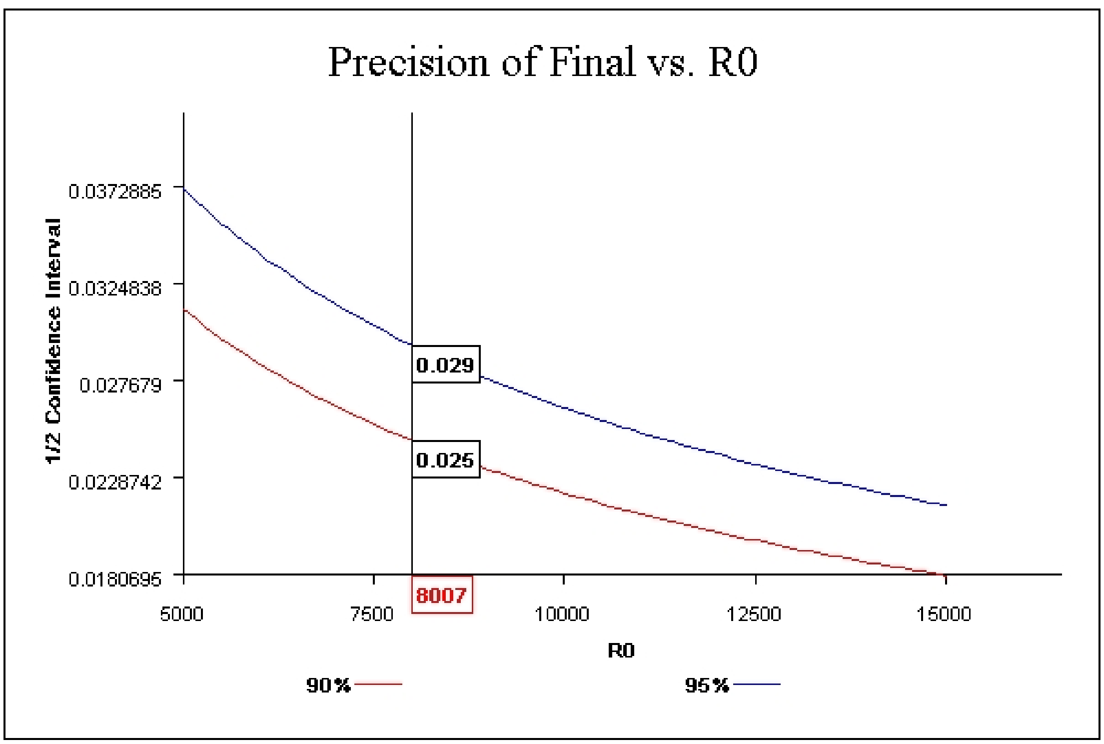


Figure 3. Hatchery summer steelhead sample size needed to generate a 90% confidence interval for survival rates to John Day and Bonneville Dams using PIT-tags.

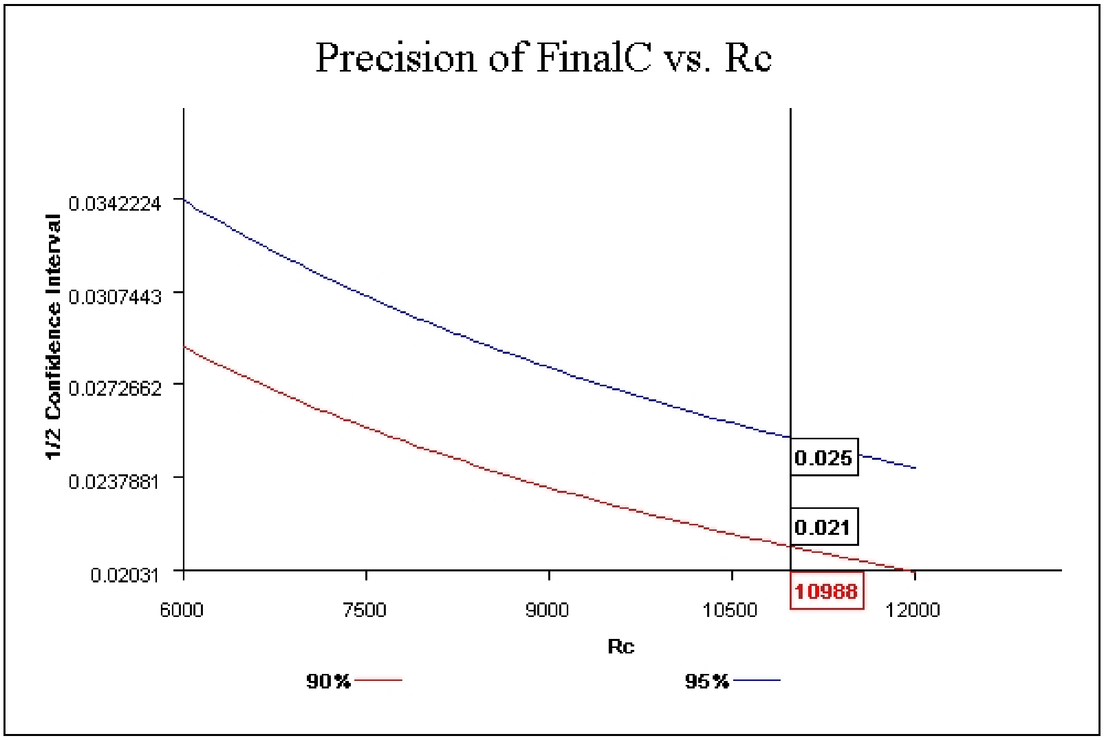


Figure 4. Natural summer steelhead sample size needed to detect 10% survival differences to Bonneville Dam for natural and hatchery summer, provided a hatchery sample size of ~6000 fish.

Table 3. PIT-tag detection rates at John Day Dam for Umatilla Chinook. See (Contor 2003) for a description of detection period details

John Day Dam Detection Probabilities (Chinook)

1999		
Begin Date	**End Date**	**Detection Probability**
1/1/1999	4/24/1999	0.30
4/25/1999	4/25/1999	0.16
4/26/1999	4/28/1999	0.34
4/29/1999	4/29/1999	0.22
4/30/1999	5/1/1999	0.07
5/2/1999	5/3/1999	0.23
5/4/1999	5/6/1999	0.29
5/7/1999	5/9/1999	0.21
5/10/1999	5/10/1999	0.31
5/11/1999	5/11/1999	0.36
5/12/1999	5/12/1999	0.30
5/13/1999	5/15/1999	0.20
5/16/1999	5/16/1999	0.28
5/17/1999	5/18/1999	0.33
5/19/1999	5/24/1999	0.20
5/25/1999	5/31/1999	0.14
6/1/1999	6/1/1999	0.23
6/2/1999	6/4/1999	0.30
6/5/1999	6/7/1999	0.39
6/8/1999	6/16/1999	0.27
6/17/1999	6/19/1999	0.26
6/20/1999	6/28/1999	0.35
6/29/1999	12/31/1999	0.14

2000		
Begin Date	**End Date**	**Detection Probability**
1/1/2001	5/8/2001	0.60
5/9/2001	5/11/2001	0.61
5/12/2001	5/14/2001	0.49
5/15/2001	5/21/2001	0.56
5/22/2001	5/23/2001	0.41
5/24/2001	5/24/2001	0.63
5/25/2001	5/25/2001	0.29
5/26/2001	5/28/2001	0.06
5/29/2001	5/29/2001	0.13
5/30/2001	6/1/2001	0.23
6/2/2001	6/4/2001	0.15
6/5/2001	6/6/2001	0.29
6/7/2001	6/9/2001	0.42
6/10/2001	6/14/2001	0.28
6/15/2001	6/17/2001	0.39
6/18/2001	6/19/2001	0.70
6/20/2001	12/31/2001	0.74

2000		
Begin Date	**End Date**	**Detection Probability**
1/1/2000	4/14/2000	0.57
4/15/2000	4/16/2000	0.50
4/17/2000	4/19/2000	0.36
4/20/2000	4/28/2000	0.30
4/29/2000	5/1/2000	0.36
5/2/2000	5/3/2000	0.32
5/4/2000	5/5/2000	0.24
5/6/2000	5/9/2000	0.17
5/10/2000	5/15/2000	0.08
5/16/2000	12/31/2000	0.03

2000		
Begin Date	**End Date**	**Detection Probability**
1/1/2002	4/25/2002	0.30
4/26/2002	5/1/2002	0.23
5/2/2002	5/8/2002	0.32
5/9/2002	5/9/2002	0.26
5/10/2002	5/13/2002	0.14
5/14/2002	5/14/2002	0.32
5/15/2002	5/15/2002	0.35
5/16/2002	5/16/2002	0.28
5/17/2002	5/17/2002	0.24
5/18/2002	5/18/2002	0.16
5/19/2002	5/20/2002	0.10
5/21/2002	5/21/2002	0.15
5/22/2002	5/22/2002	0.23
5/23/2002	5/23/2002	0.28
5/24/2002	5/24/2002	0.22
5/25/2002	5/25/2002	0.17
5/26/2002	5/27/2002	0.13
5/28/2002	5/28/2002	0.24
5/29/2002	5/29/2002	0.32
5/30/2002	5/30/2002	0.38
5/31/2002	5/31/2002	0.40
6/1/2002	6/1/2002	0.31
6/2/2002	6/2/2002	0.23
6/3/2002	6/8/2002	0.17
6/9/2002	6/10/2002	0.28
6/11/2002	6/13/2002	0.23
6/14/2002	6/14/2002	0.38
6/15/2002	6/17/2002	0.26
6/18/2002	12/31/2002	0.33

Table 4. Estimated survival rates of Umatilla Chinook to John Day Dam. See (Contor 2003) for a description of release groups and detection details.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Natural Vs. Hatchery Groups									
CHK1	1999	N	All	All	All	999	767	0.768	<0.001
CHK2	1999	H	All	All	All	3044	1216	0.400	
CHK4	2001	N	All	All	All	1676	423	0.253	<0.001
CHK5	2001	H	All	All	All	3650	1569	0.430	
CHK7	1999	N	Three Mile Dam & ODFW Trap	3/1-5/31	All	653	560	0.858	<0.001
CHK8	1999	H	Three Mile Dam & ODFW Trap	All	All	1104	404	0.366	
CHK9	2001	N	CTUIR Mainstem Trap & Meacham Cr.	3/1-4/30	All	656	219	0.334	<0.001
CHK10	2001	H	Imeques Acc. Pond	All	All	2911	1134	0.390	

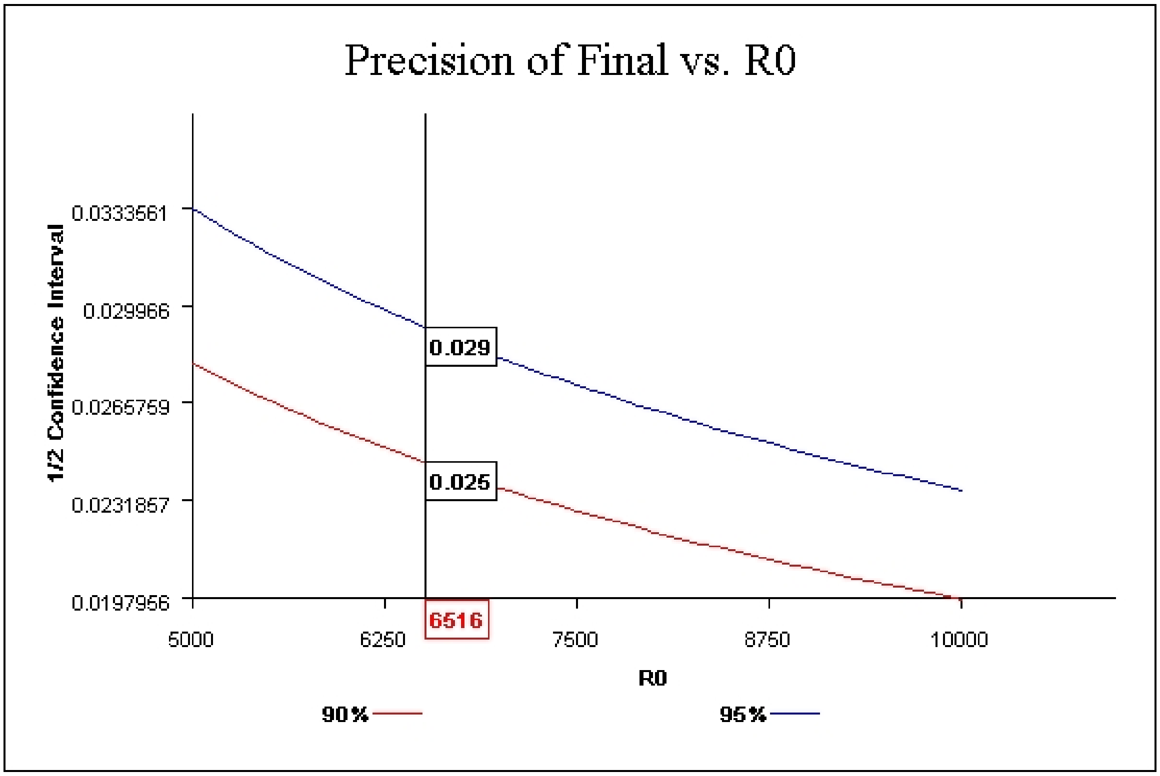


Figure 5. Natural Chinook sample size needed to generate a 90% confidence interval for survival to John Day and Bonneville Dams using PIT-tags.

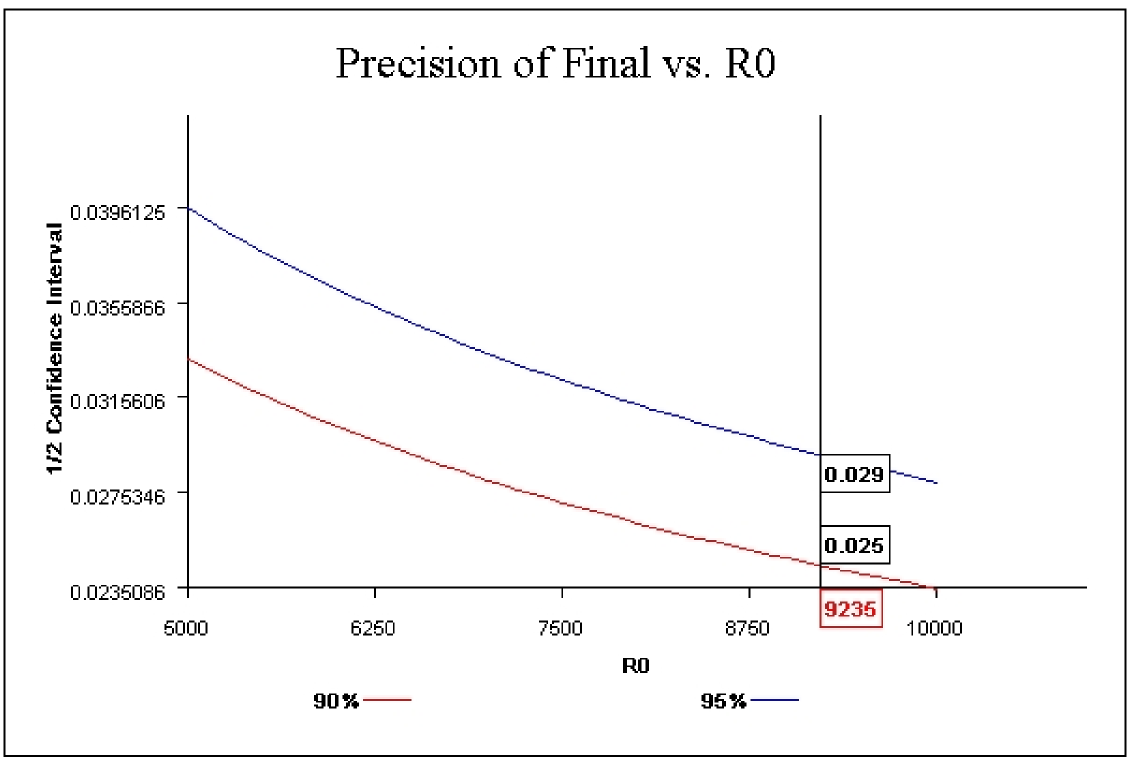


Figure 6. Hatchery Chinook sample size needed to generate a 90% confidence interval for survival to John Day and Bonneville Dams using PIT-tags.

Relative survival of PIT tagged groups to John Day and Bonneville Dams is also tested using the binomial test ($p<0.05$). A minimum of five unique detections are needed to satisfy testing. PIT tag information is submitted and recovery data obtained from the Pacific States Marine Fisheries Commission (PSMFC) database. Number, travel time, and length at PIT tagging are recorded for each release group at all reporting observation sites. Database records are downloaded in December for the entire run year. Detections from fish migrating in later years are combined with their respected release group.

Migration Parameters: Migration parameters are also monitored using PIT tags and subsequent detections at Three Mile Falls and downstream Columbia River dams. Parameters analyzed include emigration timing, duration, and travel speed and are monitored to evaluate the migration success of hatchery species compared with that natural. Smolt emigration timing is considered the proportion of juvenile salmonids moving past Three Mile Falls Dam during a particular period. Peak smolt movement is the date when the maximum number of tagged emigrants pass through the trap. Median emigration is the date when 50% of the tag detections are observed. Diel movement is determined by the percentage of fish detected within hourly blocks of time. Migration duration is considered the period between the first and last date of tag detections.

Travel speed is calculated for each tagged fish detected at West Extension Canal using the following equation:

$$TS = (RM-3.7)/D-R)$$

where *TS* = travel speed, *RM* = river mile of release, *D* = date and time of detection at West Extension Canal, and *R* = date and time of forced release. The median travel speed is calculated for all natural species and comparable release groups of hatchery fish. Median rather than mean travel speeds are computed because detection distributions tended to be skewed. Negative travel speed estimates due to volitional movement of hatchery fishes are omitted from the analysis, as are tagged fish interrogated during fish sampling operations, due to the inability to assign an accurate date and time of detection.

If insufficient numbers of hatchery or natural fish are tagged, a fish passage index is used to analyze the migration parameters of juvenile salmonids emigrating past Three Mile Falls Dam. The fish passage index is the number of fish captured during a designated block of time expanded by the sampling rate. Designated blocks of time range from a few minutes to several hours and sample rates are between 1 and 100%. Regardless of which method is used (PIT tag analysis or fish passage index), migration parameters have been found to be similar.

Trapping

A rotary-screw trap and incline plane trap are utilized to capture emigrating juvenile salmonids in the lower Umatilla River. The rotary-screw trap is operated at RM 1.2 beneath the Interstate 82 bridge and the incline plane trap is situated at RM 3.7 within West Extension Canal's juvenile bypass facility. Trapping is conducted year round, with operations focusing RM 3.7 from February through June and at RM 1.2 between July and January.

The rotary-screw trap consists of a 5-ft diameter perforated cone and 12.8-ft^2 livebox, supported between two 16-ft long aluminum pontoons. Fish enter the upstream end of the trap and are forced rearward into the livebox by rotation of the perforated cone, driven by the water current. Fish captured are held for a maximum of 24hrs prior to sampling.

The incline plane trap is situated within the fish bypass channel and consists of a dewatering plate and fish separator. Large fish (> 400 mm) pass over the separator bars, into the downwell and back to the river through a 24-inch bypass pipe. Small fish (< 400 mm) fall through the separator bars into the flume and are then directed into the sample tank or returned to the river depending upon mode of operation (fish sampling or bypass mode). Mode of operation is determined using a pneumatically actuated gate that is set at timed intervals according to the number of fish moving through the facility. When on sampling mode, fish are diverted into a 100-ft^3 sampling tank equipped with a crowder, divider, and lift basket. Fish are crowded into the forward half of the tank and separated from incoming fish by lowering the divider. On bypass mode of operation, fish are returned directly to the river via the bypass downwell and 24'' river return pipe. Fish are held no longer than 24 hours prior to sampling. Both the rotary screw trap and the inclined plane trap are checked and cleared of debris on a daily basis. Checks are more frequent during high flow and debris events.

Regardless of trapping type or location, all salmonids captured are anesthetized with a stock solution of MS-222 (40 mg/l) prior to sampling. Fish are enumerated by species, race, origin, rear type, and developmental (smoltification) stage. All salmonids are measured for fork length and scales collected, if required. Data is recorded directly into the PITTag3 program using a CalComp Drawing Board III (digitizer).

Fish origin is categorized as "natural" or "hatchery" based on the presence/absence of a fin clip, wire tag, and the worn appearance of the dorsal and ventral fins. Scales are collected on all natural summer steelhead and a subsample of unmarked coho salmon for age and origin analysis. Scales are also taken from natural chinook salmon in May and June in attempt to differentiate age (yearlings versus subyearlings) and race (spring versus fall).

Fork length is recorded to the nearest mm and single character descriptor codes are used to describe descaling, injuries, parasites, and disease for all juvenile salmonids captured during fish sampling. During instances of high fish numbers subsampling is implemented and only 100 to 200 fish are measured and examined. Developmental (smoltification) stage is assessed by visible brightness and the absence or presence of parr marks.

All smolts captured during fish sampling are manually interrogated for PIT tags. Fish are also scanned for the presence of a wire tag using a tabletop coded-wire tag detector. All recaptured PIT tagged smolts are reported to the PTAGIS database.

Trap Efficiency: To calibrate the collection efficiency of the traps and estimate outmigrant abundance and survival, groups of 50 to 100 fish per species are collected, PIT-tagged and released upstream of the traps for recapture. Tests are generally conducted 2 times a week for each species while sufficient numbers of fish are being captured. Tagged fish are typically held for 24 hours prior to release, to assess latent mortality (tagging effect), tag loss and determine the probability of survival of individual release groups. The probability of survival and estimated survival of tagged fish released is calculated using the following equation:

$$s = L/H,$$
$$\text{and}$$
$$M = N(s)$$

where s = probability of survival, L = number of live tagged fish after holding, H = initial number of tagged fish held, M = estimated survival of tagged fish released, N = total number of tagged fish released. Tagged fish which die or drop their tags prior to release are removed from the test group. Tag retention and fish survival for all factors other than tagging are assumed to be 100% after release. Specific details regarding tagging, holding, and fish transport operations can be found in White et al. 2003.

Recaptured fish are enumerated by species/origin and trap efficiency estimates are computed using the following formula:

$$TE = R/M$$

where, TE = estimated trap efficiency, R = number of recaptured tagged fish, and M = number of tagged fish released and adjusted for survival. Separate trap efficiency estimates within a species are compared using Chi^2 analysis and pooled if the estimates are not significantly different ($P \leq 0.05$). If less than five tagged fish of a particular release group are recaptured, adjacent test groups are pooled until the number of recaptures is greater than five. Pooling is continued until a significant difference was determined. The final trap efficiency estimate is the weighted mean of the pooled estimates.

Smolt Emigrant Abundance: Smolt emigrant abundance is defined as the number of smolts leaving the Umatilla River or reaching Three Mile Falls Dam (RM 3.7). It is calculated for natural emigrants only and is a key component required to address critical uncertainties surrounding in-basin productivity and natural production capacity.

Smolt abundance is derived based on the number of fish collected at lower river trap sites and the estimated trap efficiency. Abundance of fish sampled at West Extension Canal's juvenile bypass facility is estimated by:

$$A = B/TE$$
$$\text{and}$$
$$B = (C/T)/D$$

where, A = estimated number of outmigrants, B = number of fish passing through the trap, TE = estimated trap efficiency, C = sample rate, T = proportion of time sampled, and D = diel pattern of fish movement.

Smolt abundance at the rotary screw trap is estimated using a slight variation in the formula:

$$A = (C/TR)/TE$$

whereby, A = total number estimated outmigrants, C = the number of fish captured, TR = trap retention efficiency and TE = estimated trap efficiency. Sampling rate and time were not adjusted for due to 24 hr a day trap operation.

Emigrant abundance is calculated on a monthly basis and then summed (for both trap sites) to derive a total number of natural outmigrants for the season. For months where trap efficiencies of natural species are not available or are sparse, efficiency estimates from hatchery conspecifics are used to supplement the average estimate. If hatchery conspecifics are not available for a particular month, efficiency estimates from the month before or month after are used.

The Bootstrap method (Efron and Tibshirani 1986; Thedinga et al. 1994), with 1,000 iterations, is used to derive a variance for abundance estimates. Confidence intervals (95%) for the abundance estimate are calculated using the square root of the variance ($CI = 1.96 \sqrt{V}$).

Alternate means of collecting smolt abundance data are currently being explored. Operations are being reviewed and refined to: 1). Ensure accurate, confident estimates, with the lowest possible standard error; 2). Address fish passage and operational concerns at West Extension Canal; 3) Ensure sampling activities are conducted in the most feasible manner possible; 4). Explore alternate trapping locations and methodologies; and to 5). Keep up-to-date on the latest available science. Alternate trapping options include: 1). Maintaining the current trap location and methods at West Extension Canals juvenile sampling facility, 2). Modifying the juvenile facility, 3). Moving to a rotary screw trap in an alternate location year round. Options for estimating emigrant abundance include utilizing mark- recapture techniques via PIT tag technology or applying in-basin survival rates to upriver smolt estimates. These approaches are contingent upon sufficient numbers of fish being tagged and later approach can only be used if upriver smolt abundance can be estimated.

Juvenile life history characteristics: Juvenile life history characteristics including smolt emigration timing, length, age, health, condition and smolt status is monitored annually during sampling at lower river trap sites. The Spearman rank correlation test is used to assess relationships between fish size, period of peak emigration, and level of smoltification for hatchery emigrants. Testing for trends over time is conducted at five year intervals.

Smolt emigration timing: Smolt emigration timing is considered the proportion of juvenile salmonids moving past Three Mile Falls Dam during a particular period. Methods used to analyze migration timing are described in the “Outmigrant PIT tagging and Detection” section of the methods.

Age at Emigration is characterized as the annual proportion of smolts in a particular age class migrating past Three Mile Falls Dam. Percent age composition analysis from a five year mean of adult returns is applied to annual smolt abundance estimates to derive the total estimated number of emigrants by freshwater age class for a particular year. Validation of age at emigration is accomplished through collection and scale pattern analysis of all summer steelhead and a subsample of coho and chinook salmon annually. Scales are analyzed to decipher ciculi patterns reflecting age and growth.

Size at Emigration: Size at emigration is quantified for each species and race of salmonid. Fork length (FL) is measured to the nearest millimeter (mm) for all natural salmonids and a sample of 60-100 hatchery salmonids per day. All PIT tagged fish encountered in hand samples are measured to assess growth from tag date to recapture date. Length data is used to create length-frequency distributions on a monthly basis for all species and to distinguish race of natural chinook (spring versus fall).

The growth in length (mm/d) for individual tagged fish is calculated as length at recapture minus length at tagging divided by the number of days between tagging and recapture.

Condition at Emigration: Condition at emigration is characterized as the proportion of cumulative scale loss evident on the fish at the time of emigration. Fish condition is divided into three categories: good, partially descaled and descaled. Condition is considered "good" if cumulative scale loss on either side of the fish was less than 3%. Fish are considered "partially descaled" if cumulative scale loss was greater than 3% but less than 20%. Fish with scale loss greater than 20% are considered "descaled". Descaling is categorized following criteria used by the Umatilla Hatchery Monitoring and Evaluation project (Keefe et al. 1994).

The Spearman rank correlation test is used to analyze the possible relationship of fish condition with various independent variables. Independent variables included river discharge, water temperature, and secchi depth (water clarity). A nonparametric test is used because the assumption of bivariate normal distribution was not fulfilled.

Smolt status: Smolt status is the developmental smoltification stage of the fish and is determined by brightness and the absence or presence of parr marks.

Juvenile fish health: Juvenile fish health is monitored during emigration. Unusual marks or indications of disease on dead fish are noted. Single character descriptor codes are used to describe body injuries, external parasites, bird marks, obvious fungal infections of the body surface and potential disease for all juvenile salmonids. Symmetrical bruises on each side of the fish are classified as bird marks. Fish mortalities are noted by species/origin and identified as pre or post sampling. Percent sampling mortality and natural mortality are computed separately. Percent mortality is determined from the total number of fish sampled. All dead natural fish and some diseased and dead hatchery fish sampled are forwarded to the ODFW Fish Pathology Lab. Sample, diagnostic and statistical analyses conform if possible with the Integrated Hatchery Operations Team (IHOT) and the Pacific Northwest Fish Health Protection Committee guidelines. Analysis of samples follow standard protocols defined in the latest edition of the American Fisheries Society " Fish Health Blue Book" (Procedures for the Detection and Identification of Certain Fish Pathogens).

Physical and Environmental Variables: Physical and environmental variables including river discharge, flow augmentation, water temperature and water clarity are monitored annually to characterize conditions in the Umatilla River and to assess their effects on smolt survival and emigration success. Daily river discharge, flow augmentation from McKay Reservoir, and water temperature data is obtained from the USBR Hydromet Achieves: http://mac1.pn.usbr.gov/umatilla/umawebhydreadarc.html. Weekly mean discharge and temperature from the Umatilla gauging station (RM 2.1) is plotted against time. Weekly mean discharge and daily mean water temperature from McKay Reservoir is also plotted against time. Water clarity is measured to the nearest 0.05 m using a 7-in-diameter Secchi disk. Weekly mean secchi depth is plotted against time.

The relationship between river discharge and the number of emigrants passing a trap site (passage index) is tested using a Spearman rank correlation test. A separate test is run for each species/origin type. The Spearman rank correlation test is also used to test for a relationship between water temperature and the number of emigrants passing a trapping site. The variable reflecting the river discharge or water temperature during the passage period is the average of the mean of the day before and the day of passage. The time period used for the analysis is between the day when the first and last emigrant was observed. Discharge and temperature variables from the Yoakum gauging station (RM 37.6) are utilized for the analysis. The Yoakum gauge is located below all anadromous fish bearing tributaries and hatchery acclimation facilities, is directly influenced by McKay Reservoir releases, and is located above any major irrigation diversion operations. Any missing discharge or temperature records are estimated by taking the average of the mean daily discharge or temperature three days prior and three days after the missing record.

The χ^2 goodness-of-fit test is used to analyze the proportion of the emigration (passage index) of natural juvenile salmonids that occurs within a given environmental range. For river discharge, five ranges reflecting the percent change from the previous day are calculated. Changes in discharge are characterized as rapidly decreasing: $\geq$ -10, slowly decreasing: < -10 to > - 1, no change: ± 1, slowly increasing: > 1 to < 10, and rapidly increasing: $\geq$ 10 %. For water temperatures, six temperature ranges are utilized: < 10, 10 to < 12.2, 12.2 to < 15.0, 15.0 to < 17.2, 17.2 to < 20.0, and $\geq$ 20.0°C. The analysis is based on the null hypothesis that the percentage of emigrants captured within an environmental range would not differ from the percentage of the emigration season within that environmental range. The emigration season is defined as being between the day when the first and last emigrant is observed.

Associations between canal diversion rate and trapping efficiency, river discharge and trapping efficiency, and water temperature and trapping efficiency are assessed using regression analysis. The variable reflecting diversion rate, river discharge, and water temperature is the average of the mean of the day of and the day after the trap efficiency release was made. Mean canal diversion rate is calculated by dividing the daily canal flow by the daily river flow. Daily river flow is calculated by adding the RM 2.1 gauge reading and the daily canal flow.

Adult Monitoring

P.I.T. Tagging and Detection

Adults are PIT-tagged regularly by mainstem monitoring programs under BPA, Lower Snake Compensation Program, or ESA mandated support. In addition a number of juveniles tagged in the Umatilla Subbasin will return with PIT-tags intact, and will produce adult detections. Adult

PIT-tag returns will be monitored using PITAGIS, and will be utilized to inform run prediction models.

Adult Trapping, Collection, and Enumeration

The east bank fish ladder at Three Mile Falls Dam is the primary counting and brood collection facility for adult steelhead and Chinook on the Umatilla River (river mile 3.7). All returning adults pass Three Mile Falls Dam through the east-bank fish ladder. Returns have been enumerated at this location using an electronic fish counter from 1966-1987, afterwhich, a fish trapping and collection facility was constructed. The collection and counting facility includes a back-lit viewing window, Denil steeppass, holding pond, and a fish sorting complex. Adults are enumerated at the ladder whenever river flow is adequate to provide fish passage which is typically from mid-August until mid-July.

All returning adults were trapped up until the 1999 return year, afterwhich, alternating trapping - video enumeration was implemented to reduced handing stress on fish, particularly ESA-listed steelhead. Currently, the facility operates in a trapping mode from mid-August thru November, afterwhich a schedule of five days trapping and nine days of video enumeration is followed until summer shutdown. Additional trapping may occur if brood or CWT collection goals are not being met. Video enumeration has been attempted in the fall, but coho and fall chinook could not be reliably differentiated.

During trapping, a diffuser panel with 1” gaps between slats is placed in the ladder to divert fish into the steeppass and holding pond. Fish are then routed into the sorting complex where they are anesthetized with buffered carbon dioxide to facilitate handling. Fish are examined, then routed either to adjacent holding ponds, transport vehicles, or a recovery tank for release to the river. Timing of broodstock collection is intended to be proportional to the run timing of natural steelhead returns and the combined hatchery and natural returns for Chinook. We follow monthly and bi-weekly brood collection schedules that are modeled from the most recent 5-year average run timing of the aforementioned steelhead and Chinook returns, respectively. Proportionate representation of all adult age classes in the brood is also desired, but formal protocols are only defined for jack Chinook. Equal numbers of males and females are collected for brood with one of ten males being jacks for Chinook. Total numbers of brood collected for hatchery production are 100 natural steelhead (plus 20 hatchery males that will only be spawned if needed), 380 fall chinook, and 560 spring chinook. An additional 60 hatchery steelhead are collected for progeny marker research, all CWT’ed fish if possible. Collection of these research steelhead will be at a 1:1 male-female ratio, and timed at 20 within the periods of September - November, December - February, and March - April.

Data collected during the sorting stage includes date, disposition, and number trapped by sex, age class, and marks. Hatchery-natural origin is determined by the respective presence or absence of an adipose fin for steelhead and wire-tag for fall Chinook. Presence of wire tags is determined using R9500 tunnel wire-tag detector. Hatchery- and natural-reared origin of spring Chinook is determined by a combination of recording fin marks on hatchery fish at the sorting complex and examining scale patterns from unmarked fish collected for broodstock, and those sampled in in-subbasin fishery and spawning ground surveys. Scales will be collected from all unmarked fish during these activities. Natural-reared origin of unmarked steelhead and non-wire-tagged or fin-clipped Chinook will be cross-checked by examining scales patterns on all un-marked fish collected for broodstock or sampled in fisheries and on the spawning grounds. The percentage of misclassified natural origin fish determined from the scale analysis will be extrapolated to the entire run and brood, harvest, and spawning components of the run. Age is classified by fork length. One- and two-ocean resident steelhead are split at 660 mm. Subjack, jack, and adult Chinook are split at 381 and 610 mm. Additional age, length, and CWT information is obtained when broodstock collected at Three Mile Falls Dam are spawned. A total of 120 steelhead snouts are collected for CWT data. Twenty CWT's are recovered from broodstock, the remaining 100 are collected either by sacrificing fish at the trap or from snouts collected in the Umatilla River fishery. A monthly CWT collection schedule is followed that is proportional to the 5-year average run timing of hatchery steelhead to Three Mile Falls Dam. Fishery monitoring staff provide trap operators with weekly updates of steelhead CWT recoveries.

During video enumeration, a time-lapse video camera records fish movement past the viewing window 24 hours a day at a rate of 1 frame per second. Total counts of steelhead and Chinook are obtained from review of the video tapes. During the video review, about 50% of steelhead can be classified as hatchery or natural by the presence or absence of an adipose fin, respectively. Origin of the unidentified steelhead, and age, sex, and mark composition of video monitored Chinook and steelhead are estimated as their mean percent composition from trapping periods immediately before and after the video period.

The Fish Passage Operations program has a 3,500 gallon, one 3000, and two 370 gallon fish liberation units available for use. The 3,500 gallon unit is a diesel operated tractor- trailer equipped with a 12 inch discharge opening and a single holding chamber. The 3,000 gallon unit is a diesel operated tractor-trailer equipped with a 12 inch discharge opening and two holding chambers capable of isolating two groups in the same load. Both tractor-trailer units are equipped with liquid oxygen and electric aeration to reduce fish stress during transport. The two 370 gallon transport tanks are mounted on dual axle trailers and are pulled by pick-up trucks. Each is equipped with both compressed oxygen aeration and a re-circulation system. Both units have an eight inch discharge opening. These transportation units are used in the Umatilla and Walla Walla Subbasin. ODFW liberation protocols are used as the basic guideline for hauling operations. In addition to these units, the project also has access to a Bureau of Indian Affairs 750 gallon portable fiberglass tank which can be mounted on a flatbed truck. This unit is also equipped with both compressed oxygen aeration and a re-circulation system and has a 12 inch discharge opening.

Adult transportation requirements are based on flow criteria outlined in the 1981 USFWS study (USFWS 1981) and past project observations of salmon migrations in the Umatilla River. The AOP also identifies criteria for transportation of adults collected at TMFD. Generally, returning adults are to be hauled whenever flows in the Umatilla River are projected to fall below 150 cfs at Dillon within 30 days. The project is also responsible for the collection and transportation of broodstock from TMFD.

The AOP outlines release locations for CHS and STS adults hauled upstream from TMFD. Fish are to be released at either the Pendleton boat ramp (RM 52.5) or Pendleton juvenile acclimation site (RM 56) unless flows at Pendleton drop below 250 cfs. Releases are then to be made as high in the basin as temperature differentials will allow. STS releases are to be alternated between the various upriver release locations. It is not anticipated that CHF would be hauled from TMFD, so no release sites are identified.

Returning adults are released at TMFD whenever flows at Dillon are anticipated to remain above 150 cfs for a minimum of 30 days after release. Now that the Umatilla Subbasinasin Project flow enhancement program is in place, flows generally remain above 150 cfs for all but the very beginning and end of the adult return season. The majority of adults entering the Umatilla River are either released at, or volitionally migrate past, TMFD. The AOP identified the following groups for release at TMFD regardless of flow condition; CHF subjacks and excess CHF jacks, coho adults, and coho jacks.

Passage Monitoring

Radio telemetry study provides critical information to managers regarding the effectiveness of new passage facilities, and potential migration barrriers. Telemetry methods and techniques will follow CTUIR's adult passage evaluations in the Umatilla Basin as conducted by Volkman (1994 and Contor et al. 1996 and 1997). Monitoring will include detailed examination of how fish negotiate the modified Westland-Ramos facility. Following renovations we will tag 40 adult steelhead and Chinook at TMFD during the adult return period (fall-spring).

CTUIR will maintain up to four fixed-site receivers in the Umatilla Subbasin. The mobile and fixed-site receivers will be able to read and differentiate tagged fish from both species. Individually coded radio-tags combined with 4 fixed-site receivers with multiple antennas will allow the tracking of individual steelhead and Chinook at strategic locations 24 hours a day. Having multiple antennas at each fixed-site will show if the fish use the new ladder or jump over the new structure. The fixed-site receivers will also record how long individual fish hold below the facility before migrating over the structure. A mobile receiver will be used to locate individuals away from the fixed-sites and follow individuals to and from the headwaters. It is necessary to follow tagged fish throughout their spawning cycle to determine if delay or stress at the new facility results in aberrant migratory behavior following passage.

Juvenile fish screens/bypasses and adult ladder facilities, associated with irrigation diversions within the basin, will be monitored throughout the year to ensure that adequate passage conditions exist for upstream adult and downstream juvenile and adult migrants. Inspections include checking for proper installation and operation of screens, gaps and holes in screens or seals, debris buildup on screens and trash racks, proper flows to smolt bypasses and adult ladders, adequate access and exit conditions at bypasses and ladders, and signs of fish activity.

Spawning and Carcass Surveys

Spawner and carcass surveys will be conducted during the appropriate spawning and holding season for each species. Effort will be allocated using a stratified randomization of tributaries based on known and historic spawning habitat for each species. Redds and carcasses will be enumerated as an index of spawner abundance using multiple-pass visual surveys of the spawning grounds. The location of each redd and carcass will be georeferenced using OmniSTAR differential GPS. The condition of each redd and any observed spawner activity will be noted. Each observed redd will be flagged by marking tape on adjacent vegetation to avoid re-sampling.

Carcasses will be measured (fork length and MEHP) and weighed, and a scale sample will be collected for age, growth and origin analysis. Each carcass will be cut open to determine the spawning success of females. All external marks and tags will be noted. The snouts of adipose clipped fish will be removed for CWT analysis.

STS survey efforts will be stratified using the six index sites that have ten-year datasets will be visited annually and receive at least three passes each year. An additional two to six tributaries will be surveyed annually. These sites will be divided between three and five year streams using a rolling panel design. The watershed location of three and five year streams will be distributed evenly throughout the spawning grounds.

CHS spawner surveys will be conducted differently due to the limited spawner range of CHS in the Umatilla Subbasin. All spawning grounds will receive at least three passes annually. Historic and marginal habitat will be surveyed during the spawning season to collect carcasses, and to watch for increased colonization of new spawning grounds. CHF spawner surveys will be conducted similar to CHS surveys. A boat will be used to survey the mainstem, conducting at least five passes annually. Additional effort will be allocated to sampling carcasses throughout the spawning grounds. Carcasses will be used as an index of CHF spawner densities because CHF redds are difficult to detect in the mainstem.

Redds and carcasses will serve as independent estimators of spawner density and total spawner abundance. Redds will be compared to TMFD escapement minus harvest estimates and pre-spawn mortalities (total fish available to spawn) to determine the average number of redds per fish, and the approximate spawner success of the population. Spawned carcasses will be used to estimate the spawner density by reach in known spawner habitat. Pre-spawn carcasses will be used to estimate the exploration of new spawning habitat. Spawner and carcass observations will be expanded using habitat data and geostatistical analysis of distribution and abundance. Associative and trend analysis will be used to evaluate temporal correlates of production and return.

Harvest Monitoring

Tribal Fisheries

The purpose of tribal harvest monitoring is to estimate total catch and document the harvest benefit of the Umatilla River salmon and steelhead programs. Limitations in personnel and the low catch rates observed in past years lead to the cessation of field harvest monitoring surveys for the tribal CHF and STS fisheries in the Umatilla River during the 2002-2003 season (fall winter and spring). Past tribal harvest estimates of steelhead consistently found low numbers of tribal anglers catching a total of about 30 to 60 steelhead annually. Limited use of CHF was also consistently observed (Tribal Fisheries Program 1994, Contor et al. 1995, Contor et al. 1996, 1997, Contor et al. 1998, Contor and Kissner 2000). Much of the information gathered during previous STS surveys was collected during interviews away from the river and after the season.

Increased coverage and sampling intensity will be required to develop estimates of variance in tribal CPUE and total catch for STS, CHF, and CHS. Tribal harvest will be monitored using complemented roving creel, volunteer fishing journals, and telephone surveys. NPMEP crews will monitor tribal harvest activities in the field during March through November annually. In addition a number of volunteers will be recruited to keep fishing journals that outline all fishing activities. Harvest monitoring efforts will concentrate on the Umatilla River from the black railroad bridge near Homely (RM 71.9) to the upper boundary of the harvest area at Fred Gray's Bridge (RM 80.1), and the mainstem of Meacham Creek (Figure 7, and Table 5). All sections of the reservation and above will be surveyed at least once during every sampling shift.

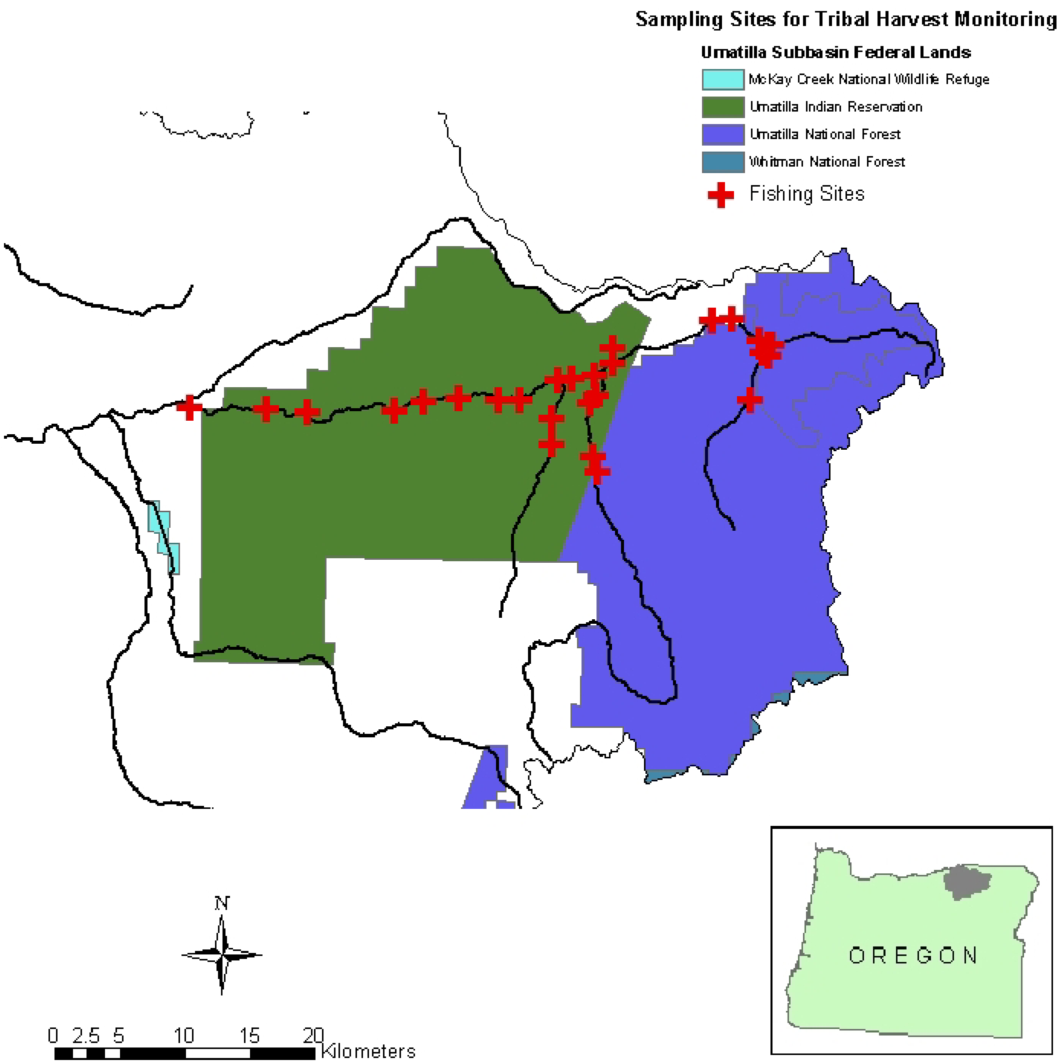


Figure 7. Probable encounter sites during roving creel sampling for tribal harvest monitoring.

Field surveys will incorporate a roving strategy with a schedule that is stratified between weekdays, weekend days and holidays as well as between morning and evening sample periods (05:00 to 13:00 and 13:00 to 21:00 hours). Effort will be allocated using stratified two-stage sampling of weekdays, weekends and holidays, mornings, afternoons, and evenings (Malvestuto 1996). All tribal fishers encountered will be approached and interviewed if received. Daily and year-to-date questions will be asked. The number, size, origin, and destination of all fish hooked will be recorded. Whenever possible the catch will be measured, weighed, and checked for PIT-tags and CWT, and sampled for scales

All information will be georeferenced and recorded on a hand-held computer. For fishermen counts, surveyors will record the reach name, survey direction, date, start time, stop time and the total number of fishers observed. Start time will be recorded when the river reach is first approached. The stop time will be recorded when the surveyor leaves the reach. The time spent in each reach can be variable depending on the presence of anglers and the number of interviews conducted. Reach boundaries are flexible and fishermen observed outside the described boundaries will be recorded with counts of the nearest defined reach. Fishers outside of the entire monitoring area will also be recorded and interviewed with a special notation in the reach location.

Table 5. Roving creel sites for tribal harvest monitoring.

Survey Reach	Sub Reach	RM	Procedure
Black Bridge	Black Bridge	71.9	check pool at the bridge and go over RR tracks, walk 300 yards upstream to bend with large pool at RM 72.1 along the bedrock corner
City Levee	City Levee	73.7	stop at gate, walk 400 yards to levee, check long pool
Thorn Hollow	Buckaroo Confluence	74.1	from Thorn Hollow Bridge walk downstream to pool at the mouth of Buckaroo
	Below Thorn Hollow Bridge	74.3	pool at acclimation facility, 20 yard below outlet
	Above Thorn Hollow Bridge	74.5	bedrock pool 250 yards above bridge
Weathers' Levee	Weathers' Levee	75.3	survey 1 mile of river above, below and along the river levee
Squaw Creek	Squaw Cr. Confluence	77.8	one pool at mouth of Saddle Hollow (200 yards long)
Gibbon	Lower Graybeal Pool	78.2	cross RR tracks, turn left, drive 200 yards to gate, from gate walk to river, two pools next to hillside
	Upper Graybeal Pool	78.6	100 yds above Graybeal's, follow trail from RR switch to bend next to north hillside
	Gibbon Right of Way	78.8	pools and runs along tracks for 0.3 miles
Meacham Confluence	Ed Clarks Lower Pool	79.4	300 yards below Ed Clark's upper pool
	Ed Clarks Upper Pool	79.6	old mouth of Meacham Creek
	Mouth of Meacham	79.8	walk up from upper Ed Clarks pool
	Beehive	79.9	walk up from Meacham C., 2 pools north of beehives
Imaques	Imaques Facility	80.1	walk from upper bridge to outlet, pools near hillside

Telephone surveys and postseason interviews will be conducted in two separate ways. Initially, everyone available on a list of known tribal fishers will be asked about yearly catch through a standardized set of questions. These surveys will include questions about their catch of STS, CHF, and CHS. During a second interview process, individuals will be randomly selected from a list of all tribal members and asked the same questions as the initial post season survey of known tribal fishers. If a randomly selected individual has already been interviewed during the first stage, their first response will be used for the second survey as well. This will prevent fishermen from being interviewed twice. Responses will be compiled and expanded depending on the sub-sample rate obtained. The interview rate goal is 90% of the known fishers and about 30% (600) of the tribal-membership. The large numbers of interviews are needed for quality tribal-wide estimates because not all tribal members are fishers, and fishing effort is highly variable between individuals.

Analysis will follow Malvestuto (1983) for the field work by expanding sub-samples by sample strata and proportional coverage rates. Similar expansions will be used to extrapolate tribal wide harvest estimates based on postseason interviews. CPUE will be estimated directly from interview responses and fishing journals. Total fishing effort will be estimated based on time period, week period, and site encounter probabilities. Tribal harvest estimates for each species will be reported along with a discussion of the limitation of each survey method and the implications to management and monitoring strategies.

Non-Tribal Fisheries

Overview: We have been monitoring the non-tribal steelhead and Chinook fisheries in the Umatilla River since 1992. Complete survey of the entire fishery from Pendleton to the river mouth from 1992 thru 1995 indicated angling effort is concentrated in two locations. Concentrations of anglers occur in the lower river from Three Mile Falls Dam (RM 3.7) to the river mouth and in the upper river in Pendleton (RM 51.5) and the 15 miles downstream of town (Keefe et al. 1993 and 1994, Hayes et al. 1996a and 1996b). Overall, angling effort and catch is considerably higher in the lower river. The middle 33 miles of river receives light angling effort due to limited public access for both bank and boat anglers.

The fall chinook fishery in the Umatilla River is open from 1 September to 30 November and occurs almost exclusively in the lower river. The steelhead fishery occurs primarily in the lower river from September through January or February, and the upper river survey area from January or February through 15 April. The spring chinook fishery is scheduled for April 16 thru 30 June. The occurrence and duration of the spring Chinook fishery is dependant on adequate run strength and in-season harvest rate, respectively. Typical timing for the fishery is late-April through late-May in the lower river and May through mid-June in the upper river.

Creel surveys are composed of three main components: 1) angler counts, 2) interviews to obtain information on catch rate, harvest rate, gear types, and angler demographics, and 3) collection of biological, mark, and coded-wire tag information from catch. Creel survey design and data analysis are the same in the steelhead and fall Chinook fisheries, but slightly modified to better fit the spring Chinook fishery.

Steelhead and Fall Chinook: A roving creel survey is used to count and contact anglers in the steelhead and fall Chinook fisheries. Sampling is stratified into lower and upper river survey areas, two day types (weekdays and weekend-holidays), and morning and evening when day length is > 10 hours. We conduct 5 surveys/week and schedule equal numbers of early- and late-shifts within weekday and weekend strata each month. Selection of survey days follows a systematic design with the starting date selected randomly. We sample 90% of weekend-holiday days and 40-60% of weekdays. Total number of survey days scheduled is 172 minus unfishable days due to flooding or high turbidity. We survey the lower river from September 15 to January or February, then survey the upper river from January or February until April 15. The month in which the survey location transitions from the lower to upper river is determined by which area is receiving (or is expected to receive) the higher amount of angling effort and catch. During this transition period, we gauge upriver angling activity by periodically contacting anglers in the upper river and maintaining frequent communication with a local sporting goods vendor and angling club in Pendleton.

We estimate fishing effort from three angler counts per survey day. The counts are obtained by tallying the number of steelhead and Chinook anglers observed while driving the full length of the survey area. Upstream-downstream direction of travel for the first count is randomized. Travel direction of subsequent counts within a day are in the same direction as the first count. During winter months, counts are made 1-2 h after sunrise, at mid-day, and 1-2 h before sunset. In fall and spring, counts are three hours apart with the first count made 1-2 h after sunrise on the early-shift and 1-2 h before sunset on the late-shift.

We interview anglers in between effort counts. There are some fairly consistent spatial and temporal fishing patterns in both the lower and upper river. Our travel routes for contacting anglers is aligned with these fishing patterns to maximize numbers of anglers contacted and interviews conducted near the end of their fishing trip. During interviews we obtain information on residency, hours fished, whether their angling trip was complete or incomplete, target species, gear type, and catch and harvest by species. Residency is categorized as 1) Umatilla and Morrow counties, 2) any other county in Oregon, and 3) out-of-state. Categories for gear types are 1) fly, 2) bait, and 3) lure. On harvested steelhead and Chinook, we record species, sex, fin clips, and marks, measure fork length, and collect snouts and scales from coded-wire-tagged fish. We record number of released natural and hatchery steelhead, and adult and jack Chinook.

Spring Chinook: Creel survey methodology and design for the spring Chinook fishery are similar to those used for the steelhead and fall Chinook fisheries with some exceptions. Staffing requirements for surveying the spring Chinook fishery are at least 2.5 times greater than surveys conducted in the fall and winter because the spring Chinook fishery occurs simultaneously in both the lower and upper river throughout most of the season and day length in spring is considerably longer than in fall and winter. Temporary staff for surveying the spring Chinook fishery was reduced from two to one seasonal in 2003 due to reduced funding levels. Present funding levels do not provide enough staff to adequately sample all four survey strata (morning and evening time blocks in both the upper and lower survey areas). As a result, we streamlined our past survey design to focus on adequately surveying the locations and times of greatest angling effort and harvest. We only survey the lower river where about 84% of the total non-tribal harvest occurs, based on past survey of both the lower and upper river (Chess et al. 2003). Upriver harvest is estimated as the mean percent of total run harvested upriver from 2000-2002 (2.2%, Chess et al. 2003).

Most surveys are conducted in the "morning" from sunrise to early afternoon (1500 h) because past surveys have indicated 67% of angling effort and 84% of the harvest occurs during this time period. For 2000-2002, proportionate evening effort was 41%, 30%, and 28% of morning effort, and proportionate evening harvest was 14.5%, 13.2%, and 20.0% of morning harvest (Chess et al. 2003). We conduct morning surveys 5 days per week, and on two or three of those days, we conduct an "evening" survey (1500 h - sunset) to estimate the proportion of daily effort, catch, and harvest that occurs in the morning and evening time blocks.

Computation of effort, catch, and harvest for tribal and non-tribal fisheries: We estimate fishing effort, catch, and harvest within monthly and weekday/weekend strata for the fall salmon and steelhead fisheries, and within weekly, weekday/weekend, and morning/evening strata for the spring Chinook fishery. We use one-half hour before sunrise and one-half hour after sunset to determine angling start and end times. We estimate fishing effort (angler hours) as the area under an angling pressure curve (number of anglers by time of day). Total angling effort within each strata is calculated as mean daily effort times the number of fishable days with the strata. Fishable days are when river flow and water clarity provide suitable fishing conditions. The river is generally not fishable when flow exceeded 2,000 cfs or turbidity imparts a brown color to the water and reduces visibility to <10 cm.

Fishing effort for a sampling day (E_i) is estimated from angling pressure counts according to the following formula:

$$E_i = \tfrac{1}{2} \sum_{k=1}^{r} (T_k - T_{k-1})\,(C_k + C_{k-1})$$

where:
r = number of angling pressure counts per day,
C_k = angler count at time k, and
T_k = time at the k^{th} count.

Both catch rate (CR_i) and harvest rate (HR_i) are estimated by the following formula:

$$CR_i \text{ or } HR_i = \sum_{k=1}^{mi} f_{ij} \;/\; \sum_{j=1}^{mi} h_{ij}$$

where:
m_i = number of anglers interviewed on the i^{th} day,
f_{ij} = number of fish caught or harvested by the j^{th} angler on the i^{th} day, and
h_{ij} = number of hours fished by the j^{th} angler on the i^{th} day.

Mean catch rates and harvest rates for combined monthly strata and the total season are weighted by the proportion of total hours fished in each stratum.

Both total daily catch (TC_i) and total daily harvest (TH_i) are estimated by the following formula:

$$TC_i = (CR_i)\,(E_i) \quad \text{and} \quad TH_i = (HR_i)\,(E_i)$$

Both total catch (TC) and total harvest (TH) for a stratum are estimated by the following formula:

$$TC = (N/n) \sum_{i=1}^{n} TC_i \quad \text{and} \quad TH = (N/n) \sum_{i=1}^{n} TH_i$$

where
N = number of days in the stratum, and
n = number of days sampled in the stratum.

Both the variance of catch V(TC) and variance of harvest V(TH) for each stratum are estimated following Cochran (1977):

$$V(TC) \text{ or } V(TH) = N^2(1 - (n/N))(S_i^2/n) + (N/n) \sum_{i=1}^{n}(1-(\sum_{i=1}^{n} h_{ij}) / E_i)(E_i^2)(S_{2i}^2 / m)$$

where:

$$S_i^2 = \sum_{i=1}^{n}(TC - TC_i) / (n - 1) \text{ or } \sum_{i=1}^{n}(TH - TH_i) / (n - 1), \text{ and}$$

$$S_{2i}^2 = \sum_{i=1}^{n}((f_{ij} / h_{ij}) - CR_i)^2 / (m_i - 1) \text{ or } \sum_{i=1}^{n}((f_{ij} / h_{ij}) - HR_i)^2 / (m_i - 1),$$

Total monthly catch, harvest, and variances are calculated by summing stratum totals. Catch and harvest rates for combined monthly strata and season total will be weighted by the proportion of total angling effort in each stratum.

A bound on the error of estimation (bound) is then calculated to approximate a 95% confidence interval for strata and season total catch and harvest estimates. A bound is approximately equal to a 95% confidence interval if data have a normal probability distribution and at least a 75% confidence interval regardless of the probability distribution (Scheaffer et al. 1979). Bounds for total catch (BTC) and total harvest (BTH) are calculated by the following formulas:

$$\text{BTC} = \pm 2 * \sqrt{V(TC)}$$

Out-of-Basin Harvest

Described in Methods section 11.9.6

Age and Growth Monitoring

Hard structures will be collected from juvenile and adult fishes during a variety of sampling activities. These hard structures will be analyzed to detect growth rings and other growth patterns including accelerated development of the nuclei (indicating hatchery origin) and marine/freshwater transitional depositions (indicating years at sea and years in-river). A centralized age and growth lab is being developed at CTUIR facilities. The lab will be capable of detecting growth patterns from scale, otolith, vertebrae, and rays of fishes. The lab will use light-microscopy and computer digitalization to create a digital archive of all hard structures analyzed. The lab will be staffed with CTUIR and ODFW personnel who will share responsibility for age and growth determinations.

Scales will be mounted on gum cards and pressed in cellulose acetate. Hard structures will be sanded flat and mounted in CrystalBond © medium and sanded or sectioned using a diamond saw. Adult scales will be examined under a stereo microscope at a magnification of 42x and/or 72x. Age designation utilized the European method; a fish returning in 2002 at age 1.2 was spawned in 1998, emerged from the gravel in January-March of 1999, migrated to the ocean in the spring of 2000, returned to freshwater in the spring 2002 and spawned in the late summer of 2002 at total age 4. Juvenile scales, otoliths, rays, and vertebrae will be examined under a compound scope at 100X or greater magnification. Daily, lunar, seasonal, and annual patterns will be discerned. Growth curves will be developed using von Bertalanffy (Bertalanffy 1934) and Parker and Larkin (Parker and Larkin 1959) equations.

Habitat and Environmental Monitoring

A variety of complementary habitat monitoring activities will be regularly conducted in the Umatilla Subbasin to capture variance in physical, biological, and chemical conditions. The sampling regime of these activities will vary from continuous monitoring of flow and temperature, to decadal monitoring of riparian conditions. Monitoring will focus on factors that are not primarily controlled by upstream conditions so that measurable improvements can be detected in important elements of salmon habitat. Habitat recovery will be measured in terms of regrowth of the riparian vegetation, vegetation structure and cover. In addition, vegetative recovery is related to improvements in bank stability and channel morphology; therefore geomorphic characteristics will also be monitored. These broader parameters, though not useful for project specific monitoring, are more important when tracking comprehensive basin-wide recovery. The spatial coverage of these activities will vary as well. Protocols were developed using a variety of tools, and follow guidelines of the current regional and local protocols (Hankin and Reeves 1988, ODFW 1993, Johnson et al. 2001).

In-Stream Features

The quantitative goal of the habitat monitoring program is to estimate the total abundance and distribution of essential fish habitat throughout the subbasin for each species every ten years. EMAP sampling routines will be used to determine the order and magnitude of each reach that is surveyed annually. Reaches will be divided into contiguous quadrats based on linear habitat characteristics. The percent substrate composition will be estimated using the following categories;

1. Silt and fine organic matter
2. Sand
3. Gravel (pea to baseball; 2-64 mm)
4. Cobble (baseball to bowling ball; 64-256 mm)
5. Boulders
6. Bedrock

Relative embededness and approximate depth of annual bedscour will be recorded. A longitudinal and cross-sectional survey of conditions will be made to quantify wetted width, bank full width, and bank full (maximum) depth. The in-stream conditions of pools, glides, riffles, rapids, cascades and steps will be assessed using the following attributes.

POOLS

PP **Plunge Pool:** Formed by scour below a complete or nearly complete channel obstruction (logs, boulders, or bedrock). Substrate is highly variable. Frequently, but not always, shorter than the active channel width.

SP **Straight scour Pool:** Formed by mid-channel scour. Generally with a broad scour hole and symmetrical cross section.

LP **Lateral scour Pool:** Formed by flow impinging against one stream bank or partial obstruction (logs, rootwads, or bedrock). Asymmetrical cross section. Includes corner pools in meandering lowland or valley bottom streams.

TP **Trench Pool:** Slow flow with U or V-shaped cross section typically flanked by bedrock walls. Often very long and narrow.

DP **Dammed Pool:** Water impounded upstream of channel blockage (debris jams, rock landslides).

BP **Beaver dam Pool:** Dammed pool formed by beaver activity.

AL **Alcove:** Most protected type of pool. Alcoves are laterally displaced from the general bounds of the active channel. Substrate is typically sand and organic matter. Formed during extreme flow events or by beaver activity; not scoured during typical high flows.

BW **Backwater Pool:** Found along channel margins; created by eddies around obstructions such as boulders, rootwads, or woody debris. Part of active channel at most flows; scoured at high flow. Substrate typically sand, gravel, and cobble.

IP Isolated Pool: Pools formed outside the primary wetted channel, but within the active channel. Isolated pools are usually associated with gravel bars and may dry up or be dependent on inter-gravel flow during late summer. Substrate is highly variable. Isolated pool units do not include pools of ponded or perched water found in bedrock depressions.

GLIDES

GL **Glide:** An area with generally uniform depth and flow with no surface turbulence. Low gradient; 0-1% slope. Glides may have some small scour areas but are distinguished from pools by their overall homogeneity and lack of structure. Generally deeper than riffles with few major flow obstructions and low habitat complexity.

RIFFLES

RI **Riffle:** Fast, turbulent, shallow flow over submerged or partially submerged substrate. Often with 5-15% of surface area with white water. Generally broad, uniform cross section. Low gradient; usually 0.5-2.0% slope.

RP **Riffle with Pockets:** Same flow and gradient as Riffle but with <u>numerous</u> sub-unit sized pools or pocket water created by scour associated with small boulders, wood, or streambed dunes and ridges.

<u>RAPIDS</u>

RB **Rapid with protruding Boulders:** Swift, turbulent flow including chutes and some hydraulic jumps. Surface with 15-50% white water. Exposed substrate composed of individual boulders, boulder clusters, and partial bars. Moderate gradient; 2-4% slope.

RR **Rapid over Bedrock:** Swift, turbulent, "sheeting" flow over smooth bedrock. Sometimes called chutes. Little or no exposed substrate, 15-50% white water. Moderate to steep gradient; 2-20% slope.

<u>CASCADES</u>

CB **Cascade over Boulders:** Very fast, turbulent flow; many hydraulic jumps, strong chutes and eddies; 30-80% white water. Much of the exposed substrate composed of boulders organized into clusters, partial bars, or step-pool sequences. High gradient; usually 3.5-10% slope, sometimes greater.

CR **Cascade over Bedrock:** Same flow characteristics as Cascade over boulders but structure is derived from sequence of bedrock steps. Slope 3.5% or greater.

<u>STEPS</u>

Steps do not fit our general definition of channel units because they usually are much shorter than the channel width. However, they are important, discrete breaks in channel gradient with 10 to >100% slope. Steps are classified by the type of structure forming the step.

SR **Step over Bedrock (include hardpan and clay steps**
SB **Step over Boulders**
SC **Step over face of Cobble bar**
SL **Step over Logs(s), branches**
SS **Step created by Structure (culvert, weir, dam, beaver dam)**

<u>SPECIAL CASES</u>

DU **Dry Unit:** Dry section of stream separating wetted channel units. Typical examples are riffles with subsurface flow or portions of side channels separated by large isolated pools. Record the length, active channel width, and other variables for the dry areas.

PD **Puddled:** Nearly dry channel but with sequence of small isolated pools less than one channel width in length or width.

DC **Dry Channel:** Section of the main channel or side channel that is completely dry at time of survey. Record all unit data, use active channel width for width.

CC **Culvert Crossing:** Stream flowing through a culvert. The height from the culvert lip to the stream surface (drop), diameter, and shape of culvert will be recorded.

LARGE WOODY DEBRIS

Class 1 Woody debris absent or in very low abundance. No habitat complexity or cover created.

Class 2 Wood present, but contributes little to habitat complexity. Mostly small, single pieces, creating little cover or complex flow patterns. Ineffective at moderate to high discharge.

Class 3 Wood was present as combinations of single pieces and small accumulations. Providing cover and some complex habitat at low to moderate discharge, less effective at high discharge

Class 4 Wood present with medium and large pieces comprising accumulations and debris jams that incorporate smaller rootwads and branches. Good hiding cover for fish. Woody debris providing cover and complex habitat that persists over most stream discharge levels.

Class 5 Wood present as large single pieces, accumulations, and jams that trap large amounts of additional material and create a variety of cover and refuge habitats. Woody debris providing excellent persistent and complex habitat. Complex flow patterns will exist at all discharge levels.

Riparian and Land Use Conditions

Riparian conditions are excellent indicators of land use, and help describe the interface of water and watershed. For each in-stream contiguous quadrat we will estimate the primary, secondary, and tertiary structural components. Percent canopy cover will be visually estimated. Riparian and adjacent land use conditions will be categorized using the following attributes.

Riparian Conditions

RIPARIAN VEGETATION

N No vegetation (bare soil, rock)

B Sagebrush (sagebrush, greasewood, rabbit brush, etc.)

G Annual grasses and herbs

P Perennial grasses, forbs, sedges and rushes

S Shrubs (willow, salmonberry, some alder)

D Deciduous dominated (canopy more than 70% alder, cottonwood, big leaf maple, or other deciduous species)

M Mixed conifer/deciduous (approximately a 50:50 distribution)

BANK STABALIZATION

NE **Non-Erodible**. Stable bedrock, hardpan, or boulder-lined bank

BC **Boulder Cobble**. Stable matrix dominated by boulders and cobble combined with soil, vegetation, and large roots.

VS **Vegetated-Stabilized**. Vegetated and/or overhanging bank, partly or wholly stabilized by root systems. Some exposed soils may be present, but with no evidence of recent bank failure.

AE **Actively Eroding**. Actively or recently eroding or collapsing banks. Exposed soils and inorganic material. Superficial vegetation may be present, but it does not contribute to bank stability.

Land Use Conditions

AG Agricultural crop land

TH Timber Harvest. Active timber management including tree felling, logging, etc. Not yet replanted.

YT Young forest Trees. Can range from recently planted harvest units to stands with trees up to 15 cm dbh.

ST Second growth Timber. Trees 15-30 cm dbh in generally dense, rapidly growing, uniform stands.

LT Large Timber (30-90 cm dbh)

MT Mature Timber (50-90 cm dbh)

OG Old Growth Forest. Many trees with 90+ cm dbh and plant community with old growth characteristics.

PT Partial cut Timber. Selection cut or shelterwood cut with partial removal of large trees. Combination of stumps and standing timber. If only a few live trees or snags in the unit, describe in notes.

FF Forest Fire. Evidence of recent charring and tree mortality.

BK Bug Kill. Eastside forests with >60% mortality from pests and diseases. Enter bug kill as a comment in the notes when it is observed in small patches.

LG Light Grazing Pressure. Grasses, forbs and shrubs present, banks not broken down, animal presence obvious only at limited points such as water crossings. Cow pies evident.

HG Heavy Grazing Pressure. Broken banks, well established cow paths. Primarily bare earth or early successional stages of grasses and forbs present.

UR Urban

RR Rural Residential

IN Industrial

MI Mining

Biological Conditions

Biological habitat conditions will be sampled during EMAP surveys. The examination of aquatic macroinvertebrate communities is an important aspect of monitoring and evaluation programs because these communities are an integral component of aquatic and riparian ecosystems, and they can be used as an index of potential stream reach quality for salmonids and other cold-water fishes. One of the most important ecosystem functions of macroinvertebrates is the role they play in aquatic and riparian food webs. Macroinvertebrates are the main conduit of energy between basal resources (primary production and detritus) and fish (Allan 1995b), and they are an important energy subsidy to surrounding riparian areas (Nakano and Murakami 2001).

The use of macroinvertebrate communities as an index of stream quality has a long history (Cairns and Pratt 1993), and indices of community structure exist that allow assessments of the types and degrees of various disturbances (Resh and Jackson 1993). Most species are affected by conditions at fairly small scales (e.g., a stream reach) because many species have small home range sizes (Platts et al. 1983a). Thus, communities are likely to be influenced by local environmental conditions within a specific stream reach. This feature makes macroinvertebrates ideal for assessing the impact of restoration projects at the reach and watershed scales (Laasonen et al. 1998, Weigel et al. 2000).

Many species of aquatic invertebrates live for about one year (Wallace and Anderson 1996). This lifespan is long enough that individuals and populations integrate inherent variability in water quality that occurs on a daily and seasonal cycle. This is in contrast to many chemical and physical measures which are only snapshots of immediate conditions. However, this lifespan is short enough that impacts of environmental conditions on populations can be determined in just several years.

Quantitative samples of macroinvertebrate communities will be made at EMAP reaches following the standard USDA Forest Service methods (Platts et al. 1983b). Invertebrates will be sampled at 5 points within each study reach using a Surber sampler, a device with a sampling quadrat of known size. Only riffle areas will be sampled for several reasons. Sampling riffles minimizes between-sample and between-site variability that results from habitat type and not habitat quality. In addition, riffles are known for their high invertebrate productivity (Allan 1995a) and many of the invertebrates useful in biomonitoring are found primarily in riffles (Hilsenhoff 1987a).

Four indices will be used to assess stream reach quality. Each of these metrics has potential biases, which can influence assessments based on only one metric. By measuring multiple indices, these biases can be at least partially taken into account (Karr and Chu 1999). The four metrics are: Simpson's Diversity Index, the number of Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa, the number of disturbance-tolerant taxa, and the Hilsenhoff Biotic Index (HBI). Diversity is predicted to increase with decreasing human disturbance (Karr and Chu 1999). EPT taxa are sensitive to many anthropogenic disturbances and are most abundant in cold, clean-water reaches with little sediment (i.e., conditions good for salmonids) (Karr and Chu 1999). Their numbers are expected to decline with increasing human disturbance (Karr and Chu 1999). In contrast, the number of disturbance-tolerant taxa is expected to increase with increasing human disturbance. The HBI measures the dominance of taxa known to be insensitive to organic pollution (Hilsenhoff 1987b).

Instream Flow

Instream flow is monitored continuously be BOR, NOAA, and USGS. These federal agencies are responsible for data management, data archiving, flow predictions, and flow analysis. The following web-sites describe flow monitoring programs in the Umatilla Subbasin.

http://www.usbr.gov/pn/hydromet/umatilla/umatea.html (Subbasin overview, link to archive data)

http://ahps.wrh.noaa.gov/cgi-bin/ahps.cgi?pdt&tchw1 (NOAA flow predictions and real time data) http://www.usbr.gov/pn/hydromet/graphs/wcro_qd_wy.html (Wildhorse Creek flow data)

http://waterdata.usgs.gov/or/nwis/uv?site_no=14020300 (Real time data for Meacham with archive data)

http://water.usgs.gov/waterwatch/ (Over view map of real time data for USGS)

http://waterdata.usgs.gov/or/nwis/current/?type=flow (Real time data index for Oregon)

Water Temperature

Thermographs will be deployed throughout the Umatilla Subbasin in coordination with other projects and agencies to maximize consistency and coverage without duplicating effort.

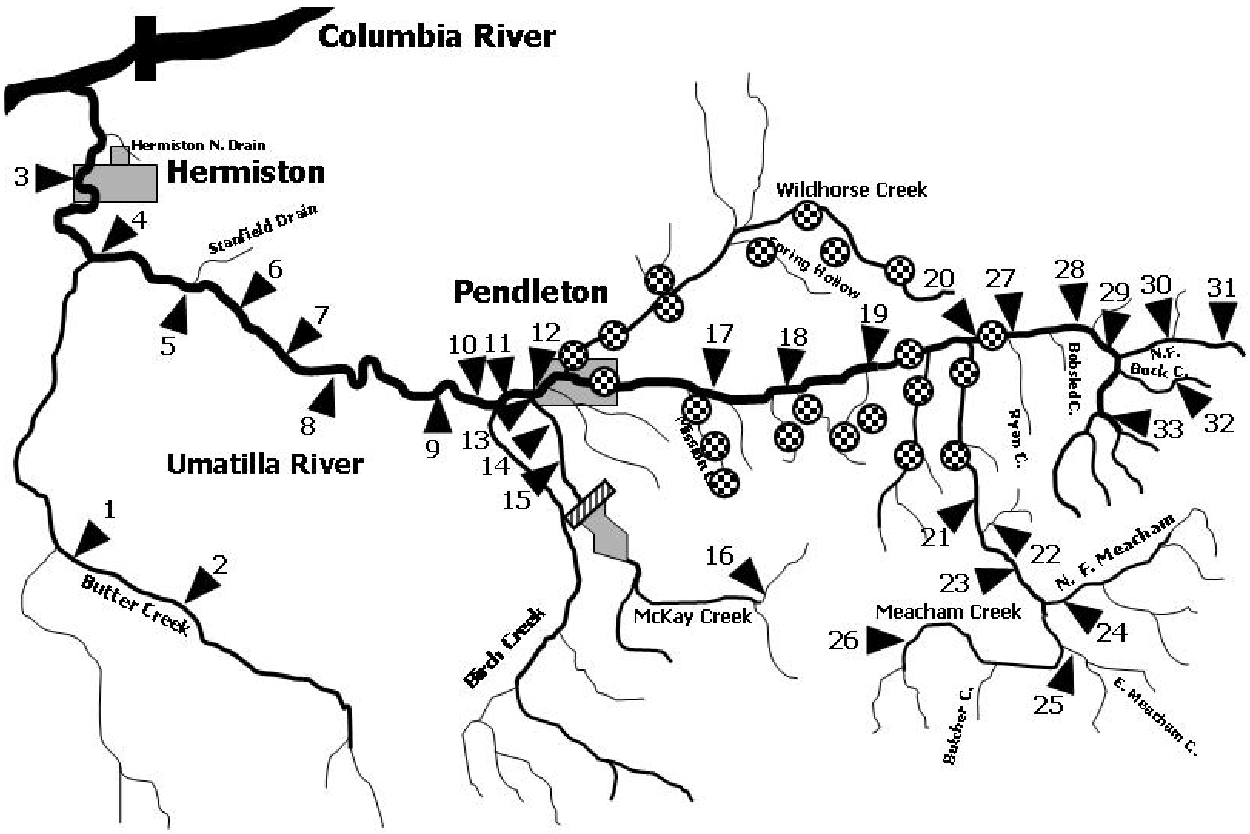


Figure 8 shows the location of thermograph deployment for UMEP. Some of the thermograph locations have been monitored consistently since 1993 while other sites were only monitored one or two years. Details of all project water temperature data are currently available at http://www.umatilla.nsn.us (CTUIR website). The website also lists water temperature from other projects with additional data being added regularly. NPMEP used Ryan RTM2000 thermographs from 1993 through 1996. In 1997 NPMEP began using the newly developed Vemco Mini-Loggers because of their smaller size, lower cost, and improved reliability. The Vemco instruments replaced all the Ryan instruments by 2001. Instruments are initialized in the office. The batteries, seals and clamps of the Ryan instruments are cleaned, inspected and changed as needed. Steel chains or cables are used to anchor all units to large trees or boulders on the shore. We conceal thermographs, chains and cables to minimize tampering by the public. Thermographs are checked regularly after deployment to ensure proper function and placement. In November and December we collected all thermographs and downloaded data. During 1993 and 1994 we deployed thermographs during the winter but we discontinued that practice in 1995 to avoid instrument loss and damage during high flows. UMEP will calculate and report the number of hours (by month) when water temperatures exceed benchmark temperatures of 12.78, 17.78, 20.0 and 25°C (55, 64, 68, and 77°F respectively). Temperature data will be examined in relation to past data, seasonal discharge, water quality standards. Associative and trend analysis will be used to analyze and evaluate temperature data.

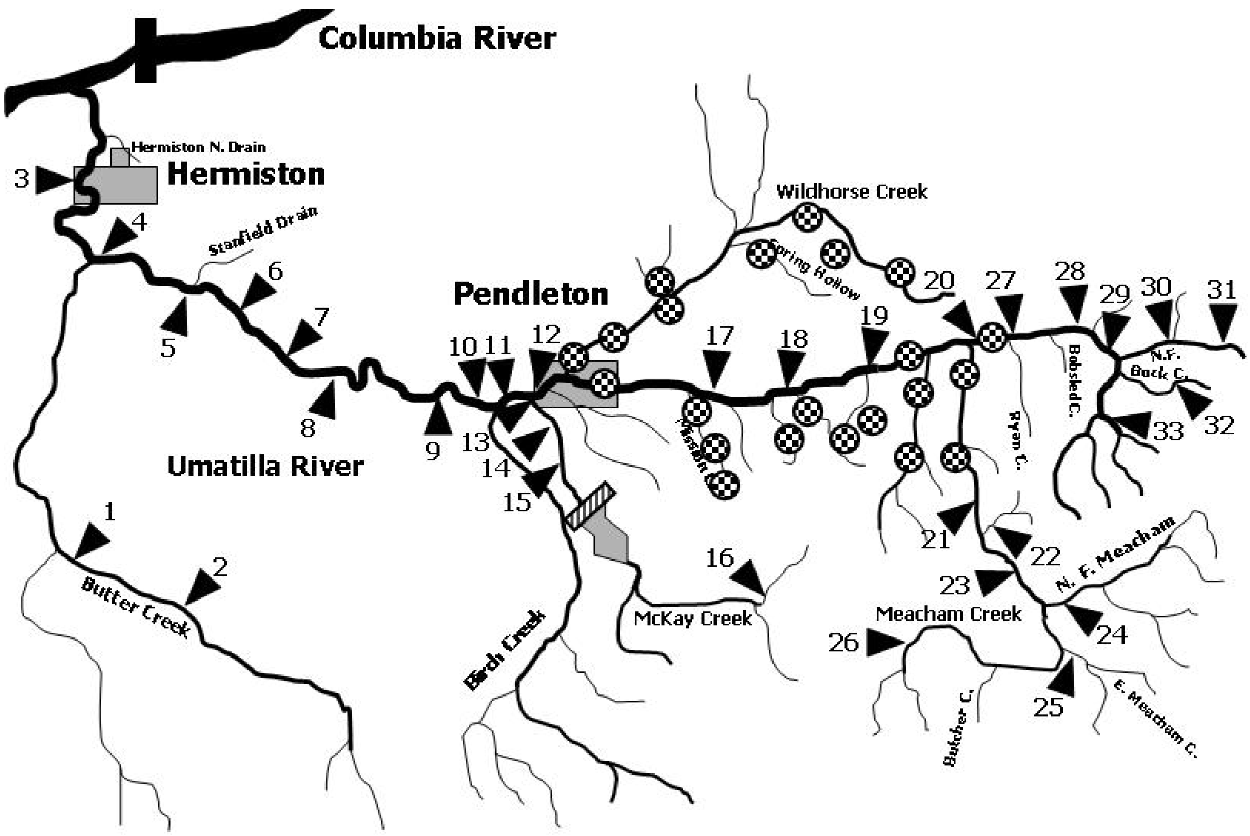


Figure 8. Location of UNPMEP thermograph deployment. Thirty three units are deployed throughout the Umatilla Subbasin to monitor summer temperatures by EDT reach in CHS and CHF spawning areas. A number of additional thermographs are deployed by habitat, water quality, and water planning programs (some of which are shown as checkered circles) to monitor site-specific habitat restoration projects.

Water Quality and Chemical Conditions

Thirty water quality samples will be collected from each watershed each summer, and studied by CTUIR's Water Quality Department under support of the Environmental Protection Agency.

To assess and monitor the toxicological conditions of each watershed, a maximum of thirty whole juvenile STS and juvenile Chinook and thirty carcass tissue samples will be collected from each watershed annually during EMAP juvenile and spawner/carcass surveys. Tissue samples will be analyzed to estimate the concentrations of persistent organics and heavy metals, to estimate the corresponding realized contiguous trophic level from stable isotopic composition (Satterfield and Finney 2002). Based on prior studies this sample size should be sufficient to test for a 10% difference in size and age adjusted bioaccumulation rates of adult carcasses (Easton et al. 2002) and juveniles (Warren and Liss 1977) from different watersheds.

Derived Habitat Metrics

A number of habitat metrics, including land use, total solar radiation, total chlorophyll and thermal irradiation will be derived from remotely sensed data. These watershed-scale metrics will be analyzed for their watershed-scale variability to develop associations between total land-use and waterscape use conditions and in-stream biological performance of managed species and their cohabitants.

Habitat and Environmental Analysis

The quantitative goals for habitat assessment and monitoring require ongoing monitoring subbasin wide. Therefore no power analysis is necessary. In-stream and riparian habitat features will be surveyed for every reach of stream every ten years, and annually where specific habitat restoration actions are implemented. Flow and temperature monitoring will be continuous. Every five years UMEP will work with MBI to develop a revised ecosystem based model (0), and will estimate salmon survival rates in the Umatilla Subbasin as a function of habitat condition (Cuenco and McCullough 1996).

Ecological Monitoring

Community and Trophic Monitoring

Fish community information will be collected during EMAP surveys (0), and will be monitored throughout the subbasin using baited passive fish traps. Predator, competitor, and prey relationships will be derived. Trophic relationships will be assembled using stable isotope values (0), previously published research, and ecological inference (Gatz 1979).

Bioenergetics models have been drafted for several Columbia Basin fishes (Hanson et al. 1997). We will refine bioenergetics models for CHS, CHF, and STS based on observed age and growth data (0), locally adapted trophic relationships, and environmental correlates (0), using perturbation protocols (Bartell et al. 1986, Stockwell and Johnson 1997). The bioenergetics models will be used to produce absolute estimates of energy flow within and through each managed fish juvenile and spawner populations. These interactions will be used to estimate the strength of community-wide interactions between fishes, their predators, and their prey (e.g. (Rodriguez and Magnan 1995, Sala and Graham 2002).

Community and trophic metrics for each watershed will be analyzed structurally to monitor changes in the flow of resources to target and non-target species. Fish diversity, food web structure, connectivity, food web lengths, link densities, omnivory rates, cannibalism, and predator prey ratios will be evaluated. Undesirable structural changes in fish communities or their food webs will be described quantitatively and qualitatively as part of regular reporting.

Ecosystem Monitoring

The subbasin planning process has made imminently clear the benefits of an ecosystem perspective in off-site mitigation. MBI's EDT model has been used with considerable success to describe ecological conditions where data is available. EDT provides a general estimate of carrying capacity, and presents a hypothetical increase in production associated with habitat, passage, and flow restoration.

Unfortunately EDT falls short of addressing three pit-falls that have been clearly pointed out by ecosystem modelers. First, EDT fails to address variability in individual behavior, growth, and physiology. This variance can contribute significantly to salmonid production and productivity (Kooijman et al. 1989, Werner 1992, Werner and Anholt 1993), and is relatively easy to address mathematically. Second, EDT is associative at several critical scales. Numerous subbasins have noted a need to "tune" EDT to regional stream and climatic conditions. This inaccuracy of the model stems from its lack of mechanistic detail that is essential to models with portable applicability (DeAngelis 1988). Last, EDT does not incorporate the density-dependent consequences a of age-structured or spatially-structured life history variability. This variance represents a critical compensatory response of most fish populations (McCauly et al. 1993, Walters et al. 1999), and must be mathematically represented in aquatic ecosystem models approaching carrying capacity (Christensen and Pauly 1998).
UMEP will work with MBI and CBR to develop an individual-based version of EDT that is more portable to the diversity of ecosystems that is represented within and among the Columbia's subbasin. We will build upon EDT's "biological rules" using data derived from the UMEP comprehensive monitoring program, and parallel programs around the Columbia Basin. The revised EDT model will be developed from EDT core algorithms, and less proprietary models such as SURPH, CRiSP, Vitality, and egg-growth models (www.cbr.washington.edu). This product will be less empirical and more mechanistic and explanatory, and less associative and empirical, in part because it will represent a combination of bottom-up (UMEP) and top down (MBI and CBR) developmental forces. It will consist of a single software package in which every aspect of survival, production, productivity, emigration, and immigration can be evaluated and assessed under future conditions. The model will produce estimates of the community, aggregate, and ecosystem metrics that describe ecological function, including the flow of energy throughout Umatilla fish populations, and the survival and production of all species and life-stages of interest.

Genetic Sampling

Genetic samples will be collected from a sub-sample of TMFD run STS, all Iskuulpa Creek spawners, a sub-sample of Iskuulpa RBT (n=10-50), and a sub-sample (n=300) of Iskuulpa pre-smolts annually. Samples will be taken from adipose or ventral fin clips. Samples will be frozen, stored in ethanol, or placed directly in lysis buffer. This sampling regime will be followed for ten years; the completion of two full STS generations.

In parallel with these efforts NPMEP will begin testing a progeny marker currently under development at Oregon State University. Approximately 10% of the hatchery escapement to Iskuulpa will be injected with the marker. The strontium progeny marker is a new tool that has only recently been developed to assess reproductive success of anadromous fishes. Although the marker has shown great utility in the laboratory, there are physical and physiological complications that might hinder its utility in the field. We will mark fish using the progeny marker for three years and assess its utility. If significant marked progeny are not recovered, we will conclude that the progeny marker is unable to detect the reproductive success of hatchery reared fish in the Umatilla Subbasin. It will not be clear at that time whether hatchery reared fish are not successful, or the progeny marker is not robust enough to detect their success. Results from the pedigree study will be used to validate or invalidate the utility of strontium marking in hatchery programs.

Umatilla STS samples will be analyzed by the Columbia Rive Inter-Tribal Fisheries Commission cooperative genetics program at the Hagerman Fish Culture Experiment Station using microsatellite loci that have been optimized for steelhead studies. Samples will be analyzed for each brood and return year. DNA will be extracted using a Qiagen® 3000 robot. A polymerase chain reaction (PCR) will be used to amplify 10-12 microsatellite loci. PCR amplifications will be performed using the AmpliTaq Reagent System (Applied Biosystems®) in an MJ Research® PTC-100 thermal cycler following manufacturer's protocols. Forward PCR primers will be fluorescently labeled (Applied Biosystems®), and PCR products genotyped using manufacture's protocols with an Applied Biosystems® model 3100 or 3730 genetic analyzer.

Genotypes will be assembled using 16 microsatellite markers. Parentage will be estimated using a variety of exclusion, likelihood, pair-wise relatedness, and genetic similarity algorithms (Wilson and Ferguson 2002). The relative and "long-term" reproductive success of hatcheryXhatchery, hatcheryXwild, and wildxwild (including STSXSTS and STSXRBT) crosses will be evaluated.

Pedigree studies are being used in a variety of subbasins to answer a number of questions, including NMFS RPAs 182 and 184. These endeavors are costly and resource intensive, but may provide essential management information. Unless the utility of an ongoing pedigree analysis is established by one of the co-management entities, this study will terminate following a final report in December 2015. During each year of operations the project will be evaluated to determine if biologically or statistically significant patterns in fitness can be detected, to determine the likely importance of this information given the status of ongoing artificial and natural production, and to determine if new insight is being produced that can effectively inform the population or harvest recovery strategies.

Hatchery Monitoring

Holding

Information on adult holding is documented in annual reports produced by the CTUIR Umatilla Hatchery and Satellite Facilities O&M Project (BPA Project # 83-435).

Spawning

Spawning information is documented in annual reports produced by the CTUIR Umatilla Hatchery and Satellite Facilities O&M Project (BPA Project # 83-435). The information is also reported to the ODFW Hatchery Database. Lengths (fork and mid-eye to peduncle), fin clips and marks are recorded for all spawned fish. Snouts are collected from all CWT fish and sent to ODFW fish identification laboratory in Clackamas for reading. The CWT in steelheads are read immediately to prevent spawning of strays into the Umatilla River. Scales are collected from all unmarked Chinook salmon, and a number of STS and CHF to verify natural-reared origin.

Egg Take Enumeration

Numbers of eggs taken during spawning is monitored by hatchery staff at Umatilla and Bonneville hatcheries and reported to the ODFW Hatchery Database. Total egg take is determined for each species by counting eyed embryos and discarded eggs. All eggs are physical shocked at eyeing stage to break the yolks of the unfertilized eggs. Eyed eggs are counted with a Denny McLeary egg counter. Female fecundity for each group is determined by dividing the total number of eggs by the total number of spawned females. An average fecundity is determined for all years of spawning. The average fecundities for spring and fall Chinook salmon and steelhead are 4,000, 3,800, and 5,289.

Growth and Production Monitoring

Fish growth is monitored by hatchery staff and reported to the ODFW Hatchery Database for fish reared at Umatilla, Bonneville, Cascade, and Oxbow hatcheries and for fish reared at Little White Salmon Hatchery. Fish growth is monitored by estimating average fish weight over time. Fish weight expressed as number of fish per pound (fish/lb) is measured monthly by averaging three weight samples of 100 fish per raceway. Feed is then adjusted to meet size-at-release targets.

Mass Marking

All steelhead and Chinook in the Umatilla Subbasin hatchery program receive a “mass” mark to identify their hatchery-reared origin. The mass mark for steelhead and spring Chinook salmon is an adipose fin clip. The mass mark for fall Chinook is a blank-wire tag. A portion of each hatchery group are also CWT’ed and given and external fin clip to identify presence of the tag for monitoring their total adult production, smolt-to-adult survival, out-of-subbasin stray rates, and contributions to harvest and spawning. Coho are CWT’ed, but not mass marked. The mark to identify presence of a coded-wire tag is a left ventral fin clip for steelhead, left or right ventral fin clip (alternates annually) for spring chinook, and an adipose fin clip for fall Chinook and coho.Detailed CWT methods are described below in section 11.9.6. Appendix Table XX summarizes marking and CWT’ing of the various hatchery production groups.

Tag retention and fin clip quality in each group is determined at least 30 days after tagging. Missed tags and clips along with total number released are reported to ODFW Hatchery Database and PSMFC RMIS database

Coded-wire Tagging and Associated Monitoring

Coded-wire tags (CWT’s) are one of the key tools used to assess the performance of each rearing and release strategy utilized in the Umatilla Subbasin hatchery program. Each hatchery production group (G_i) that has a unique rearing or release strategy is CWT’ed with a unique code for either monitoring or evaluation purposes. Fish that are CWT’ed also receive an external mark (adipose or ventral fin clip) to indicate presence of the tag. Performance measures that can be tracked if adequate numbers of fish are coded-wire tagged and recovered include total adult production, smolt-to-adult survival, out-of-subbasin stray rates, harvest contributions to fisheries, and relative survival to spawning of hatchery groups. Descriptive characteristics of the hatchery groups can also be obtained if adequate numbers of fish are coded-wire tagged and recovered including age-at-return, sex ratios, return timing, and spawning distribution. Table XX lists upcoming rearing and release strategies, smolt production targets, and coded-wire tagging rates utilized in the subbasin hatchery program.

Determination of how many fish in each hatchery production group should be CWT’ed is dependant on several factors including the number of CWT recoveries required to provide a reasonable level of statistical confidence, annual variability in smolt-to-adult survival, intensity and success of CWT recovery efforts in various locations, and the proportionate representation of a hatchery group in the conglomerate of adults at a particular recovery location. Maximum number of fish that can be CWT’ed is capped by smolt production. To determine the desired number of CWT recoveries required to provide a reasonable level of statistical confidence, we utilized the mathematical relationship between precision of the statistical comparison and observed numbers of CWT recoveries established by De Libero (1986). In this relationship, covarince (CV) of estimating total numbers of fish from hatchery group G_i at location L_i decreases as the number of CWT recoveries increases, but the CV does not significantly decrease further beyond a certain number of CWT recoveries. On the basis of De Libero (1986)’s findings, it takes about 30 observed recoveries per replicate (or hatchery group G_i) to achieve a

CV of 28.2%. As a general rule, 30 to 35 tag recoveries are needed to provide evaluation with a reasonable chance to detect change (Figure CWT1; Lichatowich and Cramer 1979, De Libero 1986). We will use 35 CWT recoveries as our target to provide for a margin of error in the analysis of power and realization of recoveries.

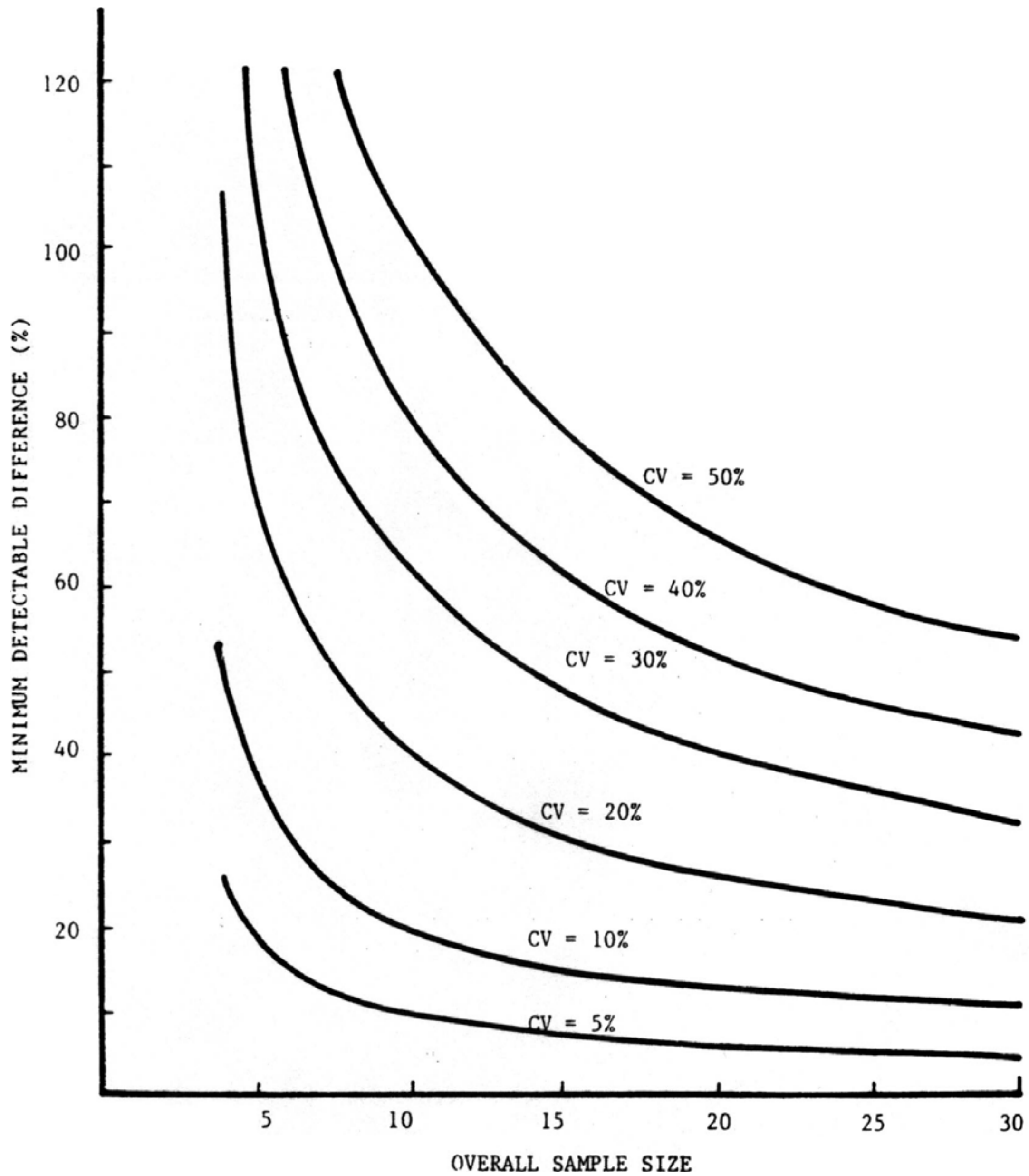


Figure CWT1. The effect of overall sample size (unexpanded number of coded-wire tag recoveries) on minimum detectable difference (ß = 0.2) for different levels of variability (CV). Taken from Lichatowich and Cramer (1979).

Determination of tagging rates for a hatchery group will be influenced by the uncertainties and monitoring strategies comanagers decide are a priority for the program along with policy and regulatory considerations. Tagging rates needed to recover 35 CWT's will be lowest if the only question of interest is determining overall SAS. In this case, CWT recoveries are pooled from all locations and tagging rates are minimal. However, if we want to assess contributions of a hatchery group to spawning, a specific fishery, or a stray location, appropriate tagging rates will be determined by our ability to recover CWT from those specific locations.

Ability to recover 35 CWT's is primarily influenced by SAS and sampling intensity at most recovery locations except Three Mile Falls Dam. At Three Mile Falls Dam, ability to recover CWT's is primarily influenced by trapping rates for steelhead, and total numbers of brood collected for Chinook. For steelhead, most CWT recoveries are obtained by sacrificing fish at Three Mile Falls Dam because numbers of recoveries from fisheries, strays, spawning grounds, and brood collection is typically low. Therefore, trapping rate at Three Mile Falls Dam is the primary factor we used in our calculation of tagging rates needed to recover 35 CWT's. We also factored in recoveries from all other sources in the calculation. For Chinook, fish collected for brood can supply most or all of the 35 CWT recoveries needed to assess survival to Three Mile Falls Dam for most hatchery groups. Numbers of CWT recoveries in brood for hatchery group G_i is determined by the proportionate representation of CWT'ed fish from hatchery group G_i in the run. Proportionate representation of hatchery groups in the run are in turn determined by the relative smolt production and SAS of the hatchery groups and proportion of natural fish collected in brood.

In order to model expected numbers of recoveries for a specific hatchery group G_i, we must make the following assumptions. It is important to mention that tagging rates will need to be reassessed if any of the relationships in these assumptions are not met in the future.

1) smolt production of hatchery group G_i remains relatively constant,
2) relative survival of hatchery groups remains relatively constant,
3) relative proportion of natural- to hatchery-reared Chinook in the run remains relatively constant,
4) recovery rates at location L_i remains relatively constant over time with varying SAS rates, and
5) number of brood collected at Three Mile Falls Dam remains relatively constant.

We used the most representative data we have on recovery rates of CWT's for fish produced in the Umatilla hatchery program at various recovery locations (L_i) and smolt-to-adult survival rates (SAS_i). We used the following formula to estimate, over a range of SAS, the number of fish that would need to be tagged in hatchery group G_i to recover 35 CWT's in out-of-subbasin fisheries, in-subbasin fisheries, spawning grounds, and stray location.

$$RNT_{Gi\ Li\ SASi} = (35 / \bar{x}\ REC_{Gi\ Li})\ (\bar{x}\ SAS_{Gi} / SAS_i)\ (\bar{x}\ NT_{Gi})$$

where:
$RNT_{Gi\ Li\ SASi}$ = Required number of fish to CWT to recover 35 CWT's for hatchery group G_i at location L_i and smolt-to-adult survival SAS_i,

$\bar{x}\ REC_{Gi\ Li}$ = mean number of CWT recoveries for hatchery group G_i at location L_i (calculated from data),
$\bar{x}\ SAS_{Gi}$ = mean smolt-to-adult survival (SAS) for hatchery group G_i (calculated from data),
SAS_i = SAS (variable), and
$\bar{x}\ NT_{Gi}$ = mean number of fish CWT'ed (NT) for hatchery group G_i.

We used the following formula to calculate numbers of CWT's recovered for hatchery group G_i in brood collected at Three Mile Falls Dam. Brood collection is the first priority for returns to Three Mile Falls Dam, and collection goals are typically met except in cases when SAS is very low.

$$REC_{Gi\ Lbc} = (N_{bc})\ (PRET_{Gi})\ (PTAG_{Gi})$$

where:
$REC_{Lbc\ Gi}$ = Number of CWT's recovered in brood collection for hatchery group G_i,
N_{bc} = Total number of brood collected,
$PRET_{Gi}$ = Proportion of hatchery group G_i in the return to Three Mile Falls Dam, and
$PTAG_{Gi}$ = Proportion of hatchery group G_i returning to Three Mile Falls Dam that is CWT'ed.

We solved the following formula at varying SAS to calculate the number of fish in hatchery group G_i that would need to be tagged to recover 35 CWT's from brood collection and one or more other locations.

$$35\ REC = REC_{Gi\ Lbc\ SASi\ NTi} + REC_{Gi\ Li\ SASi\ NTi}$$

where:
35 REC = 35 CWT recoveries,
$REC_{Gi\ Lbc\ SASi\ Ti}$ = Number of CWT recoveries for hatchery group G_i from brood collection (L_{bc}) at SAS_i and tagging rate NT_i, and
$REC_{Gi\ Li\ SASi\ Ti}$ = Number of CWT recoveries for hatchery group G_i from one or more locations other than brood (L_i). at SAS_i and tagging rate NT_i.

In general, greater numbers of fish need to be CWT'ed to achieve a desired number of CWT recoveries when SAS decreases. The key to determining what number of fish to tag is the ability to predict SAS prior to tagging. Figure CWT2 summarizes representative past SAS for steelhead and Chinook produced by the Umatilla Subbasin hatchery program. Lower 90% and 95% confidence limits for SAS are presented on the figure to illustrate how often low SAS might be expected. Note that logarithmic y-axis's were needed for Chinook due to their highly variable and sometimes very low SAS compared to steelhead. Results of modeling tagging rates required to recover 35 CWT from various locations and hatchery production groups G*i* are presented in Figures CWT3-6. Recovery locations used in the models vary by hatchery group due to varying M&E information needs for each group. These models provide comangers with the information needed to balance tagging cost or policies with M&E needs to recover a statistically sound data. Given these opposing considerations, it is probable statistically sound numbers of CWT recoveries will not be achieved when SAS is very low. Table CWT1 summarizes current and required numbers of CWT'ed fish to achieve 35 recoveries at varying locations at the lower 90% and 95% SAS confidence interval. From this table we can conclude current tagging rates for

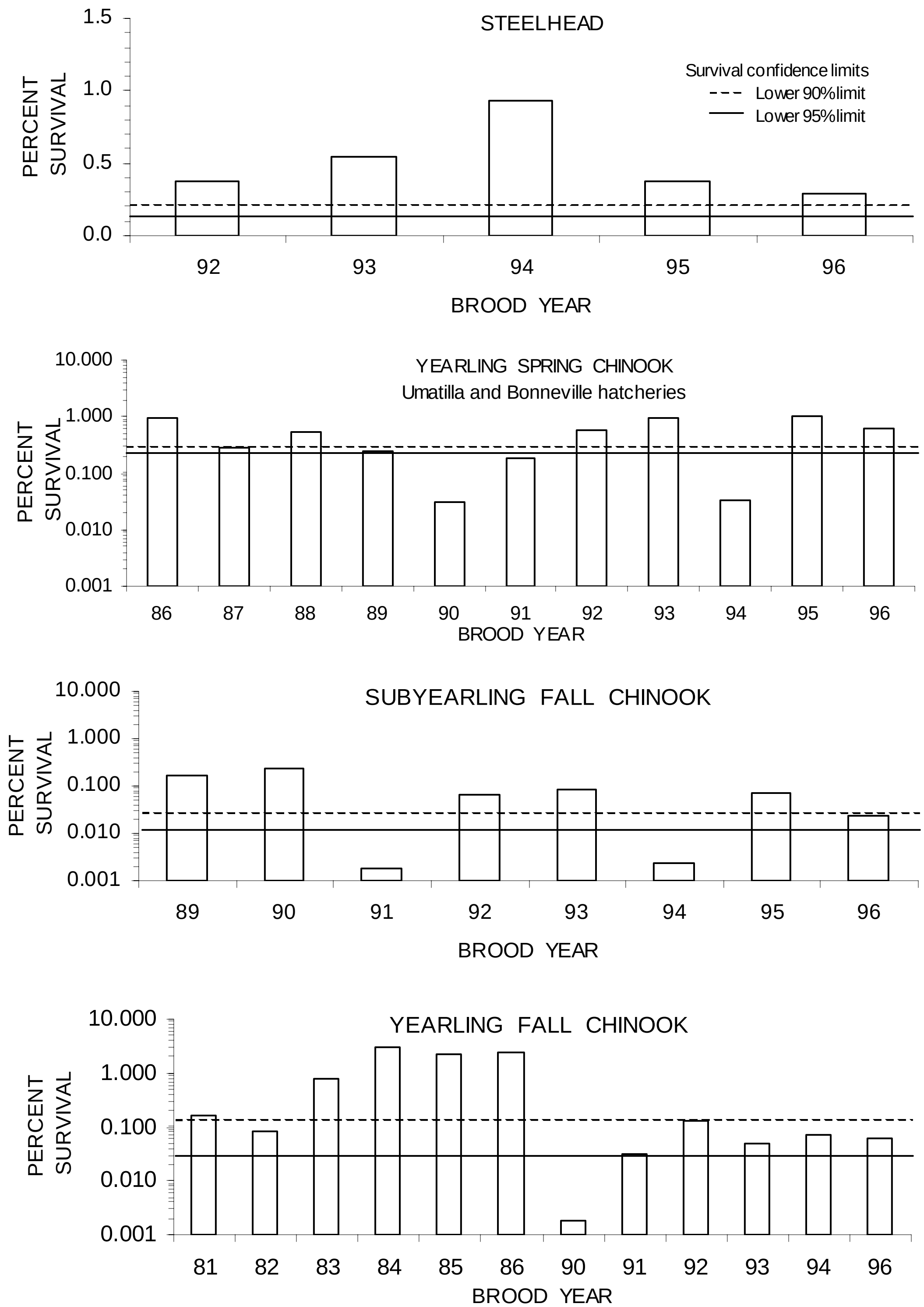
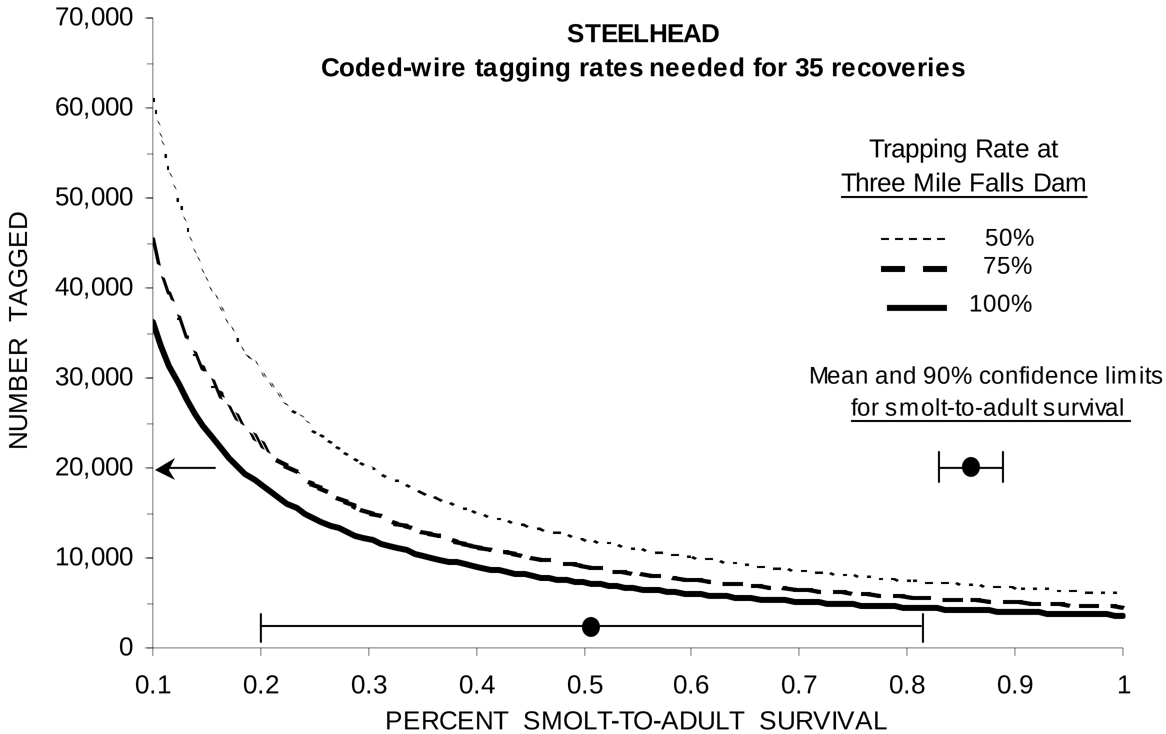


Figure CWT2. Past smolt-to-adult survival of hatchery steelhead and Chinook released in the Umatilla River that are most representative of current hatchery production strategies. Graphs include lower 90% and 95% confidence interval for smolt-to-adult survival assuming a normal distribution.



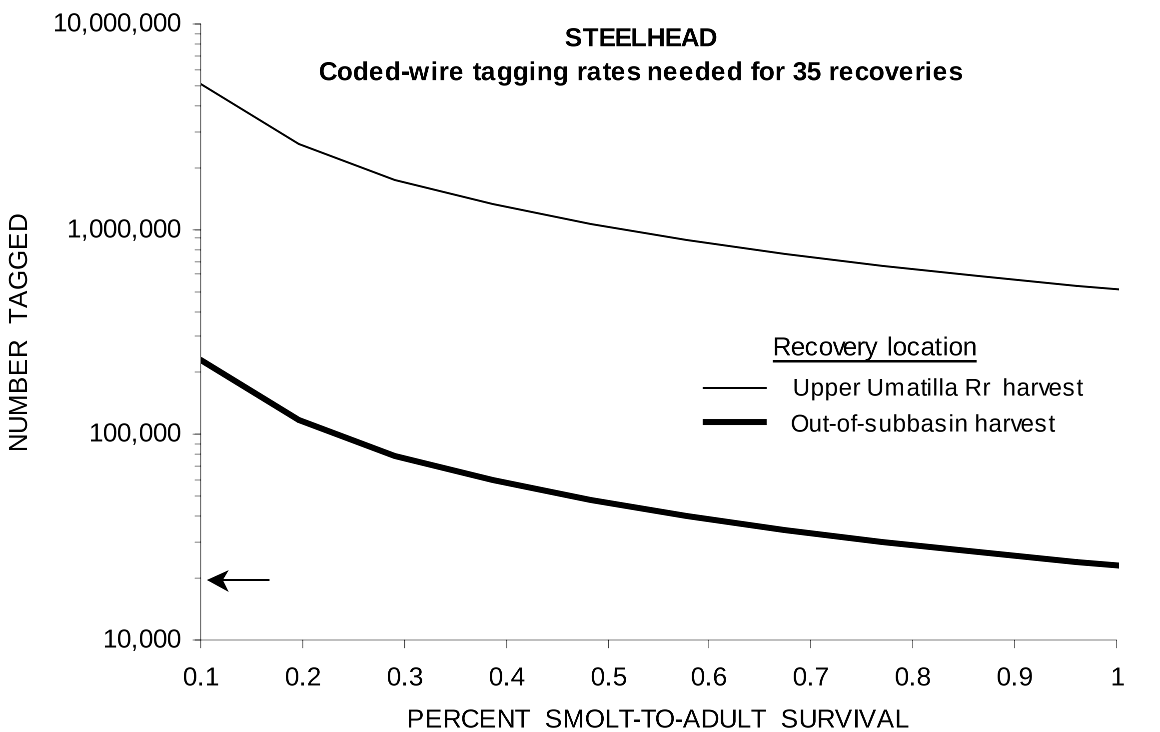
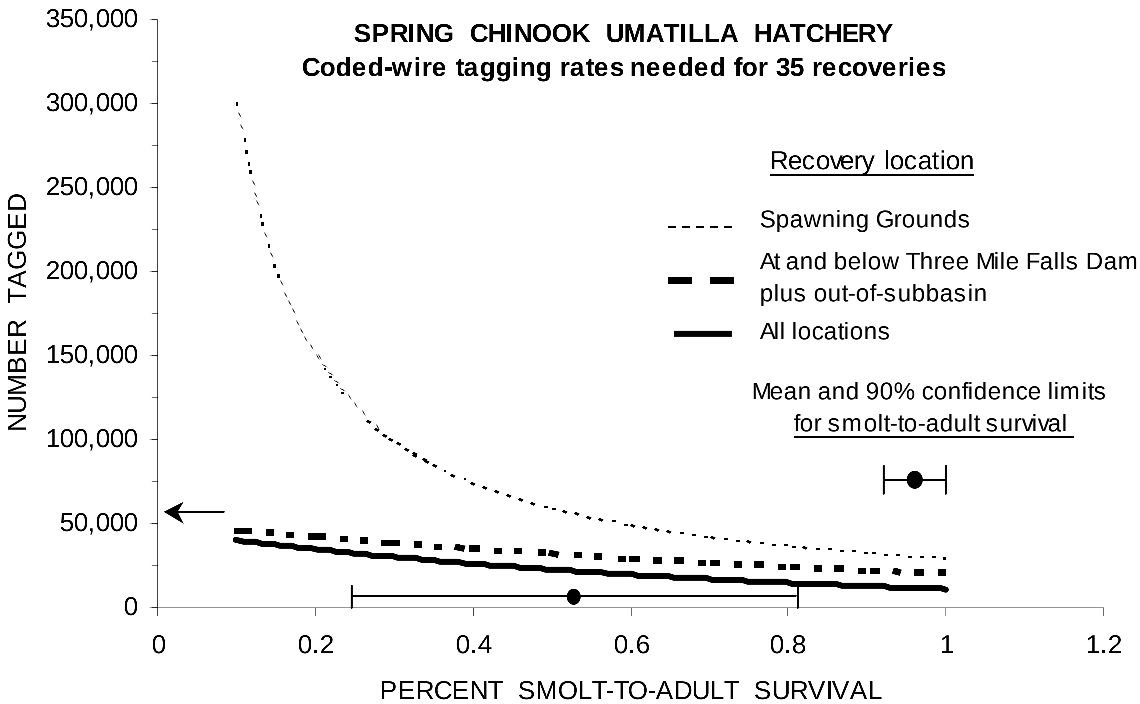


Figure CWT3. Coded-wire tagging rates at varying smolt-to-adult survival rates for steelhead reared at Umatilla Hatchery (per unique rearing/release group) required to recover 35 tags in the Umatilla River when trapping rate at Three Mile Falls Dam is 50%, 75%, and 100% of the run, and in the Upper Umatilla and Columbia river fisheries. Arrows indicate current coded-wire tagging rate.



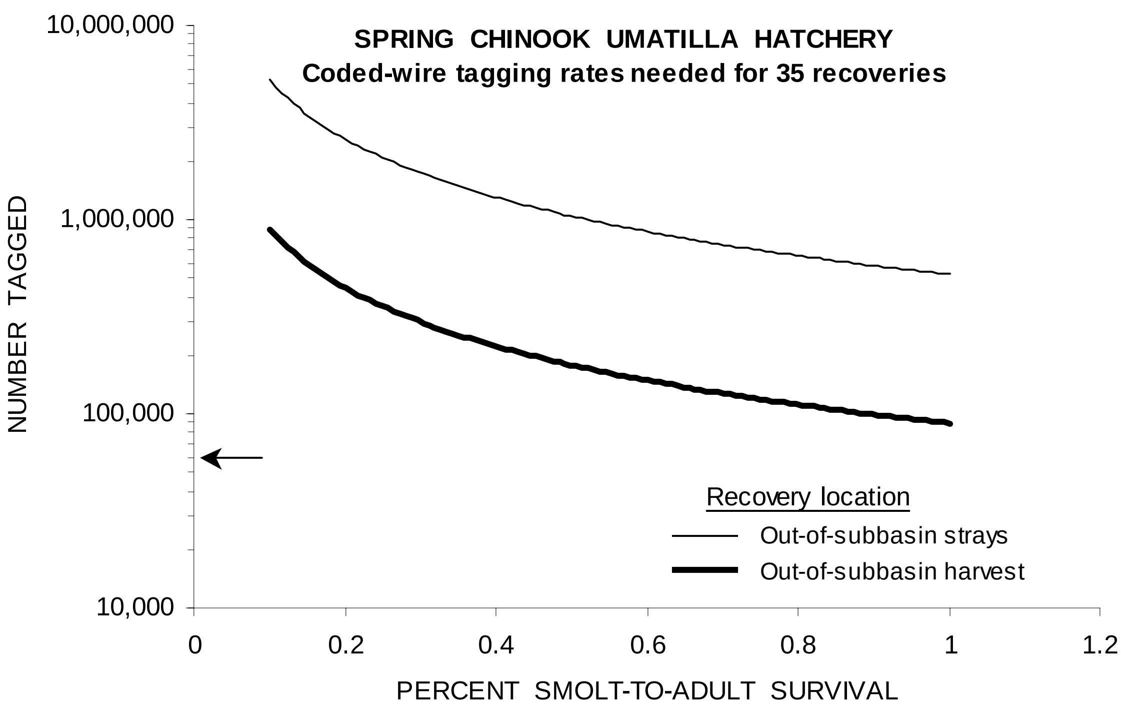
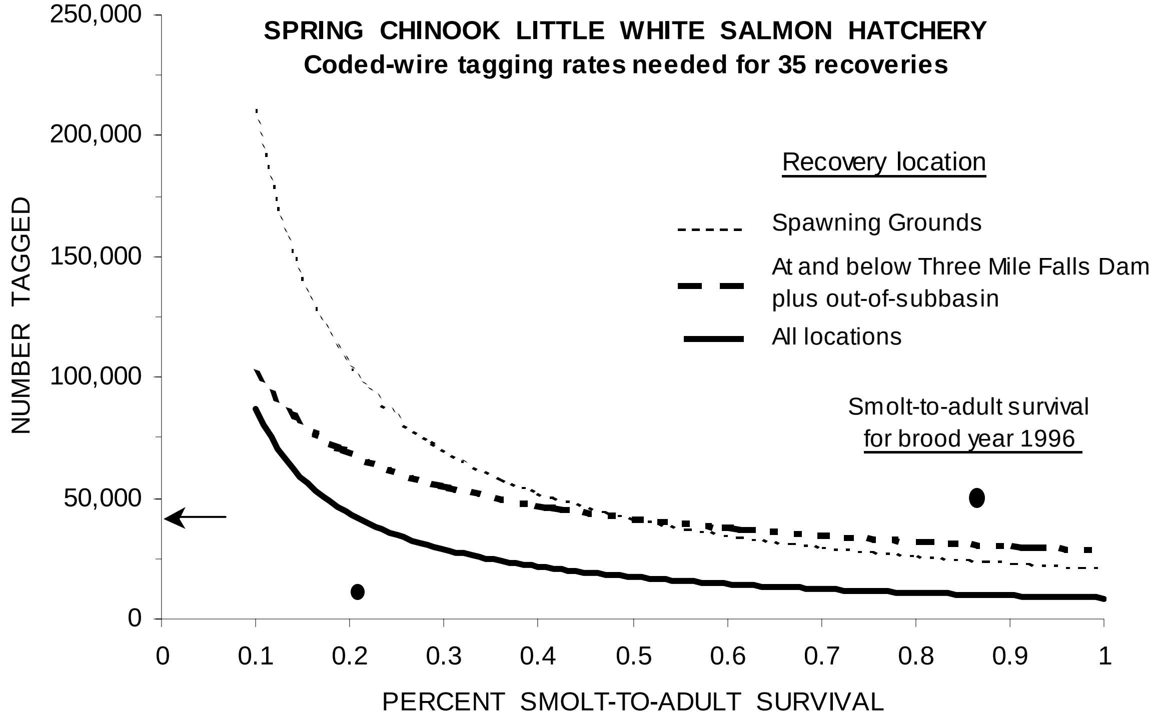


Figure CWT4. Coded-wire tagging rates at varying smolt-to-adult survival rates for spring Chinook reared at Umatilla Hatchery (per unique rearing/release group) required to recover 35 tags at varying locations. Recovery locations include the spawning grounds, out-of-subbasin strays and fisheries, at and below Three Mile Falls Dam plus out-of-subbasin locations, and all locations combined. Arrows indicate current coded-wire tagging rate.



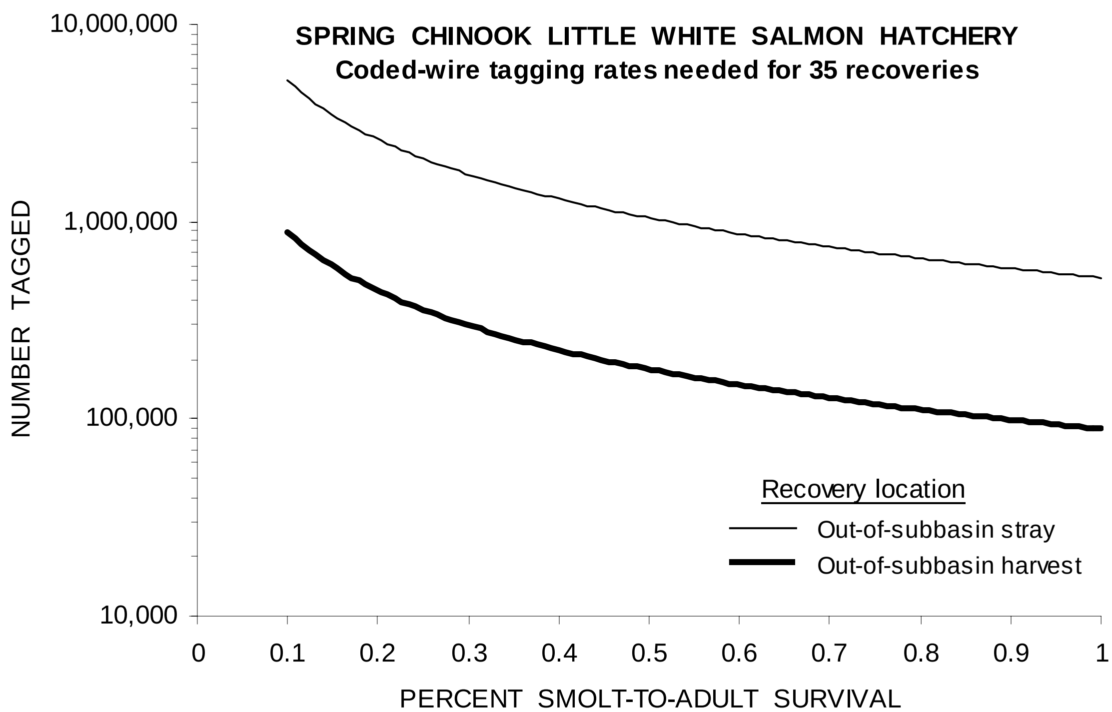
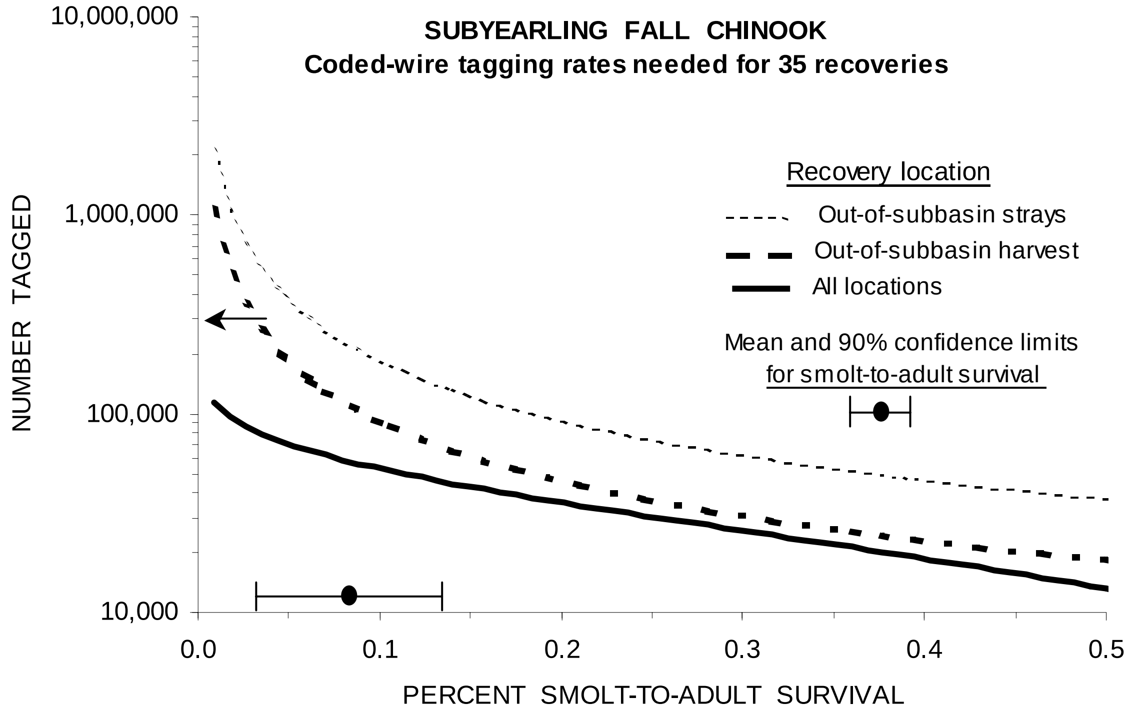


Figure CWT5. Coded-wire tagging rates at varying smolt-to-adult survival rates for spring Chinook reared at Little White Salmon Hatchery (per unique rearing/release group) required to recover 35 tags at varying locations. Recovery locations include the spawning grounds, out-of-subbasin strays and fisheries, at and below Three Mile Falls Dam plus out-of-subbasin locations, and all locations combined. Arrow indicates current coded-wire tagging rate.



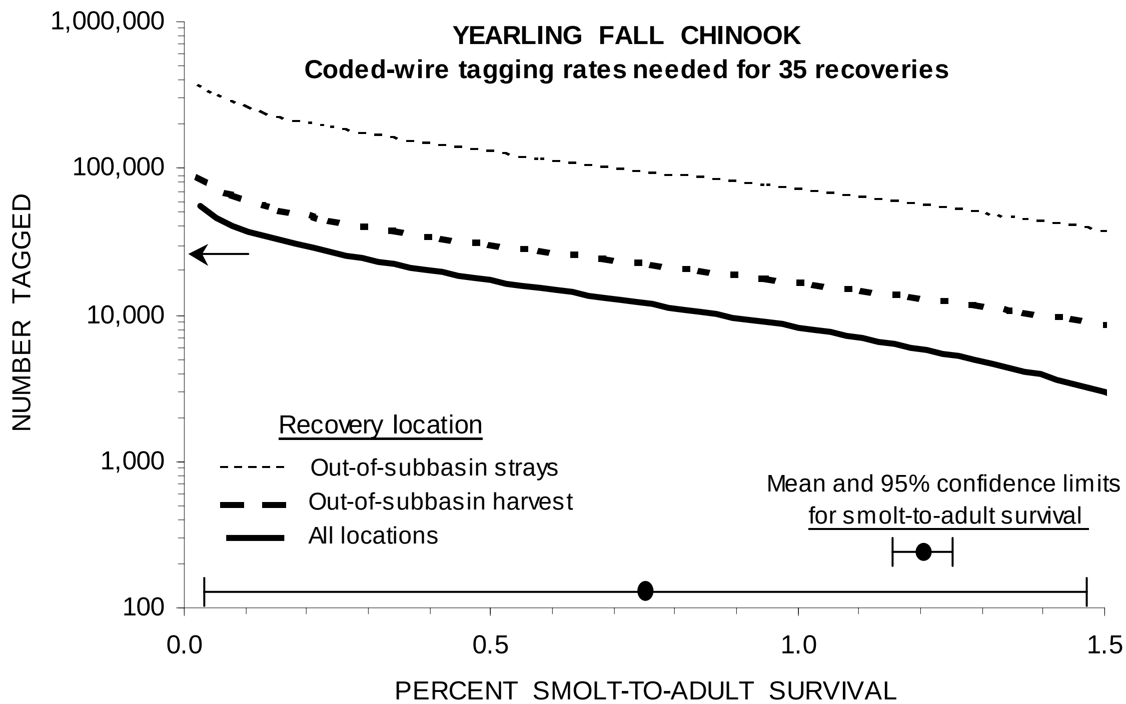


Figure CWT6. Coded-wire tagging rates at varying smolt-to-adult survival rates for fall Chinook reared at Umatilla Hatchery (per unique rearing/release group) required to recover 35 tags at varying locations. Recovery locations include out-of-subbasin strays and fisheries, and all locations combined. Arrows indicate current coded-wire tagging rate.

Table CWT1. Predicted coded-wire tagging rates required to obtain 35 tag recoveries at various sampling locations when smolt-to-adult survival is at the lower 90% and 95% confidence limit of the mean (90% L.C.L. and 95% L.C.L.).

Hatchery[a] - Production Group (Current no. CWT'ed)	Coded-wire tag recovery locations[b]: Trapping rate at Three Mile Falls Dam, 50% of run	75% of run	100% of run	Out-subbasin harvest	Upper Umatilla River harvest
UFH - Steelhead					
95% L.C.L.	48 K	36 K	28 K	181 K	4.0 M
90% L.C.L.	28 K	21 K	16 K	105 K	2.3 M
(20,000 CWT'ed)					
	All locations	**Out-subbasin + at and below TMFD**	**Spawning grounds**	**Out-subbasin harvest**	**Out-subbasin strays**
UFH - Spring Chinook					
95% L.C.L.	35 K	43 K	133 K		2.3 M
90% L.C.L.	35 K	43 K	108 K		1.9 M
0.5% SAS (fisheries open)				110 K	
(60,000 CWT'ed)					
LWSH - Spring Chinook					
Current survival	42 K	64 K	101 K	431 K	2.5 M
(40,000 CWT'ed)					
UFH - Subyearling fall Chinook					
95% L.C.L.	112 K			832 K	1.7 M
90% L.C.L.	79 K			262 K	528 K
(300,000 CWT'ed)					
BFH - Yearling fall Chinook					
95% L.C.L.	57 K			344 K	1.5 M
90% L.C.L.	30 K			64 K	279 K
(25,000 CWT'ed)					

[a] *CWT'ed = coded-wire tagged, UFH = Umatilla Hatchery, LWSH = Little White Salmon Hatchery, BFH = Bonneville Hatchery, SAS = smolt-to-adult survival.*
[b] *K = thousand, M = million.*

steelhead are adequate for years when the trapping rate at Three Mile Falls Dam is 75% and SAS is at or above the 90% lower confidence limit (LCL) for mean SAS. Trapping rate at Three Mile Falls Dam has averaged 70% with a low of 49%. However, trapping rates are adjusted inseason if monthly CWT collection goals are not expected to be met. Setting tagging rates according to the 90% LCL (0.23% SAS) would seem reasonable given observed SAS for steelhead reared at Umatilla Hatchery (Figure CWT2). Smolt production is too low to provide tagging rates required for comparison of harvest contributions in out-of-subbasin and upper Umatilla River fisheries between the hatchery groups. However, pooling CWT recoveries from the hatchery groups will provide adequate CWT recoveries to monitor harvest contributions in out-of-subbasin fisheries when SAS is > 0.4%. Current tagging rates for spring Chinook are adequate for monitoring SAS, but not for comparing contributions of the individual hatchery groups to spawning, or out-of-subbasin harvest and straying. The ISRP has repeatedly recommended monitoring all these fates for each hatchery production group in previous reviews of the Umatilla Hatchery Evaluation (ISRP 2001-8, ISRP 2003-10). Increasing coded-wire tagging to about 100,000 per hatchery group would allow comparison of spawner contributions for all hatchery groups and comparison of out-of-subbasin harvest for Umatilla Hatchery groups. Low numbers of CWT recoveries from out-of-basin strays result in unachievable tagging needs to monitor out-of-basin straying when SAS is low. Current tagging of subyearling fall Chinook hatchery groups is adequate to monitor SAS and out-of-subbasin harvest when SAS is at the 90% LCL, and out-of-subbasin strays when SAS is about 0.05%. Tagging rate of subyearlings can not be increased because all production is already CWT'ed. Current tagging of yearling fall Chinook is inadequate. Since yearlings are currently mass marked with a blank-wire tag, coded-wire tagging rates of this group could be increased at a minimal cost. If all production were CWT'ed, adequate numbers of CWT's could be recovered to monitor SAS, and out-of-subbasin harvest and strays. Monitoring out-of-subbasin straying of both subyearling and yearling fall chinook is an ESA BiOp mandate.

Computation of total adults produced, and harvest, natural spawning, and straying components

Total adults produced: Numbers of adults produced for a specific hatchery group and their final fate is calculated from CWT recovery data and associated marking rates reported on the PSMFC RMIS database. This database compiles CWT recoveries from multiple locations and entities. Individuals will report observed numbers of CWT's recovered by tag code for their location, and if known, an estimated total number of CWT'ed fish calculated by expanding observed recoveries by sampling rate of CWT'ed fish at that location. Total number of adults at a specific location are estimated by expanding total CWT recoveries for that location by an expansion factor that adjust for the proportion of marked to unmarked fish. Summing total number of adults from all locations provides an estimate of total numbers of adults produced for specific hatchery groups.

Harvest contributions: Harvest contributions are grouped by three main fishery areas: ocean, Columbia River, and in-subbasin fisheries. We will report number of adult harvested by individual hatchery groups and total numbers for all hatchery groups by run year. We will also maintain a database of recoveries by brood year contributions. More detailed breakdown of the three main fishery areas is as follows. We segregate ocean harvest by United States, Canadian, and tribal treaty commercial fisheries and provide a single category for all ocean sport fisheries. Categories of Columbia River fisheries include tribal commercial, tribal subsistence, non-tribal commercial, and non-tribal sport above and below Bonneville Dam. Categories for in-subbasin fisheries are tribal, lower-river non-tribal, and upper-river non-tribal. Computation of number of adults harvest by location and hatchery group are described above in "Total adults produced".

Spawners: Spawning contributions are calculated from CWT's recovered during spawning ground surveys. Spawning contributions can only be reported for spring Chinook, because few or no CWT's are recovered during steelhead and fall Chinook spawning ground surveys (We will increase fall Chinook carcass survey efforts, and should be able to get sufficient carcasses in coming years). Computation of number of adults contributing to spawning by hatchery group are described above in "Total adults produced". We will use graphic analysis to describe the distribution of CWT's recovered during spring Chinook spawning ground surveys. Spatial locations of CWT recoveries will correspond with river reaches used as sampling units in spawning ground surveys. We will only use CWT's recovered from female carcasses to describe spawner distribution since their carcasses are more likely to be recovered close to their spawning location, whereas this is less likely for male spawners. We will describe the following variations of spawner distributions for each hatchery group: successful spawners, prespawn mortalities, and age-at-return. Annual CWT recoveries for some locations and spawner categories will likely be low, therefore recoveries will be pooled across years or groups of years with similar environmental conditions.

Strays: Numbers of adults that are recovered at terminal locations outside of the Umatilla subbasin (spawning grounds, hatcheries, and adult traps) will be reported for the following four areas: Snake River Basin, Columbia River Basin above McNary Dam, Columbia River Basin below McNary Dam, and all other locations. Most out-of-subbasin strays are from our fall chinook hatchery program. No steelhead and few spring Chinook CWT's have been recovered at terminal locations to date.

Computation of smolt-to-adult survival: Percent SAS is reported for each hatchery group and all production combined. Percent survival is calculated as total adults produced time 100, divided by total number of smolts released. Computation of total numbers of adults produced are described above in "Total adults produced".

Umatilla River run composition monitoring: Rearing and release history of hatchery steelhead and Chinook returns to the Umatilla Subbasin is monitored using CWT's recovered from all locations within the subbasin, PIT-tag recoveries from mainstem and TMF dams, and scale analysis. Computation of total numbers of adults in the run by hatchery group are described above in "Total adults produced". A correction factor is applied to total numbers of adults for each hatchery group so that total numbers of adults from all hatchery groups equals total numbers of hatchery fish counted at Three Mile Falls Dam plus in-subbasin harvest below Three Mile Falls Dam. Applying this correction factor assumes the differences between the two estimates of total number of hatchery fish returning to the Umatilla Subbasin is attributable to sampling error rather than other factors such as unmarked production groups in the return. We are not able to directly test this assumption. However, if significant numbers of unmarked hatchery fish are in the return, hatchery run size would be consistently underestimated using the

CWT method, which is not the case. We can provide a gross description of arrival timing to Three Mile Falls Dam for the more abundant groups hatchery steelhead by pooling data over years. In particular, we will describe percent of return by month for hatchery groups released within the Umatilla Subbasin and the most prevalent hatchery groups released outside of the subbasin. Of particular regional interest is the identification of non-Umatilla origin hatchery groups that enter the Umatilla River in spring that will likely spawn with ESA listed Umatilla steelhead. It is questionable whether non-Umatilla origin steelhead observed in the lower Umatilla River (RM 3.7) in fall and early winter will remain and spawn in the subbasin or fall back out of the Umatilla Subbasin.

Life history monitoring: Life history information is obtained from several sources; from fish trapped at Three Mile Fall Dam, from CWT recoveries, from PIT-tag detections, from carcass surveys, and from scale analysis. Trap data is used for comparison of life history traits for hatchery-reared and natural-reared fish. However, CWT recoveries are the method used to obtain adult life history information individual hatchery groups. We pool CWT recoveries from all freshwater locations to describe age-at-return, size-at-return, and sex ratios by brood year for each hatchery group. Value of differences in life history traits expressed by hatchery groups will be assessed in terms of their effect on meeting management objectives for natural and hatchery production, harvest, minimizing impacts to natural populations.

Release Monitoring

All fish are forced out of the acclimation facilities by draining and seining them through the outlet. Fish are randomly sampled and 300 fork lengths (mm) and 100 weights (g), and condition factors (wieight/length$^3 * 10^5$) are determined. Smoltification and descaling were estimated from 100 randomly sampled fish from each acclimation pond. Each fish was judged to be smolted if parr marks were absent and body was silvery, intermediate if parr marks and silvery body was faded, or parr if parr marks were present and body was dull. Each fish was judged to be descaled if scales were more than 50% lacking on either side, partial if scales on either side were lacking between 25-50%, or no descaling if scales on either side were less than 25 % lacking

Pathology Monitoring

Detailed fish health sampling of hatchery production groups is outlined annually in the AOP (Umatilla Hatchery and Basin Annual Operation Plan 2004 and work statement). Fish that are removed from rearing facilities because they are dead or moribund will be temporarily frozen and examined monthly for fish pathogens. Routine health examinations will be conducted annually on grab-sampled fish before release at each facility. In addition a minimum of 60 spawning adults per stock (if available) and adult mortality will be tested as per AOP and work statement guidelines.

Brood

Hatchery Rearing

Smolt Release

In-stream

TableX. Performance metrics, spatial scale, sampling frequency, methods, and linkage to Umatilla Management and RM&E Objectives.

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
Abundance	Adult	Escapement to the Umatilla River	Subbasin	Annual	Visual observation and trapping	1a, 9b, 10a, 13a, 14a, 15a, 15b, 16a, and 16b
		Harvest	Subbasin	Annual	Creel surveys	13b2, 14a, 15a, 15b, 16a, and 16b
		Run to Three Mile Falls Dam	Watershed, release group, and subbasin	Annual	PIT-tagging	1a, 9a, 9b, 10a, 10b, 13a, 14a, 15a, 15b, 16a, and 16b
		Broodstock Collected	Subbasin	Annual	TMFD trap plus mainstem traps	1a, 9a, 14a, 15a, 15b, 16a, and 16b
		Spawner Escapement	Subbasin	Annual	Spawner surveys	1a, 3a, 5a, 3e, 4e, 12a, 14a, 15a, 15b, 16a, and 16b
		Spawner Abundance	Reach and Subbasin	Annual	Redd Counts	1b, 2b, 3a, 5b, 5a, 7b, 8a1, 8a2, 9a, 14a, 15a, 15b, 16a, and 16b
		Run Prediction	Subbasin	Annual	Modeling	1a, 13a, 14a, 15a, 15b, 16a, and 16b
	Juvenile	Fry Abundance	Reach	Annual	Emap surveys	1b, 2b, 14a, 15a, 15b, 16a, and 16b
		Parr and Pre-smolt Abundance	Reach	Annual	Emap surveys	1b, 2b, 1d, 14a, 15a, 15b, 16a, and 16b
		Smolt Abundance	Watershed and release group.	Annual	Trapping, outmigration monitoring	3a, 5a, 1c, 2b, 7a, 8a1, 8a2, 10b, and 12b

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
Abundance	Juvenile	Residual Abundance	Reach	Annual	Trapping	1b, 1d, 14a, 15a, 15b, 16a, and 16b
Survival and Productivity	Adult	Broodstock Survival	Subbasin	Annual	Hatchery M&E	2a, 7a, 6a, 6b, 14a, 15a, 15b, 16a, and 16b
		Harvest	Out-of-Subbasin	Annual	CWT analysis	7a, 13b2, 14a, 15a, 15b, 16a, and 16b
		Smolt-to-Adult Return	Subbasin and release group	Annual	PIT-tagging, CWT, and population modeling	3a, 5a, 7a, 14a, 15a, 15b, 16a, and 16b
		Smolt-to-Adult Survival	Subbasin and release group	Annual	PIT-tagging, CWT, modeling	2a, 3a, 5a, 7a, 7b, 8a1, 8a2, 14a, 15a, 15b, 16a, and 16b
		Parent Progeny Ratio	Subbasin and release group	Annual	PIT-tagging, CWT, modeling	3a, 5a, 7a, 14a, 15a, 15b, 16a, and 16b
		Pre-spawn Mortality	Reach	Annual	Spawner surveys	2a, 3a, 5a, 14a, 15a, 15b, 16a, and 16b
		Recruit per spawner	Subbasin and watershed	Annual	PIT-tagging, CWT, modeling, passage operations	3a, 5a, 7a, 14a, 15a, 15b, 16a, and 16b

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
Survival-Productivity	Juvenile	Egg to Fry Survival	Reach	Annual	Spawner surveys, juvenile surveys, modeling	2a, 2b, 14a, 15a, 15b, 16a, and 16b
		Fry to parr and parr to smolt survival	Reach and Subbasin	Annual	Spawner surveys, juvenile surveys, modeling	2a, 2b, 14a, 15a, 15b, 16a, and 16b
		Smolt Survival to Three Mile Falls Dam	Subbasin and release group	Annual	PIT-tagging, modeling	1c, 2a, 2b, 7a, and 10b, 14a, 15a, 15b, 16a, and 16b
		Smolt Survival through the Columbia River	Subbasin, watershed, and release group	Annual	PIT-tagging, modeling	1c, 2a, 7a, 14a, 15a, 15b, 16a, and 16b
Distribution and Movement	Adult	Spawner Spatial Distribution	Subbasin, watershed, and reach	Annual	Spawner surveys	1b, 3e, 4e, 5b, 14a, 15a, 15b, 16a, and 16b
		Stray Rate	Subbasin and release group	Annual	PIT-tagging, CWT	9b, 14a, 15a, 15b, 16a, and 16b
	Juvenile	Rearing Distribution	Subbasin, watershed, and reach	Annual	Juvenile surveys	1b, 14a, 15a, 15b, 16a, and 16b

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
Distribution and Movement	Juvenile	Residual Distribution	Reach	Annual	Trapping	1b, 14a, 15a, 15b, 16a, and 16b
Life History	Adult	Run Timing	Subbasin and release group	Annual	PIT-tagging, CWT, passage operations, run modeling	3b, 3e, 4e, 9a, 10a, 10b, 12a, 14a, 15a, 15b, 16a, and 16b
		Passage efficiency	Subbasin	Annual	Telemetry, passage operations	3b, 3e, 14a, 15a, 15b, 16a, and 16b
		Age at Return	Subbasin and watershed	Annual	Passage operations, age and growth, CWT, PIT-tagging	3b, 7b, 14a, 15a, 15b, 16a, and 16b
		Size at Return	Subbasin and watershed	Annual	Passage operations, spawner surveys	3b, 14a, 15a, 15b, 16a, and 16b
		Sex Ratio at Return	Subbasin and watershed	Annual	Passage operations, PIT-tagging, spawner surveys	3b, 14a, 15a, 15b, 16a, and 16b
		Fecundity	Subbasin	Annual	Hatchery M&E	9a, 14a, 15a, 15b, 16a, and 16b
		Spawn-timing	Subbasin and watershed	Annual	Spawner surveys	3b, 5b, 14a, 15a, 15b, 16a, and 16b
	Juvenile	Size at Release	Release group	Annual	Hatchery M&E	1c, 14a, 15a, 15b, 16a, and 16b
		Release Location	Release group	Annual	Hatchery M&E	1c, 14a, 15a, 15b, 16a, and 16b
		Emigration Timing	Subbasin, watershed, and release group	Annual	PIT-tagging, outmigration monitoring	1c, 3b, 10b, 12a, 12b, 14a, 15a, 15b, 16a, and 16b

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
Life History	Juvenile	Age at Emigration	Subbasin, watershed, and release group	Annual	Trapping, outmigration monitoring	1c, 3b, 14a, 15a, 15b, 16a, and 16b
Life History	Juvenile	Size at Emigration	Subbasin, watershed, and release group	Annual	Trapping, outmigration monitoring	1c, 3b, 14a, 15a, 15b, 16a, and 16b
Life History	Juvenile	Condition at Emigration	Subbasin, watershed, and release group	Annual	Trapping, Outmigration monitoring	1c, 3b, 14a, 15a, 15b, 16a, and 16b
Fish Health	Adult and Juvenile	Disease Incidence	Subbasin and watershed	Annual	Pathology	1c, 6b, 9c, 14a, 15a, 15b, 16a, and 16b
Fish Health	Adult and Juvenile	Disease Severity	Subbasin and watershed	Annual	Pathology	1c, 6b, 9c, 14a, 15a, 15b, 16a, and 16b
Genetic	Adult and Juvenile	Genetic Diversity and Integrity	Subbasin and watershed	Annual (two 5 year cycles)	Juvenile surveys, passage operations, molecular studies	3c, 3d, 3f, 9a, 14a, 15a, 15b, 16a, and 16b

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
Genetics	Adult and Juvenile	Reproductive Success	Subbasin and watershed	Annual (5 year cycle)	Juvenile surveys, passage operations, molecular studies	3d, 3f, 14a, 15a, 15b, 16a, and 16b
		Effective Population Size	Subbasin, watershed	Annual (two 5 year cycles)	Juvenile surveys, passage operations, molecular studies	3c, 14a, 15a, 15b, 16a, and 16b
Fisheries	Adult	Spatial and temporal amount of Catch & Effort	Subbasin	Annual	Harvest monitoring	13b1, 14a, 15a, 15b, 16a, and 16b
		Gear types	Subbasin	Annual	Harvest monitoring	13b1, 14a, 15a, 15b, 16a, and 16b
		Angler demographics	Subbasin	Annual	Harvest monitoring	13b1, 14a, 15a, 15b, 16a, and 16b
Habitat	Adult and Juvenile	Instream flow	Subbasin and reach	Continual	Gauge stations	1e, 10a, 10b, 12a, and 12b, 14a, 15a, 15b, 16a, and 16b
		Water temperature	Subbasin and reach	Continual	Water quality monitoring	1e, 10a, 10b, 14a, 15a, 15b, 16a, and 16b
		Water quality	Subbasin and reach	Annual	Water quality monitoring	1e1, , 15a, 15b, 16a, and 16b
		Physical habitat conditions	Reach	Every 10 years	Habitat surveys	1e, 2b, 14a, 15a, 15b, 16a, and 16b
		Biological habitat conditions	Reach	Every 10 years	Habitat surveys	1e, 2b, 14a, 15a, 15b, 16a, and 16b

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
Habitat	Adult and Juvenile	Habitat Quantity	Reach	Every 10 years	Habitat surveys	1e, 2b, 11a, 14a, 15a, 15b, 16a, and 16b
		Passage barriers and diversions	Reach	Every 10 years	Telemetrey, passage operations	1e, 14a, 15a, 15b, 16a, and 16b
		Habitat utilization	Reach and watershed	Annual	Juvenile surveys, spawner surveys	1e, 14a, 15a, 15b, 16a, and 16b
		Smolt production of habitat	Reach and watershed	Annual	Juvenile surveys, PIT-tagging,	1e, 2b, 3e, 11a, 14a, 15a, 15b, 16a, and 16b
Ecosystem	Juvenile and Adult	Trophic relationships	Reach and watershed		Juvenile surveys, spawner surveys, stable isotope studies, modeling	1e, 12b, 14a, 15a, 15b, 16a, and 16b
		Competition	Reach and watershed		Juvenile surveys, spawner surveys, stable isotope studies, modeling	1f, 2c, 3g, 5c, 14a, 15a, 15b, 16a, and 16b
		Natural mortality	Reach and watershed		Juvenile surveys, spawner surveys, stable isotope studies, modeling	1f, 2c, 3g, 5c, 14a, 15a, 15b, 16a, and 16b
		Marine ecology	Out of basin		New project	1f, 2c, 3g, 5c, 14a, 15a, 15b, 16a, and 16b

Performance Indicator	Life Stage	Performance Measure	Spatial Scale	Sampling Frequency	Method	Management Objective, Assumption and RM&E Objective
		Redd impacts	Reach and watershed		Spawner surveys, stable isotope studies, modeling	1f, 2c, 3g, 5c, 14a, 15a, 15b, 16a, and 16b
		Carcass impacts	Reach and watershed		Spawner surveys, stable isotope studies, modeling	1f, 2c, 3g, 5c, 14a, 15a, 15b, 16a, and 16b

STATUS AND PRIORITIZATION

Prioritization can be expressed at multiple scales within the management processes. We can set priorities for the management objectives down to the performance measures that we quantify (i.e. what data is accurately collected). It is unlikely that we will acquire the resources necessary to implement all of the monitoring and evaluation activities identified in the plan. However, we believe the goals are important regardless of our ability to achieve all of the objectives. The prioritization scheme identifies all of the activities according to current status, relative importance and ability to provide the most useful information. Performance measures will be prioritized into three levels (essential, recommended, and low importance). Considerations during ranking will include:

- Position within the overall management list
- Multifunction of performance measures. This is best portrayed in Appendix Table C as the relative number of monitoring and evaluation objectives that require a specific performance measure.
- Spatial scale of application appropriate at only the local population or regionally useful (tributary specific versus basin).
- Ability and appropriateness to use surrogate information;
  - Small-scale studies,
  - Basin wide average or index,
  - Published/literature demonstrated processes,
  - Hatchery surrogates
- Number of focal ESA species present.
- Cost/infrastructure required to address the objective and collect the data

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II. Terrestrial Wildlife Research, Monitoring, and Evaluation Plan

UMATILLA/WILLOW SUBBASIN MANAGEMENT PLAN FOR TERRESTRIAL RESEARCH, MONITORING AND EVALUATION

INTRODUCTION

The following plan was developed by the Umatilla/Willow Basin Terrestrial Technical Team through the adaptation of the Draft Terrestrial Research Monitoring and Evaluation plan for the SE Washington Ecoregion (Ashley and Stovel, 2004) and the Draft Monitoring and Evaluation Plan for The Albeni Falls Wildlife Mitigation Project, (Albeni Falls Work Group, August 2001). These two products were considered by the planners in the Subbasin to be the best representation of terrestrial R, M and E planning in the Columbia Basin to date. Subbasin planners in the Region understand the importance of consistency in application of common monitoring and evaluation tools to inform the larger landscape level management decisions. Planners expect to continue to work at the regional level to reach the goal of common standards for terrestrial R, M and E and to modify this plan to meet those standards once they are established. A summary of other ongoing R, M and E efforts in the subbasin is found at the end of this document.

The process used to develop wildlife assessments and management plan objectives and strategies was based on the need for a landscape level holistic approach to protecting the full range of biological diversity at the Province scale. Attention was focused on the size and condition of core habitat areas at a subbasin scale, maintaining physical connections between core areas, and providing buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most wildlife populations extend beyond subbasin or other political boundaries, this “conservation network” must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation of wildlife resources.

In developing Subbasin plans, managers made the following assumptions which served to focus planning efforts:

1. Planners assumed that by focusing resources primarily on generalized focal habitats, the needs of most listed and managed terrestrial and aquatic species would be addressed during this planning period. As more detailed data becomes available on specific habitat conditions and distributions, additional habitats and species assemblages will be addressed as needed in plan updates.
2. It was assumed that focal and other obligate species requirements can be used to guide ecosystem management. The main premise is that the requirements of an obligate focal species or demanding focal species/assemblage encapsulate those of many co-occurring less demanding species. This assumption guided selection of the

subbasin focal wildlife species. While the planners tried to limit the number of focal species in the plan, they used existing species assemblage information and multi species databases to support the monitoring efforts. These focal and other obligate species population trends may be monitored and evaluated over time. Focal habitats are functional if a focal and other obligate species recommended management conditions are achieved.

3. For purposes of development of habitat objectives and strategies, focal species assemblages adequately represent focal habitats. However, planners recognized that the development of multi species data bases, such as IBIS, provide for a more complex species/habitat assessment than has been practical in the past. This lessens the need for single species or guild assessments to represent a range of desired management issues for each focal habitat within the subbasins. Additionally, application of general trend monitoring for land birds, herptofauna, small mammals and plant communities can help inform managers on landscape level ecological changes that may not be captured through monitoring of focal species and habitats at a project level. The results of these species monitoring and evaluation efforts are expected to function as potential performance measures to monitor and evaluate the results of implementing future management strategies and actions on focal habitats.

Working hypotheses for focal habitat types were developed based on factors that affect focal habitats (the term, “factors that affect habitat” is synonymous with “limiting factors” for wildlife species). Working hypotheses are statements that assist subbasin planners and their communities to clearly articulate a program aimed at addressing the most pressing needs in a given area. The basis for the hypothesis is the proximate or major factors affecting focal habitats as described within individual subbasin assessments. The relationship subbasin planners attempted to address is that between management objectives, strategies or actions, and recommended (desired future) focal habitat conditions necessary to meet habitat and/or wildlife objectives and goals. These relationships are tested through implementation, followed by monitoring and evaluation. Ultimately, adaptive management is used to respond to the outcomes of these “tests” of “working hypotheses.”

The assessment and inventory synthesis cycle is illustrated in Figure 1. Movement through the cycle is summarized below:

1. Document and compare historic and current conditions of focal habitats to determine the extent of change.
2. Review habitat needs of focal and other obligate wildlife species/assemblages to assist in characterizing the “range” of recommended future conditions for focal habitats. Combine species habitat needs with desired ecological/habitat objectives to determine recommended future habitat conditions.
3. Determine the factors that affect habitat conditions and species (limiting factors) and compare to current and recommended future habitat conditions to establish needed future action/direction.
4. Develop strategies to address habitat “needs” and identify “road blocks” to obtaining biological goals.

5. Review strategies and compare to existing projects, programs, and regulatory statutes (Inventory) to determine the level at which existing inventory activities address, or contribute towards amelioration of factors that affect habitat conditions and species assemblages.
6. Develop goals and objectives to address strategies that define the key components of the management plan.

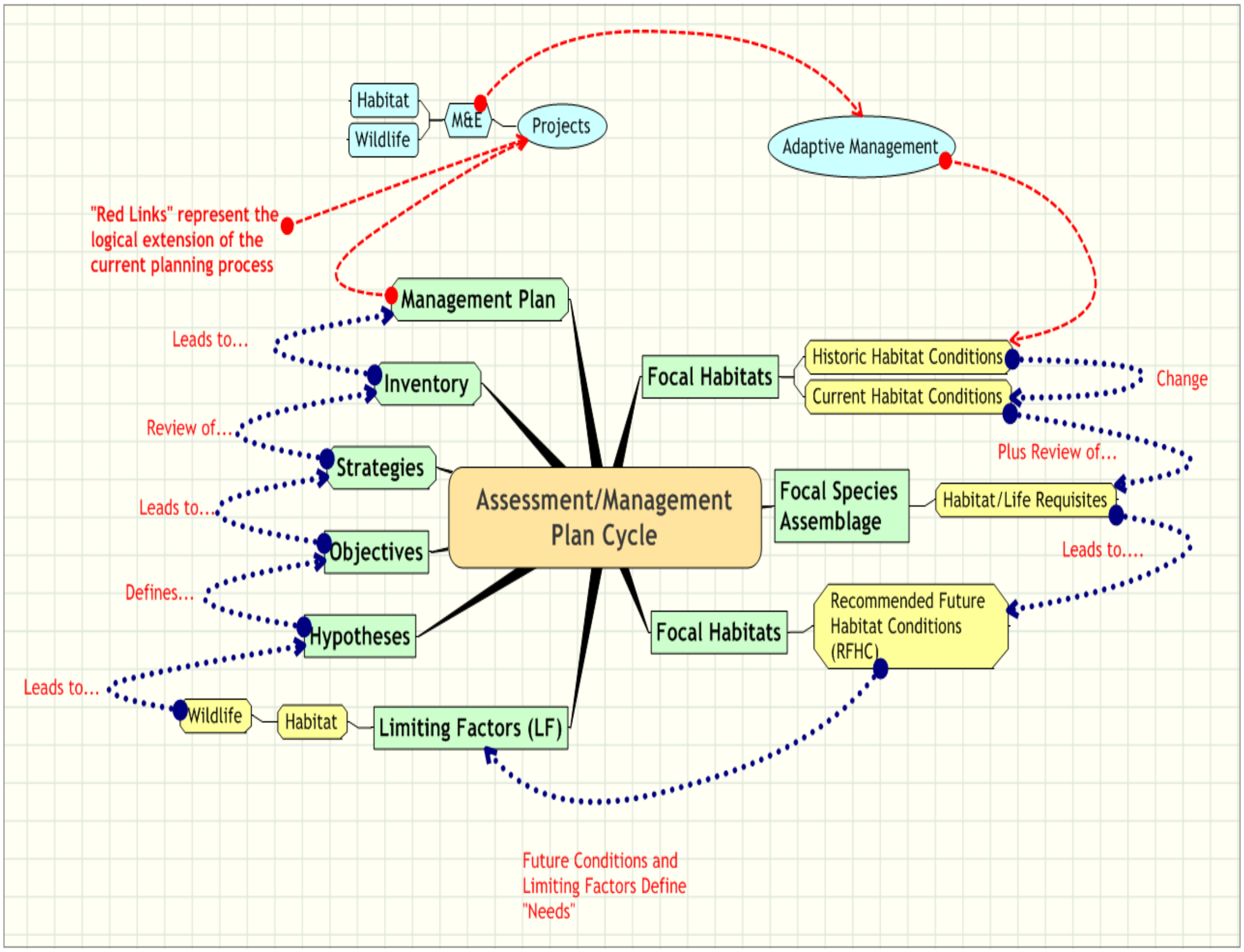

Figure 1. Assessment and Inventory Synthesis Cycle

Post subbasin planning algorithms (Research, Monitoring and Evaluation) are described in 7 through 9 below.

7. Projects are approved, based on management plan strategies, goals, and objectives, and implemented.
8. Habitat and species response to habitat changes are monitored at the project level and compared to anticipated results.
9. Adaptive management principles are applied as needed, which leads back to the "new" current conditions restarting the cycle.

The Research Monitoring and Evaluation (RME) Plan lays out the framework that will allow for evaluation of the efficacy of employed strategies in achieving corresponding focal habitat objectives for the subbasin, as per post subbasin planning algorithms 8 and 9. The RME plan emphasizes cooperative efforts among managers and stakeholders, and is designed to:

- evaluate success of focal habitat management strategies, via monitoring of focal wildlife species (The results of focal species monitoring and evaluation efforts are expected to function as potential performance measures to monitor and evaluate the results of implementing management strategies and actions on focal habitats).

- determine if management strategies undertaken are achieving recommended range of habitat management conditions, via monitoring and assessment of habitat conditions over time

- allow for evaluation of the assumptions and working hypotheses upon which the management plan is based, by determining if a correlation does indeed exist between focal habitat management conditions and focal species population trends

- Finally, the Adaptive Management portion of this REM plan outlines a strategy that will allow managers to adjust and/or focus management activities within the subbasin, based upon monitoring and evaluation data. The feedback loop thus formed will facilitate development of future iterations of the subbasin management plan.

The RME plan, as presented, consists of a variety of quantitative elements, ranging from scientific wildlife and vegetation surveys, spatial analyses of project location and acreage, to simple enumeration of land use projects/regulations commented upon by cooperating agencies. Summaries of other ongoing R, M and E activities in the basin that are not focused on subbasin planning under the NPCC Fish and Wildlife Program are appended for informational purposes.

Implementation of the Subbasin Plans is ultimately the responsibility of all managers and stakeholders who participated in its development. It is recommended that this group form an "Implementation Oversight Committee", to track and guide research, monitoring and reporting activities included in the plan.

Monitoring can be conducted at three qualitative levels of intensity:

Tier 1 (trend or routine) monitoring obtains repeated measurements, usually representing a single spatial unit over a period of time, with a view to quantifying changes over time. Changes must be distinguished from background noise. In general, Tier 1 monitoring does not establish cause and effect relationships (i.e., is not research) and does not provide statistical inductive inferences to larger areas or time periods (ISRP 2003). On a programmatic scale (the NPPC Fish and Wildlife Program) we believe that

HEP analysis (U.S. Fish and Wildlife Service 1980a) falls into this category. Particularly for projects that endeavor to mitigate a finite ledger of HUs associated with losses from a specific hydropower project, HEP adequately meets the monitoring needs, at a programmatic level, to ensure mitigation goals are being achieved. Consequently, HEP will remain an integral part of our overall monitoring strategy. Modern GIS will be used to geo-reference Tier 1 data.

Tier 2 (statistical) monitoring provides statistical inferences to parameters in the study area as measured by certain data collection protocols (i.e., the methods in a report). These inferences apply to areas larger than the sampled sites and to time periods not studied. The inferences require both probabilistic selection of study sites and repeated visits over time. Individual proposals can support larger Tier 2 statistical monitoring projects such as the Oregon Plan by using the same field methods and methods to select study sites that contribute information to Tier 2 statistical monitoring. Most large projects should implement sampling designs that allow Tier 2 statistical monitoring or contribute data to statistical monitoring (ISRP, Comments on the Clearwater Plan, 2003). Most of the methods outlined in the M&E plan fall into this level of monitoring. A purposeful effort was made to select methods that are widely employed in field biology or to adopt appropriate monitoring protocols from national monitoring programs to maximize the utility of the data collected.

Tier 3 (research) monitoring is for those projects or groups of projects whose objectives include establishment of mechanistic links between management actions and salmon or other fish or wildlife population response. Tier 3 research monitoring requires the use of experimental designs incorporating “treatments” and “controls” randomly assigned to study sites (ISRP 2003).

RESEARCH, MONITORING AND EVALUATION PLAN

Organization of the RME plan is as follows:

Existing Data Gaps and Research Needs

- Existing Data Gaps, as identified through the subbasin planning process, are listed in this section, because many will require effort above routine monitoring and evaluation to address.
- Research needs, with justification, are also listed. Detailed research project design is not presented, however, being beyond the scope of the current planning effort

Monitoring and Evaluation: Ecological Trend, Focal Habitats and Species Monitoring Methodology

- Ecological Trend Monitoring (Plant Community, Land Birds, Herptofauna, Small Mammals)
- Focal habitat monitoring methodology, and Management Plan strategies addressed
- Focal species monitoring methodology, and Management Plan strategies addressed

- Other Research, Monitoring and Evaluation Efforts in the Subbasin including those from managed species plans.

EXISTING DATA GAPS AND RESEARCH NEEDS

In the course of subbasin plan development, a number of data gaps were identified. Some of these gaps will be filled as data is collected via the monitoring and evaluation process as the plan is implemented. Others will require formal research efforts to address. Data gaps and research needs identified during development of the subbasin plan are listed in Table 1.

As part of the adaptive management philosophy of subbasin planning, managers believe that additional research needs not yet identified will become apparent over time. These needs will be addressed in future subbasin plan iterations.

Table 1. Data Gaps and Research Needs, Umatilla/Willow Subbasin, as identified during subbasin planning.

GENERAL		
RESEARCH NEEDS AND DATA GAPS	**STRATEGY TO ADDRESS**	**AGENCY/ PERSONNEL**
Testing of assumption that focal habitats are functional if a focal species assemblage's recommended management conditions are achieved		Coordinated government & NGO effort
Testing of assumption that selected focal or other obligate species/assemblages adequately represent focal habitats		Coordinated government & NGO effort
Current, broad-scale, high quality habitat data including structural KEC data	Spatial data collection and GIS analysis	Coordinated government & NGO effort
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current data, current CREP, WHIP program/field delineations and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Refinement of recommended management conditions for all habitats	Research need; use for update to future subbasin plan iterations	Coordinated government & NGO effort.
Local population/distribution data for focal species	Species Monitoring,	Subbasin managers

Evaluate the role of management treatments to maintain/improve habitat quality	Spatial data collection, and GIS analysis Coordinated, standardized monitoring efforts	Subbasin managers

Ponderosa Pine

- Obtain data on the quality of ponderosa pine habitat in the Umatilla/Willow subbasin, including data on structural state, seral stage, and ecological function as related to the White-headed Woodpecker and other obligate species. Use these data to improve existing information on habitat suitability for the White-headed Woodpecker (see Section 3.2.4.1).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of ponderosa pine.
- Identify areas that could be converted to ponderosa pine habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the White-headed Woodpecker and other species associated with ponderosa pine.
- Determine the amount of good quality ponderosa pine habitat needed to support viable populations of the White-headed Woodpecker in the subbasin.

Quaking Aspen

- Gather comprehensive data on the location, size, spatial distribution, ownership, and protected status of quaking aspen in the subbasin.
- Obtain data on the quality of quaking aspen habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Red-naped Sapsucker and other obligate species. Use these data to improve existing information on habitat suitability for the Red-naped Sapsucker (see Section 3.2.4.1).
- Identify areas in the subbasin that could be converted to quaking aspen habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.
- Generate population and distribution data for the Red-naped Sapsucker and other species associated with quaking aspen.
- Determine the amount of good quality quaking aspen habitat needed to support viable populations of the Red-naped Sapsucker in the subbasin.

Western Juniper Woodland

- Gather comprehensive data on the location, size, spatial distribution, ownership, and protected status of western juniper in the subbasin.
- Obtain data on the quality of western juniper habitat in the Umatilla/Willow subbasin, including data on its ecological function as related to the Ferruginous Hawk and its prey and other obligate species. Use these data to refine existing information on habitat suitability for Ferruginous Hawk (see Section 3.2.4.1).

- Identify areas that could be converted to western juniper habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.
- Generate population and distribution data for the Ferruginous Hawk, it prey, and other species associated with western juniper.
- Determine the amount of good quality western juniper habitat needed to support viable populations of the Ferruginous Hawk in the subbasin.

Shrub-steppe

- Obtain data on the quality of shrub-steppe habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Sage Sparrow and other obligate species. Use these data to improve existing information on habitat suitability for the Sage Sparrow (see Section 3.2.4.1).
- Reconcile differences between IBIS and other data with regard to the total acreage and distribution of shrub-steppe habitat in the subbasin, and refine and field-truth data on ownership and protected status of shrub-steppe in the subbasin.
- Identify areas in the subbasin that could be converted to shrub-steppe habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.
- Generate population and distribution data for the Sage Sparrow and other species associated with shrub-steppe in the Umatilla/Willow subbasin.
- Determine the amount of good quality shrub-steppe habitat needed to support viable populations of the Sage Sparrow in the subbasin.

Interior Grassland

- Obtain data on the quality of grassland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Grasshopper Sparrow and other obligate species. Use these data to refine existing information on habitat suitability for the Grasshopper Sparrow (see Section 3.2.4.1).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of grassland in the subbasin.
- Identify areas in the subbasin that could be converted to grassland habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Grasshopper Sparrow and other species associated with grassland in the Umatilla/Willow subbasin.
- Determine the amount of good quality grassland habitat needed to support viable populations of the Grasshopper Sparrow in the subbasin.

Herbaceous Wetlands

- Obtain data on the quality of herbaceous wetland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Columbia spotted frog and other obligate species.
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of herbaceous wetlands in the subbasin.

- Identify areas in the subbasin that could be converted to herbaceous wetland habitat to enlarge existing wetlands, provide new reservoir habitat, or enhance connectivity between two or more extant wetlands.
- Generate population and distribution data for the Columbia spotted frog and other species associated with herbaceous wetlands in the Umatilla/Willow subbasin.
- Determine the amount of good quality herbaceous wetland habitat needed to support viable populations of the Columbia spotted frog in the subbasin.

Riparian Wetlands

- Supplement, refine, and field-truth existing data on the location, size, spatial distribution, and protected status of riparian wetlands in the subbasin. Reconcile differences in estimates of ownership of riparian wetlands in the subbasin.
- Obtain data on the quality of riparian wetland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Great Blue Heron, the Yellow Warbler, and the American beaver and other obligate species. Use these data to create maps of habitat suitability for the Great Blue Heron, the Yellow Warbler, and the American beaver.
- Identify areas in the subbasin that could be converted to riparian wetland habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Great Blue Heron, Yellow Warbler, and American beaver and other species associated with riparian wetland in the Umatilla/Willow subbasin.
- Determine the amount of good quality riparian wetland habitat needed to support viable populations of the Great Blue Heron, Yellow Warbler, and American beaver in the subbasin.

MONITORING AND EVALUATION: ECOLOGICAL TREND, FOCAL HABITAT, AND SPECIES MONITORING METHODOLOGY

Recommended monitoring and evaluation strategies contained below for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established by Partners in Flight for avian species (Ralph et al, 1993, 1995) and habitat monitoring (Nott et al, 2003). In addition, protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure standards (USFWS 1980a and 1980b) and Sampling Vegetation for Monitoring Plant Communities (Johnson, C.G. Jr., USDA Forest Service, Area 3 – Malheur, Umatilla, and Wallowa-Whitman National Forests, May 1998).

A common thread in the monitoring strategies which follow is the establishment of permanent roadside and off-road census stations to monitor bird population and habitat changes (See Land Bird Monitoring Section Below), small mammal census to track abundance, diversity and trends (see Small Mammal Monitoring Section below), herptofauna census to track presence/absence and abundance (see Herptofauna Monitoring section below).

Wildlife managers will include statically rigorous sampling methods to establish links between
habitat enhancement prescriptions, changes in habitat conditions and target wildlife population
responses at the project level.

Specific methodology for selection of Project Level Monitoring and Evaluation sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest. The following protocols describe how M&E sites will be selected:

- Vegetation/HEP monitoring and evaluation sites are selected by combining stratified random sampling elements with systematic sampling. Project sites are stratified by cover types (strata) to provide homogeneity within strata, which tends to reduce the standard error, allows for use of different sampling techniques between strata, improves precision, and allows for optimal allocation of sampling effort resulting in possible cost savings (Block et al. 2001). Macro cover types such as shrub-steppe and forest are further sub-cover typed based on dominant vegetation features i.e., percent shrub cover, percent tree cover, and/or deciduous versus evergreen shrubs and conifer versus deciduous forest. Cover type designations and maps are validated prior to conducting surveys in order to reduce sampling inaccuracies.

- Pilot studies are conducted to estimate the sample size needed for a 95% confidence level with a 10% tolerable error level (Avery 1975) and to determine the most appropriate sampling unit for the habitat variable of interest (BLM 1998). In addition, a power analysis is conducted on pilot study data (and periodically throughout data collection) to ensure that sample sizes are sufficient to identify a minimal detectable change of 20% in the variable of interest with a Type I error rate # 0.10 and P = 0.9 (BLM 1998, Hintze 1999, Block et al. 2001). M&E includes habitat trend condition monitoring on the landscape scale (Tier 1-HEP) and plant community monitoring (Tier 2) i.e., measuring changes in vegetative communities on specific sites.

- For HEP surveys, specific transect locations within strata are determined by placing a Universal Transverse Mercator (UTM) grid over the study area (strata) and randomly selecting “X” and “Y” coordinates to designate transect start points. Random transect azimuths are chosen from a computer generated random number program, or from a standard random number table. Data points and micro plots are systematically placed along the line intercept transect at assigned intervals as described in Part 2 – monitoring section of the proposal. Sample sizes for statistical inferences are determined by replication and systematic placement of lines of intercept within the strata with sufficient distance between the lines to assume independence and to provide uniform coverage over the study site.

- Permanent vegetation monitoring transect locations are determined by placing a UTM grid over the strata and randomly selecting “X” and “Y” coordinates to designate plot locations as described for HEP surveys. One hundred meter baseline transect azimuths are randomly selected from a random numbers table. Ten perpendicular 30 meter transects are established at 10 meter intervals along the baseline transect to form a 100m x 30m rectangle (sample unit). Micro plot and shrub intercept data are collected at systematic intervals on the perpendicular transects.

By systematically collecting and analyzing plant species frequency, abundance, density, height,
and percent cover data, vegetative trends through time can be described. Likewise, the effectiveness of exotic weed control methods can be evaluated and weed control plans can be
adjusted accordingly.

Presence of all exotic weeds i.e., knapweed, yellow starthistle (*Centaurea solistitialis*), cheatgrass etc. will be mapped in GIS using Global Positioning System (GPS) equipment. This
information will be used to develop an annual exotic vegetation control plan.

Causes of seeding or planting failure will be identified and planting methods/site preparation will
be modified as necessary. Data will be collected and analyzed, and, where necessary, changes in the management plan (adaptive management) will be identified and implemented.

General and site specific M&E protocols, outlining monitoring goals and objectives and specific sampling designs are included in the following monitoring section.

In addition to defining habitat and species population trends, monitoring will also be used to determine if management actions have been carried out as planned (implementation monitoring). In addition to monitoring plan implementation, monitoring results will be evaluated to determine if management actions are achieving desired goals and objectives (effectiveness monitoring) and to provide evidence supporting the continuation of proposed management actions. Areas planted to native shrubs/trees and/or seeded to herbaceous cover will be monitored twice a year to determine shrub/seeding survival, and causes of shrub mortality and seeding failure i.e. depredation, climatic impacts, poor site conditions, poor seed/shrub sources.

Monitoring of habitat attributes and focal species in this manner will provide a standardized means of tracking progress towards conservation, not only within the Subbasins of the Blue Mountain and Province Provinces, but within a national context as well. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in the subbasin planning process.

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Plant Community Monitoring:

Sampling Vegetation for Monitoring Plant Communities

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May 1998

Introduction

Landscape level plant community monitoring builds on the foundation of the reference sites for plant communities of the Blue Mountains and surrounding area as documented in Plant Associations of the Blue and Ochoco Mountains,(C. G. Johnson Jr. and R. R. Clausnitzer, 1992) and Plant Associations of the Wallowa-Snake Province, (C. G. Johnson Jr. and S. A. Simon, 1986). These larger scale monitoring efforts can provide important reference data for comparing project level monitoring results when the same methodology is implemented at a project level.

A monitoring location is selected to exemplify a particular plant community, stand, or site. Several locations may be selected to portray the variation within the plant communities across a particular landscape. The decision when and where to locate a sample point for monitoring is made by the investigator for the purposes of a particular project need. This approach will help in the standardization of procedures utilized by the investigator once a decision is made to establish a monitoring point.

Plot Location and Orientation
As much as possible, plot centers are located to avoid areas with variation due to site disturbance. Patches of disturbance may be included, however, to see how they change over time. In forested stands, old-growth vegetation representing site potential may be sought to serve as a reference point or benchmark to an adjacent monitoring plot located in an area of disturbance. The ecological condition or status of the vegetation is one of the foremost attributes evaluated in the decision as to where a plot should be located. Another rationale for plot center location is the desire for characterization of a specific plant species in relation to the associated vegetation.

Establishment of Permanent Monitoring Point
Each monitoring point, whether followed by extensive or intensive sampling, is important for trend analysis and comparative analysis at two or more points in time. Therefore, it is important to utilize metal stakes, which will withstand the ravages of time, fire, and other possible threats to the existence of the stake. In general, an 18-inch angle iron with 1 to 1-1/4 inch sides is utilized. Ideally this stake should be marked with location or reference information. The stake may be marked by either fixing a tag (which is aluminum) or marking with a letter and number punch. If the primary job is to leave a camera point behind, or conduct a reconnaissance level sampling procedure, the stake will then represent the plot center. Reconnaissance sampling techniques may be conducted in a circular plot:

1. 10.93 meters in radius (which is equivalent to 375 square meters) and 36 feet in radius.

2. One-tenth acre which is 37 feet in radius. After establishing the distance from plot center, locate a reference object such as a meter pole at the end of this measurement on the contour of the slope. This defines the perimeter of a visualized circle.

Photography of the Reconnaissance Plot
The plot center stake can become a camera point. A general view should be taken from the plot center to the perimeter. Additional photographic views can be taken in a clockwise fashion pivoting from the plot center to capture various views. These views should be recorded by azimuth on a form for future use when revisiting the camera point.

Additionally, it is recommended that a square yard be delineated using folding carpenter rulers at a point 5 feet distant from the plot center stake with the 5 foot mark in the center of the square yard. This square yard defines an area which can be redefined in future years to assess the change in stand structure and composition. More than one can be established to show the vegetation at different locations within the sample area. The locations must be measured for distance from the plot center.

Sampling of the Reconnaissance Plot

The reconnaissance vegetation sample is conducted following the photography by traversing throughout the circular area. A species list is derived in this traverse and upon the conclusion, estimates are made of percent canopy coverage of all principle species found within the area. The estimates should be made to the nearest 5 percent. Additional information taken for the plant community should include surface cover by mosses and lichens, litter, bare ground, rock, gravel, and erosion pavement.

Environmental attributes are measured to conclude the measurement process. Some attributes should always be measured, such as: elevation, aspect, slope, position on the slope, the relief of the site, and the micro relief of the plot. Other information which might be derived if desired, would include: soils information, productivity information, utilization information, down woody material, wildlife signs, etc.

Establishing the Sampling Transects

Line transects define specific locations for more labor-intensive investigation and micro-site analysis. Establishment of transects require a definite bias by the investigator to either avoid or include patches of vegetation which are deemed desirable or undesirable. Two 100-foot transects should be located approximately parallel and no closer than 30 feet between each other. A cloth or steel 100-foot tape is used to create the line. Stakes are then set at 0, 50, and 100-foot marks based on the configuration shown on the attached diagram. The zero foot stakes of Transect 1 and Transect 2 are then referenced by measurements of distance and bearing in relation to a reference or witness (i.e. tree, fence post, large rock).

Photographing the Transects

The two transects are then photographed following a very precise procedure, which is as follows: Standing at the zero stake of Transect 1, a general picture is taken down the line to the horizon. Then a long oblique picture is taken with the top of the view in the camera being the base of the 100-foot stake. This gives a good view of the composition of the vegetation along the transect. Next, square yards are defined using the carpenter's rulers with the mid points at 5, 30, 55, 80, and 95, and photographed with the photographer standing at 0, 25, 50, 75, and 100. After taking the quadrate picture at 95, the photographer then shoots a long oblique picture with the top of the view at the base of the zero foot stake. The photography of Transect 1 is concluded by shooting the general view including the horizon form the 100' stake. The photography is accomplished on Transect 2 in the same manner. Any deviation from this procedure should be noted on the plot card for subsequent investigators to note before trying to retake the photography in subsequent years.

Sampling the Transects
The transects may be sampled at 5-foot intervals along the 100-foot transect with plot frames placed at the appropriate foot marks on the tape. The plot frames are located on the upslope side of the line and on the left side when facing the 100' stake at the 0' location. Therefore, take care not to walk on the area immediately to the left of the line prior to sampling. Crown canopy cover by species are estimated to the 5 percent level. The sampling concludes after 20 plot frames are evaluated on each transect. Plot frames should be rectangular and a square foot of area in size. Density counts could also be made at each quadrant setting.

Completing the Sampling Process
After all photography and sampling has occurred, it is now time for the investigator to reflect upon what has been observed at the site and to note those observations accurately and completely in prose on the front of the sampling form. Among the observations made should be the condition of the vegetation, disturbance indicators, additional species occurring in the stand but not located in the sample area, and any other factors influencing the health and vigor of the plant species within the community.

Referencing the Plot
Transect installation and sampling requires a good deal of energy and cost. Therefore, the most important event following this expenditure is to properly reference the permanent monitoring point location so that future investigators can relocate the site and the plot. Before leaving the plot, pinprick an aerial photo and place the appropriate designation of the plot on the back of the photo. Mark a map with the location (preferably a USGS quadrangle). Place location information on the plot form. The referencing of the monitoring point in the field should utilize semi-permanent objects located in the periphery of the plot. These include fenceposts, large rocks, and trees. Metal tags appropriate for referencing should be located on trees and fenceposts with rocks being referenced either silently or with paint. A sketch map should accompany the form showing the location of the plot center or the transects in relationship to the referenced objects. The azimuth and distances should be provided from these reference objects to the plot center or the Transect 1 zero end stake.

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Land Bird Monitoring
(Adapted from the Draft Monitoring and Evaluation Plan for The Albeni Falls Wildlife Mitigation
Project, August 2001)

Introduction

Birds are important components of biological diversity in most ecosystems. Monitoring the health and long-term stability of bird communities can provide an important measure of overall environmental health (Morrison 1986). Birds are good environmental monitors for several reasons: many species can be monitored simultaneously with a single method, methods for monitoring are well understood and standardized, birds occupy all habitat types, and as a community represent several trophic levels and habitat use guilds. Monitoring species abundance, community diversity, and trends provides information that can be used to determine the effectiveness of management actions in moving towards conservation goals.

Perhaps more than any other species or community proposed for monitoring, land birds present the opportunity for standardized data collection that can be incorporated into national monitoring programs. Dovetailing our monitoring efforts with national monitoring efforts can be important in interpreting the results of our monitoring efforts. Many species of birds are neo-tropical migrants whose populations are effected by factors remote from the data collection point. Standardized methods allow for recognition of declines in abundance or diversity as a local phenomenon (triggering a change in local management) or a broader scale phenomenon that does not necessarily implicate failed management at the local level.

Methods

Point counts will be used to monitor land birds on this project. Point counts are the most widely used quantitative method used for monitoring land birds and involve an observer recording birds from a single point for a standardized time period (Ralph et al. 1995). The methodology follows the recommendations of Ralph et al. (1995) and is consistent with the methodology employed by the U.S.D.A Forest Service Northern Region Land bird Monitoring Project (Hutto et al. 2001) and recommendations for the Idaho Partners in Flight Bird Monitoring Plan (Leukering et al 2000).

A ten-minute point count will be conducted at each of the randomly selected permanent sample points within a cover type. All points will be visited a minimum of two and preferably three times during the breeding season (mid-May to early July) with a minimum of 7 days between counts. Point counts should be started at 15 minutes after official sunrise and completed by 10:00 a.m. Weather conditions should be warm and calm enough for bird detection by sight or sound. All birds seen or heard within the 10-minute count period are recorded. During the count, data should be recorded in three time periods (0-3 minutes, 3-5 minutes, and 5-10 minutes). This will allow the data to be partitioned or pooled for comparison to the U.S. Fish and Wildlife breeding bird survey data, research data reported in the literature that commonly use 5-minute point counts, and 10-minute point count data recommended and collected by national bird monitoring programs. Field observers should be highly qualified to detect birds by sight and sound. Fixed-radius plots (where the radius is arbitrarily small) reduce the interspecific difference in delectability by assuming that: a) all the birds within the fixed radius are detectable; b) observers do not actively attract or repel birds; and c) birds do not move into or out of the fix-radius during the counting period. This allows for comparisons of abundance among species. Unlimited radius plots maximize the amount of data collected because they include all detections and are appropriate when the objective is to monitor population changes within a single population (Ralph et al. 1995). Birds should be tallied in two distance bands, one 0-50 meters from the point center and one >50 meters from the point center. This will maximize data collection while permitting interspecific analysis. If density estimation is desired then additional distance data must be collected. However, density estimation is beyond the scope of this monitoring plan. Additional information on establishing point count stations, data collection, and sample data forms can be found by referencing Ralph et al. (1993, 1995) and Huff et al. (2000).

Data Analysis

Data will be pooled both within cover types, and across cover types within land management units. The mean number of detections per point (by species) within a cover type will used as an index to species abundance. Abundance across cover types within a land management unit will be expressed as the grand mean of the individual cover-type data pooled across the land management unit and weighted by the proportionate areal extent of each cover type. Trend analysis on abundance data will be done by regressing abundance on time and testing the null hypothesis that the slope of the regression is equal to 0 (Zar 1984). Regression analysis will not be conducted with less than 6 data points. The Shannon-Weaver information function (H') will be used to measure land bird community diversity, and Pielou's equitability index (J') will be used to measure the evenness of species distribution with in the community (Hair 1980). Diversity indices will be compared using a t-test following methodology described by Hutcheson (1970) and Zar (1984). A species list will also be developed as a measure of diversity. The species list will be developed and supplemented with incidental sightings from throughout the year.

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Small Mammal Monitoring

(Adapted from the Draft Monitoring and Evaluation Plan For The Albeni Falls Wildlife Mitigation
Project, August 2001)

Introduction

The small mammal community is an important component of biological diversity in most ecosystems. Small mammals act as seed dispersal agents, their burrowing disturbs soil and creates microsites for seedling development, and they provide a prey base for higher trophic level consumers. Monitoring species abundance, community diversity, and trends provides information that can be used to determine the effectiveness of management actions in moving towards conservation goals.

Methods

Small mammal populations will be sampled by snap trapping with museum special traps at the randomly selected sample points. Traps will be baited with a mixture of peanut butter and rolled oats. An array of traps will be laid out as follows. A 100-meter baseline transect centered at the sample point and running along a random compass bearing and its back azimuth will be established. From the baseline transect, five 50-meter long trap-lines that are centered on and run perpendicular to the baseline transect at 25-meter intervals will be established. Pairs of museum special snap traps will be placed at 12.5-meter intervals along the trap-lines. Trapping will be conducted for two consecutive nights yielding a total of 100 trap nights per sample point. Sample point, cover type, date of capture, and species will be recorded for each small mammal captured. Small mammals killed in snap traps will be disposed of off site.

Snap trapping will be the backbone of our small mammal sampling effort. However, snap traps are known to underestimate the relative abundance of shrews in the small mammal community (Mangak and Guynn 1987, McComb et al. 1991). Managers, at their discretion, may augment their snap trapping efforts with pit trap arrays. Trap night data from pit traps will be recorded separately from the snap trap data.

Data Analysis

Data be will be pooled both within cover types, and across cover types within land management units. An index of the abundance of each species within a cover type will be expressed as number caught/100 trap nights. Indices of abundance across cover types within a land management unit will be expressed as the mean of the individual cover type data pooled across the land management unit and weighted by the proportionate areal extent of each cover type. Trend analysis on abundance data will be done by regressing abundance on time and testing the null hypothesis that the slope of the regression is equal to 0 (Zar 1984). Regression analysis will not be performed with less than 6 data points. The Shannon-Weaver information function (H') will be used to measure small mammal community diversity, and Pielou's equitability index (J') will be used to measure the evenness of species distribution with in the community (Hair 1980). Diversity indices will be compared using a t-test (P=0.1) following methodology described by Hutcheson (1970) and Zar (1984). A species list of all mammals will be developed and supplemented with observations throughout each year.

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Herptofauna Monitoring
(Adapted from the Draft Monitoring and Evaluation Plan for The Albeni Falls Wildlife Mitigation
Project, August 2001)

Introduction

Amphibians are important components of ecosystem biodiversity that are frequently overlooked by fish and wildlife habitat managers. There is growing worldwide concern about perceived and actual declines in populations of amphibians. Permeable skin and a life cycle that involves both aquatic and terrestrial habitats makes amphibians especially susceptible to altered conditions they may encounter in their habitat. They can serve as indicators of environmental health. Local management activities may disproportionately effect amphibians (and reptiles) because of their relatively sedentary lives in contrast to species with greater mobility such as larger mammals and birds.
Many wildlife mitigation properties, especially those not yet acquired, have never been intensively surveyed for herptofauna. We have designed this monitoring program to provide managers with information about what species presently occur on individual projects (the inventory phase) and to provide them with information about the effectiveness of their habitat management practices (monitoring phase) toward benefiting the species assemblages that occur there.
<u>Methods</u>
Amphibian activity and reproductive biology are closely tied to local weather patterns. Consequently, weather data is a necessary component of amphibian monitoring. Basic weather data should include daily min-max temperature and precipitation. Other information about microhabitats could include water temperature and other factors known to influence distribution and abundance of amphibians including relative humidity, substrate moisture, barometric pressure, wind speed and direction, water level at breeding sites, and water pH.

Heyer et al. (1994) suggest the use of several standard sampling techniques to monitor amphibians. Managers should not be constrained by these suggestions and further development of these and other techniques is encouraged.

Visual Encounter Survey (VES)

1. A trained observer walks through a defined area for a prescribed period of time searching for and recording the presence of animals.
2. Time searching is expressed in man-hours.
3. This technique yields species richness and species lists and count data can be used to estimate relative abundance.
4. Repeated VES surveys combined with marking-recapture techniques can be used to estimate animal density.

Audio Strip Transects (AST)

1. A trained observer moves along a strip transect and records all animals heard.
2. Transect width is approximately 2 times the maximum distance the target animals can be heard.
3. Linear habitats (shorelines) can be sampled by counting calling individuals with no need to determine detection distance.
4. Calling-male density is calculated as the number of calling males per linear unit of transect.

Surveys at known breeding sites can be done using VES and AST techniques. Breeding site surveys can be used to estimate effective population size and operational sex ratio but must be done over an extended period (several nights) because of nightly variation in breeding populations. Managers must keep in mind that calling (by frogs) does not necessarily indicate breeding. More explicit indicators such as amplexus, egg masses or larvae are needed to demonstrate breeding. Managers may, at their option, decide to augment VES and AST methodologies with larval traps and dip net transects to determine abundance and reproductive status.

Data Analysis

Data be will be pooled both within cover types, and across cover types within land management units. An index of the abundance of each species within a cover type will be expressed as number/man-hour effort. Indices of abundance across cover types within a land management unit will be expressed as the mean of the individual cover type data pooled across the land management unit and weighted by the proportionate areal extent of each cover type. Trend analysis on abundance data will be done by regressing abundance on time and testing the null hypothesis that the slope of the regression is equal to 0 (Zar 1984). Regression analysis will not be performed with less than 6 data points. The Shannon-Weaver information function (H') will be used to measure herptofauna community diversity, and Pielou's equitability index (J') will be used to measure the evenness of species distribution with in the community (Hair 1980). Diversity indices will be compared using a t-test (P=0.1) following methodology described by Hutcheson (1970) and Zar (1984). A species list to include all reptiles and amphibians will be developed and supplemented with incidental observations from throughout the year.

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Focal Habitat Monitoring:
Adapted from Ashley and Stovel, 2004

Eastside (Interior) Riparian Wetlands

Focal Species: Yellow Warbler (*Dendroica petechia*), Great Blue Heron (*Ardea herodias*), and American Beaver (*Castor canadensis*)

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Eastside (Interior) Riparian Wetland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Overall Habitat and Species Monitoring Strategy: Establish permanent roadside and off-road censusing stations to monitor bird population and habitat changes.

Factors affecting habitat: 1.) Direct loss of riparian deciduous and shrub understory, 2.) Fragmentation of wetland habitat, 3.) agricultural and sub-urban development and disturbance, 4.) reduction in water quality, 5.) organochlorines such as dieldrin or DDE may cause thinning in egg shells which results in reproductive failure (Graber *et al*. 1978; Ohlendorf *et. al.* 1980; Konermann *et. al*. 1978)

Riparian Wetlands Working Hypothesis Statement: As indicated in the assessment (see Section 3.6.2 for summary), major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, livestock grazing, transportation corridors, hydropower, and recreational activities. Agricultural and urban development and the construction of transportation corridor have led to habitat loss through channelization and conversion and have contributed to habitat degradation and fragmentation This coupled with poor habitat quality of existing vegetation have resulted in extirpation and or significant reductions in riparian habitat obligate wildlife species.

Recommended Range of Management Conditions*:

1. Forty (40) to sixty (60) percent tree canopy closure (cottonwood and other hardwood species)
2. Multi-structure/age tree canopy (includes trees less than 6 inches in diameter and mature/decadent trees)
3. Woody vegetation within 328 feet of shoreline
4. Tree groves greater than 1 acre within 800 feet of water (where applicable)
5. Forty to 80 percent native shrub cover (greater than 50 percent comprised of hydrophytic shrubs)
6. Multi-structured shrub canopy greater than 3 feet in height

Focal Habitat Monitoring Strategies: Establish an inventory and long-term monitoring program for protected and restored Eastside (Interior) Riparian/Riverine wetlands to determine success of efforts.

1. Identify riparian wetland sites within the subbasin that support populations of focal species for this habitat.
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of great blue heron habitat. (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands, employing strategies outlined in the subbasin management plans (intermediate strategy; 2 to 10 years) and

4. Identify high quality/functional privately owned riparian wetlands sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent roadside and off-road censusing stations to monitor bird population and habitat changes

Sampling Design: HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type. (Riparian zone width within the subbasins may require modification of this 100 foot buffer requirement.)

Sampling Methods (USFWS 1980a and 1980b):

1. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular $0.5m^2$ microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

2. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

   Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

3. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

In addition, at any permanently established avian, herptofaunal, and small mammal species monitoring sites established within the Riverine Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).
(http://www.birdpop.org/DownloadDocuments/manual/HSAManual03.PDF).

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined
using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = \frac{t^2 \times s^2}{E^2}$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom
s = standard deviation
E = desired level of precision, or bounds

Literature Cited:

Anderson, S. and K. Gutzwiller. 1996. Habitat Evaluation Methods. Pages 592-606 in: T. A. Bookhout, ed. Research and Management Techniques for Wildlife and Habitats. Fifth ed., rev. The Wildlife Society, Bethesda, MD. xiii + 740pp.

Nott, R., D.F. DeSante, and N. Michel. 2003. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HAS) Protocol 2003. The Institure for Bird Populations, Pt. Reyes Station, CA.

USFWS. 1980a. Habitat as a Basis for Environmental Assessment, Ecological Services Manual (ESM) 101. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

USFWS. 1980b. Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

Herbaceous Wetlands

Focal Species: Columbia Spotted Frog

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Herbaceous Wetland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Overall Habitat and Species Monitoring Strategy: Establish permanent roadside and off-road censusing stations to monitor bird, herptile, small and small mammal populations and plant community changes. Establish monitoring program for protected and managed Herbaceous Wetland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Factors affecting habitat: 1.) disturbance, conversion and draining for agricultural and sub-urban development 2.) alteration of natural hydrologic processes resulting in lowering of ground water levels, separation of flood plain from active stream channels, 3) exotic plant invasions 4) reduction in water quality, 5) livestock grazing.

Herbaceous Wetlands Working Hypothesis Statement: **:** As indicated in the assessment (see Section 3.6.2 for summary), major factors affecting herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant invasions, and livestock grazing. As discussed in Section 3.4.2, existing information on wetlands in the subbasin is limited, and many of these habitats are small and badly underrepresented in most surveys and databases. Also make point that these habitats are important to a disproportionately large number of species.

Recommended Range of Management Conditions: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional herbaceous wetlands are:

- Abundant aquatic vegetation dominated by herbaceous species such as grasses, sedges and rushes and emergent vegetation
- Clear, slow-moving or ponded perennial surface waters
- Relatively exposed, shallow-water (<60 cm)
- Deep silt or muck substrate
- Small mammal burrows
- Undercut banks and spring heads

Focal Habitat Monitoring Strategies: Establish an inventory and long-term monitoring program for protected and restored herbaceous wetlands to determine success of efforts.

1. Identify herbaceous wetland sites within the subbasin that support populations of focal species for this habitat.
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of Columbian Spotted Frog. (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands, employing strategies outlined in the subbasin management plans (intermediate strategy; 2 to 10 years) and
4. Identify high quality/functional privately owned herbaceous wetlands sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent roadside and off-road censusing stations to monitor bird population and habitat changes

Sampling Design: HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid.

In addition, at any permanently established avian, herptofaunal, and small mammal species monitoring sites established within the Herbaceous Wetland habitat, structural

habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).
(http://www.birdpop.org/DownloadDocuments/manual/HSAManual03.PDF).

Sampling Methods (USFWS 1980a and 1980b):

1. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular 0.5m^2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined
using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = \frac{t^2 \times s^2}{E^2}$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom
s = standard deviation
E = desired level of precision, or bounds

Literature Cited:

Anderson, S. and K. Gutzwiller. 1996. Habitat Evaluation Methods. Pages 592-606 in: T. A. Bookhout, ed. Research and Management Techniques for Wildlife and Habitats. Fifth ed., rev. The Wildlife Society, Bethesda, MD. xiii + 740pp.

Nott, R., D.F. DeSante, and N. Michel. 2003. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HAS) Protocol 2003. The Institute for Bird Populations, Pt. Reyes Station, CA.

USFWS. 1980a. Habitat as a Basis for Environmental Assessment, Ecological Services Manual (ESM) 101. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

USFWS. 1980b. Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

Quaking Aspen *Focal Species:* Red-napped Sapsucker

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Quaking Aspen sites to monitor focal species population and habitat changes and evaluate success of efforts.

Establish permanent roadside and off-road censusing stations to monitor bird, herptile, small and small mammal populations and plant community changes. Establish monitoring program for protected and managed Herbaceous Wetland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Factors affecting habitat: 1) livestock and wild ungulate grazing, 2) fire suppression, 3) invasion of coniferous species.

Quaking Aspen Working Hypothesis Statement: Quaking aspen habitat is extremely limited in the Umatilla/Willow subbasin and is believed to be greatly reduced from historical conditions (see Section 3.2.4). As indicated in the assessment (see Section 3.6.2 for summary), the major factors affecting aspen habitat in the Umatilla/Willow subbasin are intensive grazing by livestock and native ungulates, fire suppression, and the invasion of coniferous species.

Recommended Range of Management Conditions: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional aspen habitat are:

- > 1.5 snags per acre
- trees > 39 feet in height and
- > 10 inch dbh

Focal Habitat Monitoring Strategies: Establish an inventory and long-term monitoring program for protected and restored quaking aspen habitats to determine success of efforts.

1. Identify quaking aspen sites within the subbasin that support populations of focal species for this habitat.
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of Red-naped Spapsucker. (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands, employing strategies outlined in the subbasin management plans (intermediate strategy; 2 to 10 years) and
4. Identify high quality/functional privately owned quaking aspen sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent roadside and off-road censusing stations to monitor bird, herptile, and small mammal population and plant communtiy changes

<u>*Sampling Design:*</u> HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid.

In addition, at any permanently established avian, herptofaunal, and small mammal species monitoring sites established within the Herbaceous Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).
(http://www.birdpop.org/DownloadDocuments/manual/HSAManual03.PDF

<u>*Sampling Methods (USFWS 1980a and 1980b):*</u>

1. <u>Herbaceous</u> measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular $0.5m^2$ microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

2. <u>Shrub</u> canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

3. Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

4. <u>Tree</u> canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

<u>*Analysis:*</u> Transects are divided into 100 ft. segments, and total transect length is determined
using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

$$\text{Sample size equation: } n = \frac{t^2 \text{ x } s^2}{E^2}$$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom
s = standard deviation
E = desired level of precision, or bounds

Literature Cited:

Anderson, S. and K. Gutzwiller. 1996. Habitat Evaluation Methods. Pages 592-606 in: T. A. Bookhout, ed. Research and Management Techniques for Wildlife and Habitats. Fifth ed., rev. The Wildlife Society, Bethesda, MD. xiii + 740pp.

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USFWS. 1980a. Habitat as a Basis for Environmental Assessment, Ecological Services Manual (ESM) 101. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

USFWS. 1980b. Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

Mixed Conifer Forest *Focal Species:* Pileated Woodpecker (*Dryocopus pileatus*)

Overall Habitat and Species Monitoring Strategy: : Establish monitoring program for protected and managed mixed conifer forest sites to monitor focal species population and habitat changes and evaluate success of efforts.

Establish permanent roadside and off-road censusing stations to monitor bird, herptile, small and small mammal populations and plant community changes. Establish monitoring program for protected and managed Herbaceous Wetland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Factors affecting habitat: 1) timber harvest and silvicultural practices, 2) altered fire regimes, 3) insect outbreaks, 4) exotic plant invasions

Mixed Conifer Working Hypothesis Statement: Although the area of mixed conifer forest in the Umatilla/Willow subbasin appears to have doubled since c. 1850 (see Table 1; Figure x), the quality of this habitat is believed to have declined due to timber harvest, altered fire regimes, ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasion (see Section 3.6.2 for summary). These factors have resulted in direct loss of old growth habitat and fragmentation and degradation of remaining mixed conifer forest. Loss of old growth habitat has occurred primarily because of timber harvesting, while habitat degradation is primarily associated with altered fire regimes. Fire suppression has promoted less fire-resistant, shade-intolerant trees, and led to mixed conifer forests with low snag density, high tree density, and stands dominated by smaller and more shade-tolerant trees.

Recommended Range of Management Conditions: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for the Pileated Woodpecker and other mixed conifer obligates are:

- complex multi-layered closed canopies with a major component of large trees (>90 feet in height) and high basal area
- mature seed producing trees
- numerous uneven-aged individual trees and smaller woody plants with emphasis on multi-conifer species composition including lodgepole pine, Douglas fir, Western larch, Engelmann spruce, subalpine fir, and white pine
- dead and dying trees 39 – 69 feet tall, 100-300 years old, and > 20 inches dbh
- dead and decaying wood, with an abundance of insects
- a minimum forest parcel size of 1,000 acres

Focal Habitat Monitoring Strategies: Establish an inventory and long-term monitoring program for protected and restored mixed conifer forest habitats to determine success of efforts.

1. Identify mixed conifer forest sites within the subbasin that support populations of focal species for this habitat.
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of Pileated Woodpecker. (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands, employing strategies outlined in the subbasin management plans (intermediate strategy; 2 to 10 years) and
4. Identify high quality/functional privately owned mixed conifer forest sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent roadside and off-road censusing stations to monitor bird, herptile, and small mammal population and plant communtiy changes

Sampling Design: HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid.

In addition, at any permanently established avian, herptofaunal, and small mammal species monitoring sites established within the Herbaceous Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).
(http://www.birdpop.org/DownloadDocuments/manual/HSAManual03.PDF

Sampling Methods (USFWS 1980a and 1980b):

2. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular 0.5m^2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

3. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

4. Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

5. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined
using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

$$\text{Sample size equation: } n = \frac{t^2 \times s^2}{E^2}$$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom
s = standard deviation
E = desired level of precision, or bounds

Literature Cited:

Anderson, S. and K. Gutzwiller. 1996. Habitat Evaluation Methods. Pages 592-606 in: T. A. Bookhout, ed. Research and Management Techniques for Wildlife and Habitats. Fifth ed., rev. The Wildlife Society, Bethesda, MD. xiii + 740pp.

Nott, R., D.F. DeSante, and N. Michel. 2003. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HAS) Protocol 2003. The Institure for Bird Populations, Pt. Reyes Station, CA.

Parks, C. G., E. L. Bull and T. R. Torgersen. 1997. Field Guide for the Identification of Snags and Logs in the Interior Columbia River Basin. USDA Forest Service, Pacific Northwest Research Station, PNW-GTR-390. 40 p.

USFWS. 1980a. Habitat as a Basis for Environmental Assessment, Ecological Services Manual (ESM) 101. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

USFWS. 1980b. Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

Ponderosa Pine Focal Species: white-headed woodpecker (*Picoides albolarvatus)*

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Ponderosa pine sites to monitor focal species population and habitat changes and evaluate success of efforts.

Factors affecting habitat:
1. Direct loss old growth forest and associated large diameter trees and snags;
2. Fragmentation of remaining Ponderosa pine habitat;
3. Agricultural and sub-urban development and disturbance;
4. Hostile landscapes which may have high densities of nest parasites, exotic nest competitors, and domestic predators;
5. Fire suppression/wildfire;
6. Overgrazing;
7. Noxious weeds;
8. Timing of silvicultural practices;
9. Insecticide use.

Ponerosa Pine Working Hypothesis Statement: As indicated in the assessment (see Section 3.6.2 for summary), major factors affecting ponderosa pine habitat in the Umatilla/Willow subbasin are mixed forest encroachment, altered fire regimes, timber harvest, exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities. Two of the major factors responsible for habitat loss and degradation of functional ponderosa pine forest is harvest of late and old structure pine and the encroachment of Douglas-fir and grand fir into ponderosa pine dominated habitats. The encroachment is due primarily to fire suppression and intense, stand-replacing wildfires; the latter results from high fuel loads associated with increases in brushy species and the establishment of ladder fuels from encroaching shade tolerant understory trees.

Recommended Range of Management Conditions: Recognizing that extant ponderosa pine habitat within the Blue Mountain and Columbia Plateau Provinces currently covers a wide range of seral conditions, Ecoregion wildlife habitat managers have identified three general ecological / management conditions that, if met, will provide suitable habitat for multiple wildlife species at the Ecoregion scale within the ponderosa pine habitat type.

These ecological conditions correspond to life requisites represented by a species' assemblage that includes white-headed woodpecker (*Picoides albolarvatus*).

1. Mature ponderosa pine forest: The white-headed woodpecker represents species that require/prefer large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH).

2. Multiple canopy ponderosa pine mosaic: Flammulated owls represent wildlife species that occupy ponderosa pine sites that are comprised of multiple canopy, mature ponderosa pine stands or mixed ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990), two layered canopies, tree density of 508 trees/acre (9 foot spacing), basal area of 250 $feet^2$/acre (McCallum 1994b), and snags greater than 20 inches DBH 3-39 feet tall (Zeiner et al. 1990). Food requirements are met by the presence of at least one snag greater than 12 inches DBH/10 acres and 8 trees/acre greater than 21 inches DBH.

3. Dense canopy closure: Rocky Mountain Elk were selected to characterize ponderosa pine habitat that is greater than 70 percent canopy closure and 40 feet in height.

<u>Focal Habitat Monitoring Strategies:</u> Establish an inventory and long-term monitoring program for protected and managed Ponderosa pine habitats to determine success of efforts. Subbasin managers recognize that restoration of late-successional forest is a long-term process, but these short-term (i.e., up to 15 years) strategies reflect the commitment and initiation of the process of management.

1. Identify Ponderosa pine habitat sites within the subbasin that support populations of focal species for this habitat.
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of focal species habitat (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
4. Identify high quality/functional privately owned Ponderosa pine sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent roadside and off-road censusing stations to monitor bird, herptile and small mammal population and plant community changes.

<u>Sampling Design:</u> Permanent survey transects will be located within Ponderosa pine habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are

established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, at any permanently established avian, herptile, and small mammal species monitoring site established within the Ponderosa Pine habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular 0.5m^2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

2. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

   Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

3. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Measurement of Attributes (Habitat Conditions):
>10 snags/40 ha (>30cm DBH and 1.8m tall)
  Method: A direct count in the 1/10 acre circle plot at the end of each 100 ft segment of the transect. DBH (measured with a loggers tape) and condition is noted for each snag. Snag condition scale follows Parks et al. (1997).

>20 trees /ha (>21" DBH)
  Method: A direct count in the 1/10 acre circle plot. DBH measured with a logger's tape.

Ponderosa Pine – old growth: >10 trees/ac (>21" DBH w/ >2 trees >31" DBH)
  Method: A direct count in the 1/10 acre circle plot. DBH measured with a logger's tape.

10-50% canopy closure

Method: A line intercept 'hit' or 'miss' measurement. Ten direct measurements along each 100 foot section of the transect (one every 10 feet) taken with a moosehorn densitometer.

> 1.4 snags/ac (>8" DBH w/ >50% >25")

Method: A direct count in the 1/10 acre circle plot at the end of each 100 ft segment of the transect. DBH (measured with a loggers tape) and condition is noted for each snag. Snag condition scale follows Parks et al. (1997).

In addition, at any permanently established avian species monitoring site established within the Riverine Wetland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

<u>*Analysis:*</u> Transects are divided into 100 ft. segments, and total transect length is determined
using a "running mean" to estimate variance (95% probability of being within 10% of the true ean).

Sample size equation: $n = \frac{t^2 \times s^2}{E^2}$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom
s = standard deviation
E = desired level of precision, or bounds

<u>*Literature Cited:*</u>

Anderson, S. and K. Gutzwiller. 1996. Habitat Evaluation Methods. Pages 592-606 in: T. A. Bookhout, ed. Research and Management Techniques for Wildlife and Habitats. Fifth ed., rev. The Wildlife Society, Bethesda, MD. xiii + 740pp.

Nott, R., D.F. DeSante, and N. Michel. 2003. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HAS) Protocol 2003. The Institure for Bird Populations, Pt. Reyes Station, CA.

Parks, C. G., E. L. Bull and T. R. Torgersen. 1997. Field Guide for the Identification of Snags and Logs in the Interior Columbia River Basin. USDA Forest Service, Pacific Northwest Research Station, PNW-GTR-390. 40 p.

USFWS. 1980a. Habitat as a Basis for Environmental Assessment, Ecological Services Manual (ESM) 101. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

USFWS. 1980b. Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

Eastside Interior Grassland *Focal Species:* grasshopper sparrow (*Ammodramus savannarum)*

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Interior Grassland sites to monitor focal species population and habitat changes and evaluate success of efforts.

Factors affecting habitat:

1. Direct loss grasslands due to conversion to agriculture
2. Fragmentation of remaining grassland habitat, with resultant increase in nest parasites
3. Fire Management, either suppression or over-use, and wildfires
4. Invasion of exotic vegetation
5. Habitat degradation due to overgrazing, and invasion of exotic plant species
6. Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.
7. Conversion of CRP lands back to cropland.

Eastside Interior Grassland Working Hypothesis Statement: As indicated in the assessment (see Section 3.6.2 for summary), major factors affecting grassland habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. These factors result in direct habitat loss, fragmentation, and degradation. The single largest factor in habitat loss is conversion to agriculture. The largest factor in habitat degradation is the proliferation of annual grasses and noxious weeds, such as cheat grass and yellow starthistle, which either replace or radically alter native bunchgrass communities. This invasion of exotic weeds is facilitated by the loss of cryptogamic crusts[1], resulting from soil disturbances associated with tillage and livestock grazing. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also impact native species productivity. The effects of non-native species are magnified by habitat fragmentation. Additionally, grassland habitats in proximity to agricultural and recreational areas may be subject to high levels of human disturbance. All of these factors are responsible for significant reductions in grassland obligate species.

*Recommended Range of Management Conditions; S*ubbasin planners selected the grasshopper sparrow to represent the range of habitat conditions required by grassland obligate wildlife species and to serve as potential performance measures to monitor and evaluate the results of implementing future management strategies and actions on interior grassland habitats. In addition, sharp-tailed grouse winter food/roosting needs account for

[1] cryptogamic crusts: a complex association of living cyanobacteria, microfungi, lichens, and mosses that live within and immediately on top of the soil in arid and semi-arid regions of the world, forming a cohesive crust that resists wind and water erosion (Belnap and Lange 2001).

macrophyllus shrub draws and riparian shrublands that historically punctuated interior grassland habitats.

<u>For Native Grasslands</u>

- native bunchgrass cover > 15% and comprising than 60% of total grassland cover
- tall bunchgrass > 10 inches tall
- native shrub cover < 10%

<u>For Non-Native and Agricultural Grasslands (e.g. CRP lands)</u>

- grass forb cover > 90%
- shrub cover < 10%
- variable grass heights (6-18 inches)

<u>Landscape Level</u>

- patch size greater > 100 acres or multiple small patches greater than 20 acres, within a mosaic of suitable grassland conditions

<u>Focal Habitat Monitoring Strategies:</u>

1. Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
2. Identify high quality/functional privately owned grassland sites that are not adjacent to public lands (long-term strategy 2 to 15 years).
3. Establish permanent roadside and off-road censusing stations to monitor bird, herptile, and small mammal population and plant community changes

<u>Sampling Design:</u> Permanent survey transects will be located within Eastside Interior Grassland habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, at any permanently established avian, herptile and small mammal species monitoring site established within the Eastside Interior Grassland habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

<u>Sampling Methods (USFWS 1980a and 1980b):</u>

1. <u>Herbaceous</u> measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular $0.5m^2$ microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

2. <u>Shrub</u> canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment).

If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

3. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined
using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = \frac{t^2 \times s^2}{E^2}$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom
s = standard deviation
E = desired level of precision, or bounds

Literature Cited:

Anderson, S. and K. Gutzwiller. 1996. Habitat Evaluation Methods. Pages 592-606 in: T. A. Bookhout, ed. Research and Management Techniques for Wildlife and Habitats. Fifth ed., rev. The Wildlife Society, Bethesda, MD. xiii + 740pp.

Nott, R., D.F. DeSante, and N. Michel. 2003. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HAS) Protocol 2003. The Institute for Bird Populations, Pt. Reyes Station, CA.

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USFWS. 1980b. Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

Shrubsteppe *Focal Species:* Sage Sparrow (*Amphispiza bilineata*), Ferruginous hawk (*Buteo regalis*) for Juniper within Shrub-steppe

Overall Habitat and Species Monitoring Strategy: Establish monitoring program for protected and managed Shrubsteppe sites and scattered juniper within shrubsteppe habitats to monitor focal species population and habitat changes and evaluate success of efforts.

Factors affecting habitat:

1. Direct loss shrubsteppe due to conversion to agriculture
2. Fragmentation of remaining shrubsteppe habitat, with resultant increase in nest parasites
3. Fire Management, either suppression or over-use, and wildfires
4. Invasion of exotic vegetation
5. Habitat degradation due to overgrazing, and invasion of exotic plant species
6. Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.
7. Conversion of CRP lands back to cropland.

Shrubsteppe Working Hypothesis Statement: The near term or major factors affecting this focal habitat type are direct loss of habitat due primarily to conversion to agriculture, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and livestock grazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and yellow-star thistle that either supplant and/or radically alter entire native bunchgrass communities significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of extant vegetation have resulted in extirpation and or significant reductions in grassland obligate wildlife species.

Recommended Range of Management Conditions:

Characterizing very specific critical environmental correlates that apply to all shrub-steppe habitat is difficult because shrub-steppe habitats are highly variable with respect to structure and plant species composition, both of which are strongly influenced by site conditions (e.g., hydrology, soil, topography). Sound management will take into account site conditions, and thus the inherent capability of the site to support a particular type of shrub-steppe community and wildlife assemblage. However, general ranges of critical environmental correlates that support the sage sparrow and most other obligate shrub species (e.g., loggerhead shrike, burrowing owl, sage thrasher) are as follows:

- late seral big sagebrush or bitterbrush with patches of tall shrubs with a height greater than 1 m
- mean sagebrush cover of 5-30%
- mean native herbaceous cover of 10-20% with <10% cover of non-native annual grass (e.g., cheatgrass) or forbs
- mean open ground cover, including bare ground and cryptogamic crusts > 20%
- mean native forb cover > 10%

Ferruginous hawk was selected to represent juniper which, in the Umatilla Subbasin, is an important KEC component of shrubsteppe, functioning as nest and perch sites for Ferruginous hawks and other species.

As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional ponderosa pine habitat are:

- isolated, mature juniper trees with a density > one per square mile
- native perennial grasses and other low shrub cover between 6-24 inches to support ground squirrels and jackrabbits, which are major prey of Ferruginous Hawks
- mature, short (< 33 ft. in height) juniper for Ferruginous Hawk nesting trees

Focal Habitat Monitoring Strategies: Establish an inventory and long-term monitoring program for protected and managed shrubsteppe habitats to determine success of management strategies. Subbasin managers recognize that restoration of shrubsteppe is still very much a fledgling field, and complete restoration of degraded or converted shrubsteppe may not be feasible. These Monitoring strategies reflect the commitment to and initiation of the process of longterm management.

1. Identify shrubsteppe habitat sites within the subbasin that support populations of focal species
2. Evaluate habitat site potential on existing public lands and adjacent private lands for protection of focal species habitat (short-term strategy i.e., < 2 years).
3. Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
4. Identify high quality/functional privately owned shrubsteppesites that are not adjacent to public lands (long-term strategy 2 to 15 years).
5. Establish permanent roadside and off-road censusing stations to monitor bird population and habitat changes.

Sampling Design: Permanent survey transects will be located within shrubsteppe habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, at any permanently established avian, herptile and small mammal species monitoring site established within the Shrubsteppe habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).

Sampling Methods (USFWS 1980a and 1980b):

1. Bare ground or cryptogram crust measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular $0.5m^2$ microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

   The percentage of the microplot consisting of either bare ground or cryptogram crust is estimated via ocular estimate.

2. Herbaceous measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular $0.5m^2$ microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval.

   Herbaceous cover % is measured via an ocular estimate of the percentage of the microplot shaded by any grass or forb species.

3. Shrub canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible "hits" per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible "hits" per 100 ft segment).

   Shrub canopy cover is measured on a line intercept 'hit' or 'miss'. Measurements are taken every 2 or 5 feet, depending upon shrub density.

   Shrub height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e. all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.

4. Tree canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of the circle is 37.2 ft.

Analysis: Transects are divided into 100 ft. segments, and total transect length is determined
using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = \frac{t^2 \times s^2}{E^2}$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom
s = standard deviation

E = desired level of precision, or bounds

Literature Cited:

Anderson, S. and K. Gutzwiller. 1996. Habitat Evaluation Methods. Pages 592-606 in: T. A. Bookhout, ed. Research and Management Techniques for Wildlife and Habitats. Fifth ed., rev. The Wildlife Society, Bethesda, MD. xiii + 740pp.

Nott, R., D.F. DeSante, and N. Michel. 2003. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HAS) Protocol 2003. The Institure for Bird Populations, Pt. Reyes Station, CA.

USFWS. 1980a. Habitat as a Basis for Environmental Assessment, Ecological Services Manual (ESM) 101. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

USFWS. 1980b. Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102. Division of Ecological Services, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. Unnumbered.

Focal Species Monitoring:

Yellow Warbler

Rationale: Maintaining and enhancing yellow warbler populations within the Eco-region will assure the maintenance and rehabilitation of riparian wetlands.

Limiting Factors: 1) Loss of deciduous tree cover and sub-canopy/shrub habitat in riparian zones. 2.) Conversion of riparian habitat due to channelization, agriculture, and development, 3) flooding of habitat resulting from hydropower facilities, 4) habitat fragmentation, 5) degradation of existing habitats from overgrazing and introduced weedy vegetation, and 6) tree/shrub removal in riparian areas (Sec 5.2.3.1). Proximity to agriculture, suburban development creates a hostile landscape where a high density of nest parasites, such as, brown cow bird and predation by domestic cats may occur. Disturbance from agriculture and recreational activities can also cause nest abandonment (Sec. 5.2.3.1.2).

Assumptions: 1) Addressing factors that affect eastside (interior) riparian wetlands, will also address yellow warbler and other wetland obligate species limiting factors. 2) If riparian wetland habitat is of sufficient quality, extent, and distribution to support viable yellow warbler and beaver populations, the needs of most other riparian wetland obligate species will also be addressed and habitat functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 25% increase in abundance of yellow warbler with a power of 0.8 or greater (pers. comm. Ferguson). This protocol is based on the point count survey (Ralph et al. 1993, Ralph et al. 1995), with each survey station referred to as a "point count station." In addition to these bird survey data, information about the distance at which individual birds are detected will also be collected, allowing absolute density estimated to be made using distance-sampling methodology (e.g., the program DISTANCE).

Methods: We will survey birds on randomly selected (stratified) points along the riparian corridor. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established along a transect and spaced 200m apart (Fig 4). Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

Analysis: Analysis is described by Nur et al. (1999). Absolute density estimation (see Buckland et al. 1993) can be estimated using the program DISTANCE, a free program available on the World-Wide Web (http://www.ruwpa.st-and.ac.uk/distance); an example is given in Nur et al. (1997). In brief: for species richness and species diversity, these can be analyzed as total species richness or as species richness for a subset of species; the same is true for species diversity. Species diversity can be measured using the Shannon index (Nur et al. 1999), also called the Shannon-Weiner or Shannon-Weaver index. Statistical analysis can be carried out using linear models (regression, ANOVA, etc.), after appropriate transformations (examples in Nur et al. 1999).

References:

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Nur, N., S. Zack, J. Evens, and T. Gardali. 1997. Tidal marsh birds of the San Francisco Bay region: Status, distribution, and conservation of five Category 2 taxa. Final draft report to National Biological Survey (now US Geological Survey). Available from Point Reyes Bird Observatory, Stinson Beach, CA. Wetlands Regional Monitoring Program Plan 2002 Part 2: Data Collection Protocols Tidal Marsh Passerines.

Nur, N., S.L. Jones, and G.R. Geupel. 1999. A Statistical Guide to Data Analysis of Avian Monitoring Programs. Biological Technical Publication, US Fish & Wildlife Service, BTP-R6001-1999.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Field methods for monitoring landbirds. USDA Forest Service Publication, PSW-GTR 144. Albany, CA.

Ralph, C.J., S. Droege, and J.R. Sauer. 1995. Managing and monitoring birds using point counts: standards and applications. In C. J. Ralph, J. R. Sauer and S. Droege (Eds.), Monitoring Bird Populations by Point Counts. USDA Forest Service Publication, Gen. Tech. Rep. PSW-GTR-149, Albany, CA.

Great Blue Heron

Rationale: The great blue heron is the only focal species that has a direct relationship with salmonids (Ashley and Stovel 2004, Table 55). The great blue heron requires multiple cover types to meet its life requisites. Suitable great blue heron habitats include herbaceous wetlands, scrub-shrub wetlands, forested wetlands, riverine, lacustrine or estuarine habitats within 0.5 mil of heronries (Sec. 5.2.3.3). Maintaining great blue heron populations will require a wide diversity of riparian wetlands be maintained or enhanced within the Ecoregion.

Limiting Factors: 1.) loss of nesting habitat near riparian zones, 2.) loss of foraging areas due to stream alteration or flows, 3.) reproductive failure due to pesticides.

Assumptions: Addressing factors that affect eastside interior riparian wetlands, will also address great blue heron and other riparian wetland obligate species limiting factors. 2.) If interior riparian wetland is of sufficient quality, extent, and distribution to support viable great blue heron populations, the needs of most riparian wetland obligate species will also be addressed and wetland functionality could be inferred.

Sampling Strategy: The sampling strategy was developed by the Bird Focus Group of the Wetland Regional Monitoring Program Plan 2002 - Part 2: Data Collection Protocols Herons and Egrets: Heron and Egret Breeding Distribution, Abundance, and Success By John P. Kelly

Methods: At each known colony site, establishing a monitoring effort involves five steps:
1. Determine number of "active nests" early in the season. Before 1 April, nests are considered active if two adults are present or if one adult is seen carrying nest material or incubating. After 1 April, any occupied nest is considered active.

2. Create a nesting panorama. The nesting panorama is a landscape sketch or photograph that indicates the location of numbered nests to be followed through the season. Each panorama includes an exact description of the viewing position, which should be located far enough from the colony to avoid disturbance to the nesting birds. More than one panorama may be necessary to monitor all focal nests in the colony (see below).

3. Identify focal nests. Focal nests are numbered nests and monitored through the season to measure nest survivorship. Focal nests must be observed as "active" either before incubation or at Stage 1 (incubation, see below), and should be observed as active in March, although new focal nests can be added until 15 April. In colonies with 15 or fewer active nests, or with volunteer observers that can commit to monitor every nest in the

colony, all nests that meet the above criteria are considered focal nests. *Random samples:* In colonies with more than 15 active nests, which cannot be monitored on every visit, a random subset of at least 15 focal nests is selected for each species. Observers are encouraged to monitor as many nests as they can.

4. Obtain necessary access permits or authorization to enter the area. Most colony sites are on privately owned lands, or on public wildlife refuges with restricted access.

5. Visit each site at least four times during the nesting season. Observers are encouraged to conduct more frequent visits if possible (weekly or biweekly). Regional observation periods are scheduled each year, during five 3-day windows at approximately monthly intervals: early March, early April, early May, early June, and late June. During each of these periods, all colony sites are visited. Diurnal timing of observations is generally not important, but site-specific effects on viewing conditions should be considered. For example, position of the sun might affect visibility of nests; low temperatures can cause brooding adults to hide nest contents; and afternoon wind can enhance the visibility of hidden nests. Because average timing of nesting varies among years, colony sites, and species, closely synchronizing colony site visits with nesting phenology is problematical.

Ancillary Information

The following information is recorded for each colony site:
1. geographic location in UTMs
2. description of nesting habitat, including vegetation, topography, and available nesting space
3. nest locations numbered on a standardized panoramic sketch or photo, updated each visit
4. property ownership
5. number of active nests on each visit, and peak number during the season, using the following criteria: *Before 1 April, "active" nests must have either two adults present or one adult carrying nest*
6. focal nest status: active or inactive
7. nesting stage of each focal nest. Seasonal timing is indexed by the distribution of focal nests across 5 nesting stages:
   Stage 1: Egg-laying or incubation; adult lying down in nest for long periods, standing to turn eggs, defecate, or for nest relief
   Stage 2: Hatching; small (downy) nestlings, or feeding observed low in the nest
   Stage 3: Nestlings usually standing; most or all of down replaced by juvenal plumage; parent(s) continuously at the nest
   Stage 4: Adults not continuously at the nest, but may be present for some time after feeding; nestlings usually on the nest platform
   Stage 5: Young often off the nest, on nearby branches
8. number of adults and chicks on each focal nest
9. prefledging brood size in completely visible broods 4-8 weeks old, for Great Blue Heron
10. type and level of disturbance, observed or inferred: A=avian; H=human; O=observer; M=mammal; W=weather; P=other predator; U=unknown

Levels: 0=none 1=behavioral response only; 2=nest or nestling mortality 3=colony abandonment
11. human land use: a description of human activity and development in the immediate vicinity (within 300 m) of the colonies

<u>Analysis:</u> Reproductive success (rs) is calculated as the product of focal nest survivorship (s) and prefledging brood size (b): rs = *s x b*. Regional estimates should use weighted averages of *s* and *b* among colonies, based on colony size. Variance of reproductive success is estimated following Goodman (1960, *J. Am. Stat. Assoc.* 55:708- 713): var(rs) = [*s*2 (var(*b*)] + [*b*2 (var(*s*)] - [var(*b*) · var(*s*)].

Nest survivorship (*s*) is "apparent" survivorship based on focal nests monitored through the nesting season. Great Blue Heron and Great Egret nests are considered successful if they survive to 8 weeks post-hatch. Snowy Egret and Black-crowned Night-Heron nests are considered successful at 15 days post-hatch, but this level of resolution is not achieved unless monitored frequently.

Prefledging brood size (*b*) is based on the latest counts of completely visible broods observed during Stage 4 (nestlings 4-8 weeks old). During this period, most nestlings are old enough to be standing and visible, but too young to hop away from the nest platform. Most brood reduction in occurs during the first four weeks after hatching (Pratt 1970, *Condor* 72:407-416).

<u>Sample size:</u> Previous (unpublished) data suggest that observations from 65 nests (within or among colony sites) may be adequate to detect a 20% difference in prefledging brood size between consecutive years 80% of the time, with a significance level (a) of 0.10. At some colony sites, the number of brood size observations possible may be substantially limited by incomplete visibility of broods.

<u>*Literature Cited:*</u>
Kelly, John P. 2002. Bird Focus Group of the Wetland Regional Monitoring Program Plan 2002 - Part 2: Data Collection Protocols Herons and Egrets: Heron and Egret Breeding Distribution, Abundance, and Success

American Beaver

No monitoring protocol established under Terrestrial program.

White-headed woodpecker

<u>Rationale:</u> Suitable white-headed woodpecker habitat includes large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH). Maintaining white-headed woodpecker populations will require that this mature/old growth component of ponderosa pine habitat is maintained or enhanced within the Ecoregion.

Limiting Factors: 1) Silvicultural practices that reduce habitat quality; 2) pesticide use; 3) predation/competitors; 4) exotics. (Sec. 5.2.1.2.2)

Assumptions: If ponderosa pine habitat is of sufficient quality, extent, and distribution to support viable white-headed woodpecker populations, the needs of most other ponderosa pine obligate species will also be addressed and ponderosa pine functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 25% increase in abundance of white-headed woodpecker with a power of 0.8 or greater (pers. comm. Ferguson).

Methods: The method used, point counts, is derived from Dixon (1998)
POINT COUNTS
Each observer will conduct one transect per day individually. Survey low-elevation transects first to assure accessibility. The protocol for point counts will follow standardized methods for variable circular plots (Reynolds et al. 1980, Ralph et al.1995, Hutto and Hoffland 1996), but modified to better census White-headed Woodpeckers.

WHEN TO SURVEY: Point counts should be conducted between April 1 and May 15 when the detectability of White-headed Woodpeckers is highest and most stable. After this period the woodpeckers typically excavate from within the nest cavity and become less visible and less vocal. Counts should begin at official sunrise and end no later than 1030 and 1100. Each transect will be visited once.

POINT COUNTS: Counts will begin as soon as the observer arrives at the station and will be comprised of a 5-minute listening period without the use of tape playbacks followed by a 6-minute sequence of tape playbacks of White-headed Woodpecker calls and drums for a total count of 11 minutes. Data from the two types of counts will be recorded separately-with a code-on a the bird data sheet.

TAPE PLAYBACK PROCEDURE: Tape playback procedures will essentially follow the Payette National Forest Protocol for Broadcast Vocalizations (Payette National Forest 1993). The tape playback sequence should begin immediately after the 5-min unsolicited point count-be ready to start the tape at exactly 5 min. A total of four 30-second tape-playbacks of White-headed Woodpecker drums and calls will be projected at 1-min intervals (e.g. using a Johnny Stewart™ game caller); that is, begin the first sequence of vocalizations to the north. During the one minute pause after the first sequence, rotate 90° for the second sequence, pause, then rotate another 90° for the third sequence of vocalizations after the second one minute break. When the third sequence is complete, rotate 90° for the fourth and final sequence for a total of 6 minutes of tape-playbacks.

WHEN NOT TO SURVEY: Surveys will not be conducted during heavy rain, fog, or when wind interferes with an observer's ability to detect calls (greater than 20 mph). If the weather appears prohibitive, wait 1 to 1.5 hours, or until you cannot reasonably complete the transect by 1100 hours. If the weather puts you in danger, STOP-your safety comes first.

WHAT TO RECORD: Record all species detected, visual or auditory. At the bottom of the data sheet, record any birds you might have detected either before or after a point count, or between stations.

References:

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Grasshopper Sparrow

Rationale: Suitable grasshopper sparrow habitat consists of undisturbed grasslands of intermediate height, often associated with clumped vegetation interspersed with patches of bare ground (Bent 1968; Blankespoor 1980; Vickery 1996). Other habitat requirements include moderately deep litter and sparse coverage of woody vegetation (Smith 1963; Bent 1968; Wiens 1969, 1970; Kahl et al. 1985; Arnold and Higgins 1986). In addition, the grasshopper sparrow like other grassland species shows a sensitivity to the grassland patch size (Herkert 1994; Samson 1980; Vickery 1994; Bock *et al.* 1999). Within the entire Interior Columbia Basin, overall decline in source habitats for grasshopper sparrow (71 percent) was third greatest among 91 species of vertebrates analyzed (Wisdom et al. in press). Maintaining grasshopper sparrow populations will require that native grassland habitat is maintained or enhanced within the Ecoregion.

Limiting Factors: 1) Conversion of native steppe habitat for agricultural purposes, 2) flooding of habitat resulting from hydropower facilities, 3) habitat fragmentation, 4) degradation of existing habitats from overgrazing and introduced weedy vegetation, 5) alteration of historic fire regimes (Sec. 5.2.4.1.2).

Assumptions: 1) Addressing factors that affect eastside (interior) grasslands, will also address sharp-tailed grouse and other grassland obligate species limiting factors. 2) If grassland habitat is of sufficient quality, extent, and distribution (Hyperlink to SHGR requirements and/or recommended conditions) to support viable sharp-tailed grouse and grasshopper sparrow populations, the needs of most other grassland obligate species will also be addressed and grassland functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 25% increase in abundance of key species with a power of 0.8 or greater.

Methods: We will survey birds on 64 sites in different vegetation types and levels of fragmentation. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established along a transect and spaced 200m apart (Fig 4). The outer points of the point-count circles will describe a rectangular plot of 16ha that will be the focus of all survey work in Objectives 2-4. Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

References:

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin and D. F. DeSante. 1993. Handbook of field methods for monitoring birds, Pacific Southwest Research Station, Forest Service, U. S. Department of Agriculture, Albany, CA, pp. 41.

Sage Sparrow, Brewer's Sparrow, Sage Thrasher

Rationale: The main premise for focal species selection is that the requirements of a demanding species assemblage such as sage thrasher, sage sparrow and Brewer's sparrow encapsulate those of many co-occurring less demanding species. By directing management efforts toward the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met. Therefore, managing habitat conditions for a species assemblage comprised of these three species should provide life requisite needs for most other shrubsteppe obligate species.

Limiting Factors: 1) Conversion of native shrub-steppe habitat for agricultural purposes, 2) habitat fragmentation; 3) degradation of existing habitats from overgrazing and introduced weedy vegetation, and 5) brush removal, 6.) wildfire (Sec. 5.2.2)

Assumptions: 1) Addressing factors that affect shrub steppe habitat will address our three-species assemblage; 2) If shrub steppe habitat is of sufficient quality, extent, and distribution to support viable sage thrasher, sage sparrow and Brewer's sparrow populations, the needs of most other shrub steppe obligate species will also be addressed and shrub steppe functionality could be inferred.

Sampling Strategy: Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 35% increase in abundance of key species with a power of 0.8 or greater.

Methods: We will survey birds on 64 sites in different vegetation types and levels of fragmentation. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established along a transect and spaced 200m apart (Fig 4). The outer points of the point-count circles will describe a rectangular plot of 16ha that will be the focus of all survey work in Objectives 2-4. Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

References:

Dobler, F. C., J. Eby, C. Perry, S. Richardson, and M. Vander Haegen. 1996. Status of Washington's shrub-steppe ecosystem: extent, ownership, and wildlife/vegetation relationships. Phase One Completion Report. Washington Department of Fish and Wildlife. Olympia. 39p.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin and D. F. DeSante. 1993. Handbook of field methods for monitoring birds, Pacific Southwest Research Station, Forest Service, U. S. Department of Agriculture, Albany, CA, pp. 41.

Rotenberry, J. T., and J. A. Wiens. 1980. Habitat structure, patchiness, and avian communities in North American steppe vegetation: A multivariate analysis. Ecology 61.
Vander Haegen, W. M., and B. Walker. 1999. Parasitism by brown-headed cowbirds in the shrubsteppe of eastern Washington. Studies in Avian Biology 18:34-40.

Vander Haegen, W. M., F. C. Dobler, and D. J. Pierce. 2000. Shrubsteppe bird response to habitat and landscape variables in eastern Washington, USA. Conservation Biology 14:1145-1160.

<u>Other Ongoing Research and Monitoring In the Subbasin:</u>

Research

Interior Northwest Landscape Analysis System (INLAS)
A suite of analytical tools (models) that evaluate succession and disturbance dynamics across landscapes and potential changes in ecological and socioeconomic systems. Analyzes vegetation, aquatic, terrestrial species habitat, economic conditions, and socioculture systems at multiple scales (fine, mid, and broad).
USDA, Forest Service. Pacific Northwest Region, La Grande Forest and Range Science Laboratory http://www.fs.fed.us/pnw/lagrande/inlas/index.htm

Effects of Ungulates on the Ecosystem (Starkey Project)
The Starkey Project involves four major studies that document deer, elk and cattle response to intensively managed National Forests. Research animal numbers within the Starkey enclosure include 550 cow-calf pairs, 450 elk and 250 deer. Primary studies include, Breeding Bull Efficiency, Roads and Traffic, Animal Units, and Intensive Forest Management.
USDA, Forest Service. Pacific Northwest Region, La Grande Forest and Range Science Laboratory
http://www.fs.fed.us/pnw/starkey/

Sagebrush Landscape Project
The project conducts research on habitats for species of conservation concern in the sagebrush ecosystem. Current work includes, identifying regional assessment procedures to evaluate multiple species of concern in sagebrush ecoregions; develop methods to address systematic and defensible trade-offs between single versus multiple species for land use planning; complete a regional assessment in the Great Basin Ecoregion; and provide guidance for effective multi-species planning at regional scales.
USDA, Forest Service. Pacific Northwest Region, La Grande Forest and Range Science Laboratory
http://www.fs.fed.us/pnw/lagrande/sagebrush/index.htm

Effects of Reintroducing Fire in Eastside Ponderosa Pine Forests
Throughout the West, forest managers are interested in prescribing a series of repeated underburns in an attempt to return fire to pre-exclusion frequencies and to maintain and protect old-growth structural characteristics that are important for wildlife. Yet there is little quantitative information available on the effects of repeated prescribed fires. This study will help fill that void.
USDA, Forest Service. Pacific Northwest Region, La Grande Forest and Range Science Laboratory
http://www.fs.fed.us/pnw/lagrande/dem/metolius.htm

Eastside Forest Prescribed Fire Study
The intent of the study is to document effects of both fall and spring prescribed burning on forest songbirds by comparing avian nesting success and productivity between burned units and unburned controls. Direct comparison of fall vs. spring burns also may be possible. The results will be applicable to a range of dry forest conditions (ponderosa pine, dry Douglas fir, and dry grand fir habitats) throughout the region.
The Sustainable Ecosystems Institute and USDA Forest Service, Wallowa-Whitman National Forest, Baker City, OR

Inventory and Monitoring

Current Vegetative Survey (CVS)
A plot-grid system on National Forest lands in the Pacific Northwest that collect data on all above ground vegetation (live and dead). The collected data is used to answer questions about a particular resource area, used for resource planning at a broad scale.
USDA, Forest Service. Pacific Northwest Region. http://www.fs.fed.us/r6/survey/

Monitoring Avian Production and Survivorship (MAPS)
The program provides annual indices of adult populations size and post-fledging productivity, as well as annual estimates of adult survivorship, recruitment into the adult population, and population growth rate as multiple spatial scales for many landbird species. The Umatilla and Wallowa-Whitman National Forests have six MAPS stations in various habitats on the Forest. The study was initiated in 1992 and is expected to terminate in 2004.
The Institute for Bird Populations, Point Reyes Station, CA

Terrestrial Wildlife Inventory on CVS Plots
Conduct a variety of wildlife surveys on CVS plots across the Umatilla National Forest. The intent is to provide basic occurrence and distribution data for project planning and Forest Plan monitoring. Habitat relationships for some species in general forest vegetation types may be possible.
USDA, Forest Service. Umatilla National Forest, Pendleton, OR.

Designated and Managed Old Growth Monitoring
Determine changes in inventoried old growth habitat and effects of projects on old growth (maintain integrity of old growth units). Determine if old growth habitat is meeting management objectives (characteristics, species, etc.). Conduct inventories or surveys to validate all old growth and dedicated habitat units documenting suitability and use.
USDA, Forest Service. Umatilla National Forest, Pendleton, OR.

Inventory Basic Watershed Resources
Proper management of Forest watersheds requires a good understanding of its basic components - soil, water, climate, and vegetation. The Umatilla National Forest upgrades its resource information base by conducting the following inventories and surveys: soil, water, fishery resources, potential watershed, improvement projects, and riparian zones (areas adjacent to streams and lakes)
These watershed surveys provide vital information for improving the management of surface water resources.
USDA, Forest Service. Umatilla National Forest, Pendleton, OR.

Monitoring Water Temperatures
Annually, thermographs are deployed in streams across the Forest to record water temperatures changes through the year. Instruments are collected at the end of the year and data is downloaded and used to evaluate stream condition.
USDA, Forest Service. Umatilla National Forest, Pendleton, OR.

Managed Species Monitoring

Big Game:

Definition: Big game mammals in the state of Oregon are defined as deer, elk, pronghorn, bighorn sheep, Rocky Mountain goat, black bear, and cougar.

Why: Big game mammals are managed species in the state of Oregon, which are subjected to recreational harvest by the hunting public. As a result, the Oregon Department of Fish and Wildlife is required to monitor the composition and population size of managed species in order to determine biological surpluses to be allocated each year.

Harvest: For each species, harvest statistics of hunter harvested animals are collected through the use of hunter telephone surveys. The harvest statistics are gathered to achieve a statistical confidence of 90% with 10% error.

Reference:

Composition counts: All composition counts conducted by the Oregon Department of Fish and Wildlife on big game mammals seek to achieve an 80% confidence with 20% error as a minimum precision for each count.

Reference:

Mule Deer: One composition count in late November or early December to determine the number of bucks per 100 does present in the population. In addition, a subordinate count on the number of fawns per 100 does is obtained at that time. A second composition count or trend count is obtained in the spring, usually in March or early April. The spring count provides a measure of winter fawn survival in the form of the number of fawns per 100 adults. In the case of computer modeled populations, the spring count is a composition count only. Where population size is determined from an observed index, the count serves as a trend measurement as well.

Reference: Oregon Department of Fish and Wildlife. 2003. Oregon's mule deer management plan. Salem, Oregon, USA.

Elk: One helicopter composition count is conducted in March or early April. The count derives a statistically measured estimate of the number of bulls and calves per 100 cow elk. In the case of computer modeled populations, the count is a composition count only. Where population size is determined from an observed index, the count sometimes serves as a trend measurement as well. In other cases a second trend flight using a fixed wing aircraft is conducted in April, which only observes the total number of elk observed.

Reference: Oregon Department of Fish and Wildlife. 2003. Oregon's elk management plan. Salem, Oregon, USA.

Bighorn Sheep: There are no bighorn sheep in the Umatilla Sub-Basin. In the John Day Sub-Basin one composition count is conducted in March to determine the number of post winter lambs per 100 ewes and to obtain a ram age structure count. An additional count of prewinter lamb production is conducted in late May or early June.

Rocky Mountain Goat: There is no functioning population of Rocky Mountain goats in either the Umatilla or John Day sub-basins. A small number of individual goats have taken up residence in the Strawberry Mountains of the John Day sub-basin, but no structured counts have been established.

Reference: Oregon Department of Fish and Wildlife. 2003. Oregon's bighorn sheep and Rocky Mountain goat management plan. Salem, Oregon, USA.

Pronghorn: In the Umatilla Sub-Basin, the pronghorn population is monitored when the opportunity arises since the population is almost entirely on private land and structured ground based counts are not feasible. Currently there is no excess flight time available to monitor pronghorn populations in the Umatilla Sub-Basin.

In the John Day Sub-Basin, a winter trend count is conducted in late February, which is used to assess whether the population is increasing, decreasing, or stable. An aerial composition count is conducted in late July or early August which is used to determine the number of fawns per 100 does and the number of bucks per 100 does.

Black Bear: Teeth are collected voluntarily on hunter harvested bears and all bears taken on damage complaints to determine age structure as a measure of trend in the average age of bears. A trend toward younger age bears in the population would indicate harvest rates in excess of recruitment. A trend toward older age structure would indicate harvest lower than recruitment to the adult age classess. Reproductive tracts are also collected voluntarily from hunter harvested female bears and all female bears taken on damage complaints to gain a measure of reproductive capability.

Reference: Oregon Department of Fish and Wildlife. 1992. Oregon's black bear management plan. Salem, Oregon, USA.

Cougar: Managed with an emphasis on the dame data collection as black bears except that all hunter harvested cougars are required to be checked in. Teeth are removed from all cougars when they are checked in at an ODFW office. If the cougar is a female and the reproductive tract is present at the time of check-in, the reproductive tract is also taken.

Reference: Oregon Department of Fish and Wildlife. 1993. Oregon's cougar management plan. Salem, Oregon, USA.

Non-Game Wildlife Monitoring Activities By the OREGON DEPARTMENT OF FISH AND WILDLIFE

Type of Monitoring: Winter Raptor Counts. Conducted in several routes of specific length.
Timing: January or February.
Frequency: Annually
Purpose: Trend of wintering raptors
Location: Heppner and Umatilla Wildlife Districts
Level of Analysis: No statistical analysis

Type of Monitoring: Shrub steppe, grassland species monitoring through point counts (ferruginous hawk, grasshopper sparrow, loggerhead shrike, and Washington ground squirrels)
Timing: Spring. Began in 2003
Frequency: Once every three years
Purpose: Population estimates of species
Location: Boardman Conservation Area.
Level of Analysis: Statistical bounds on population estimates.

Type of Monitoring: Gull and Caspian tern and goose nest surveys on Columbia River islands.
Timing:. Late March or early April
Frequency: Annually
Purpose: Trend
Location: Columbia River Islands near Boardman, Oregon
Level of Analysis: No statistical analysis

Type of Monitoring: Golden Eagle and Perregrin falcon survey on lower John Day R.
Timing:. Late May
Frequency: Annually
Purpose: Trend
Location: Lower John Day River from Butte Creek to Cottonwood bridge.
Level of Analysis: No statistical analysis

Type of Monitoring: Bald eagle nest monitoring
Timing:. April and May
Frequency: 2 to 3 visits annually
Purpose: Count of nests for Oregon as well as avg. nest success
Location: John Day River system
Level of Analysis: No statistical analysis

Type of Monitoring: Winter bald eagle survey
Timing:. January 1 - 15
Frequency: Annually
Purpose: Total count of wintering bald eagles in Oregon
Location: 199 miles of John Day River and tributaries (mainstem, south fork, and lower north fork)
Level of Analysis: Direct count with no statistical analysis

Type of Monitoring: Breeding Bird survey conducted for US Fish & Wildlife Service
Timing:. June
Frequency: Annually
Purpose: Trend of breeding birds on a national and species scale
Location: Fixed route from Logan Valley to mainstem John Day River
Level of Analysis: no statistical analysis conducted by ODFW

Ongoing Research:

Wenaha/Sled Springs Elk Predation Nutrition Study. Study is designed to statistically measure the effect of nutrition of cow elk and predation of elk calves to determine the most significant cause of low calf survival in the study area. The study is occurring outside the sub-basin, but has management implications inside the Umatilla and John Day sub-basins