Draft
Clearwater Subbasin Assessment

November, 2003

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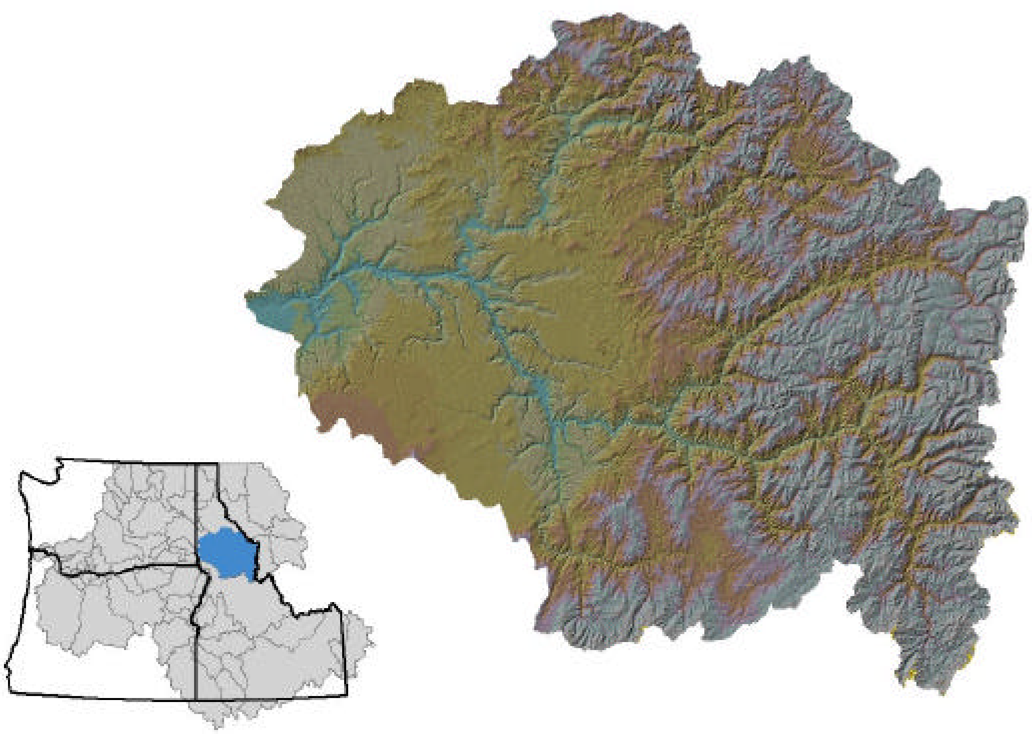

Prepared for

Nez Perce Tribe Watersheds Division
Idaho Soil Conservation Commission

PREAMBLE

In early 2001, the excitement began. Over 147,000 adult spring chinook began to cross Lower Granite Dam; most of them on their way to Idaho from the Pacific Ocean. At least a quarter of these fish were honed in on the Clearwater River Subbasin in Idaho. By the time the season ended in August, over 24,000 fish had been harvested by sportsmen and tribal fishers. Over 61,000 angler trips resulted in 24 million dollars of direct angler expenditures in the Clearwater River Subbasin. Large steelhead runs the following fall and winter provided additional opportunities and memories for recreational fishermen, in addition to important cultural and economic benefits in the subbasin.

Why so many fish following decades of so few? Above average spring flows in 1999 flushed juvenile fish to an ocean with better conditions for salmonid survival, including cooler water temperatures. In addition, hatcheries released full production capacity smolt numbers. Fisheries biologists predicted a large run, but even they could not have realized the memories and experiences that this run would provide the fortunate tribal fishers and sports anglers in the Clearwater subbasin.

The salmon and steelhead run of 2001/2002 provided us a glimpse of what runs were like historically, when thousands of self-sustaining wild fish returned to the Clearwater River every year. Unfortunately, wild fish continue to be much suppressed from historical numbers and the set of conditions that lead to the runs of mostly hatchery fish in 2001/2002 are not expected to persist in the future. In addition, a variety of in-basin and out-of-basin factors continue to negatively impact salmon and steelhead populations.

The future of salmon and steelhead in the Clearwater River will require the protection and expansion of wild fish populations, the continued production of hatchery fish for harvest and other purposes, and an openness by all parties to consider all factors which affect these important resources in the Clearwater. The members of the Clearwater PAC hope that implementation of the Clearwater Subbasin Plan will be a step in the right direction.

Table of Contents

List of Appendices

List of Figures

List of Tables

Table 1. List of acronyms used in the Clearwater Subbasin Assessment and Plan.

Acronym	Definition
Agencies or Groups	
APAC	Artificial Production Advisory Committee
BAG	Clearwater Basin Advisory Group (IDAPA 39-3613)
BLM	U.S. Bureau of Land Management
BoR	U.S. Bureau of Reclamation
BPA	Bonneville Power Administration (Bonneville)
CBFWA	Columbia Basin Fish and Wildlife Authority
CNF	Clearwater National Forest
Council	Northwest Power Planning and Conservation Council
CSWCD	Clearwater Soil and Water Conservation District
EDT	Ecosystem Diagnosis and Treatment Method
EPA	U.S. Environmental Protection Agency
FSA	USDA Farm Service Agency
HUC	Hydrologic Unit Code
IASCD	Idaho Association of Soil Conservation Districts
IDFG	Idaho Department of Fish and Game
IDEQ	Idaho Department of Environmental Quality
IDL	Idaho Department of Lands
IDT	Idaho Department of Transportation
IDWR	Idaho Department of Water Resources
IFIM	Instream Flow Incremental Methodology
ISWCD	Idaho Soil and Water Conservation District
LHTAC	Local Highway Technical Assistance Council
LSCD	Lewis Soil Conservation District
LSWCD	Latah Soil and Water Conservation District
NOAA Fisheries	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPNF	Nez Perce National Forest
NPS	National Park Service
NPSWCD	Nez Perce Soil and Water Conservation District
NPT	Nez Perce Tribe
NRCS	USDA Natural Resources Conservation Service
PAC	Clearwater Policy Advisory Committee
SCC	Idaho Soil Conservation Commission
TU	Trout Unlimited
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USACE	U.S. Army Corps of Engineers
WAG	Watershed Advisory Group (IDAPA 39-3615)
Terms	
APRE	Artificial Production Review and Evaluation
BiOp	Biological Opinion
BMP	Best Management Practice
BURP	Beneficial Use Reconnaissance Program
CCRP	Continuous Conservation Reserve Program (FSA)
CRFMP	Columbia River Fish Management Plan
CRP	Conservation Reserve Program (FSA)
CWA	Clean Water Act
EQIP	Envirnmental Quality Incentive Program
ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
GAP	Gap Analysis Program
HGMP	Hatchery Genetic Management Plan
HUC	Hydrologic Unit Code
IDAPA	Idaho Administrative Procedures Act

Acronym	Definition
INFISH	Interim strategies for managing fish-producing watersheds in Eastern Oregon and Washington, Idaho, Western Montana and portions of Nevada
LOD	Large Organic Debris
LSRCP	Lower Snake River Compensation Program
PACFISH	Interim Strategies for managing anadromous fish-producing watersheds in Eastern Oregon and Washington, Idaho, and parts of California.
PSSZ	Potential Sediment Source Zone
PMU	Potential Management Unit
RHCA	Riparian Habitat Conservation Area
RRWMA	Red River Wildlife Management Area
SI	Salmon Initiative
SPZ	Streamside Protection Zone
STIP	State Transportation Improvement Program
TMDL	Total Maximum Daily Load
WBAG II	Water Body Assessment Guidance 2002
WQPA	Idaho Water Quality Program for Agriculture (SCC)
WHIP	Wildlife Incentive Program (NRCS)
WRP	Wetland Reserve Program (NRCS)

1 Executive Summary

1.1 Subbasin Overview

The Clearwater subbasin is one of the most biologically rich and diverse drainages in the Columbia Basin. Encompassing more that 9,600 square miles of north-central Idaho (Figure 1), it is home to more than 30 species of fish, 19 of which are native, and is inhabited by as many as 340 terrestrial wildlife species. The Clearwater subbasin is bordered to the north by the St. Joe subbasin, to the south by the Salmon River subbasin, to the east by Montana, and it joins the Snake River in the west. The Lochsa, Selway, South Fork, and North Fork Clearwater rivers represent the primary tributaries in the subbasin. All but the North Fork Clearwater River are unregulated. The mouth of the Clearwater is located on the Washington–Idaho border at the town of Lewiston, Idaho where it enters the Snake River 139 river miles (224 km) upstream of the Columbia River.

Although drier and colder in the high elevation and southernmost portions of the subbasin, the climate is strongly influenced by warm, moist maritime air masses from the Pacific. A general increase in precipitation from west to east across the subbasin occurs coincident with increasing elevations, resulting in greater precipitation in the mountainous terrain in the eastern half of the subbasin compared to the low elevation canyons and plateaus to the west. Mean annual precipitation ranges from 12 inches (310 mm) at the Clearwater River's confluence with the Snake River to greater than 90 inches (2,000 mm) in the higher elevations.

Climate, along with oceanic, tectonic, and volcanic forces, has helped shape the largely erosional character of the granitic batholith, which underlies vast portions of the subbasin. Mass wasting processes of erosion are common throughout the highly precipitous terrain in the central and eastern portions of the subbasin, as are processes of surface, rill, and gully erosion in the fertile loess soils common to the western prairie region.

Unlike many other inland west subbasins, over 70% (more than four million acres) of the Clearwater is comprised of forested communities. The Clearwater also contains several unique or disproportionately important plant communities. Most notable are the prairie grasslands in the western portion, wetland and riparian areas in valley bottoms, and coastal disjunct communities within the North Fork Clearwater and Selway/Lochsa confluence.

Roughly two-thirds of the subbasin is federally managed, while the remainder is privately owned. The U.S. Forest Service manages most of the forested land within the Clearwater (over 3.5 million acres), but the state of Idaho, Potlatch Corporation and Plum Creek Timber Company also own extensive forested tracts. The western half of the subbasin is generally in the private ownership of small forest landowners and timber companies, as well as farming and ranching families and companies. Nez Perce Tribal lands are located within or adjacent to Lewis, Nez Perce, and Idaho Counties.

Land use activities that have shaped the current Clearwater subbasin include road construction, timber harvest, agriculture, grazing, mining, and impoundments, irrigation projects, and diversions. A general characterization of these activities is presented below.

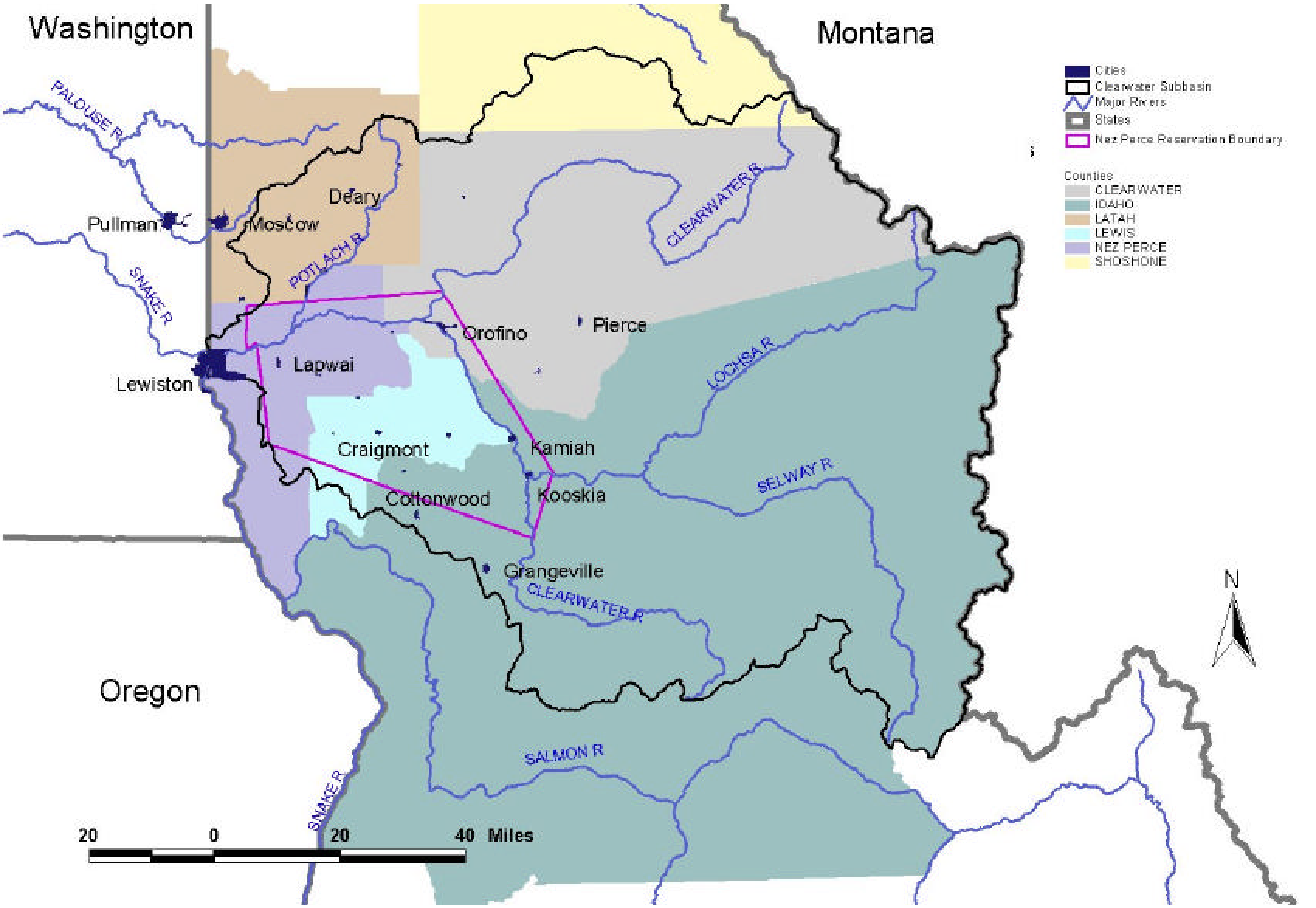

Figure 1. Location of the Clearwater subbasin

- Road densities are greatest in the central portions of the subbasin, commonly exceeding 3 miles/square mile and often exceeding 5 miles/square mile.
- An estimated 760,000 acres of the Clearwater are defined by agricultural activities. Agriculture is most pronounced in the western portion of the subbasin on lands below 2,500 feet elevation, primarily on the Camas Prairie both south and north of the mainstem Clearwater River.
- Grazing occurs throughout much of the subbasin, although available data is only limited to that occurring on federally managed allotments. Subwatersheds with the highest proportion of grazeable area (> 50%) within the Clearwater subbasin are typically associated with USFS grazing allotments in lower elevation portions of their management areas.
- Mining has occurred throughout the entire subbasin, but is most widely and densely distributed within the South Fork drainage. The South Fork Clearwater drainage in particular has a complex mining history that included periods of intense placer, dredge, and hydraulic mining.
- Seventy dams currently exist within the boundaries of the Clearwater subbasin. The majority of dams occur in the lower Clearwater. The seven largest reservoirs in the subbasin include Dworshak, Reservoir A, Soldiers Meadows, Winchester, Spring Valley, Elk River, and Moose Creek.

The Clearwater and Nez Perce National Forests contain some of the last significant spans of roadless terrain and wild fish habitat in the lower forty-eight states, and support a number of threatened and endangered plant and wildlife species. Approximately 47% of the Clearwater subbasin is designated as having some degree of protected status, the majority of which is either inventoried roadless or wilderness area. Portions of the Selway-Bitterroot and Gospel Hump Wilderness exist within the Clearwater subbasin, contributing substantially to the total protected area.

Various ‘focal’ plant and animal species occur in the subbasin. These organisms often serve as indicators of the biological health of the ecosystem, as their presence, absence, or relative abundance is typically dependent upon the condition of an undisturbed, or in some cases, disturbed environment. The requirements of these focal species are such that if their basic needs are met then most other species will have their requirements met as well. The species with the most demanding requirements are usually selected to define the minimum acceptable values for each landscape parameter. This process was applied to the key habitat attributes in the Clearwater subbasin and a list of focal plant, animal, and fish species developed.

Selected focal plant species include

- Clearwater phlox (*Phlox idahonis*)
- Jessica’s Aster (*Aster jessicae*)
- Palouse Goldenweed (*Haplopappus liatriformis*)
- Spacious Monkeyflower (*Mimulus ampliatus*)
- Salmon-flowered Desert Parsley (*Lomatium salmoniflorum*)
- broadfruit mariposa lily (*Calochortus nitidus*)
- Mountain Moonwort (*Botrychium montanum*)
- Crenulate Moonwort (*Botrychium crenulatum*)

Selected focal wildlife species in the Clearwater include

- fisher (*Martes pennanti*)
- wolverine (*Gulo gulo*)
- flammulated owl (*Otus flammeolus*)
- white-headed woodpecker (*Picoides albolarvatus*)
- black-backed woodpecker (*Picoides arcticus*)
- harlequin duck (*Histrionicus histrionicus*)
- Townsend's big-eared bat (*Corynorhinus townsendii*)
- fringed myotis (*Myotis thysanodes*)
- Northern Goshawk (*Accipiter gentilis*)
- peregrine falcon (*Falco peregrinus anatum*)
- boreal toad (*Bufo boreas*)
- Coeur d'Alene salamander (*Plethodon vandykei idahoensis*)

Selected focal fish species in the Clearwater include

- chinook salmon (*Oncorhynchus tshawytscha*)
- steelhead trout (*Oncorhynchus mykiss* subspecies)
- westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
- bull trout (*Salvelinus confluentus*)
- brook trout[1] (*Salvelinus fontinalis*)

A brief summary defines the occurrence of wildlife and plant focal species by assessment unit (AU) rather than by the potential habitat in which they *might* occur.

1.2 Biophysical Assessment

Several methods of assessing relative status, condition, threats, limiting factors, and general trends of wildlife, plant, and fish species are applied in this document. One of the more important approaches, especially in the assessment of Clearwater aquatics, is the stratification of the subbasin's 9,645 square mile area into regions sharing common biophysical properties or themes. Tools used to characterize the subbasin included the use of geospatial data, which enables both visual presentation and summarization of broad-scale data. Geographic Information System software (GIS) allowed for the broad stratification of the subbasin into eight distinct assessment units (AUs). Definition of AUs was based on subjective review of six landscape level characteristics known to influence ecosystem resources at broad landscape scales: lithology, precipitation, elevation, landforms, vegetation and ownership patterns. These six characteristics have impacted both the historic and current status of resources within the subbasin due to their influence on broad-scale ecological function. They can also be expected to influence the applicability and success of future management activities and should be considered during future planning efforts.

Each AU is similar in size to a 4th field Hydrologic Unit Code (HUC) with three AUs sharing boundaries identical to associated 4th code HUCs (upper and lower North Fork and Lochsa AUs; see Figure 2). Landscape attribute combinations are similar within and different between individual AUs (Table 2). Ecological regimes/functions should follow a similar pattern. The various biophysical characteristics of each AU are summarized below. A coarse

[1] Brook trout have the potential to negatively impact other selected species

summarization of key plant, wildlife, and fish species that occur in the unit is included, with their relative status and primary factors limiting persistence.

1.2.1 Lower Clearwater Assessment Unit

The plateau comprising much of Lower Clearwater AU has moderately sloping terrain with local elevations ranging from 2,500 to 3,500 feet, and some isolated buttes reaching as high as 5,000 feet. The plateau is comprised mostly of 0 to 15% slopes with some stream valleys having side slopes exceeding 60%.

Land ownership in the Lower Clearwater AU is predominantly private, and is reflected in the largely agricultural land use pattern, which has occurred since at least the early 1900s. The Nez Perce Reservation lies primarily within the Lower Clearwater AU and Tribal lands (including Fee lands owned and managed by the Nez Perce Tribe, and properties placed in trust status with the BIA) are located primarily within the current Reservation boundaries. Pockets of timberland exist in the upper portions of the Potlatch Creek and Lapwai Creek drainages, with additional smaller scale timberlands distributed throughout many of the steeply incised canyons of the AU. Grazing activity is widely distributed throughout the Lower Clearwater AU, but often limited to the uncultivated canyons and timberlands.

Although annual precipitation in the Lower Clearwater AU is relatively low (<25”), the low elevation results in susceptibility of much of the area to rain on snow events and resultant flashy flows. In tributaries of the Lower Clearwater AU, timing of annual peak flows is highly variable, ranging from early December through late May. Flow variations in the Lower Clearwater are greatest in tributaries in the Camas Prairie where minimum mean monthly discharge can be expected to comprise less than 10% of the mean annual discharge in some areas.

Lava flows from the Columbia River Basalt Group comprise the geologic foundation in the plateau regions. Deep, clay-rich, fertile soils formed of wind blown silt (loess) and volcanic ash mantle these basalt landscapes. Soil characteristics, coupled with local land use and climatic patterns, make rill and sheet erosion a substantial issue throughout much of the Lower Clearwater AU. However, mass wasting and colluvial processes are cause for concern in areas of bench topography and on over-steepened canyon side slopes.

Road density and distribution is relatively consistent throughout the Lower Clearwater AU, with densities typically less than 3 miles/sq. mile. Localized areas with higher road densities are associated with larger forested areas and with the city of Lewiston, ID. Road distribution is typical of rural-residential areas, with predominantly rural and access roads for modern agriculture easily recognized by their straight north/south and east/west alignment.

Dominant cover types in the lower Clearwater include native bunchgrasses, shrublands, ponderosa pine, Douglas-fir/mixed xeric forest, and western red cedar/mixed mesic forest. A threat common to almost all cover type species in the lower Clearwater AU is habitat loss through construction projects and through grazing. Native bunchgrasses and shrublands in this area are particularly susceptible to grazing pressures, pesticide application, and competition with exotic species. A limiting factor common to ponderosa pine, shrubland, and bunchgrass species in this area is fire suppression. Ponderosa pine, Douglas-fir, and western red cedar production are also considered limited by timber harvest and insect/pathogen outbreak. The loss of ponderosa pine habitat in the AU currently represents a limiting factor to dependent wildlife species such as the flammulated owl. Focal plant species most closely associated with the Lower Clearwater AU are Jessica’s aster, salmon-flower desert parsley, palouse goldenweed and spacious monkeyflower . Factors limiting their persistence include small population size, habitat

Table 2. Characterization of AUs delineated in the Clearwater subbasin

Assessment Unit	Geology	Precipitation	Dominant Land Use	Primary Ownership	Predominant Landform	Elevation
Lower Clearwater	Col. River Basalt (CRB)	Low Gen. < 25”	Crop/Grazing	Private	Mixed	Low
Lower North Fork	Belt	Moderate 25-50”	Forested	Mixed	Mountains	Low - Moderate
Upper North Fork	Mixed 50/50 Belt/Granites	High Gen. >50”	Forested	Federal (USFS)	Mountains/ Breaks	Moderate
Lolo/Middle Fork	Mixed boundary; CRB/ Granites	Moderate 25-50”	Forested	Mixed	Mixed	Low
Lower Selway	Mixed 50/50 Belt/Granites	Moderate 25-50”	Forested Shrub/Brush	Federal (USFS)	Breaks	Moderate
Lochsa	Granites; Some Belt	High Gen. >50”	Forested Shrub/Brush	Federal (USFS)	Mountains/ Breaks	Moderate - High
Upper Selway/ Moose Creek	Granites	Moderate-High 25-65”	Forested Shrub/Brush	Federal (USFS)	Mountains/ Breaks	High
South Fork Clearwater	Mixed Belt/Granites	Moderate 25-50”	Forested	Federal (USFS)	Mountains	Moderate - High

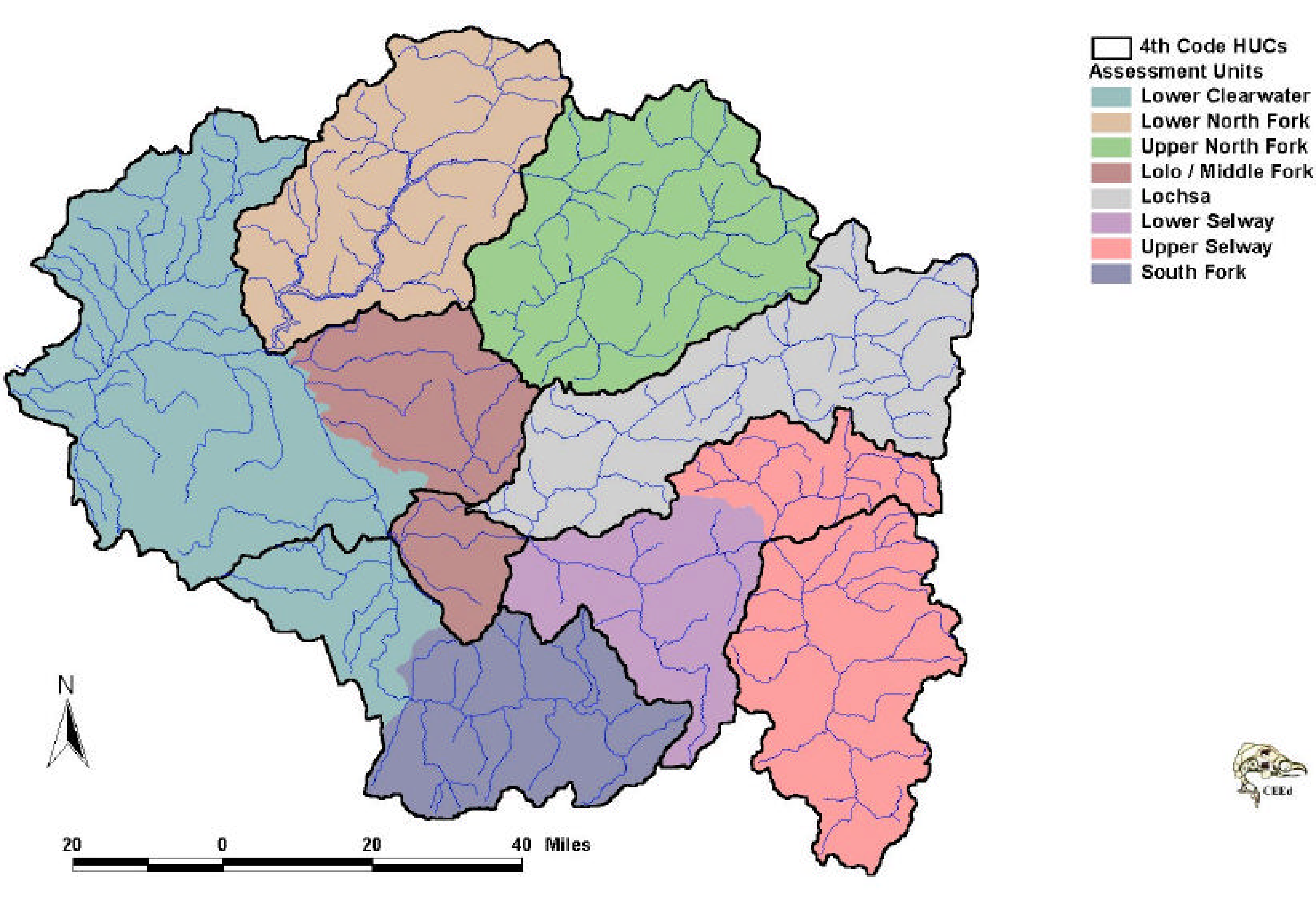

Figure 2. Comparison of assessment units (colored areas) and 4th code HUC boundaries (black outlines) in the Clearwater subbasin

loss through agricultural conversion and grazing, increased competition with nonnative species, and low reproductive capacity due to poor pollen and seed dispersal.

The black-backed woodpecker, white-headed woodpecker, Townsend's bat, fringed myotis, and the western toad may inhabit the lower Clearwater AU. Documentation of these focal species is limited, especially for the black-backed woodpecker, which have only one reported sighting in 1995 up the East Fork Potlatch River. Similarly, the white-headed woodpecker has only one confirmed sighting in the Lapwai drainage. Both woodpecker species are limited by the loss of snags used for roosting and nesting. Common limiting factors to the bat species in the lower Clearwater include human disturbance of roosting sites and subsequent roost abandonment, low reproductive rates and high juvenile mortality, grazing, insecticides that destroy prey, and removal of old buildings. The western toad is limited in this area by disease, habitat loss/fragmentation, trout introductions, livestock grazing, and recreational uses.

Within the Clearwater subbasin, the Lower Clearwater AU is critical for wild A-run steelhead (lower Clearwater tributaries) and fall chinook salmon (mainstem Clearwater River), including all or a substantial majority of their range in the subbasin. With the exception of as a mainstem migration corridor, spring chinook salmon are not known to utilize the Lower Clearwater AU. Bull trout and westslope cutthroat trout have been sporadically noted in tributaries of the Lower Clearwater AU, but their presence is not substantial. These two species do however utilize the mainstem Clearwater River.

Limiting factors to fish in the Lower Clearwater AU tributaries are typically associated with climatic and land use patterns and include temperature, sediment and flow issues (variability and base flow). The lower mainstem Clearwater River is highly influenced by operations at Dworshak Dam, which alters natural temperature and flow regimes.

1.2.2 Lower North Fork Assessment Unit

The terrain of the Lower North Fork Assessment Unit is predominantly mountainous, with side slopes commonly steeper than 60%. Elevation ranges from roughly 2,000 to 5,600 feet. Land cover is almost entirely forest, and land use has relied heavily on timber harvest activities. Due to the mixed ownership, little information on grazing intensity was available: known allotments and other grazeable lands have been defined only in approximately the western one third of the AU.

Mining activities have occurred throughout the Lower North Fork Assessment Unit. Mining activity was widely dispersed and variable by area, and a variety of methods were historically employed included dredging, hydraulics, draglines, drag shovels, and hand operations. Some mining activities have focused on the Little North Fork River drainage where a conglomeration of mining claims have been located.

The Lower North Fork AU contains the most widely and densely distributed forest road network of any AU in the Clearwater subbasin. Subwatershed road densities commonly exceed 5 miles/sq. mile and, in some portions of the AU, exceed 7.5 miles/sq. mile. Exceptions to this pattern are predominantly located in the federally owned portions of the Little North Fork Clearwater River drainage, which contain both inventoried roadless areas and a wild and scenic river corridor. Other areas of protected status within the Lower North Fork AU are minimal in both size and distribution.

Land ownership within the Lower North Fork AU is highly mixed and comprised of private, state and federal holdings. Private timber company holdings (Potlatch Corp. and Plum Creek Timber Co.) make up a substantial percentage of the land area and the state of Idaho owns more property in the Lower North Fork AU than any other area of the Clearwater subbasin. The U.S. Army Corp of Engineers manages property around Dworshak Reservoir.

Annual rainfall in the Lower North Fork AU is moderate for the Clearwater subbasin, ranging from 25-50 inches. With the exception of the highest elevation areas in the northern half of the AU, much of the AU is subject to potential rain-on-snow events. Meta-sedimentary rocks, granites and lava basalts are the dominant geologic parent materials in the AU. These various bedrock types are mantled by ashy soils in the lower elevations and by forest soils at higher elevations. The moist, cool to cold environment common throughout the AU limits soil development and may contribute to slope instability.

Western red cedar/mixed mesic forest and Douglas-fir/mixed xeric forest are the dominant cover types of the lower North Fork AU. Shrublands, which delineate transition areas in vegetative communities, and grand fir represent other important cover types in this area. Cover type habitat loss has resulted from construction projects, logging, and grazing. Herbivory and/or damage from insects has also been a problem. Grand fir communities are especially susceptible to pathogens and may be dominated by dead, suppressed or diseased late-successional stands. Clearwater phlox, Jessica's aster, crenulate moonwort, broadfruit mariposa, and Palouse goldenweed represent focal plant species associated with the lower North Fork. A factor limiting each species is habitat loss, destruction, or modification.

The lower North Fork AU is home to numerous terrestrial vertebrates and has been inhabited by the North American wolverine, fisher, Townsend's big-eared bat, western toad, and Coeur d'Alene salamander. Innundation of habitat following the construction of Dworshak Dam has reduced the occurrence of many terrestrial focal species in this area. Migratory corridors used by the wide-ranging North American wolverine have likely been compromised by the creation of Dworshak reservoir, as have structurally complex riparian areas used by the fisher. Both Townsend's big-eared bat and the western toad are rare and are threatened by loss or fragmentation of habitat. The Coeur d'Alene salamander has been documented throughout several portions of the AU. Based on surveys conducted in the 1980s, the North Fork Clearwater drainage represented the core distribution area for Coeur d'Alene salamanders in the Clearwater subbasin. Recent surveys, however, have been unable to confirm the occurrence of the Coeur d'Alene salamander in many of the previously occupied locations, suggesting the possibility of localized population extirpation.

With the exception of the lower 1.9 miles of the mainstem North Fork Clearwater River, passage of anadromous species into the Lower North Fork AU is completely blocked by Dworshak Dam. Dworshak Reservoir is located entirely within the Lower North Fork AU and provides a substantial fishery for kokanee, smallmouth bass, rainbow trout, and other native salmonids. Limitations to the Dworshak Reservoir fishery are primarily related to dam operations resulting in highly variable flows and fluctuating water levels.

Bull trout distribution is restricted to the highest elevation tributaries of the Lower North Fork AU, and to Dworshak Reservoir. Although westslope cutthroat trout are known to be widely distributed throughout most of the AU, limited information is available on the status of populations. Strong populations of both bull trout and westslope cutthroat trout exist in the Little North Fork Clearwater River drainage. Resident salmonids throughout the AU tributary systems are impacted by sediment and temperature issues associated with land use activities, as well as by introductions of exotic species. Brook trout are widely distributed throughout the AU, however little is known about their population status in most areas.

1.2.3 Upper North Fork Assessment Unit

Like much of the Clearwater subbasin, the terrain of the Upper North Fork Assessment Unit is predominantly mountainous, with side slopes commonly exceeding 60% slope. Elevation ranges from roughly 3,600 to 6,000 feet. Land cover is primarily forested with shrub and brush rangelands intermixed. Ownership is roughly 90% federal (managed by USFS) with the remaining 10% divided among the State of Idaho, Potlatch Corporation, and other private holdings. Non-federal holdings are clustered in the western most portion of the AU.

Approximately 75% of the Upper North Fork AU is included in inventoried roadless areas. Where roads do exist, densities are relatively high for the Clearwater subbasin, ranging from 5 to 7.5 miles/sq. mile at the subwatershed scale. Historic mining activities occurred throughout the North Fork Clearwater drainage, although activities were widely dispersed. A variety of mining methods were historically employed including dredging, hydraulics, draglines, drag shovels, and hand operations, and legacy impacts of past mining is still noted today.

Precipitation in the Upper North Fork AU is higher than any other AU in the subbasin, averaging about 59 inches annually. Portions of the AU receive nearly 100 inches of annual precipitation, more than any other area in the Clearwater subbasin. Winter precipitation falls mainly as snow, although lower elevation canyons along mainstem tributaries may be susceptible to rain-on-snow events.

Geologic parent materials are dominated by granitic batholith, with meta-sedimentary rocks also commonly occurring, particularly in the northernmost portions of the AU. Ash-derived soils are common in the upper North Fork AU, and, when combined with topographic and climatic features, contribute to high levels of vegetative productivity. Landslides on steep canyon slopes are common, and based on the relatively undisturbed nature of much of the area, may be the predominant sediment source to streams.

Western red cedar/mixed mesic forest, Douglas-fir/mixed xeric forest, and shrublands make up the dominant cover types in the Upper North Fork. Subalpine fir and lodgepole pine are also common. Western red cedar/devils club, and/or western red cedar/maidenhair fern habitat types may occur in moist, warm portions of the assessment unit. These sites are known to support disjunct, relict populations of coastal plant species due to the persistent locally intensified expression of a maritime environment. The only focal plant species known to occur in the Upper North Fork AU is spacious monkeyflower. Spacious monkeyflower is threatened by livestock trampling.

Focal wildlife species documented in the Upper North Fork Clearwater AU include the Harlequin duck, the Coeur d'Alene salamander, fisher, and possibly woverines. Each of these terrestrial focal species have limited doumentation, which may be related to their affinity for undeveloped andr remote habitats. Small breeding populations, habitat fragmentation, and displacement by humans represent factors limiting species persistence and abundance in the Upper North Fork AU. The harlequin duck, Coeur d'Alene salamander, and fisher are closely associated with riparian areas and lotic environments. Changes to habitat components such as woody debris jams, vegetation, and/or hydrology are most likely to affect these species.

The Upper North Fork Clearwater AU fishery is predominantly managed for native resident species, with bull trout and westslope cutthroat trout as aquatic focal species. The tributary systems also provide important spawning areas for some Dworshak Reservoir salmonids including bull trout and kokanee. Limited information is available on the status of bull trout population(s) in the Upper North Fork AU, but indicate a depressed condition where available. In contrast, the status of westslope cutthroat trout population(s) is strong throughout the majority of the AU. Recent studies have suggested that introgression of westslope cutthroat trout and introduced rainbow trout may be occurring in the Upper North Fork AU. Information on the distribution and status of brook trout is limited, although they are known to be present and relatively strong in some areas where they may compete with bull trout.

Major factors limiting fish populations in the Upper North Fork AU include sedimentation and localized watershed disturbances. Introduction of exotic species and related competition/introgression is also a major factor influencing native salmonid populations in the Upper North Fork AU.

1.2.4 Lolo/Middle Fork Assessment Unit

The Lolo/Middle Fork AU in many ways represents a transitional area in the Clearwater subbasin. Elevations range from about 2,300 feet in the western portions of this AU along the mainstem Clearwater River to about 4,300 feet in the easternmost portions. The change in elevation follows a change in topography from west to east, progressing from plateau to foothills to mountainous terrain.

Climatic conditions vary with changes in elevation and terrain, with annual precipitation increasing from roughly 25-75 inches on a west to east gradient through the Lolo/Middle Fork AU. Average annual precipitation of approximately 40 inches for the AU as a whole is moderate for the Clearwater subbasin. The vast majority of the Lolo/Middle Fork AU lies below 4,000 feet in elevation, making it subject to mixed winter precipitation and the possibility of rain-on-snow events.

Land ownership in this AU is highly mixed and comprised of private, state, federal and tribal holdings. Potlatch Corporation and the Idaho Department of Lands manage substantial portions of the land within the AU, and properties managed by these two entities are highly intermixed. The eastern-most portion of the Lolo/Middle Fork AU is federally owned and managed by the U.S. Forest Service. Private holdings are an important component in the western half of the AU, which are also interspersed by Nez Perce Tribal lands. Less than 10 percent of the land area is afforded any protected status, with the majority of that being inventoried roadless area.

Land cover is primarily forest, with agricultural use limited to portions of the western plateaus. Western red cedar/mixed mesic forest and Douglas fir/mixed xeric forest cover types are dominant in the AU. Much of the forested area has been intensively harvested in the past, a fact reflected in the high densities of forest roads through much of the AU. Subwatershed-scale road densities exceed 5 miles/sq. mile through most of the AU, and in some areas exceed 7.5 miles/sq. mile.

The Lolo/Middle Fork AU has a rich mining history, the impacts of which are still notable today. Substantial numbers of mining claims are present on federal and state lands throughout the AU. Mines have been located throughout the AU, and the headwaters of Orofino Creek contain numerous mines with relatively high ecological hazard ratings.

Geology and soils also vary considerably throughout the Lolo/Middle Fork AU. Low relief hills lead up into the Clearwater Mountains as the lava basalt from the west interfingers with a series of metamorphic and sedimentary rocks that eventually change into the granite of the Idaho Batholith in the east. Clay-rich grassland soils follow the progression in elevation and grade into clay-rich forest soils in the higher, cooler climates. Landslide hazard potential is high in the southern portion of this AU.

Palouse goldenweed, salmon-flowered desert parsley, Jessica's aster, and broadfruit mariposa lily are focal plant species documented in the Lolo/Middle Fork AU. Competition with nonnative species, pathogens, conversion of habitat to agriculture and herbivory represent common factors limiting their abundance, distribution, and persistence.

Although specific documentation of focal wildlife species in the Lolo/Middle Fork AU is limited, fisher, wolverine, flamulated owl, and northern goshawk have been documented. Road construction, urban development, timber harvest, and other means of habitat loss/conversion represent common factors limiting the persistence of these rare species. The loss of mature or old growth timber and decline in multi-stage forests has probably reduced the suitability of the assessment unit for ponderosa pine dependents such as flammulated owls and northern goshawks.

Steelhead trout and westslope cutthroat trout utilize all major stream systems in the Lolo/Middle Fork AU. Spring chinook salmon and bull trout are found in the Lolo Creek system and tributaries to the Middle Fork Clearwater River. Populations of all four species are depressed throughout their known range in this AU, and current management practices incorporate substantial outplanting of both spring chinook salmon and steelhead trout. Pacific lamprey are thought to occupy portions of the AU, but no information is available on their distribution or status. Brook trout distribution includes all areas where bull trout are known to occur, with potentially important management consequences. Major factors limiting fish populations within the Lolo/Middle Fork AU include temperature, sediment, and upland and instream habitat disturbance or degradation.

1.2.5 Lochsa Assessment Unit

Topography of the Lochsa Assessment Unit is dominated by mountainous terrain and breaklands, with side slopes commonly exceeding 60%. Elevations range from about 3,200 feet near the mouth of the drainage to roughly 7,000 feet in the headwaters.

Due to differing climatic regimes in the Clearwater subbasin, the Lochsa AU represents the southern-most area in which the climate is predominantly influenced by maritime conditions. This, coupled with relatively high elevation results in a high level of mean annual precipitation relative to other AUs in the subbasin. Average annual precipitation for the entire AU is about 53 inches, with some areas receiving over 80 inches of annual precipitation. Winter precipitation falls mainly as snow although lower elevation canyons along the Lochsa River and some tributaries may be susceptible to rain-on-snow events.

Land ownership in the Lochsa AU is predominantly federal (managed by USFS) with Plum Creek Timber Company having intermixed holdings in the Crooked and Brushy Forks. Nearly 80 percent of the Lochsa AU is included in either wilderness or inventoried roadless areas. Road densities related primarily to timber harvest activities in remaining areas are moderate to high, typically ranging from about 3 to greater than 7.5 miles per square mile.

Granitic batholith is the dominant bedrock through much of the AU, with schist common in portions of headwater areas. Where granite is the dominant parent material, soils tend to be weakly developed, vary in depth, and maintain porous surface and subsurface textures. Soils occurring on metasedimentary landscapes are typically fine textured, consisting of silt loam on the surface and silty clay loam in the subsurface. The potential hazard for mass wasting is most pronounced in the western portion of the AU.

A diversity of vegetative cover types occur in the Lochsa AU. Western red cedar/mixed mesic forest, subalpine fir, Douglas-fir/mixed xeric forest, lodgepole pine, and shrublands comprise the dominant types. A common limiting factor to all but the subalpine fir cover type is habitat loss,destruction or modification through the effects of logging. The loss of late and early seral habitats in the Lochsa AU represents a limiting factor to focal wildlife species such as fisher and black-backed woodpecker (respectively). Focal plant species occurring in the Lochsa AU are not defined. However, at the confluence of the Selway and Lochsa Rivers are areas containing many plant species more typically found in the Oregon and Washington coastal rainforests. These communities have been referred to as a “refugium ecosystem” because of their unique distribution and species composition. Elements from the moist coastal area intermingle with more typical Rocky Mountain species. Many species associated with this community are considered rare or sensitive.

Fisher, wolverine, flammulated owl, black-backed woodpecker, harlequin ducks, and Coeur d'Alene salamander have been documented in the Lochsa AU, although most species are considered to be uncommon or rare. Fisher and wolverine populations are likely suppressed by the presence of Highway 12, clearcuts, and logging roads. Black-backed woodpecker habitat is limited by fire suppression and post-fire logging that reduces the number of decaying snags. The distribution and habitat of harlequin ducks is limited by logging, road construction, destruction of riparian areas, disturbance by recreational anglers and hikers, and flooding.

The Lochsa AU provides important habitat areas for steelhead trout, spring chinook salmon, bull trout, and westslope cutthroat trout. Management of anadromous species focuses on maintenance of wild/natural steelhead trout populations, and naturally reproducing chinook salmon populations. Chinook salmon are influenced through active hatchery practices. Bull trout populations are depressed in most areas where they exist in the Lochsa AU, as are chinook salmon. The Fish and Hungery Creek system maintains one of the strongest steelhead runs in the Clearwater subbasin. Westslope cutthroat trout populations are strong throughout most of the Lochsa AU. Information regarding brook trout distribution is limited, but suggests that they are typically widespread where they are known to occur.

Major factors limiting fish populations in the Lochsa AU include sedimentation, poor instream cover and impacts from upland disturbances. Introgression or competition with exotic species is a concern for resident species. High mainstem temperature conditions are a concern for all species, but are presumed to result primarily from natural conditions.

1.2.6 Lower Selway Assessment Unit

Topography of the Lower Selway AU is dominated by breaklands and glaciated mountains, with land slopes commonly exceeding 60%. Elevation ranges from about 3,200 feet to over 6,000 feet. Land ownership is almost entirely federal and managed by the U.S. Forest Service.

Nearly 90 percent of the Lower Selway AU is afforded some level of protected status, primarily as inventoried roadless or wilderness area. This status limits land use activities in the area and results in minimal road densities (<1 mile/sq. mile) in most areas. At the subwatershed scale, the highest road densities in the AU are less than 3 miles/sq. mile.

The climate of the Selway River drainage shows a marked difference from much of the remainder of the Clearwater subbasin, and is dominated by dryer Rocky Mountain climatic regimes. Relative to other AUs in the Clearwater subbasin, the Lower Selway AU experiences a moderate average annual precipitation (approx. 42 inches) despite its moderate to high elevation. Winter precipitation falls mainly as snow although lower elevation canyons along the Selway River and some tributaries may be susceptible to rain-on-snow events.

Western red cedar/mixed mesic forest, Douglas fir/mixed xeric forest, subalpine fir, shrublands, and lodgepole pine comprise the dominant cover types in the lower Selway AU. Douglas-fir, which is adapted to the drier climate of the lower Selway, is well established throughout the AU and in some areas may occur as dense thickets, which provide a continuous fuel ladder to the crown of overstory trees. In the upper montane zone, Douglas fir is less shade tolerant and is replaced by, among other species, western redcedar. Documentation of focal plant species is not available.

North American wolverine, fisher, northern goshawk, and Coeur d'Alene salamander have been documented as occurring within the lower Selway AU. Because of the comparative amount of undeveloped habitat, the lower Selway AU is more likely than other portions of the subbasin to contain species requiring solitude or connectivity with other undisturbed habitats (i.e. wolverine and fisher). The focal wildlife species documented in this area are commonly associated with tributary or mainstem stream or river corridors. Natural disturbance, such as fire, flooding, and drought, are factors most likely to limit species' distribution, abundance, and persistence.

Parent material is dominated by schist throughout much of the lower Selway AU, with granitic batholith dominating the northeastern one third of the AU. Soils on breakland landforms tend to be unconsolidated and mobile. High-elevation soils are fine textured, consisting of silt loam on the surface and silty clay loam in the subsurface. Landslides on steep slopes are common.

Management of anadromous species focuses on maintenance of wild/natural steelhead trout populations in the Selway River system. Spring chinook salmon have been re-introduced and although naturally reproducing runs exist, hatchery influences to chinook stocks continue. Where status information is available, spring chinook salmon, steelhead trout, and bull trout populations in the Lower Selway AU are generally depressed. However, strong populations of both bull trout and steelhead trout do exist in the Meadow Creek drainage. Westslope cutthroat trout populations are considered strong in much of the Lower Selway AU where status information is available. Brook trout are widely distributed throughout the Lower Selway AU.

Due to the predominance of wilderness and roadless area in the Lower Selway AU, limiting factors are closely tied to natural regimes with one primary exception. Introduced species are a threat to resident salmonid populations. Natural temperature and sediment regimes may impact all fish species. High stream gradient is known to limit both steelhead trout and chinook salmon access to some areas, and likely has similar impacts to resident salmonids.

1.2.7 Upper Selway Assessment Unit

Topography of the Upper Selway AU is dominated by high elevation breaklands and glaciated mountains, with steep slopes that commonly exceed 60%. Elevation ranges from about 3,800 feet to over 8,000 feet on the highest peaks. Land cover is mostly evergreen forest, interspersed with shrub and brush rangeland and exposed rocky peaks. Land ownership is almost entirely federal and managed by the U.S. Forest Service.

One hundred percent of the Upper Selway AU is afforded some level of protected status, with the majority of the AU established as wilderness area. This status limits consumptive land use activities in the area. A few roads exist within the wilderness boundary, but densities are minimal (<1 mile/sq. mile) where they do exist.

The climate of the Selway River drainage shows a marked difference from much of the remainder of the Clearwater subbasin, and is dominated by dryer Rocky Mountain climatic regimes. Similar to the Lower Selway AU, the Upper Selway AU experiences a moderate average annual precipitation (approx. 44 inches) despite its high elevation and mountainous terrain. Winter precipitation falls mainly as snow although some portions of lower elevation canyons along the Selway River and some tributaries susceptible to rain-on-snow events.

Parent material is almost entirely composed of granitic batholith. The granite is primarily covered by submature soils containing noncohesive particles of sand and gravel intermixed with volcanic ash. Grus is a common soil type throughout the AU, contributing to the erosivity of the landscape.

The dominant vegetative cover types in the Upper Selway AU include Douglas-fir/mixed xeric forest, subalpine fir, western red cedar/mixed mesic forest, and lodgepole pine. The dry climate of the AU favors the establishment of drought tolerant species, although hydrophyllic species are commonly associated with moist areas such as toeslopes, riparian areas, seeps, or springs. Common limiting factors to vegetative cover types include natural disturbance processes such as fire, flooding, drought, or insect outbreaks. Documentation of focal plant species in the Upper Selway AU was not available.

North American wolverine, fisher, harlequin duck, and Coeur d'Alene salamander have confirmed sightings in the Upper Selway AU. TheUpper Selway is likely used by wolverine as a migratory corridor, connecting the Salmon River subbasin to northern habitats. The Selway drainage represents the southern range of distribution for the Coeur d'Alene salamander. Because of its protected status, focal populations are most likely limited by natural disturbance processes including wildfire, drought, and flooding.

Management of anadromous species focuses on maintenance of wild/natural steelhead trout population(s) in the Selway River system. Spring chinook salmon have been re-introduced and although naturally reproducing runs exist, hatchery influences to chinook stock(s) continue. Steelhead trout population(s) are strong in the Moose Creek and Bear Creek drainages, and depressed throughout the remainder of the AU where status information is available. Chinook salmon, like elsewhere in the Clearwater subbasin, are depressed throughout their distribution in the Upper Selway AU.

Bull trout and westslope cutthroat trout are widely distributed throughout the Upper Selway AU. Westslope cutthroat trout population(s) are strong through the majority of their range. Status information on bull trout populations is sporadic, but strong and depressed areas appear to be somewhat evenly divided. Information on distribution and status of brook trout is limited in the Upper Selway AU, but they are known to exist.

Due to the predominance of wilderness and roadless area in the Upper Selway AU, limiting factors are closely tied to natural regimes with one primary exception. Introduced species, particularly brook trout, are a threat to resident salmonid populations. Natural sediment regimes may impact some fish species, and high stream gradients and other natural barriers are known to limit the distributions of multiple species.

1.2.8 South Fork Assessment Unit

The South Fork AU differs dramatically in character from most other AUs in the Clearwater subbasin. Elevation is relatively high, ranging from about 4,000 to over 7,000 feet. However, the general topography differs from much of other high elevation topography in the subbasin in that it is comprised, to a large degree, of rolling hills rather than the more jagged mountainous peaks commonly associated with the Bitterroot Mountain range.

The South Fork AU is strongly influenced by the dry Rocky Mountain climatic patterns rather than maritime patterns which influence much of the northern and western portions of the subbasin. Mean annual precipitation throughout the AU is only about 36 inches. Most precipitation falls as snow, with very little of the area potentially subject to rain-on-snow events. Only about 10-15 percent of the precipitation falls in the summer months.

The Clearwater Mountains in this area are composed of a variety of bedrock types including basalt, granite, metamorphic and some sedimentary rocks. The geology in this area has been exposed to varying climatic conditions and erosional processes, creating an assortment of landforms. Ashy soils are the dominant soil in the area and have greatly varying characteristics making erodibility highly variable and difficult to predict.

The dominant cover types in the South Fork AU include western red cedar/mixed mesic forest, Douglas fir/mixed xeric forest, grand fir, subalpine fir, and lodgepole pine. The grand fir mosaic is a unique community type found only in the Clearwater River drainage of northern Idaho and in the Blue Mountains of northeast Oregon. Within the Clearwater, this community type occupies approximately 500,000 acres between the Selway and South Fork Clearwater rivers. It occurs on all aspects in all topographic positions between 4,200 feet and 6,000 feet elevation. Factors limiting the persistence of the primary vegetative cover types in this area include timber harvest, insect infestation, wildfire/fire suppression, pathogens, herbivory, and competition. The only focal plant species documented as occurring in the South Fork AU is salmon-flowered desert parsley. Salmon-flowered desert parsley exhibits an affinity for canyon bottoms and stabilized talus, both of which occur in the South Fork AU. The species is threatened by road maintenance and gravel quarry operations.

There have been confirmed sightings of focal wildife species in the South Fork AU, including North American wolverine, fisher, white-headed woodpecker, black-backed woodpecker, and flammulated owl. The South Fork Clearwater AU represents a key habitat unit for black-backed woodpeckers. The loss of mature pine trees and snags at varying degrees of decay is considered a limiting factor to the persistence of both woodpecker species and the flammulated owl. Habitat losses have occurred through timber harvest, road construction, mining, and grazing.

Ownership is primarily federal (managed by USFS and BLM) with a small percentage held by the state of Idaho or private landowners. Approximately 25 percent of the South Fork AU is designated as either wilderness or inventoried roadless area. Forestry activities are represented in both past and present land use patterns. Forest road densities are unevenly distributed as a result of interspersed wilderness or inventoried roadless areas ranging to over 5 miles/sq. mile in some roaded areas, and commonly exceeding 3 miles/sq. mile in others.

The South Fork AU has the most diverse and extensive mining histories of any area in the Clearwater subbasin. A large number of the historic mines have high ecological hazard ratings, and many of the major tributary systems have been historically dredged. In addition, hydraulic mining was commonly used throughout the South Fork AU, leaving glory holes which continue to produce high sediment loads.

Both chinook salmon and steelhead trout populations in the South Fork AU are widely distributed and currently influenced by hatchery practices. Populations of both species are considered depressed throughout their known range in the South Fork Clearwater drainage. Westslope cutthroat trout are widespread but depressed through much of their range, with strong populations in southern tributaries originating in the wilderness area. Bull trout follow a similar pattern of distribution and status to westslope cutthroat trout. Known strong populations of bull trout are located in tributaries originating in wilderness areas although a strong population is known to exist in the Newsome Creek drainage as well. Brook trout are widely distributed throughout the South Fork drainage, and may compete with resident salmonids.

Sedimentation is a principal factor limiting fish populations within much of the South Fork AU. Upland and instream habitat disturbances are also important, and temperature limits the use or distribution of some species, particularly in the mainstem South Fork Clearwater River. Steep stream gradients are known to limit use of some areas by anadromous species, and similar impacts probably impact resident species as well.

2 Introduction

The Clearwater Subbasin Plan has been developed as part of the Northwest Power and Conservation Council's (Council; See Table 1 for a complete list of acronyms used in this document) Columbia River Basin Fish and Wildlife Program. Subbasin plans will be reviewed and eventually adopted into the Council's Fish and Wildlife Program to help direct Bonneville Power Administration (Bonneville) funding of projects that protect, mitigate and enhance fish and wildlife habitats adversely impacted by the development and operation of the Columbia River hydropower system. The, National Marine Fisheries Service (NMFS, also referred to as NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) intend to use subbasin plans as building blocks in recovery planning to meet the some of their requirements of the 2000 Federal Columbia River Power System Biological Opinion. Subbasin planning through the Council's program will also assist Bonneville with some of the requirements they have under the 2000 BiOp.

The Clearwater Policy Advisory Committee and the Nez Perce Tribe intend the Clearwater Subbasin Plan to serve multiple purposes. They intend the plan to meet the Council's call for subbasin plans as part of its Columbia Basin wide program and to provide a resource for federal agencies involved with Endangered Species planning efforts. But equally important this plan is a locally organized and implemented effort involving the major resource managers and local governments in the subbasin to develop the best possible approach to protecting, enhancing and restoring fish and wildlife in the Clearwater Subbasin. This plan is intended to provide resources necessary to develop activities forwarding the vision of the Clearwater Policy Advisory Committee at both subbasin/programmatic scales and to provide the context and information for developing site specific projects. The Clearwater Subbasin Plan is comprised of three volumes that are interdependent, but each provides a unique way in understanding the characteristics, management, and goals for the future of the Clearwater subbasin. The three volumes generally conform to the guidance set forth in the Council's *Technical Guide for Subbasin Planners* (2001), which became available during the middle of the project.

Assessment-- The assessment develops the scientific and technical foundation for the subbasin plan. The assessment provides an overview, a discussion of focal species and habitats, including environmental conditions and ecological relationships, limiting factors and synthesis and interpretation. The Clearwater Subbasin Assessment provides the analysis and background information to support the recommendations made in the Clearwater Subbasin Management Plan.

Inventory-- The inventory includes information on existing fish and wildlife programs, projects and activities past (last 5 years) and future. This information provides an overview of the management context, including existing resources for protection and restoration in the subbasin.

Management plan-- The management plan includes a vision for the future of the Clearwater subbasin, biological objectives, and strategies for reaching management goals.

The initial planning and cooperation building efforts that culminated in the development of the Clearwater Subbasin Plan began with the designation of the Clearwater subbasin as a Council Focus Program in late 1996. The purpose of the Clearwater Focus Program is to coordinate projects to enhance and restore fish and wildlife habitats in the Clearwater River subbasin to meet the goals of the Council's program. Idaho Soil Conservation Commission (SCC) and the Nez Perce Tribal Watershed Division (one of 6 divisions within the NPT Fisheries Department) co-coordinate the Focus Program on behalf of Idaho State and the Nez Perce Tribe (NPT).

Beginning in the fall of 1999, the NPT Watershed Division contracted with Washington State University, Center for Environmental Education (CEEd) to produce the Clearwater Subbasin Assessment. NPT provided funding for the assessment and planning via contracts with the Bonneville Power Administration. Idaho Soil Conservation Commission provided supplemental funding and staff resources. Early assessment work focused on anadromous and resident fish populations, available habitat quantity and quality, and land management implications to fish populations.

The Clearwater Focus Program convened the Clearwater Policy Advisory Committee (PAC) to coordinate a multi-agency, ecosystem-based approach to protection and restoration of fish and wildlife habitat and to oversee the Clearwater subbasin planning process. PAC membership includes representatives from the major resource management agencies, private landowners, and local governments in the Clearwater subbasin. Current PAC members include:

George Enneking*, Idaho Association of Counties, Chairman
Cal Groen, IDFG, Vice Chairman
Bruce Bernhardt, Nez Perce National Forest
Dale Brege, U.S. National Marine Fisheries Service
Kerby Cole, Idaho Department of Environmental Quality
Terry Cundy, Potlatch Corporation
Larry Dawson, Clearwater National Forests
Allen Slickpoo, Jr.*, Nez Perce Tribe Executive Committee
Kyle Hawley*, Idaho Assoc. of Soil Conservation Districts
Bob McKnight, Idaho Department of Lands
Bill Miller, U.S. Fish and Wildlife Service
*Elected officials of local or tribal government

In response to the more complete ecosystem view of subbasin planning emerging in the Council, a terrestrial subcommittee was formed by the PAC in mid-2000 to guide the development of the Clearwater Terrestrial Subbasin Assessment. The NPT's Wildlife Department was contracted to produce the terrestrial portion of the assessment in early 2001. Terrestrial subcommittee members included representatives from the NPT, Idaho Department of Fish and Game, U.S. Bureau of Land Management, Clearwater National Forest, U.S. Army Corps of Engineers and Potlatch Corporation.

Ecovista, a private company started by the original project staff from Washington State University, produced the Draft Clearwater Aquatic Assessment in September of 2001. The NPT Wildlife Department completed the Draft Clearwater Terrestrial Assessment in October of 2001. Ecovista integrated the two assessments into one document, addressed comments and integrated the collaborative efforts of subbasin resource managers into the Clearwater Subbasin Plan during 2002. Writing team members for these efforts include the following

Aquatic Assessment and Subbasin Management Plan

Thomas Cichosz,	fisheries biologist
Craig Rabe,	aquatic ecologist
Anne Davidson,	spatial ecologist
Darin Saul, Ph.D. ,	project manager/editor

Terrestrial Assessment

Angela Sondenaa, Ph.D.	botanist, wildlife biologist
Gail Morgan,	wildlife biologist, GIS analyst
Shana Chandler,	wildlife ecologist
Blair McClarin,	field biologist
Jeff Cronce,	GIS Analyst
Marcie Carter,	wildlife biologist
Carl Hruska,	wildlife biologist

The aquatics portion of the assessment was disseminated for review throughout the development phase using email lists compiled by Focus Program staff and as an entire draft in August 2001. Large portions of the aquatic assessment were also incorporated into the Clearwater Subbasin Summary, released May 2001 (Cichosz et al. 2001) and reviewed accordingly as part of the development process for that document. The terrestrial portion of the assessment was first disseminated for review as described for the aquatic assessment and as an entire draft in January 2002 and then again in a merged document March 2002. Through these review processes, hundreds of comments, suggestions and clarifications were received from local, state, tribal, and federal representatives with relevant professional expertise (Individual reviewers and contributors are listed in Table 3). Data, comments, and working knowledge of these individuals as it relates to the Clearwater subbasin have been integrated into the document to improve its accuracy and utility. There were 14 PAC and 10 subcommittee technical meetings, six Focus Program contracting meetings, and 2 meetings with NOAA Fisheries, Focus Program, and CEEd staffs during development of the Clearwater Subbasin Assessment (September 1999 – August 2001).

Subbasin planning began January 2002. The Clearwater PAC had functioned as the aquatic technical review subcommittee during the assessment phase, calling on respective staff for participation. The PAC decided for the planning phase an Aquatic Subcommittee should be formed to complement the Terrestrial Subcommittee, to provide technical direction to the contract writers of the subbasin plan. Membership on the subcommittees included Clearwater PAC members and staff representatives from fish and wildlife agencies in the subbasin. The subcommittees reviewed and worked on components of the subbasin plan as they were developed prior to each Clearwater PAC review. E-mail announcement of component re-writes were distributed to the technical contact list developed by the Focus Program staff (also used during the assessment phase). These reviews were prior to and independent of the July, August, September, and October (2002) releases of the subbasin plan drafts, which included the subbasin assessment, for comment. There were 13 PAC and nine technical subcommittee meetings, one conference call with NOAA Fisheries staff, and 11 public meetings held during development of the Clearwater Subbasin Management Plan and Inventory (January 2002 – October 2002). See Appendix C of the Subbasin Plan for a complete description of the Public and Government Participation Plan and overview of its implementation during the planning process. Individuals who participated in meetings, provided comment, or drafted portions during the planning phase of the Clearwater Subbasin Plan are listed in Table 3.

The Nez Perce Tribe Executive Committee passed a resolution on October 8, 2002 approving the motion to forward the Clearwater Assessment and Plan to the Council for review. The members of the Clearwater PAC endorsed the Final Draft Clearwater Subbasin Plan on October 8, 2002.[2]

The *Final Draft Clearwater Subbasin Plan* was presented to the full Council on November 14, 2002; a workshop was held later in November 2002 for the Independent Scientific Review Panel (ISRP) and a number of federal agencies in November 2002. The ISRP review of the Clearwater Subbasin Plan became available in February (Council Document 2003-3). NOAA Fisheries provided informal comments on the plan in February 2003 as well. The Clearwater PAC decided to go through a revision phase prior to submitting the subbasin plan for adoption into the Council's program.

Revision of the *Final Draft Clearwater Subbasin Plan* began April 2003 and was completed October 31, 2003 with the Clearwater PAC having held six meetings and the technical subcommittees four to complete revisions. Clearwater PAC representatives, Ecovista staff, and Council staff (Idaho) meet with NOAA fisheries staff from Idaho and Portland on May 8, 2003 to discuss the ESU population delineations made by the Interior Columbia Technical Recovery Team and again in a more regional meeting in July 2003. After each technical subcommittee meeting another draft of the subbasin management plan was prepared and announced for review using email lists compiled throughout the process. Individuals who participated in meetings, provided comment, or drafted portions during the revision phase of the Clearwater Subbasin Plan are listed in Table 3.

The Clearwater PAC endorsed the Clearwater Subbasin Plan and recommended it be submitted to the Council for adoption by motion on October 31, 2003.

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[2] The Clearwater PAC (referred to hereafter as the Parties)understand that this Plan shall be presented to the Northwest Power and Conservation Council (Council), as a proposed amendment to the Fish and Wildlife Program, for its review and appropriate action under the authority of the Northwest Power Planning Act. The Parties, except where specifically noted therein, support the Plan as an amendment to the Council's Fish and Wildlife Program, and its implementation if adopted as an amendment by the Council. The Parties believe that the Plan represents many areas of agreement, reached through a broadly collaborative process. However, the Parties recognize that the Plan does not resolve all differing legal, scientific and/or policy perspectives of the Parties, and that each Party may, at its own discretion, continue to advance their unique perspectives in the many fora dealing with the subject matter of the Plan. The Parties to this Plan specifically recognize that each Party reserves all legal rights, powers, and remedies now or hereafter existing in law or in equity, by statute, treaty, or otherwise. Nothing in this Plan is nor shall be construed to be a waiver, denial, or admission of any current or future legal claim or defense.

The Clearwater PAC will continue under the 2000 Columbia Fish and Wildlife Program and the Clearwater Subbasin Plan. The Clearwater Subbasin Plan will be reviewed and amended as necessary at least every five years after adoption into the Council's program.

The Clearwater Focus Program created by the 1994 Columbia Basin Fish and Wildlife Program will continue under the 2000 Columbia Basin Fish and Wildlife Program and the Clearwater Subbasin Plan. Proposals for appropriate operational funding will be made during provincial reviews or whatever other funding cycle the program endorses after subbasin planning. See Section 2 of the Clearwater Subbasin Inventory for a description of the subbasin plan review process and the functions of the Focus Program and PAC.

Table 3. Individuals who participated in the development of the Clearwater Subbasin Plan. Present and former Clearwater PAC members and alternates are shown in bold print.

Name	Agency	Specialty
Althouse, Scott	NPT	Law
Ballou, Erv	IDWR	Mining/Water Resources
Beach, Ted	Rocky Mtn Elk Foundation	
Bellatty, Jim	**IDEQ**	**Management**
Bennett, David	UI	Biology Fish
Blair, Steve	NPNF	Biology Wildlife
Blew, David	IDWR	Biology Aquatic
Bowler, Bert	IDFG	Biology Fish
Brege, Dale	**NOAA**	**Biology Fish**
Brostrom, Jody	IDFG	Biology Fish
Burge, Howard	USFWS	Biology Fish
Butterfield, Bart	IDFG	Biology Fish
Carter, Marcie	NPT	Biology Wildlife
Caswell, Jim	**IOSC**	**Management**
Cichosz, Tom	Ecovista	Biology Fish
Cochanauer, Tim	IDFG	Biology Fish
Cronce, Jeff	NPT	Biology Wildlife
Cundy, Terry	**Potlatch Corp**	**Hydrology**
Dansart, Bill	**ISCC**	**Geology/Hydrology/GIS**
Davidson, Anne	Ecovista	Biology Wildlife
Davis, Dan	CNF	Biology Wildlife
Davis, Russ	ACOE	Biology Wildlife
Dawson, Larry	**CNF**	**Management**
Dupont, Joe	**IDL**	**Biology Fish**
Eichert, Joe	**IDL**	**Management**
Eichstaedt, Rick	NPT	Law
Enneking, George	**Idaho County Commissioner**	**Local Government**
Espinoza, Al	Consultant	Biology Fish
Falter, Michael	UI	Limnology
Funkhouser, Zachary	ITD	Planner
Garcia, Steve	USGS	Hydrology
Gerhardt, Nick	NPNF	Hydrology

Name	Agency	Specialty
Gould, Justin	**Nez Perce Tribe Executive Committee**	**Local Government**
Graham, Bill	IDWR	Planning
Gray, Karen	Idaho Native Plant Society/Palouse Prairie Foundation	Biology Botany
Green, Dave	NPNF	GIS/database
Groen, Cal	**IDFG**	**Management**
Haagen, Ed	NRCS	Soils
Hansen, Jerome	**IDFG**	**Biology Wildlife**
Hansen, Richard	IDWR	Water Rights
Hassemer, Pete	IDFG	Biology Fish
Hawley, Kyle	**Farmer**	**Local Government**
Henderson, Kent	Idaho Wildlife Federation	
Hesse, Jay	NPT	Biology Fish
Hohle, Janet	SCC – Focus Program	Management
Hood, Ric	Clearwater County Commissioner	Local Government
Hornbeck, Twila		State Legislator
Huntington, Chuck	Clearwater Biostudies	Biology Fish
Iverson, Tom	CBFWA	Biology Fish
Jackson, Bob		Rancher/Houndhunter
Jahn, Phil	**NPNF**	**Management**
Johnson, Craig	BLM	Biology Fish
Johnson, Dave	NPT	Biology Fish
Jones, Dick	CNF	Hydrology
Jones, Ira	**NPT – Focus Program**	**Management**
Keen, Shelly	IDWR	Water Rights Coordinator
Keersemaker, John	**CNF**	**Management**
Kendrick, John	NRCS	Planning
Kiefer, Sharon	IDFG	Biology Fish
Klein, Linda	LRK Communications	Soils
Kozakiewicz, Vince	**NOAA**	**Biology Fish**
Koziol, Deb	NPSWCD	Biology Wildlife
Krakker, Joe	USFWS	Biology Fish
Kronemann, Loren	NPT	Biology Wildlife
Kucera, Paul	NPT	Biology Fish
Larson, Ed	NPT	Biology Fish
Larson, Jessica	IDWR	GIS / Water Planning
Lawrence, Keith	NPT	Biology Wildlife
Leitch, Joe	Lewis County Commissioner	Local Government
Lewis, Reed	Idaho Geological Survey	Geology
Lloyd, Rebecca	NPT	Engineer Environmental
Lozar, Ed	CNF	GIS/database
Macfarlane, Gary	Friends of the Clearwater	Range Ecology
Maiolie, Melo	IDFG	Biology Fish
McCool, Don	USDA Research	Agriculture
McGowan, Felix	NPT	Biology

Name	**Agency**	**Specialty**
McKnight, Bob	**IDL**	**Management**
McRoberts, Heidi	NPT	Biology Aquatic
Miles, Aaron	NPT	Forestry
Miller, Bill	**USFWS**	**Biology Fish**
Mitchell, Victoria	USGS	Geology
Morgan, Gail	NPT	Biology Wildlife
Morse, Tony	IDWR	Geology/GIS
Moser, Brian	**Potlatch Corp**	**Biology Wildlife**
Murphy, Pat	CNF	Biology Fish
Papanicolaou, Thanos	WSU	Hydrology
Paradis, Wayne	NPNF	Biology Fish
Parsons, Russ	UI Landscape Dynamics Lab	GIS
Peppersack, Jeff	IDWR	Water Rights
Rabe, Craig	Ecovista	Biology Aquatic
Rabe, Fred	Consultant	Biology Aquatic
Rasmussen, Lynn	NRCS	Agriculture
Rieman, Bruce	USFS-RMRS	Biology Fish
Ries, Bob	NOAA	Biology Aquatic
Russell, Scott	NPNT	Biology Fish
Saul, Darin	Ecovista	Ecology
Schriever, Ed	IDFG	Biology Fish
Scott, Mike	UI Landscape Dynamics Lab	Spatial Ecology
Servheen, Gregg	**IDFG**	**Biology Wildlife**
Somma, Angela	NOAA	Biology Fish
Sondenaa, Angela	NPT	Biology Wildlife/Botany
Spinazola, Joe	Bureau of Reclamation	Planner
Sprague, Sherman	NPT	Biology Fish
Statler, Dave	NPT	Biology Fish
Stinson, Ken	**LSWCD**	**Management**
Storrar, Ann	NPT	Water Resources
Svancara, Leona	UI Landscape Dynamics Lab	GIS
Taylor, Emmit	NPT	Engineer
Ulmer, Lewis	**Idaho County Commissioner**	**County Government**
Villavicencio, Adam	NPT	Conservation Enforcement
Weigel, Dana	BoR	Biology Fish
Yetter, Dick	NRCS	Biology Fish

3 Overview of Data Collection, Analysis, and Synthesis

3.1 Data and Information Gathering

Data and information presented in this series of documents (Assessment, Inventory, Plan) was gathered from a substantial variety of sources familiar with the ecological recources of the Clearwater subbasin (See Table 3 for a complete list of contributors). Initial data gathering was conducted through review of regional databases (i.e. ICBEMP, Streamnet, etc.) and through in-person, phone, and mail requests to the land and resource management agencies with responsibilities in the subbasin. In addition, representatives of those agencies were queried for other potentially relevant information sources. Subsequent data and information gathering was done through a chain referral type of process; As draft documents were presented for review and comment, all individuals involved in the review process were invited to supply additional information or relevant data not yet represented in the draft document(s). Since new information is constantly being collected and compiled, the data/information utilized in this series of documents can not be considered truly “complete”. However, it is believed to represent the most complete and up-to-date information available (relevant to the subbasin scale) at the time each of the documents in this set were compiled.

3.2 Use and Processing of Spatial (GIS) Data

Availability and use of spatial (GIS) data in this series of documents provides a substantial progression beyond prior subbasin planning efforts in that it allows for visual presentation of information, in many cases making that information more easily understood and applied by users. In numerous instances, GIS was the primary tool used for data presentation, analysis, and synthesis (Tabular data was however, readily used to supplement GIS information or where no GIS information was available). A list of GIS data layers and their associate sources and scales is provided in Appendix A.

Although most GIS data layers used were not modified from their original state prior to use, processing steps were commonly necessary to allow for data summarization and/or analysis and the overlay of layers for presentation. Common data processing steps included reprojection, clipping layers to fit subbasin boundaries, joining layers from multiple data sources to form a single subbasin-wide layer (e.g. ownership), and summarizing data by HUC, AU, etc. When necessary, data processing was performed using basic database management tools available in (or supplemental to) ArcView software.

The projection chosen for presentation of GIS information throughout this series of documents is Universal Transverse Mercator Zone 11, North American Datum 1927. This projection was chosen due to its common use by land and resource management agencies within the Columbia Basin and, particularly, within the Clearwater subbasin. Spatial data obtained in other projections was reprojected to UTM Zone 11, NAD27 prior to analysis or presentation. Following reprojection of data layers, recalculation of relevant information (e.g. line lengths, polygon areas or perimeters, etc.) was performed as necessary to ensure consistency of data sets prior to any data analysis.

3.3 Information Development

Although this series of documents relied primarily on existing data sources, in a limited number of instances, it was practical and/or necessary to develop new information to aid in the subbasin assessment and planning process. Most commonly, development of new information involved basic modeling or synthesis of existing data to provide a useful tool for current and future planning efforts (e.g. uniform prediction of landslide hazard ratings across the subbasin). For cases when new information was developed, specific methods used to do so are described in the corresponding sections of this assessment. Table 4 provides an overview of new information developed for use in this assessment, including relevant section and figure numbers where readers can find additional details on the methods used for development of each item.

Table 4. Overview of new information developed during the Clearwater subbasin planning and assessment process.

Assessment Section	General Topic	New Information	Relevant Figures	Overview
4.6	Sedimentation	Potential Sediment Source Zone (PSSZ)	Figure 14, Figure 15	Variable width buffer around streams, based on topography. Subbasin wide surrogate for sediment transport efficiency.
4.6	Sedimentation	Landslide Hazard	Figure 13	Uniform application of an existing landslide hazard model across the subbasin.
4.8	Water Use	Max. Allowable Water Use	Figure 19, Figure 20	Defines maximum allowable potential use of groundwater or surface water by land section; derived from existing water rights and adjudication claims databases.
4.10.7	Land Uses	Index of Grazeable Lands	Figure 37	Uniform overview of the distribution of probable grazing activities for each 6th field HUC within the subbasin.
7.2	Aquatic Productivity	Modeled results–Aquatic Production Potential.	Figure 98, Figure 99	Applies an experimental approach to estimate relative production potential (productivity) by 5th field HUC across the subbasin.
8.3.5	Aquatic Limiting Factors	Road Culvert Index	Figure 110	Index of road culvert abundance, by 6th field HUC, across the subbasin.
8.3.6	Aquatic Limiting Factors	Mean Weekly Maximum Temperature (MWMT)	Figure 111, Figure 112	Uniform application of an existing water temperature model across the subbasin. Results are compared to requirements of focal aquatic species.
Chapter 9	Resource Synthesis	Potential Management Units (PMUs)	Figure 113, Figure 114, Figure 115, Figure 116,	PMUs are derived to assist in data synthesis and interpretation, spatial prioritization of protection and/or restoration, and identification and prioritization of primary issues to be addressed to restore fish and wildlife resources.

4 Subbasin Description

4.1 Subbasin Location

The Clearwater River subbasin is located in northcentral Idaho between the 46th and 47th latitudes in the northwestern portion of the continental United States. It is a region of mountains, plateaus, and deep canyons within the Northern Rocky Mountain geographic province. The subbasin is bracketed by the Salmon River subbasin to the south and St. Joe River subbasin to the north. The Clearwater River drains approximately a 9,645 square mile (24,980 km^2) area. The subbasin extends approximately 100 miles (161 km) north to south and 120 miles (193 km) east to west (Maughan 1972). Four major tributaries drain into the mainstem Clearwater River: the Lochsa, Selway, South Fork Clearwater, and North Fork Clearwater rivers. The Idaho–Montana border follows the upper watershed boundaries of the Lochsa, Selway, and eastern portion of the North Fork Clearwater rivers in the Bitterroot Mountains. The North Fork Clearwater then drains the Clearwater Mountains to the north, while the South Fork Clearwater River drains the divide along the Selway and Salmon Rivers. Dworshak Dam, located two miles above the mouth of the North Fork Clearwater River, is the only major water regulating facility in the subbasin. Dworshak Dam was constructed in 1972 and eliminated access to one of the most productive systems for anadromous fish in the subbasin. The mouth of the Clearwater is located on the Washington–Idaho border at the town of Lewiston, Idaho where it enters the Snake River 139 river miles (224 km) upstream of the Columbia River.

4.2 Climate

The Clearwater subbasin experiences a wide variety of climates. Warm, moist maritime air masses from the Pacific strongly influence the climate across the Clearwater subbasin (Lipscomb 1998; Stapp et al. 1984), except for the southernmost and high elevation eastern portions of the subbasin, which experience dryer and colder climatic conditions more typical of the northern Rocky Mountains (Bugosh 1999; Finklin 1977; N. Gerhardt, Nez Perce National Forest, personal communication February 2000).

A general increase in precipitation occurs from west to east across the subbasin coincident with increasing elevation (Stapp et al. 1984), resulting in greater precipitation in the mountainous terrain in the eastern half of the subbasin compared to the low elevation canyons and plateaus to the west. Mean annual precipitation ranges from 12 inches (310 mm) at the Clearwater River's confluence with the Snake River to greater than 90 inches (2,000 mm) in the highest elevations. Precipitation also varies seasonally, with little occurring during the summer months (Stapp et al. 1984; Bugosh 1999). Due to colder average temperatures, winter precipitation above 4,000 feet (1,219 m) falls largely as snow (McClelland et al. 1997; Paradis et al. 1999b; Bugosh 1999), where it may remain through late spring to early summer. Below 4,000 feet, a higher probability of winter precipitation falling as rain occurs with subsequently reduced storage duration. The area below the 4,000-foot elevation band also defines the rain-on-snow zone in the subbasin, an area susceptible to rapid melting and extreme runoff events. Rain-on-snow events can occur from November through March (Thomas et al. 1963). The highest precipitation areas tend to be in the northeastern portion of the subbasin, with the Upper North Fork Clearwater AU averaging nearly 60 inches (152 cm) per year. The Lower Clearwater AU has the lowest annual precipitation, averaging 25.7 inches (65 cm; Figure 3; Table 5).

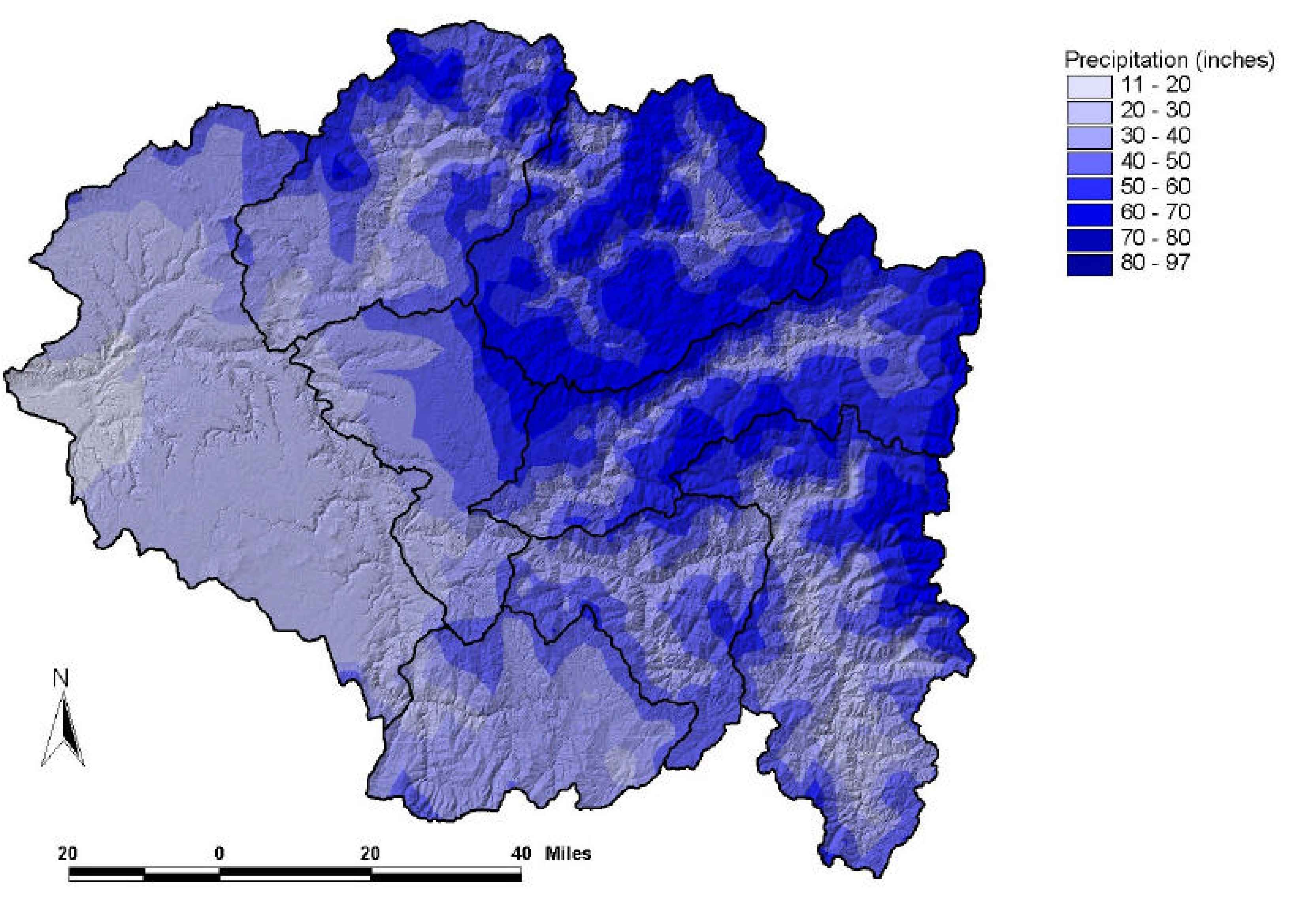

Figure 3. Precipitation levels in the Clearwater subbasin

Table 5. Minimum, maximum, and mean annual precipitation

Assessment Unit	Min. Precipitation (inches/cm)	Max. Precipitation (inches/cm)	Mean Precipitation (inches/cm)
Lower Clearwater	11.0/28.0	57.0/144.8	25.7/65.3
S. F. Clearwater	25.0/63.5	53.0/134.6	36.0/91.4
Lolo/Middle Fork	23.0/58.4	75.0/190.5	40.2/102.1
Lower Selway	27.0/68.6	61.0/154.9	41.6/105.7
Lower North Fork	23.0/58.4	87.0/221.0	43.1/109.5
Upper Selway	19.0/48.3	71.0/180.3	43.7/111.0
Lochsa	27.0/68.6	81.0/205.7	53.0/134.6
Upper North Fork	31.0/78.7	97.0/246.4	59.0/150.0

Mean annual temperature throughout the Clearwater subbasin ranges from 50–55^{0}F (10–13^{0}C) at lower elevations to 25-32^{0}F (-3–0^{0}C) in the upper elevations (Figure 4). Temperatures are generally below freezing in higher elevations of the subbasin during the winter and can be in excess of 90°F (32^{0}C) in the lower elevation canyons during the summer (Bugosh 1999; Maughan 1972). The highest temperatures recorded in Idaho occurred at Orofino and Lewiston, Idaho (118° and 117°, respectively; Stapp et al. 1984). Both towns are located at low elevation at the bottom of the main Clearwater canyon, with Lewiston having the lowest elevation of any location in Idaho (679 feet (207 m) above MSL).

Based on a statewide classification of climate, the National Climatic Data Center (NCDC) has defined three distinct climatic zones in the Clearwater drainage. These areas are roughly characterized as the North Central Prairies (zone #2), North Central Canyons (zone #3), and Central Mountains (zone #4). Combined, the North Central Prairie and Canyons encompass the vast majority of privately owned and agricultural lands found within the Clearwater subbasin. More specifically, the North Central Prairies encompass areas surrounding the mainstem Clearwater River upstream to its confluence with the Middle Fork Clearwater River. The North Central Canyons include mid-elevation areas surrounding the North Central Prairies, and also include lands surrounding Dworshak Reservoir. The Central Mountains division encompasses primarily mid to high elevation, forested areas, primarily owned by the U.S. Forest Service.

The NCDC classification allows for a characterization of drought regimes in the subbasin. Since 1895, these have been computed for each climatic division. As drought patterns have been similar between zones, only the North Central Prairies are presented here using the Modified Palmer Drought Severity Index (Figure 5). The Palmer Drought Severity Index (PDSI) is a meteorological index used to assess the severity of dry or wet weather periods. The index is calculated monthly and is based on the principles of a balance between moisture supply and demand. The index generally ranges from –6 to +6, although values to $\pm$7 may occur. Negative index values indicate dry periods (drought), and positive values indicate wet periods.

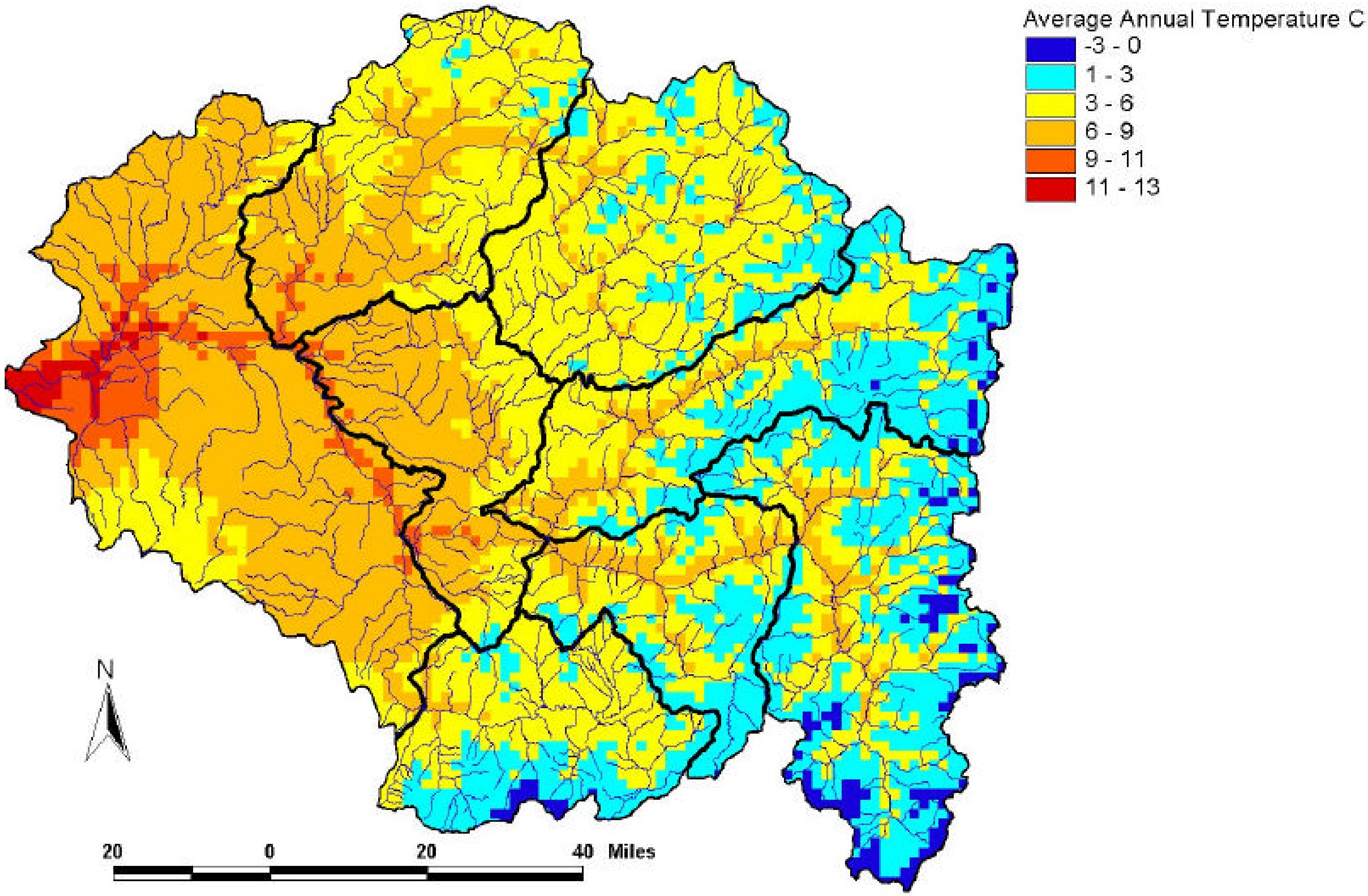

Figure 4. Average annual temperature in the Clearwater subbasin

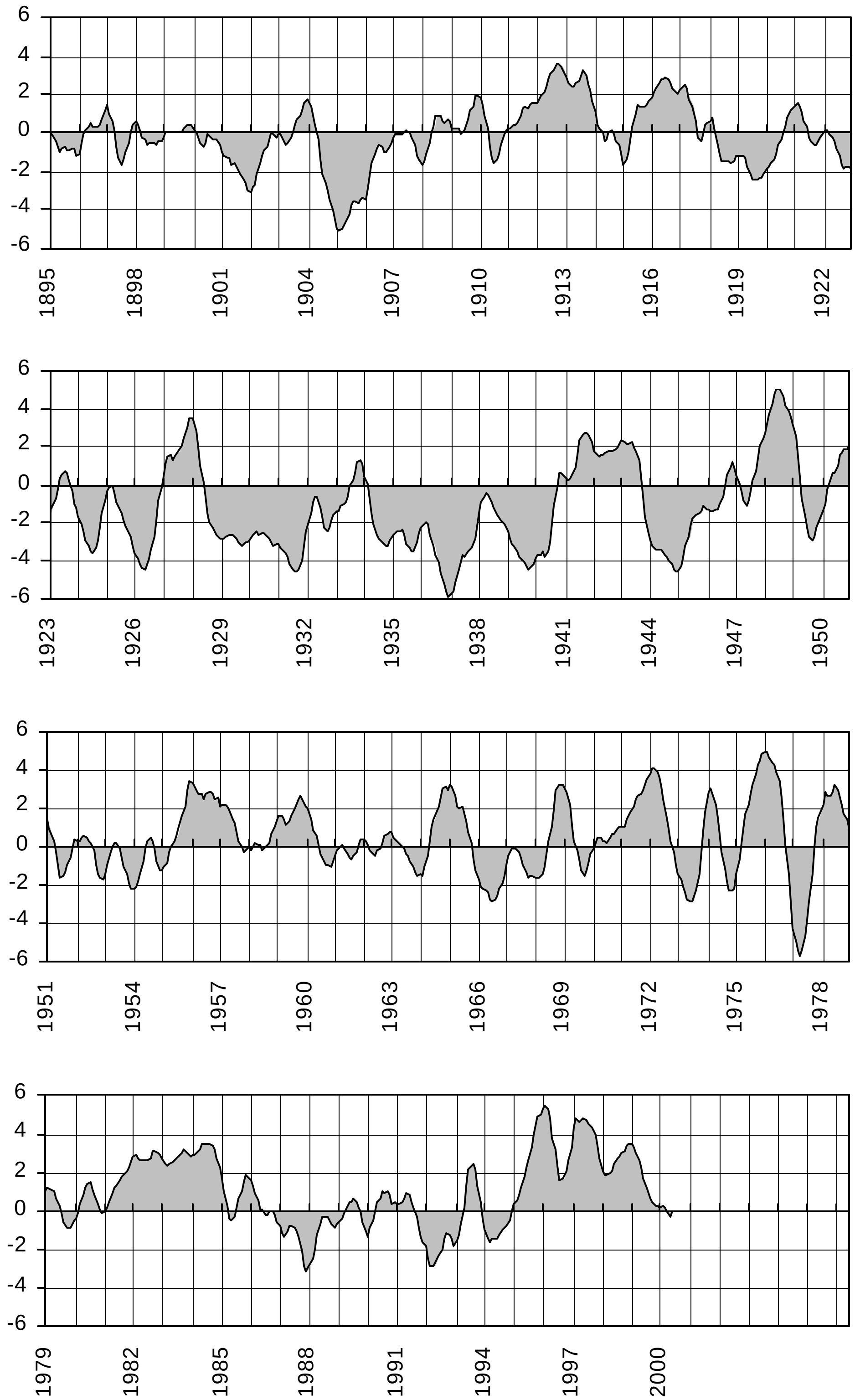

Figure 5. Modified Palmer Drought Index for Clearwater subbasin areas within the North Central Prairies. Data has been smoothed using a 6 month rolling average

4.3 Geology

4.3.1 General Geologic History

The following geologic history is supplied by Idaho Geologic Survey (Lewis, personal communication, September 25, 2003).

The geologic record in the Clearwater Subbasin extends back an estimated 1.5 billion years. Marine sediments were deposited between 1470 mya and 1400 mya in a fairly shallow portion of a basin that may have formed as the result of a rifting event. This deposition became the Precambrian Belt Supergroup, the oldest rocks known to have originated in the Clearwater area. This rock unit consists primarily of quartzites, siltites, argillites and carbonate sequences.

Metamorphic rocks of similar or greater age, the Syringa sequence, are also present within the Clearwater Subbasin. It has not been determined whether these rocks were deposited in another basin and later positioned adjacent to Belt rock sequences during a subsequent tectonic event or are actually basement rocks for the Belt Supergroup.

About 1370 mya, granitic plutons were emplaced and intruded the Belt rocks. Metamorphism and structural deformation of the overlying and adjacent Belt rocks may have been associated with this event. Rifting of the western continental margin somewhat later led to additional faulting of the Belt rocks. The present edge of the Precambrian continental margin is believed to exist in the vicinity of Dworshak Dam.

More than 100 mya, late Paleozoic to early Mesozoic-aged volcanic and sedimentary rocks were accreted to the western edge of the existing continental margin. These rocks were part of the Blue Mountains island-arc complex and form the Seven Devils greenstone terrane along the western edge of the Clearwater Subbasin.

Magmatic activity which began late in the Jurassic period and continued through the Cretaceous period led to further deformation and metamorphism of existing rock units and continued until the emplacement of the Idaho batholith 90 to 60 mya. Granitic rocks associated with the Idaho batholith are the backbone of mountain ranges within the Clearwater Subbasin. A few younger plutonic or volcanic sequences were emplaced during the Eocene period 50 to 45 mya (ex. Beaver Creek plutonic rocks and Potato Hill volcanics). Some magmatic activity occurred about 25 mya during the Oligocene (ex. Onaway and Kamiah volcanics).

Uplift and extension slowed substantially by Miocene time (about 16 mya) when drainages in the area were invaded by Columbia River basalt. Within the Clearwater Subbasin, a large irregular prism of basalt covering over 4000 square miles was created and is referred to as the Clearwater Embayment. Basalt flows covered the valleys and foothills of the Clearwater Mountains, disrupted drainages and established a new base level at a minimum altitude of 2800 feet (Bond, 1963).

During the Miocene, sediment that had previously been transported out of upland areas was now deposited at the margins of basalt flows. Stream gradients were inadequate to transport much sediment across the relatively flat basalt terrain. Sediments eroded off highlands made up interbeds between individual basalt flows. Laterally, the sediment grades into weathered rock, soil and colluvium developed on basalt and older rocks. These sediments are relatively widespread throughout the Clearwater subbasin; deposition is typically controlled by lava-damming of drainages and local subsidence which created deformational basins during the period of basalt accumulation.

Climate was humid during the Miocene period as demonstrated by the fossil record at several localities. Deeply weathered Columbia River basalt exists at higher elevations above Orofino and drainages are slowly cutting back into the canyons away from the mainstem of the

Clearwater River. Deeply weathered basalts can be confused with sedimentary units; they can be 100 feet thick in some areas. Columbia River Basalt units on the Camas Prairie show less weathering; this is likely due to a more moderate climatic history.

During and after volcanism, the Clearwater Plateau remained relatively undeformed through most of the Pliocene. A major cycle of folding and faulting, accompanied by the spreading of local basalt flows, began in late Pliocene or early Pleistocene time and created structural relief of over 4000 feet. The new erosion cycle is in a youthful stage (Bond,1963). During the Pleistocene period, alpine glaciation in the Clearwater and Selway-Bitteroot mountain ranges resulted in minor till deposition associated with isolated moraines.

4.3.2 General Geomorphic History

The oldest landforms in the Clearwater subbasin date back 58 – 25 mya during the Eocene and Miocene epochs (respectively). These are the low gradient, low relief portions of the subbasin, such as those occurring in the lower Clearwater AU. The climate during this period was subtropical and was dominated by processes of chemical weathering (Wilson et al. 1983). Intense weathering of the underlying granitics, gneisses, and schists resulted in a landscape that was highly dissected, with accordant ridges and low stream gradients.

Differential erosion of the Miocene basalt flows eventually created the current stair-step appearance characteristic of many low elevation watersheds in the subbasin (BLM 2000). The higher elevation portions of the subbasin to the east were simultaneously changing into broad convex ridges through processes of erosion and uplift. Streams draining these regions consequently flooded over the lower basalt floors creating a low relief alluvial landscape (Wilson et al. 1983).

A general cooling trend occurred from 13 million to about 1 mya, during which there was a gradual uplift in the east and gentle tilting to the west (Wilson et al. 1983). The change in elevation was estimated to be around 4,000 feet, which greatly increased stream gradients, and consequently, stream competence. Due to their higher energy, Clearwater streams rapidly dissected the basalt creating an oversteepened, high relief series of landforms with unstable slopes adjacent to river canyons. These areas are often referred to as the breaklands, or 'breaks.' The steep-sided slopes of breakland landforms play an important role in erosion from both landslides and surface runoff (Jones et al. 1997; McGreer 1981).

Coincident with the period of atmospheric cooling (during the early Wisconsin glaciation epoch, 75,000 years before present) was elevational cooling, initiated by processes of geologic uplift. This brought on mountain glaciation in the Selway-Bitterroot and Clearwater Ranges. More recent Pleistocene glaciation (approximately 11,000 years ago) caused alpine glaciers to form in the upper elevations around the rim of the subbasin in the Lower and Upper North Fork, Lochsa and Upper and Lower Selway AUs. The glacial activity during this time was primarily restricted to elevations above 5,000 feet (Anderson 1930).

Also during the early Wisconsin period, several ash falls occurred beginning about 12,000 years ago and ending about 6,600 years ago. Since the end of glaciation, the primary land forming processes in the Clearwater subbasin have been fluvial, eolian, and mass wasting erosion. Portions of the old surface remain exposed between major canyons.

4.3.3 Characterization of Geologic Parent Materials

A coarse characterization of the primary geologic parent materials in the Clearwater subbasin are shown in Figure 6. NRCS geologists and soil scientists summarized ICBEMP lithology maps to derive utilitarian parent material classifications (Table 6). When stratified by assessment unit, many of the parent materials emerge as dominating a given landscape, such as basalt in the Lower Clearwater, schist in the Lower North Fork, or granite in the Upper Selway (Table 7). Granite and schist are the dominant parent materials in the subbasin (Figure 6), both of which are widespread throughout most assessment units. Combined, these materials occur on almost 4 million acres of land in the Clearwater.

Table 6. Summarization of ICBEMP Lithology maps to local geologic parent materials

ICBEMP Lithology	Geologic Parent Material Summarization
Alluvium; glacial drift	Alluvium
Mafic volcanic flow; mafic meta-volcanic	Basalt
Granitic gneiss; mafic gneiss	Gneiss
Calc-alkaline intrusive; granite	Granite
Loess	Loess
Metamorphosed carbonate and shale; interlayered meta-sedimentary	Schist
Argillite and slate; meta-siltstone; siltstone; meta-siltstone; mixed miogeosynclinal; shale and mudstone; sandstone	Sitltite
Felsic volcanic flow; calc-alkaline volcanoclastic; felsic pyroclastic; mixed eugeosynclinal; tuff; calc-alkaline meta-volcanic	Volcanic

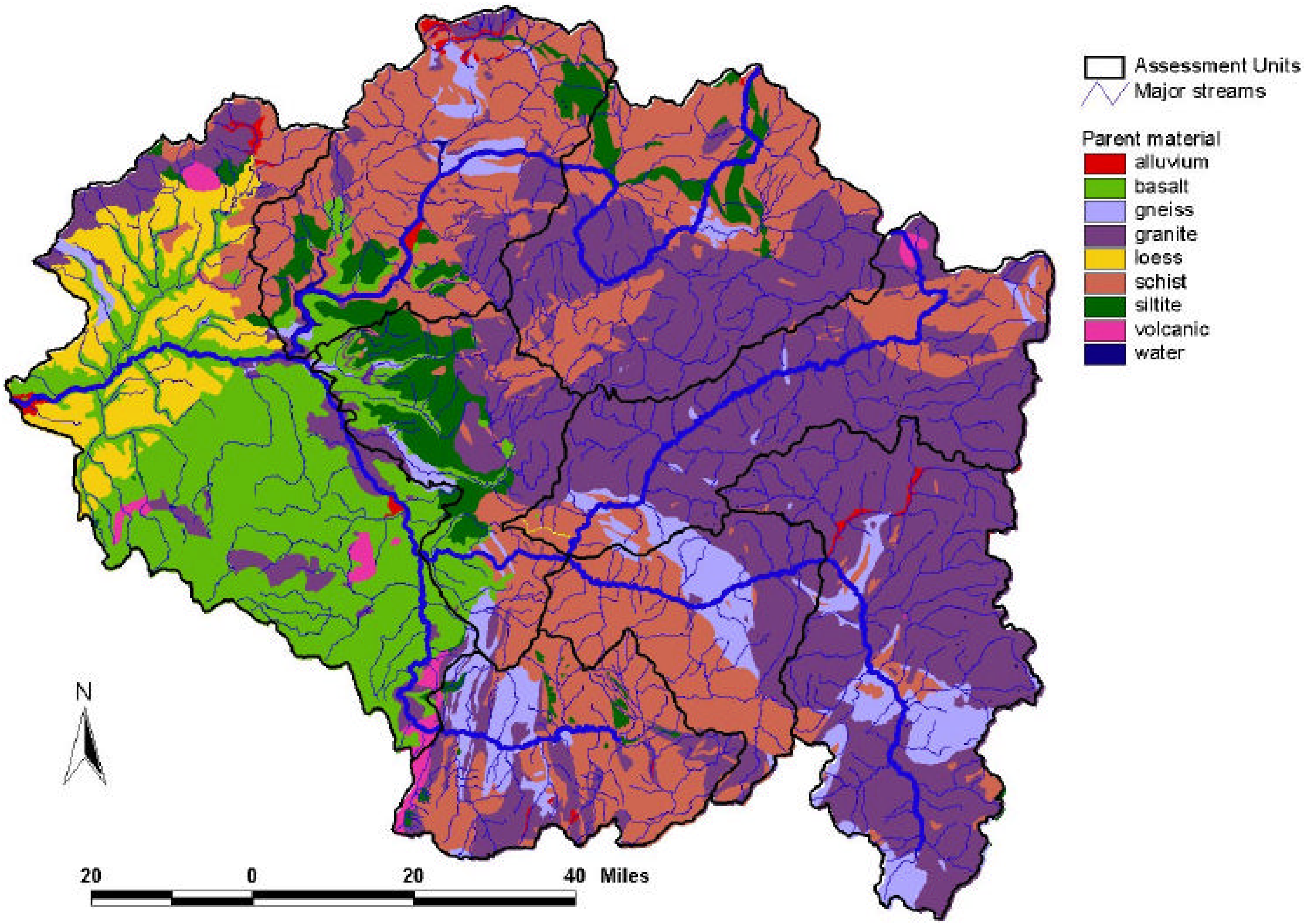

Figure 6. Geologic parent materials occurring in the Clearwater subbasin. Parent material classes were defined and summarized from ICBEMP lithology maps by NRCS personnel (J. Hohle, Nez Perce County NRCS, personal communication 2001)

Table 7. Percentage of geologic parent materials by assessment unit in the Clearwater subbasin

AU Name	Schist	Siltite	Granite	Alluvium	Water	Gneiss	Loess	Volcanic	Basalt
L. Clearwater	6.06	1.23	11.74	1.10	0.07	1.47	19.6	2.79	55.91
L. North Fork	58.19	11.86	14.36	1.52	3.14	5.45	0.01	0.00	5.48
Up. North Fork	40.60	6.51	51.64	0.04	0.02	1.20	0.00	0.00	0.00
Lolo/MF	21.26	24.34	29.64	0.03	0.00	5.74	0.00	0.00	18.99
Lochsa	22.21	0.00	72.01	0.00	0.07	4.89	0.00	0.82	0.02
Lower Selway	53.22	0.00	30.16	0.01	0.01	16.61	0.00	0.00	0.00
Upper Selway	4.90	0.02	79.58	0.80	0.08	14.61	0.00	0.02	0.00
South Fork	53.27	2.90	25.82	0.45	0.01	15.20	0.00	2.15	0.19

The term "granitics" refers to all light colored intrusive rocks of any age (Ford et al. 1997). Granitic parent material is comprised of coarse-equagranular rock made up of minerals with different properties. Because granitics typically occur as a large, homogenous mass, their relative abundance and distribution throughout the Clearwater subbasin should not be surprising. Site-specific differences do, however, exist when comparing erosivity, which is commonly classified along a 'weathering' spectrum ranging from unweathered to highly weathered. For example, when occurring in moist and acidic environments, granitic parent materials are highly prone to processes of chemical weathering, often resulting in gentle, yet erodible landforms (Ford et al. 1997). Conversely, when occurring on dry, non-acidic environments, granitics tend to be very resistant to weathering and form a more rugged or jagged landscape. The weathered product of granitics, called grus, is prone to movement due to its structure, and may be transported to stream channels via processes of surface and/or mass wasting erosion.

Metamorphic schists, which in this document also pertain to metasedimentary (belt) bedrock, are widespread throughout north and southcentral portions of the subbasin. Due to their abusive processes of formation, schist parent materials contain numerous planes of failure and uncohesive mica minerals making them highly erodible (Ford et al. 1997; Cvancara 1995). The distinct foliations in schist are readily split through processes of physical or chemical weathering, commonly resulting in a highly mobile grus or micaceous sand. These products are readily delivered to stream channels or floodplains via landslides and/or slumps (see *sedimentation* section 4.6 below), and are considered to represent among the least stable of all geologic materials in the subbasin (McClelland et al 1997; G. Hoffman, NRCS, personal communication February 27, 2001). The predominance of granite and schist in the Clearwater ultimately creates a landscape actively changing through destructive (i.e. erosion) and constructive (i.e. deposition) geologic processes.

Basalt parent materials are predominant in the lower Clearwater assessment unit, and define the lower mainstem Clearwater and many of its tributaries. This igneous rock type marks the easternmost border of the Columbia Plateau volcanic flows. Basalt parent materials typically have the flat upper surface of a fluid lava flow (Ford et al. 1997). Processes of fluvial erosion by trunk streams, such as the mainstem Clearwater, create deep dissections in basalt, forming the characteristic stepped breaks controlled by resistant flows (Ford et al. 1997). Knickpoints, or those areas of slope interruption along the longitudinal profile of a stream channel, are common in basalt-dominated tributaries, such as Lapwai, Big Canyon, and Lawyers creeks.

Much of the basalt parent material, in the Palouse and Camas Prairie regions of the Lower Clearwater AU, is mantled by loess. Loess, and other ash-derived soils, occurs in the assessment unit as a result of volcanic and windborne transport processes from Washington and Oregon (Busacca and McDonald 1994). The ash cap, which was initially laid down over the area

6,700 years before people (BP) to depths of 4–5 m, has since been mostly eroded away on steeper and/or burned slopes (Falter and Rabe 1997). This deep, silt-sized material plays an important role in soil formation and stream channel structure since it is easily transported through mechanical (i.e. fluvial and eolian) processes of erosion.

Associated with the granitic batholith and metamorphosed belt rocks are various forms of gneiss, a coarse-grained metamorphic rock type with poor foliation and rock cleavage (Cvancara 1995). Gneiss parent materials often occur in combination with the intrusion of the granitic batholith as small inselbergs (island hills) in the Upper and Lower Selway, Lochsa and Upper and Lower North Fork AUs. Gneiss plays a similar role in influencing erosion and sedimentation processes as do granitics (Megahan and Kidd 1972; McGreer 1981; Jones et al. 1997; Ries et al. 1991).

Sedimentary rock types, such as siltites and alluvium are most common along the old continental margin (i.e. Middle Fork and Lower North Fork AUs) and near historic glacial moraines or stream terraces. Siltites, which are common in the Middle Fork and Lower/Upper North Fork AUs, define the remnants of old, high terraces and glacio-fluvial areas (Wilson et al. 1983). Siltite particle size is typically <0.002 inches (0.005 cm) and has clay minerals or quartz as its primary constituents. Alluvium parent material is the least common of those defined in the subbasin. This depositional rock is weakly weathered, has a coarse texture, and is most commonly associated with stream terraces, floodplains, or glacial moraines. Rounded gravels, cobbles, and stones are generally characteristic of alluvium parent material.

4.4 Topography/Landforms

The Clearwater subbasin is well known for its rugged mountainous terrain and deep canyon-walled rivers and streams. The topographic relief, slope percent, and aspect of the subbasin vary greatly from the river valley near Lewiston, Idaho to the crest of the mountains along the Idaho/Montana border to the east. Two subsections are used below to discuss topography and landforms throughout the subbasin. The first provides a general overview of the topography and landforms found throughout the subbasin, and the second provides a more detailed look at the landform distribution and its relationship to vegetative and wildlife species.

4.4.1 Overview of Topography and Landforms

The westernmost portion of the subbasin is characterized by plateaus and foothills, which are divided by breaklands (Figure 7). The plateau region, in the southern lobe of the Lower Clearwater AU and parts of the Lolo/Middle Fork AU, has moderately sloping terrain, with local elevations ranging from 2,500 to 3,500 feet (762 – 1,067 m) above msl (Figure 8). Hill slopes are greatest in areas dissected by streams (15 to > 60%), while in other areas range from 0 to 15% (Figure 9). The isolated buttes in the western part of the plateau reach elevations to 5,000 feet (msl) and have slopes ranging from 30 to 60%. The valleys that have been eroded into the plateau have bench topography from the multiple underlying lava layers forming a series of stepped, cliff-faced outcrops of basalt up the steep slopes (BLM 2000).

Breakland landforms typify the central portion of the lower Clearwater AU and closely border the mainstem Clearwater and most associated tributaries. Slope gradients in the breaklands average between 60 to 80 percent, an attribute that greatly contributes to sediment transport efficiency.

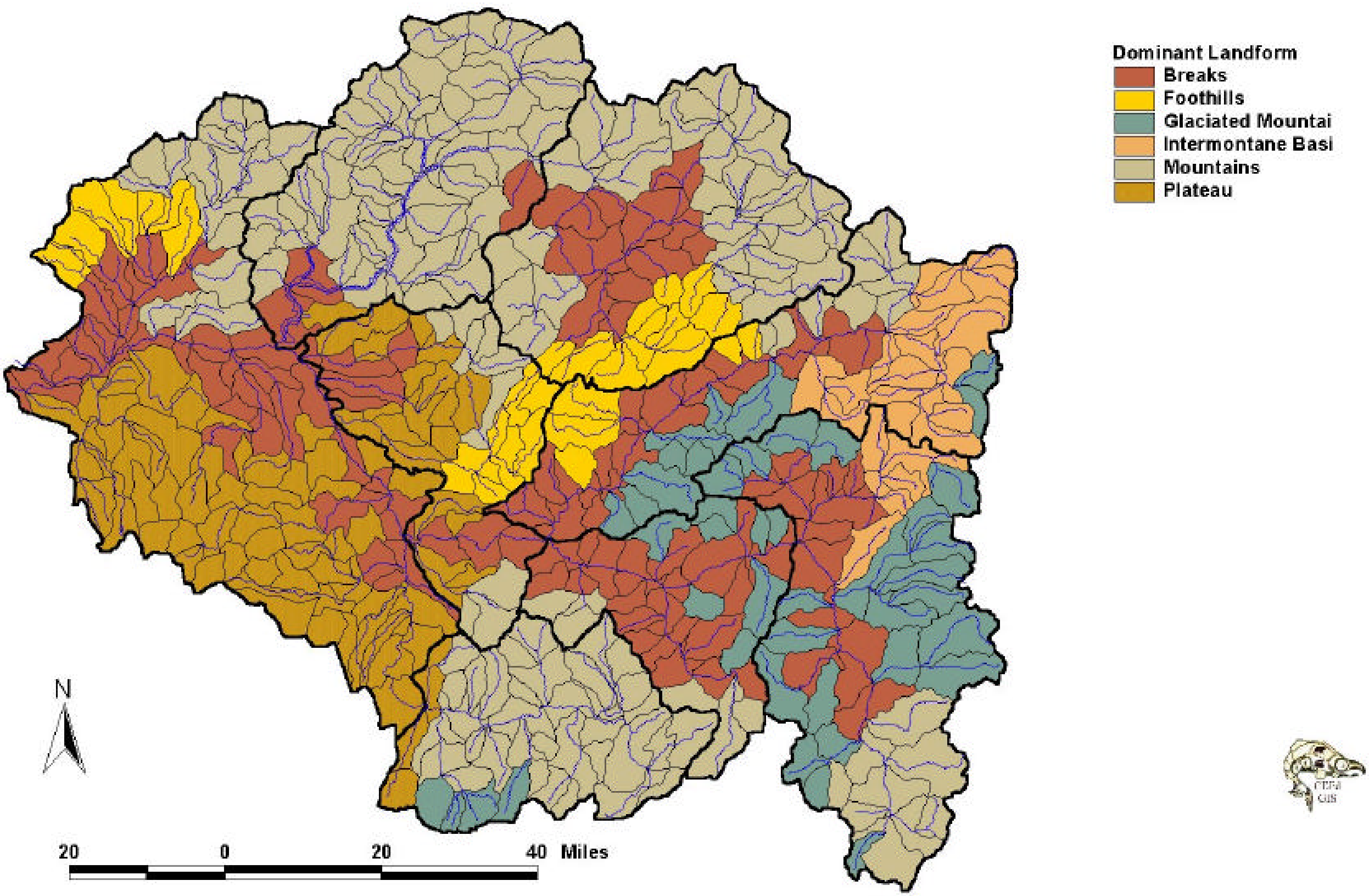

Figure 7. Dominant landforms in the Clearwater subbasin, stratified by sixth-field HUC

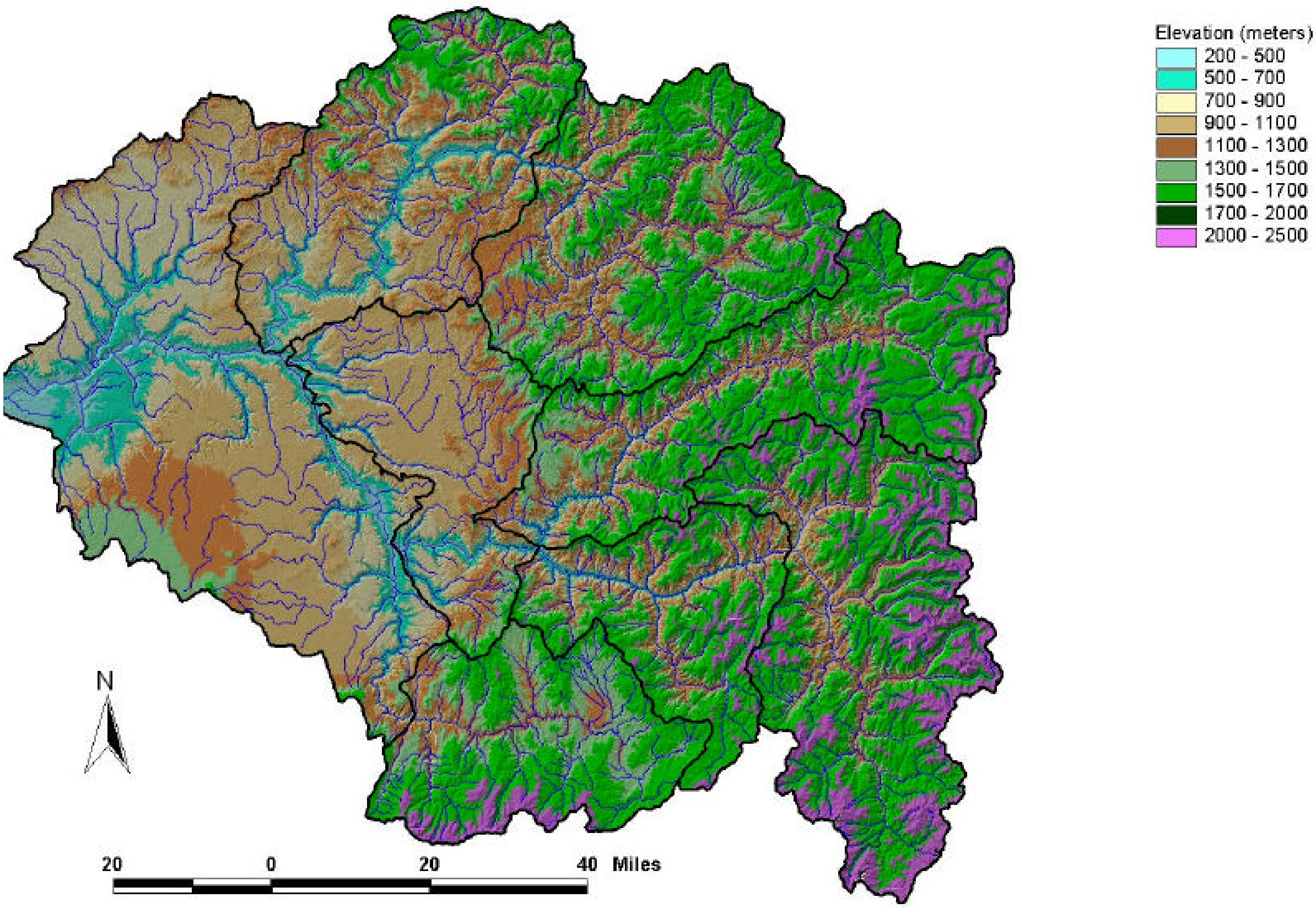

Figure 8. Elevation and topography of the Clearwater subbasin

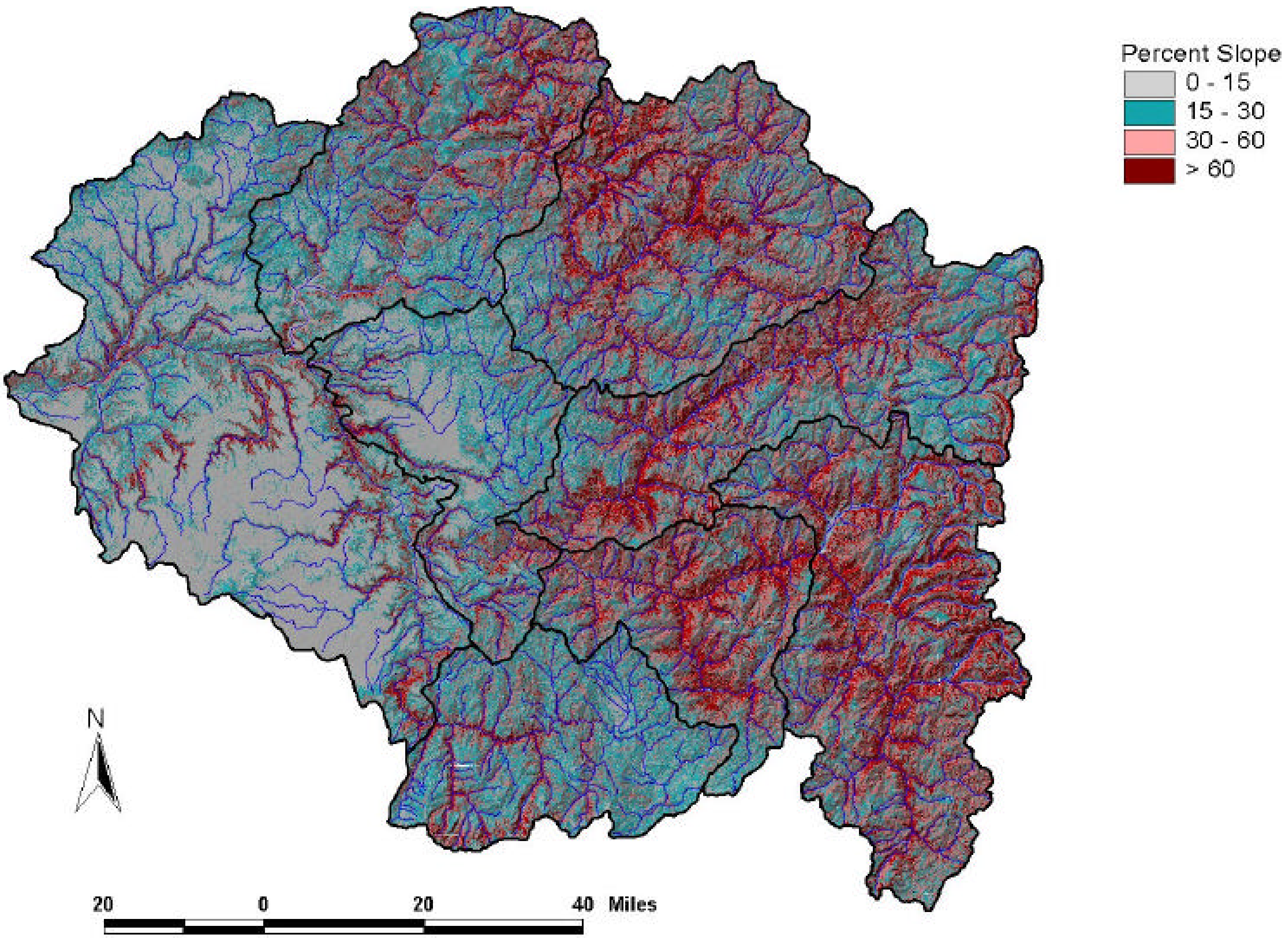

Figure 9. Relative distribution of land slope classes throughout the Clearwater subbasin

The northern lobe of the Lower Clearwater AU is characterized by low relief rolling hills and mountain landforms. The dune-like formations, which are typical throughout the Palouse Prairie, range in elevation from 1,000 to 3,000 feet (305–914 m), with slope gradients of 0 to 30 percent. Mountain landforms, which are common throughout the uppermost portions of the assessment unit (i.e. upper Potlatch River drainage), range in elevation from 3,000 to 4,500 feet (914–1,372 m), with slope gradients between 30 to 60 percent.

Moving east, the topography of the Clearwater subbasin undergoes a notable increase in relief, especially in the southern and northern portions of the drainage. Topography in the lower North Fork, upper North Fork, Lochsa, and South Fork AUs is dominated by mountain landforms, with mean elevations ranging from 3,800 to 7,100 feet (1,158–2,164 m) above msl. The Clearwater Mountains, which rise from the Salmon River breaks to the south, extend northward through the South Fork and into the North Fork Clearwater. The ridges of the Clearwater range are often frost-shattered, with convex or straight sideslopes (Ford et al. 1997). Slope gradients vary by aspect, but average 35 to 60 percent and are greatest at stream dissections. Infrequent, small basins occur throughout the higher elevations of mountain landforms, such as those in the Gospel Hump Wilderness Area. Many of the alpine lakes in the subbasin form in the cirques at the head of these snow-formed basins and provide flow to perennial Clearwater River tributaries (Hubbard 1956). Because of their rounded formation, steep (>65%) side slopes, and erodible and mobile geologic parent materials (i.e. schist), the Clearwater Mountains supply a continual source of sediment to the lower elevation streams and rivers.

Similar to the western portion of the subbasin, breakland landforms divide the southern and northern hemispheres of the mid-Clearwater drainage area, and effectively demarcate landform differences throughout the central and eastern assessment units. The confluence of the Lochsa and Selway Rivers delineate some of the most extensive of the breakland landforms in the subbasin. The Lochsa River proper is entirely bordered by breaks, which separate the glaciated mountain landforms to the south and foothills/mountain landforms to the north (refer to Figure 7).

Breakland landforms in the Lower Selway AU comprise approximately 60% of those identified (Thompson 1999), while those in the Upper Selway AU account for an estimated 29% of the landform types. In general, southerly aspects of the inherently unstable breakland landforms may experience intensified rates of erosion and retardation of soil development due to their exposure to prevailing northwesterly storm patterns (refer to *soils/sedimentation* section 4.5 and 4.6 below). Dominant geologic parent materials differ between and within assessment units but are most commonly either schist or highly weathered granite. Breakland elevations range from 2,500 to 7,500 feet (Ford et al. 1997) and relief of several thousand feet is common (Wilson et al. 1983). Breakland landscapes are deeply eroded and are typically composed of stream or structural breaks. Streams tend to be highly incised, with moderate to steep gradients and boulder substrate.

The Selway-Bitterroot mountain range dominates the landscape of the eastern portion of the subbasin, and in effect forms the Idaho/Montana border. In general, the Bitterroots are comprised of glaciated mountains to the south (upper Selway AU), intermontane basin in the central portion (upper Lochsa AU), and mountain landforms to the north (upper North Fork and portions of the lower North Fork AUs).

In the Selway AU, mean elevations range from about 5,100 feet to 7,100 feet (1,554–2,164 m) with slopes generally in excess of 50%. The glaciated mountain landforms that characterize much of the Bitterroot range in the upper Selway unit are defined by cirque headwalls, glacial troughwalls, alpine ridges and cirque basins (Ford et al. 1997). These landforms are predominantly formed by alpine glacial erosion. Slope shape tends to be straight to concave in glacial troughs, convex to concave in cirque headwall areas, and convex on alpine ridges. Wetlands (wet sidehills and avalanche chutes), lakes, and ponds are also common in the AU (Ford et al. 1997).

The intermontane basin in the eastern portion of the Lochsa AU separates the glaciated and non-glaciated portions of the Selway Bitterroot mountains to the south and north, respectively. These areas have largely been formed through glacial meltwater and fluvial action and have developed a gently rolling surface shape. Mean elevation ranges between 5,700 feet and 7,100 feet (1,737-2,164 m) while slope gradients are generally between 10-30 percent.

Topography of the Bitterroots again changes in the upper North Fork AU with the transition from intermontane basin to non-glaciated mountains. Although mean elevations (4,650–5,700 feet) are not as great as those to the south (upper Selway AU), relief tends to be high with slopes commonly in excess of 50%. The ridges and sideslopes in this area are frost shattered, convex and straight (respectively), and have been formed by fluvial and colluvial processes (Ford et al. 1997). The schist parent material, which dominates much of the landform, is erodible and considered a likely sediment source to downstream areas (Wilson et al. 1983).

4.4.2 Relationship of Landforms to Upland Biota

A detailed analysis (Ford et al. 1997) of landforms within the Clearwater subbasin resulted in a classification containing15 different landforms (Figure 8; Table 8). The three landforms that cover the greatest amount of the subbasin are mountain slopes and ridges, breaks, and low relief hills. The following information describes the major vegetative cover classes associated with each landform type in the subbasin. The reader is referred to Ford et al. (1997) for a complete description of the landform classification used.

Mountain Slopes and Ridges

The most common vegetation types on mountain slopes and ridges are mixed mesic forests, Douglas-fir (*Pseudotsuga meziesii*) forests, and warm mesic shrublands. Douglas-fir stands with multiple canopies provide habitat for flammulated owl (Groves et al. 1997a). The mountain slopes and ridges landform contains one of the larger amounts of ponderosa pine habitat in the subbasin. The 242 square kilometers of ponderosa pine habitat on mountain slopes and ridges are important for focal species such as flammulated owl, white-headed woodpecker, and black-backed woodpecker.

Breaks

Mixed mesic forests and warm mesic shrublands each occupy about 15% of the breaks in the subbasin. Douglas-fir forest, which is used by flammulated owls, is the only other vegetation type that occurs on more than 10% of the breaks. Although riparian areas only cover 2% of this landform, the breaks landform has the largest area of land in riparian zones. This landform has 85 square kilometers of riparian habitat. Riparian habitat is extremely important for many wildlife species. Another important kind of habitat in this landform is ponderosa pine habitat. The breaks landform has 255 square kilometers classified as the ponderosa pine vegetation type. Ponderosa pine communities are important for three terrestrial focal species, the flammulated owl, the white-headed woodpecker, and the black-backed woodpecker.

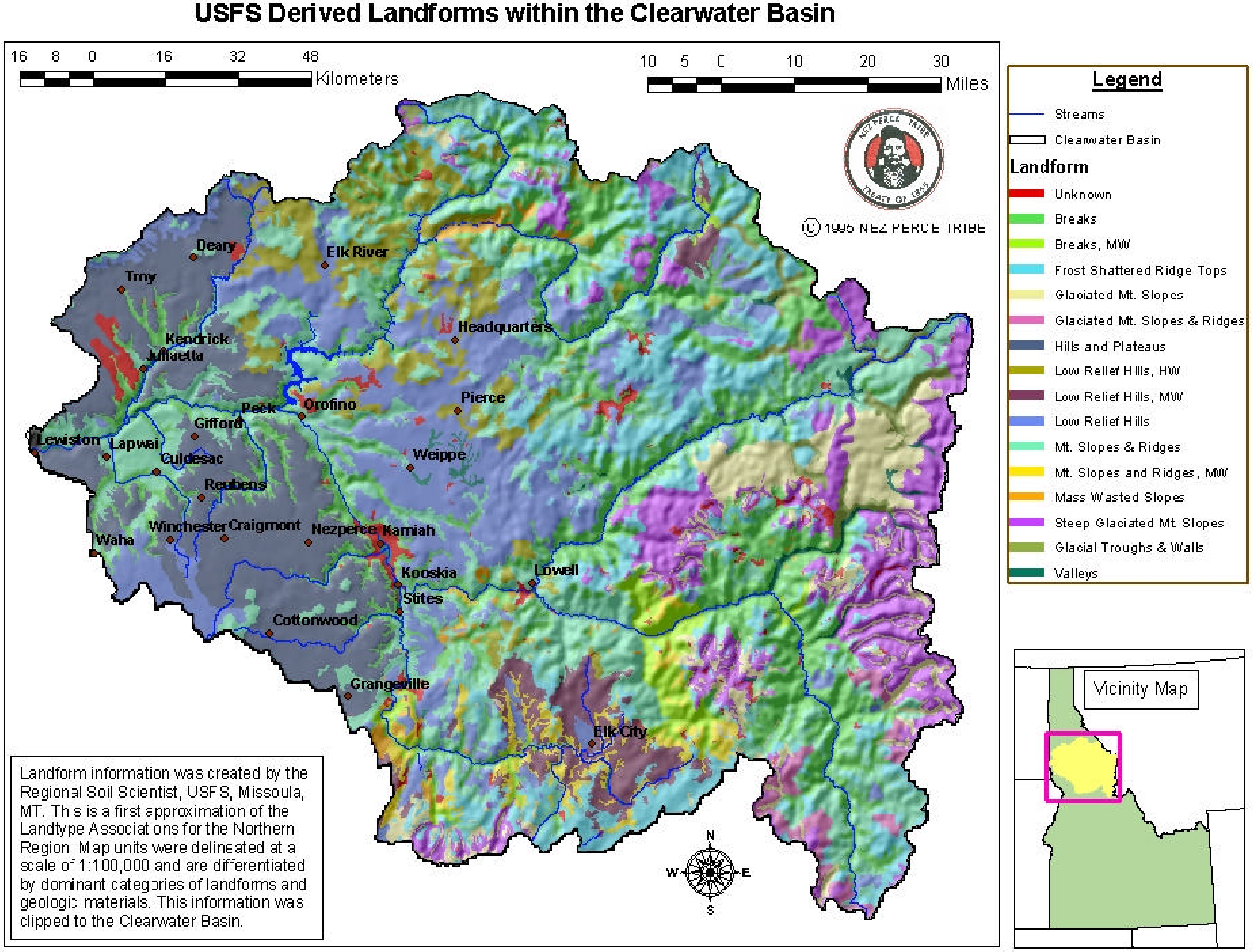

Figure 10. Detailed landform map of the Clearwater subbasin (from Ford et al. 1997)

Table 8. The landforms contained within the Clearwater subbasin

Landform	% Area
Breaks	17.1%
Breaks, Moderately Weathered	2.1%
Frost Shattered Mountain Ridge Tops	10.0%
Glaciated Mountain Slopes	4.7%
Glaciated Mountain Slopes and Ridges	1.0%
Hills and Plateaus	12.5%
Low Relief Hills, Highly Weathered	5.2%
Low Relief Hills, Moderately Weathered	3.0%
Low Relief Hills	14.2%
Mountain Slopes and Ridges	17.8%
Mountain Slopes and Ridges, Moderately Weathered	1.8%
Mass Wasted Slopes	0.6%
Steep Glaciated Mountain Slopes	7.8%
Alpine Troughs and Trough Walls	1.4%
Valleys	0.8%

Low Relief Hills

Forests cover the majority of low relief hills in the subbasin. The most common forested vegetation types are mixed mesic forest, western red cedar/grand fir (*Thuja plicata/Abies grandis*), grand fir, and Douglas fir/grand fir. Cedar forests provide habitat for two focal plant species: crenulated moonwort (*Botrychium crenulatum*) and mountain moonwort (*B. montanum*). Warm mesic shrublands are the next most common cover type; they cover 9% of low relief hills in the subbasin. The low relief hill landform contains the largest amount of ponderosa pine habitat in the subbasin with 259 square kilometers in the ponderosa pine vegetation type. Ponderosa pine habitat is very important for three of the subbasin's terrestrial focal species, flammulated owl, white-headed woodpecker, and black-backed woodpecker.

Hills and Plateaus

Over 65% of this landform is now agricultural land. The only other vegetation type covering more than 5% of this landform is the foothill grasslands vegetation type which occupies 8% of the landform. These remnant grasslands provide habitat for two focal plant species: Jessica's aster (*Aster jessicae*) and Palouse goldenweed (*Haplopappus liatriformis*). Spalding's catchfly (*Silene spaldingii*), a proposed Threatened species also inhabitats these habitats . Hills and plateaus contain the greatest amount of urban area in the subbasin: 16 square kilometers of this landform is now in urban areas.

Frost Shattered Mountain Ridge Tops

This landform provides subalpine habitat. Mixed subalpine forests make up 22% of this landform. The two other most prevalent vegetation types are mixed mesic forests and lodgepole pine forests (*Pinus contorta*). Lodgepole pine covers 17% of the landform. Old growth lodgepole pine stands provide habitat for black-backed woodpeckers. This landform contains 223 square kilometers of the Engelmann spruce and subalpine fir vegetation types. Areas containing a mixture of early and late seral stages of these vegetation types can provide lynx habitat. Lynx need old growth areas for denning and young seral areas for foraging.

Steep Glaciated Mountain Slopes
This landform contains a variety of subalpine habitats, including mixed subalpine forests (19% of landform), subalpine fir forests (9% of landform), and montane parkland/subalpine meadows (9% of landform). Other common cover types are lodgepole pine forests, mixed mesic forests, and exposed rock. Lodgepole pine forests cover 15% of the landform; old growth stands of this type provide habitat for black-backed woodpeckers. The subalpine fir and Engelmann spruce vegetation types that occur on these steep glaciated mountain slopes cover 206 square kilometers of the landform. These two vegetation types provide lynx habitat if a matrix of young and old stands exists. Also found in these high elevation sites is white-barked pine (*Pinus albicaulis*), an important wildlife food species suffering declines from blister rust.

Low Relief Hills, Highly Weathered
Mixed mesic forests covers 20% of the low relief hills, highly weathered landform. Grand fir forests, western red cedar/grand fir forests, Douglas fir/grand fir forests, and Douglas fir forests each cover approximately another 10% of the landform throughout the subbasin. Douglas fir stands provide potential habitat for flammulated owls. Mature and old growth forested stands provide nesting habitat for goshawks. Not all the habitat in this landform is forested though, the warm mesic shrubland vegetation type alone covers 12% of the landform.

Glaciated Mountain Slopes
Glaciated mountain slopes contain 25% lodgepole pine, 24% mixed subalpine forest, and 11% mixed mesic forest. Two other vegetation types found in the landform are subalpine fir and Douglas fir. Old growth lodgepole pine stands provide habitat for black-backed woodpeckers. Glaciated mountain slopes contain 115 square kilometers of Engelmann spruce and subalpine fir, important components of lynx habitat.

Low Relief Hills, Moderately Weathered
The three most common vegetation types in this landform are mixed mesic forest, grand fir, and lodgepole pine. Mixed mesic forest and grand fir each occupy over 20% of the area designated to this landform.

Breaks, Moderately Weathered
Mixed mesic forest is the vegetation type that covers the most area on moderately weathered breaks. Warm mesic shrubland and Douglas-fir are the only other two vegetation types that cover more than 10% of the landform. Douglas-fir can provide habitat for flammulated owl.

Mountain Slopes and Ridges, Moderately Weathered
Mixed mesic forest covers almost a fourth of this landform. Other types of forests commonly found include grand fir and lodgepole pine.

Glacial Troughs and Trough Walls
Mixed mesic forest covers 25% of this landform. Lodgepole pine is the next most common vegetation type, covering 16% of the landform. Douglas fir and mixed subalpine forest vegetation types each cover approximately 10% of the landform.

Glaciated Mountain Slopes and Ridges
Over 80% of glaciated mountain slopes and ridges are covered by four vegetation types. The most common vegetation types in this landform, in decreasing areas of land covered, are mixed subalpine forest, Douglas fir, lodgepole pine, and subalpine fir.

Valleys
Valleys contain a variety of vegetation types. Only two vegetation types, mixed mesic forest and foothills grassland, cover 10% or more of the landform. Six other vegetation types, including warm mesic shrubs, ponderosa pine, and western red cedar/grand fir, cover between 5% and 10% of the landform. The valleys landform has the largest proportion of its land in riparian vegetation types, with 6% of its land classified in a riparian vegetation type.

Mass Wasted Slopes
Douglas fir is the most common vegetation type in this landform, covering 16% of mass wasted slopes. Western red cedar/grand fir and mixed mesic forest each cover 13% of this landform.

4.5 Soils

The Clearwater subbasin provides a unique and diverse area for soil development due to varying climatic conditions, the diversity of geologic parent materials, and differing topographic features. In turn, soils occurring throughout the subbasin have locally unique properties of fertility, porosity, mobility, and erosivity, each with important implications to the movement and storage of energy, water, and nutrients (Nez Perce National Forest 1998).

For the purposes of this assessment, a less detailed soils characterization was conducted to facilitate ease of interpretation and relation to aquatic issues. For a more detailed discussion regarding landtype/soil associations for National Forest land in the Northern Region, the reader should refer to Ford et al. (1997), or to the Natural Resource Conservation Service website (http://www.statlab.iastate.edu/cgi-bin/osd/osdname.cgi) for a site-specific characterization of individual soil series. Additional information is available from the State Soils Geographic Database (STATSGO; http://www.il.nrcs.usda.gov/soils/statsgo_inf.html).

STATSGO data, Land Remote Sensing Satellite (LANDSAT) images, and literature review were used in the following discussion. Soils sharing similar primary and secondary characteristics are discussed based on their Great Group taxonomic classification. Descriptors were based in part on soil orders and their general area of occurrence for ease of discussion.

In general, soils in the Clearwater subbasin can be characterized as having a volcanic ash horizon over weakly developed subsoil (Wilson et al. 1983). The primary ash cap was laid down 6,700 years ago by volcanic eruptions from Mt. Mazama (Crater Lake, Oregon), and to a lesser degree recent eruptions from Mt. St. Helens (Washington) and Glacier Peak. The original deposition appears to have been between one and two feet thick, with greatest depths occurring in depressions or areas protected from redeposition and erosion (Wilson et al. 1983). Much of the ash has since been eroded away or mixed with the original soil on many steep southerly aspects or on high elevation areas that have experienced historic, high intensity wildfires (Wilson et al. 1983). Where present, volcanic ash has increased soil productivity due to its moisture retentiveness and erosion resistant properties. However, because of its poor replacement frequency (i.e. volcanic eruptions) and increasing levels of disturbance, volcanic ash is currently considered to be an irreplaceable resource and spatially limited (Nez Perce National Forest 2000).

The primary soils in the Lower and Middle Fork Clearwater AUs are deep to very deep with silt loam surface textures and silt loam to silty clay loam subsurface textures (Ford et al. 1997). These highly developed, fertile grassland soils, collectively referred to as Mollisols, occur on warm, dry, low relief slopes with parent material dominated by a thick layer (6 to 300 feet/1.8 – 91.4 m) of wind-blown loess underlain by Columbia flood basalts. The dominant potential natural vegetation is bluebunch wheatgrass and Idaho fescue in the prairie grasslands (Camas and Palouse), ponderosa pine, and Douglas fir in forested areas. Agricultural crops currently are the dominant vegetation type in prairie areas (R. Spencer, NRCS, personal communication February 28, 2001). Soils occurring along breakland landforms are shallow to moderately deep with textures ranging from silt loams to very cobbly loams, while those occurring on mountain slopes and ridges are moderately deep to deep with silt loam to loam surface textures and very gravelly to cobbly loam subsurface layers. (Ford et al. 1997).

The Mollisols grade into forest soils (Alfisols) in higher elevation portions of the plateau, and the division is discernable by stringers of ponderosa pine forest extending into grasslands. Soil types occurring in these upland areas have developed under a cooler, moister climatic regime and have thinner topsoil horizons than those commonly found lower on the plateau (Barker 1982). Alfisols do, however, have a protective organic litter layer of decomposing needles, branches and twigs, which adds to their fertility, water and nutrient transmissivity, and soil development. Forest soils can have clay hardpan subsurface horizons which, if they lie directly on crystalline bedrock on steep terrain, are prone to slope failure and mass wasting, particularly when their topsoil is disturbed or removed (Jones et al. 1997; McGreer 1981). This occurs in the lower/upper North Fork AUs and Lolo/Middle Fork AUs in the central and eastern parts of the subbasin. Unstable Alfisols are also noted on the western part of the plateau in the area of Winchester State Park at the head of Lolo creek and in the northern part of the Potlatch River drainage in the Lower Clearwater AU.

Soils that have developed from volcanic ash become more abundant with an eastward progression through the subbasin, and in some areas are considered to represent the parent material. These soil types, also referred to as Andisols, are less homogenous than those on the plateau, and vary widely in terms of their productivity and erosivity (Soil Survey Staff 1975). Ash-derived soils are common in the upper and lower North Fork AUs, and, when combined with topographic and climatic features, contribute to high levels of vegetative productivity (Wilson et al. 1983). The erosive resistant properties of these soils may, however, be compromised where the topsoil is disturbed or where little cohesiveness exists in subsurface horizons (G. Hoffman, NRCS, personal communication February 27, 2001).

Characteristics of structural or stream breakland soils, common throughout the central and eastern portions of the subbasin, differ spatially, but share a common theme of being among the most erodible of soils found in the subbasin. Their erosivity results largely from the high porosity caused by extensive gravel, cobble, or sand content. In the South Fork AU, where schist, granite, and gneiss comprise the dominant parent materials, primary soils vary in depth and texture (Ford et al. 1997). Soils occurring on breaklands in the Lower Selway AU, such as those in the Meadow Creek HUC, are similar to those in the South Fork AU: they vary in depth and have textures ranging from silt loams to very gravelly loams (Ford et al. 1997). Where granite is the dominant parent material in breakland landforms, such as in the Upper Selway AU and along the mainstem Lochsa River, breakland soils tend to be weakly developed, vary in depth, and maintain porous surface and subsurface textures due to silt, gravel, sand, and cobble content (Ford et al. 1997). Many of these soil types may be classified as Mollisols, which grade into volcanic ash in areas of increased relief.

High elevation, subsurface soil forming environments in the Idaho batholith portion of the Clearwater and Bitterroot mountains are typically moist and cold. The soils in these areas are considered to be submature, or Inceptisols, based on their retarded state of development. A thin layer of organic matter covered by a weak layer of topsoil is typical of surface components, while noncohesive coarse sand and gravels intermixed with volcanic ash form subsurface horizons. Where granitic parent material occurs on these landscapes, such as in the Lochsa, upper Selway and upper North Fork AUs, soil types are often characterized by grus. This chemically weathered granitic product is noncohesive, coarse-grained, and highly mobile. Where schist is the dominant high elevation parent material, such as in the lower Selway AU and lower/upper North Fork AUs, soil textures are finer, consisting of silt loam on the surface and silty clay loam in the subsurface.

4.6 Sedimentation

Movement of soils from hillslopes or streambanks into stream channels is a natural process with which aquatic species have evolved. Addition of sediment to the channel may occur through surface erosion, gully erosion, soil mass movement and stream channel erosion (Brooks 1991). In the Clearwater, these processes differ both spatially and temporally and influence aquatic and terrestrial habitats in different ways. Processes of sedimentation in the Clearwater also change along an elevational gradient. Within the subbasin, variations in geology, topography, climate, soil character and soil cover characteristics are influenced by elevation, and act singularly or collectively to drive the frequency, magnitude, and process of sedimentation in streams and rivers.

When factoring in the different biophysical characteristics and processes, the characterization of sedimentation at the scale of the Clearwater subbasin becomes a modeling exercise. Various modeling approaches were used to examine different forms of sedimentation, based on their ability to provide accurate information for the subbasin at a level of detail appropriate for use in the assessment. Models which could not be used across the entire subbasin were not considered for this assessment. Due to the limitations of modeling sedimentation across broad scales, results presented provide only comparative indices for general planning purposes. The resolution of these data is not sufficient to support site specific prescriptions.

Surface erosion processes are discussed using models derived during the Interior Columbia Basin Ecosystem Management Project since they were the only models found to describe surface erosion in a scientifically defensible manner across the entire subbasin. To provide an overview of mass wasting potential, a locally developed landslide hazard model developed by the University of Idaho and Potlatch Corporation was used. In addition, a third model developed by the WSU Center for Environmental Education was used to examine the likelihood that sediment, once mobilized, would enter a stream channel.

Surface Erosion

Surface erosion, also referred to as overland flow, occurs when water or wind detachs sediment particles and small aggregates (Dunne and Leopold 1978). This type of erosion is induced by rainsplash, sheetwash, rill, concentrated overland flow and wind transport. Surface erosion tends to be greatest in non-forested environments.

An examination of the base (inherent) surface erosion hazard data for the subbasin shows that the hazard is highest in the central and easternmost portions of the subbasin (Figure 11). This analysis ignores the role of vegetation cover, and is based only on the Modified Soil Loss Equation (MSLE), slope, rainfall intensity, and surficial geology. The lowest base surface erosion hazard ratings occur in the Lower Clearwater AU, the Lolo/Middle Fork AU and the South Fork AU. Inclusion of the variable 'vegetation cover' yields a much different picture of expected surface erosion hazard ratings in the Clearwater subbasin. Ratings are highest in the Lower Clearwater, Lolo/Middle Fork and Lower North Fork AUs, and lowest in the South Fork and Lochsa AUs (Figure 12). It is widely accepted that realized surface erosion within the Clearwater subbasin is greatest in the agricultural areas in the western portions of the subbasin, consistent with Figure 12.

Comparison of information presented in Figure 11 and Figure 12 is critical for future planning efforts. The relative impact of land management activities on surface erosion processes is expected to be most substantial in the agricultural lands in the western portion of the subbasin, and in the mountainous eastern portions of the subbasin, where soil and topographic conditions lead to a high likelihood of surface erosion following devegetation through timber harvest, roading, or other activities.

Mass Wasting Erosion Hazard

The Clearwater subbasin's inherently high erosion hazard is largely due to its steep slopes and unstable border or batholith parent material. These conditions, combined with high intensity storm events and soil disturbance, favor mass wasting processes throughout the central and eastern portions of the subbasin.

Several classifications of mass movements are distinguishable based on their mechanisms of movement. Among the most prevalent in the Clearwater subbasin are slides, planar failures (debris slides), rotational failures (slumps), flows, debris avalanches, debris flows, and soil creep. Cursory analyses of ICBEMP data suggest that slides, planar failures, avalanches, and debris flows are most common in the high-relief, eastern portion of the subbasin, while slumps and soil creep are more prevalent throughout central regions. The predominance of clay rich soils, which converge with steep slopes, may account for the occurrence of slumping types of mass wasting in the central subbasin, while the dominance of granular, noncohesive soils on steep slopes may relate to the preponderance of slides, flows, and avalanche sedimentation in the eastern subbasin.

While documentation of the cause (e.g. McClelland et al 1997; 1998; Huntington 1998), occurrence (e.g. Megahan et al. 1978), and effects (e.g. Pipp et al. 1997; Falter and Rabe 1997; Huntington 1998), of mass wasting has been made throughout portions of the subbasin, efforts often were limited in their treatment of the entire Clearwater drainage. Mass wasting hazard models developed for the Clearwater subbasin by the University of Idaho and Potlatch Corporation (Miller et al. 2001) provides a subbasin-wide hazard analysis of mass wasting.

The UI/Potlatch landslide hazard model was developed more recently than available ICBEMP data regarding mass wasting, and used data collected primarily within the boundaries of the Clearwater subbasin. The model incorporates aerial photo interpretation and field identification of 3,046 landslide scars. Although the majority of these landslides were associated with the severe rainstorms that occurred in late 1995 and early 1996, the survey also assessed scars predating the 1995/1996 events. Geologic parent material, slope, aspect, elevation and land use attributes were related to landslide occurrence through a logistical regression analysis. High slopes, rain-on-snow elevations, and the presence of older roads or bare ground were landscape attributes found to be the most highly correlated with landslide occurrence. Schist and quartzite parent materials and southern aspects were also positively correlated with landslide

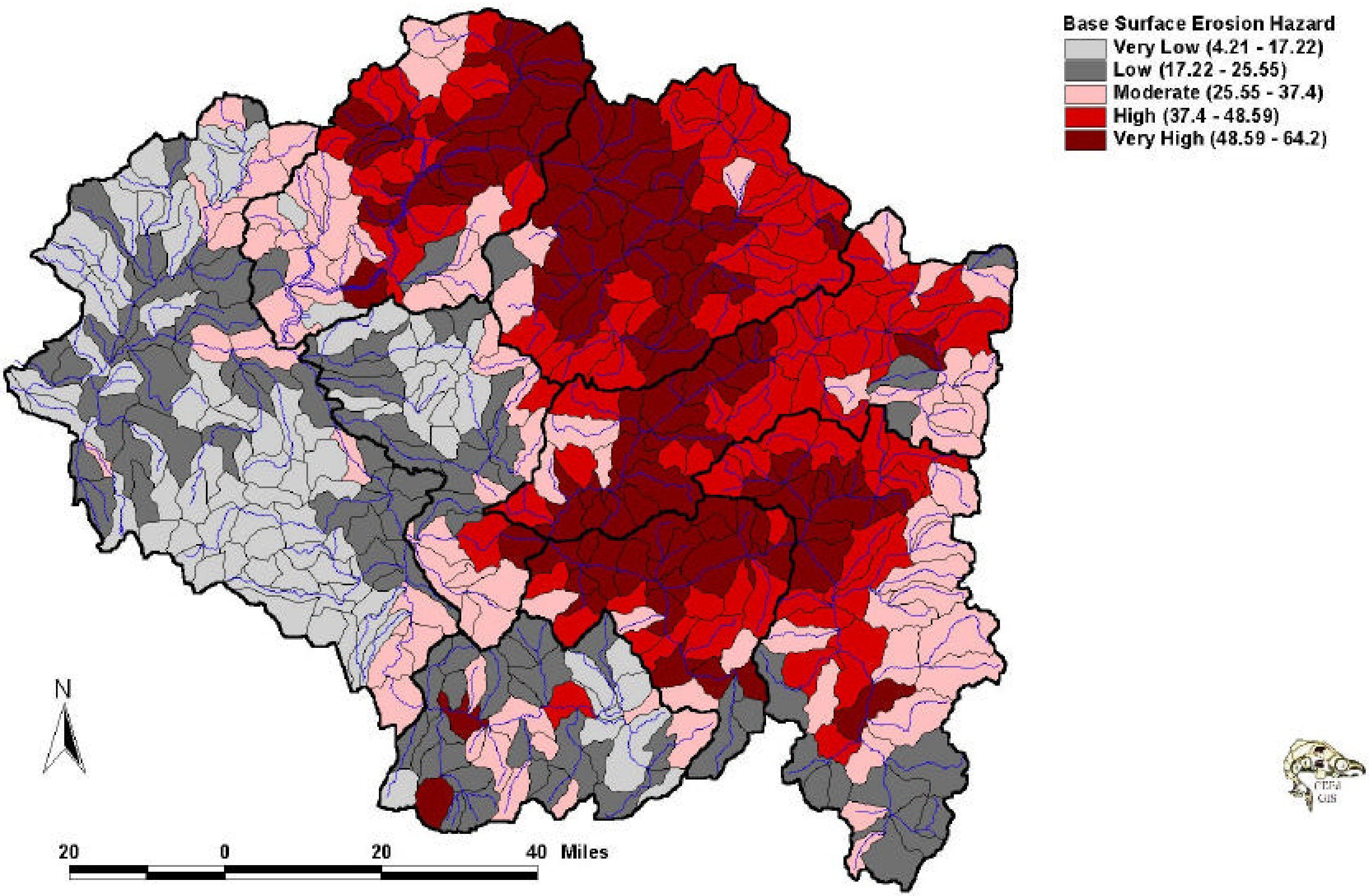

Figure 11. Base surface erosion hazard in the Clearwater subbasin. Data is taken from ICBEMP and incorporates the Modified Soil Loss Equation (MSLE), slope, rainfall intensity, and surficial geology in its derivation

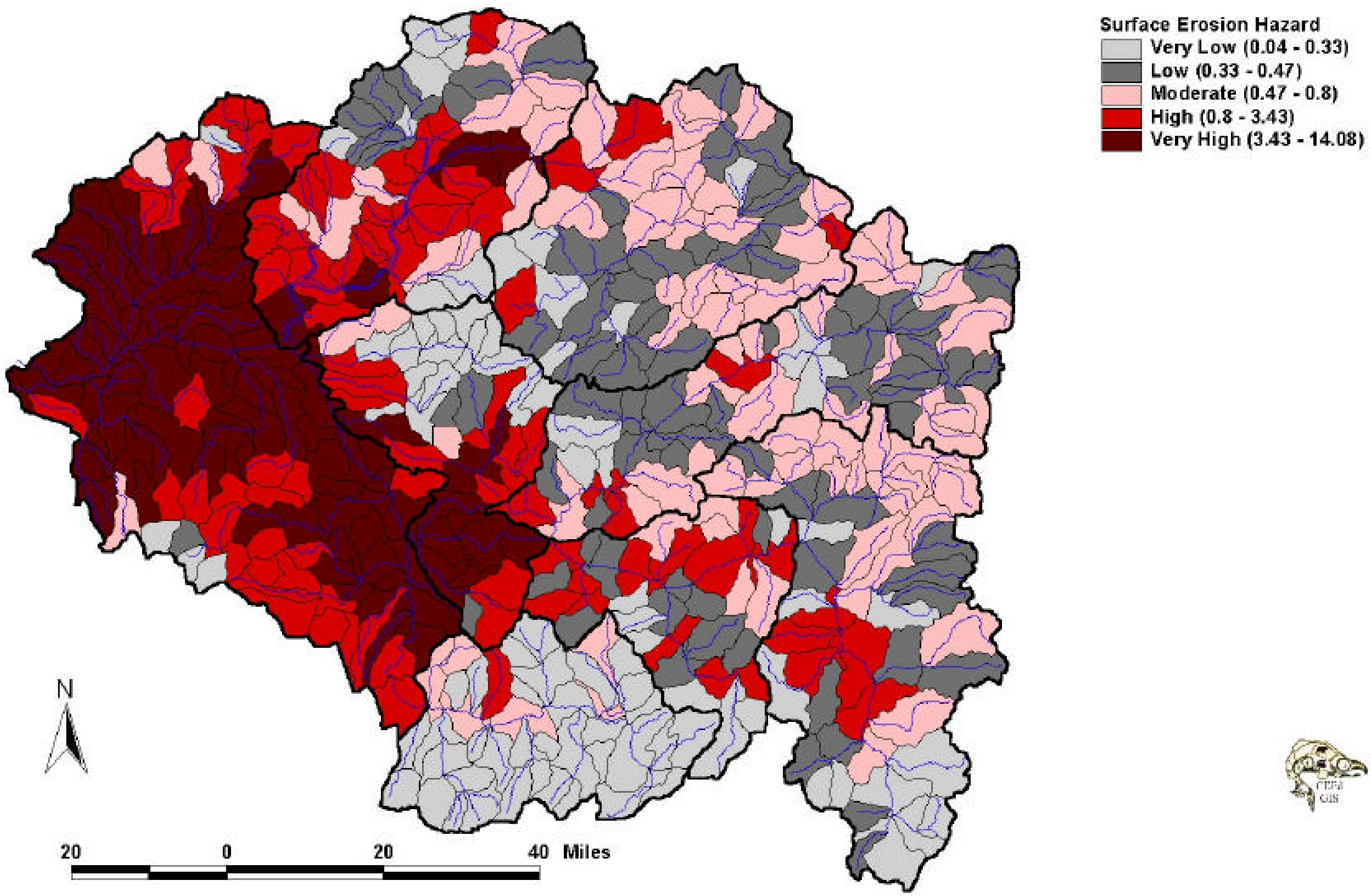

Figure 12. Surface erosion hazard in the Clearwater subbasin. Data is taken from ICBEMP and incorporates the Modified Soil Loss Equation (MSLE), vegetation cover types, slope, rainfall intensity, and surficial geology in its derivation

occurrence, though to a lesser degree (for an indepth discussion of assumptions, equations, and other quantitative data used in the UI/Potlatch model, refer to Miller et al. 2001).

To apply the UI/Potlatch model at a subbasin scale, we used data on geologic parent material, slope, aspect and elevation, since these variables were available at an appropriate resolution across the subbasin. Although road age information was a primary land use variable factored in the UI/Potlatch model, it was not uniformly available across the subbasin, and therefore prohibited inclusion of roading impacts in the modeling exercise. Model outputs therefore represent natural landslide potential, without the influence of road building activity.

Figure 13 depicts relative landslide hazard throughout the subbasin by measuring the percentage of a given 6th field HUC with moderate to high landslide potential. Generally, inherent landslide hazard is rated low throughout many of the upland portions of the subbasin, and highest along primary tributaries or trunk streams. Sixth field HUCs with the greatest percentage of their area classified as moderate to highly susceptible to landslides are clustered around the confluence of the Lochsa and Selway Rivers, the Middle Fork AU, and throughout the lower portions of the upper North Fork Clearwater AUs. Sixth-field HUCs not considered to be at high or moderate risk of landslide are clustered along glaciated and mountainous landforms bordering the Lochsa, upland portions of the Selway and South Fork AUs, and in the Camas and Weippe prairie regions.

Potential Sediment Source Zone

The influence of topography on sedimentation processes is significant, and when considered at a landscape scale, may effectively define inherent risks of various management actions. Definition of the topographic features immediately adjacent to floodplain areas and/or active channels may provide further resolution to the inherent risk of sediment entering a stream. For example, the rough, noncontinuous slopes typical of breakland landforms (high relief) in the subbasin influence sediment transport by decelerating rill and gully erosion and storing eroded material in benchlike depressions proximal to channels (BLM 2000). Conversely, streamside slope gradients in hill and plateau landforms (low relief) are often excessive due to channel incision, and may readily convey sediment to the active channel.

To determine areas throughout the subbasin most likely to transport sediment to a channel following upland soil movement, the potential sediment source zone (PSSZ) model was developed. The model provides an index of vulnerability to sediment entering the active channel or floodplain area. The PSSZ is essentially a variable-width hazard zone around streams defined by the surrounding topography (Figure 14). The intent of the PSSZ model is similar to the "sediment transport efficiency" layer developed by ICBEMP (Quigley and Arbelbide 1997).

The PSSZ index is a cell-based GIS model, using non-linear transformation of slope percent as an impedance cost. Land slope, based on a USGS 30m digital elevation model (DEM), creates an impedance that restricts the width of the source zone on flatter areas (higher impedance) and broadens the width of the zone (lower impedance) on steeper terrain. Arc-Grid command pathdistance was used to determine the distance from the stream over the impedance zone described above. A total impedance cost threshold, or buffer zone width threshold, was used to limit the impedance width of the PSSZ. This creates the variable width PSSZ along the length of the river based on the cross sectional shape of the river valley immediately adjacent to a measured stream. One value of the PSSZ is in determining variable-width buffer zones for protecting streams from sediment inputs.

Figure 15 depicts the percentage of any given 6th field HUC comprised by the PSSZ. Overall, most 6th field HUCs have less than 11% of their total area contained within the PSSZ.

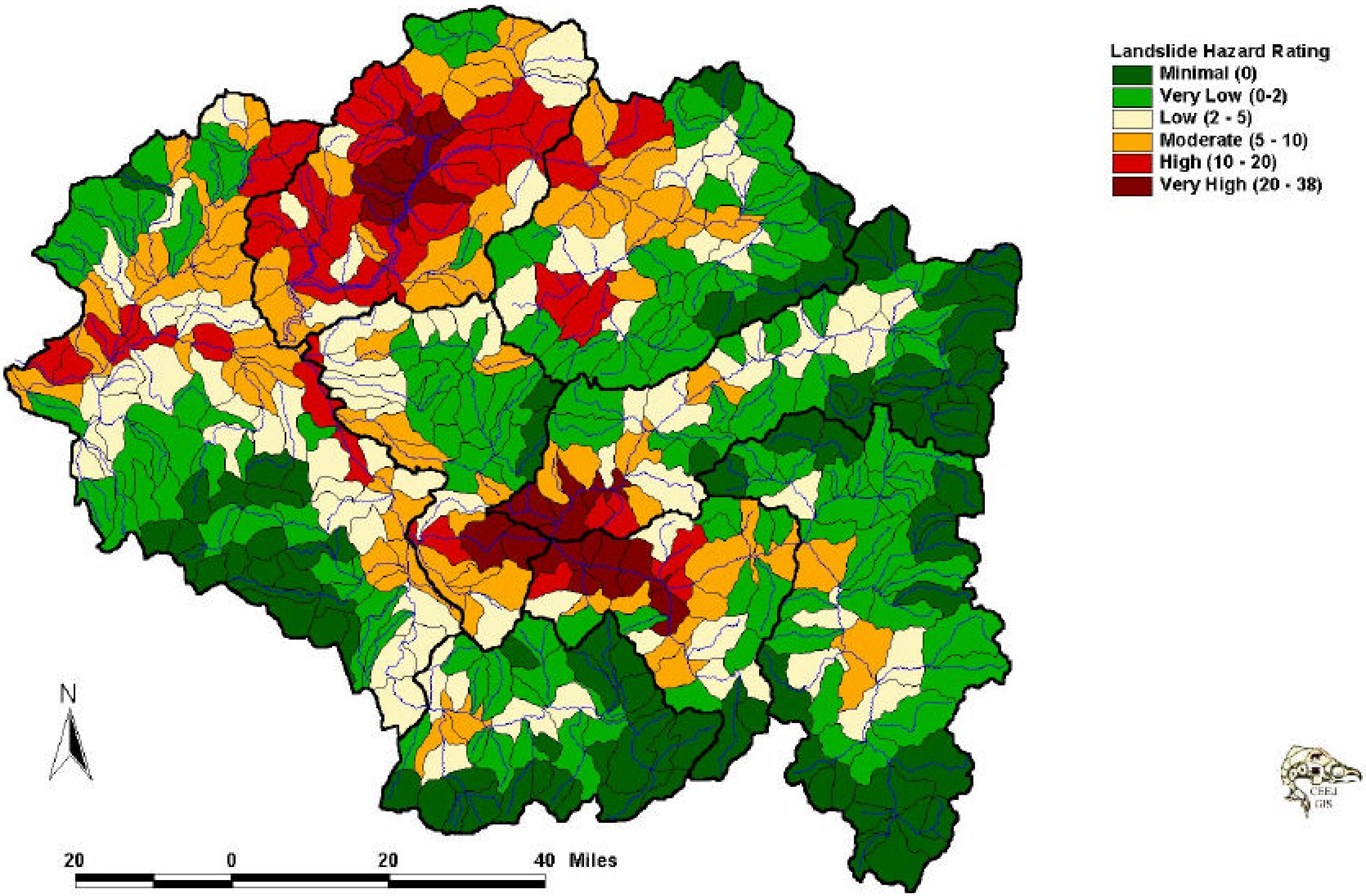

Figure 13. Relative landslide hazard in the Clearwater subbasin, as measured by the percentage of a given 6th field HUC with moderately high to high risk of landslide (adapted from Miller et al. 2001)

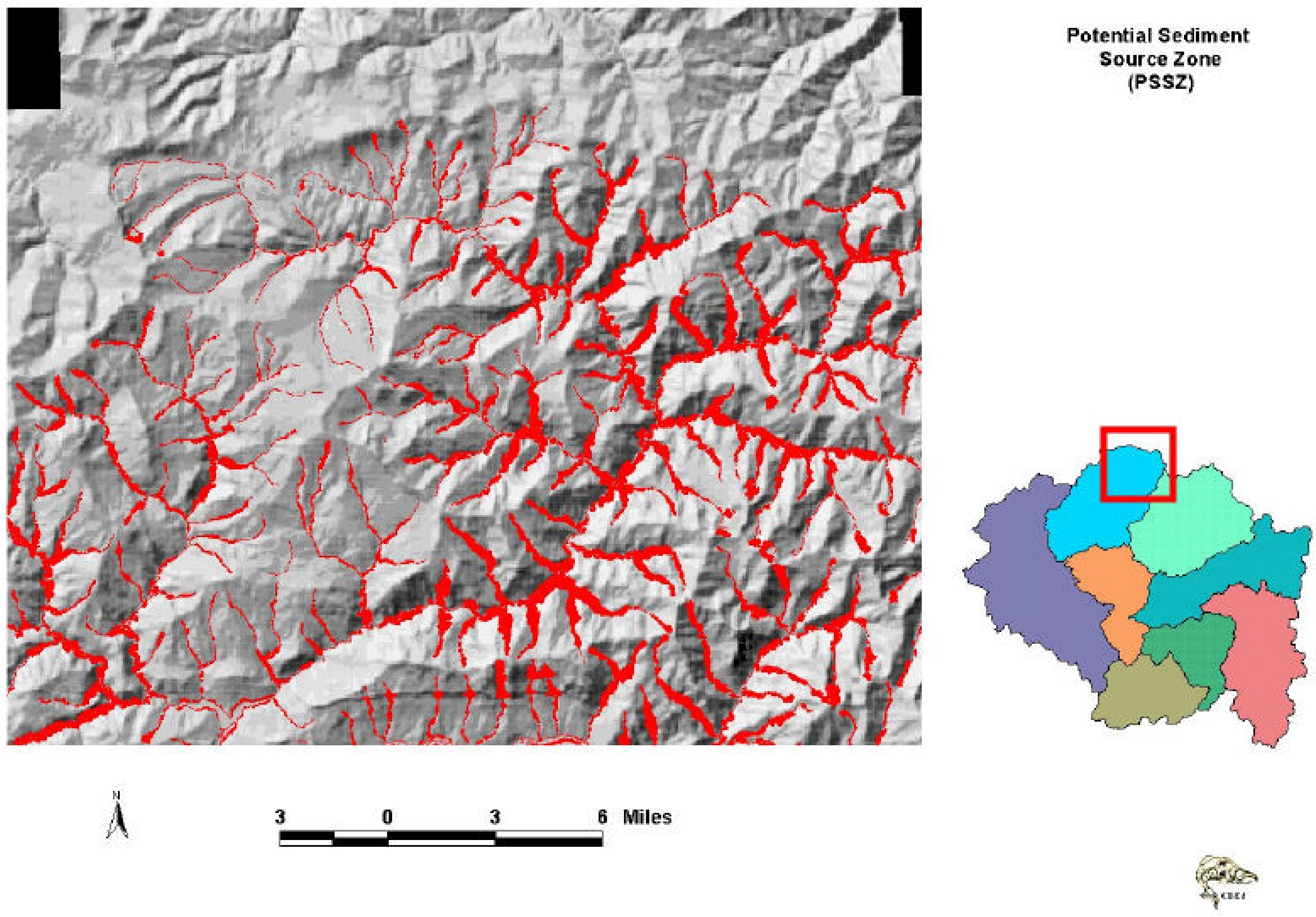

Figure 14. Example of the Potential Sediment Source Zone model output as it applies to a section of the Lower North Fork AU

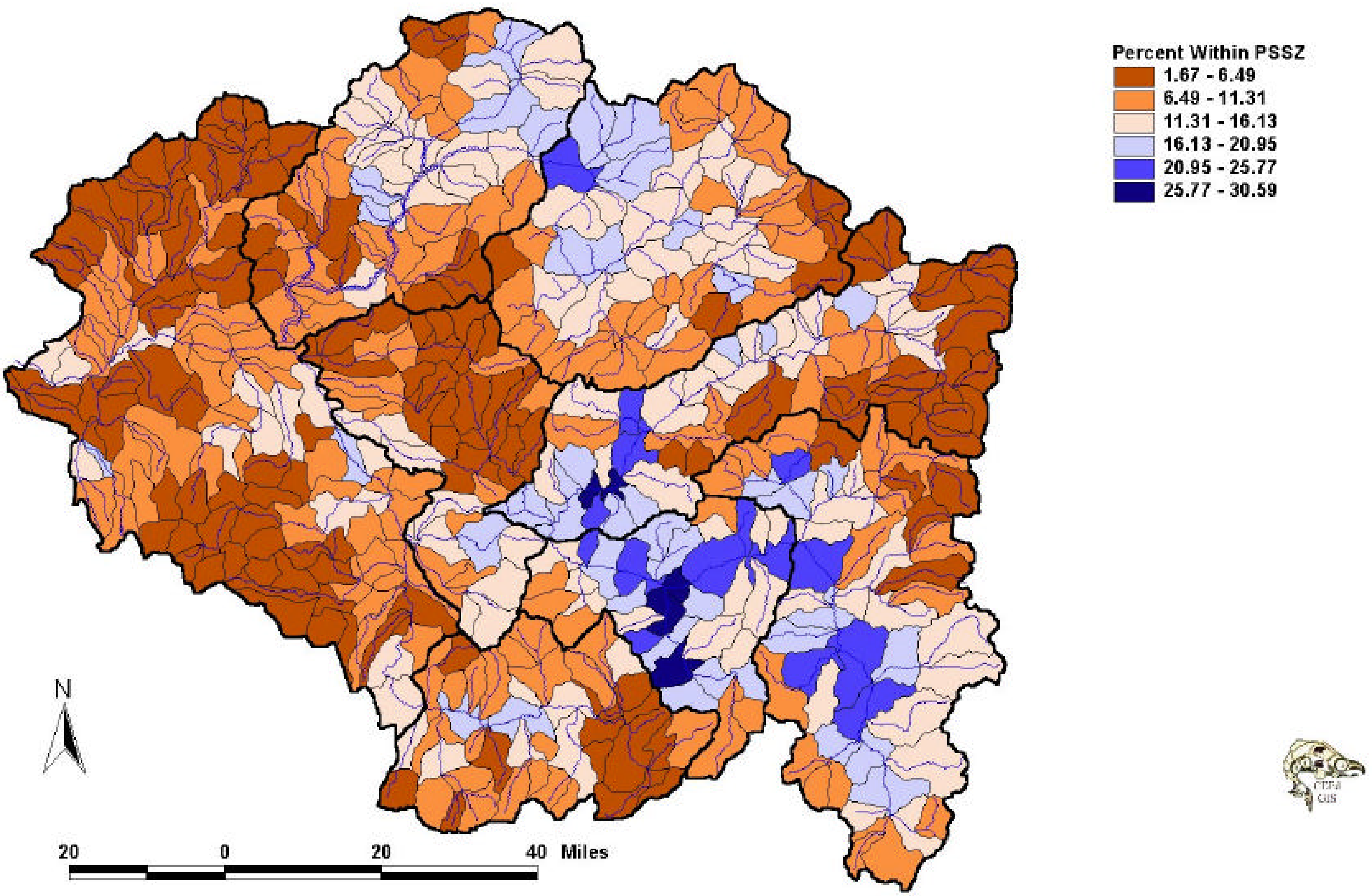

Figure 15. Percent of area, as stratified by 6th field HUC, that is within the Potential Sediment Source Zone

Based on the percentage of HUC area within the PSSZ, mobilized sediment is most likely to be conveyed to stream channels in the lower and upper Selway AUs and in downriver portions of the Lochsa AU. Similarly, PSSZs comprise relatively high percentages of 6th field HUCs upriver from Dworshak Reservoir and in mainstem portions of the South Fork Clearwater River.

4.7 Hydrology

The mainstem Clearwater River originates in the Bitterroot Mountains at elevations ranging from 8,400-9,000 feet (2,560-2,743 m). The Clearwater River contributes approximately one third the flow of the Snake River and ten percent of the flow of the Columbia River system annually (USFS 1969 cited in Maughn 1972), with a mean annual discharge of approximately 15,300 ft^3/s near its mouth (Lipscomb 1998).

The Clearwater derives its flow from a network of tributaries, four of which are primary (North and South Forks, and Lochsa and Selway rivers). The Selway and Lochsa rivers both originate at the Idaho–Montana border in the Selway Bitterroot divide and flow in a westerly to northwesterly direction through precipitous breaklands and forested canyons to their junction at Lowell, ID. The confluence of the Lochsa and Selway form the Middle Fork of the Clearwater, which flows in a westerly direction before joining the South Fork Clearwater at the town of Kooskia, ID. From this point on, the river is known as the mainstem Clearwater. The Clearwater continues to flow in a westerly to northwesterly direction through sparsely vegetated and weathered canyonlands to the town of Ahsahka, where the North Fork of the Clearwater enters. From Ahsahka, the Clearwater River courses through semi-arid canyons and agricultural land until joining the Snake River at Lewiston, ID.

4.7.1 Flood Regime

Major flood events occurred within the subbasin in 1919, 1933, 1948, 1964, 1968, 1974, and the winter/spring of 1995/1996 (McClelland et al. 1998). Stream records are not available for the 1919 event. Each of these flood events was defined based on flows recorded at the mouth of the Clearwater River (Table 9). Table 9 presents the flows recorded at various areas throughout the subbasin during these events, and illustrates the high degree of spatial variability in discharge throughout the Clearwater subbasin. The 1934 flood event appears to have been driven primarily by events originating in the North Fork Clearwater River, with relatively low flows in the South Fork Clearwater, Lochsa, and Selway AUs. Similarly, in comparing flood events of similar magnitude in the Lower Clearwater River (i.e. 1957 vs. 1964 or 1933 vs. 1938), substantial differences can be seen in the corresponding discharge from individual AUs. This data illustrates the importance of considering local hydrologic conditions in project planning and development, and accounting for the variable climatic conditions within the Clearwater subbasin which contribute to annual runoff conditions.

4.7.2 Gauging

There are a total of fifty-three gauging stations in the Clearwater subbasin. The stations are widely distributed and occur in all assessment units. Seventeen out of the fifty-three stations have only peak or historical records, and only twelve of the stations are currently active. The gauging station on the Selway River near Lowell, Id (#13342500) represents the longest period of record(70 years). The shortest period of record is at the Walton Creek Station near Powell Ranger Station (#1336635), which has collected data for only three months (Table 10).

Table 9. Comparison of discharge at various locations throughout the Clearwater subbasin during major flood events measured near the mouth of the Clearwater River

Location	1933	1934	1938	1948	1957	1964	1974
Lower Clearwater AU							
Clearwater R. at Spalding	136,000	172,000	134,000	177,000	143,000	141,000	131,000
Clearwater R. at Orofino	81,500	----	72,300	----	----	----	85,800
Potlatch River at Kendrick	----	----	----	13,000	8,500	3,800	----
Lower North Fork AU							
North Fork Clearwater R. near Ahsahka	46,700	100,000	62,700	55,600	40,600	41,800	----
Upper North Fork AU							
North Fork Clearwater R. near Bungalow Ranger Station	----	----	----	27,400	16,300	21,400	----
Lolo/Middle Fork AU							
	No Data Available						
Lower Selway AU							
Selway R. near Lowell	33,800	20,500	32,800	48,900	26,500	43,400	43,100
Upper Selway AU							
	No Data Available						
Lochsa River AU							
Lochsa R. near Lowell	34,800	22,500	24,500	34,600	21,100	35,100	32,000
South Fork AU							
South Fork Clearwater near Grangeville	6,090	2,380	6,740	12,600	8,910	----	----
South Fork Clearwater near Stites	----	----	----	----	----	17,500	6,750

The primary tributaries supplying the majority (>60%) of flow to the Clearwater are relatively similar in drainage area yet differ substantially in flow contribution (Table 11). Smaller tributaries that provide important supplemental flows to the mainstem Clearwater River include the Potlatch River, Lapwai Creek, Big Canyon Creek, Lolo Creek, Orofino Creek, and Lawyers Creek.

Mean monthly flows for select active gauging stations are shown in Table 12. Records indicate that peak flows generally occur in May and June. Base flows occur most often in August and September, corresponding with times when instream temperatures are highest and precipitation is lowest in much of the Clearwater subbasin.

In lower elevation areas, occasional thunderstorms occur from late spring through summer which may result in flash floods that produce annual peak flows in localized areas (USACE 1967). However, thunderstorms are generally brief in duration and of limited size, resulting in highly localized impacts.

Timing, duration, and volume of peak flows are driven by snowmelt or seasonal rainstorms at lower elevations (<4,000’) in the Clearwater subbasin. Therefore, interannual variability in both timing and volume of peak flows is much greater than that at higher elevations. Rainstorms having the greatest impacts to hydrology at lower elevations occurduring winter or spring, when rain falls on frozen or snow covered ground (USACE 1967). These rain-on-snow events can occur from November through March (Thomas et al. 1963), and may result in hydrograph peaks throughout this period. Table 13 shows the magnitude and frequency of instantaneous peak flows at gauging stations in the Clearwater subbasin.

Table 10. Period of record (in bar chart) for all USGS gaging stations in the Clearwater River subbasin

Station Number	Station Name	Period of records in years
13335690	Selway River Abv Moose Creek Nr Moose Creek R. S.	
13335700	Moose Creek At Mouth Nr Moose Creek Ranger Station	
13336000	Selway River Ab Meadow Creek Nr Lowell Id	
13336100	Meadow Creek Nr Lowell Id	
13336300	Gedney Creek Nr Selway Falls Guard Station Id	
13336450	Rackcliff Creek At O'Hara Guard Station Id	
13336500	Selway River Near Lowell, Id	
13336600	Swiftwater Creek Nr Lowell Id	
13336635	Walton Creek Nr Powell Ranger Station Id	
13336650	Ef Papoose Creek Nr Powell Ranger Station Id	
13336800	Warm Spring Creek Nr Powell Ranger Station Id	
13336850	Weir Creek Nr Powell Ranger Station Id	
13336900	Fish Creek nr Lowell Id	
13337000	Lochsa River Near Lowell, Id	
13337100	Clear Creek Nr Kooskia Id	
13337200	Red Horse Creek Nr Elk City Id	
13337500	Sf Clearwater River Nr Elk City Id	
13337540	Leggett Creek Nr Golden Id	
13337700	Peasley Creek Nr Golden Id	
13338000	Sf Clearwater River Nr Grangeville Id	
13338200	Sally Ann Creek Nr Stites Id	
13338500	South Fork Clearwater River At Stites, Id	
13338800	Lawyer Creek Nr Nezperce Id	
13339000	Clearwater River At Kamiah Id	
13339500	Lolo Creek Nr Greer Id	
13339700	Canal Gulch Creek At Pierce Ranger Station	
13339800	Orofino Creek Nr Orofino Id	
13339900	Deer Creek Nr Orofino Id	
13340000	Clearwater River At Orofino, Id	
13340500	Nf Clearwater River At Bungalow Ranger	

Table 10 (Continued)

Station Number	Station Name	Period of Records in Years (00 02 04 06 08 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 00)
13340600	North Fork Clearwater River Near Canyon	
13340615	Beaver Creek Nr Canyon Ranger Station Id	
13340760	Little Nf Clearwater River Nr Elk River Id	
13340780	Breakfast Creek Nr Elk River Id	
13340855	Reeds Creek Nr Headquarters Id	
13340950	Dworshak Reservoir Nr Ahsahka, Id	
13340999	Nf Clearwater R - Peck Minus Orofino	
13341000	Nf Clearwater River At Ahsahka Id	
13341002	Test Site For Base Q (13341002)	
13341050	Clearwater River Near Peck, Id	
13341100	Cold Springs Creek Nr Craigmont Id	
13341128	Long Hollow Creek At Nezperce Id	
13341200	Ef Potlatch River Bl Mallory Creek Nr Bovill Id	
13341300	Bloom Creek Nr Bovill Id	
13341400	Ef Potlatch River Nr Bovill Id	
13341500	Potlatch River At Kendrick Id	
13341600	Arrow Gulch Nr Arrow Id	
13342000	Mission Creek Nr Winchester Id	
13342200	Twenty One Ranch Spring Nr Waha Id	
13342450	Lapwai Creek Near Lapwai, Id	
13342500	Clearwater River At Spalding, Id	
13343000	Clearwater River Nr Lewiston Id	
13343010	Lindsay Creek Trib No 4 Nr Lewiston Id	

Table 11. Drainage area and runoff of major tributaries in the Clearwater subbasin

Drainage	Drainage Area (sq. mi.)	Drainage % of subbasin	Average Annual Runoff (acre/feet)	Runoff % of subbasin[1]
Selway (7 mi. abv. confl. w/Lochsa)	1,910	20	883,207	16
Lochsa (0.9 mi. abv. confl. w/Selway)	1,180	12	789,095	14
South Fork Clearwater (at Stites, ID)	1,150	12	324,325	6
North Fork Clearwater (nr. Canyon Ranger station)	1,360	14	1,151,065	21

[1]Based on comparison of average annual runoff (5,552,620 acre/feet) measured at the mainstem Clearwater River at Spalding, ID (RM 11.6)

Table 12. Average monthly flows for principle tributaries and portions of the mainstem Clearwater River

Tributary/ Stream Segment	USGS Gauge #	General Location	Period of Record	Average Monthly Flows (cfs)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Selway R.	13336500	nr. Lowell ID	69 yrs.	1277	1555	2255	5998	13380	11910	3168	926	752	964	1298	1439
Lochsa R.	13337000	nr. Lowell ID	70 yrs.	1119	1303	1840	4854	10200	8395	2210	677	562	747	1091	1247
SF Clearwater	13338500	@ Stites, ID	34 yrs.	542	651	1003	2085	3304	2512	828	293	245	282	362	462
Lolo Cr.	13339500	nr. Greer, ID	20 yrs.	232	443	634	890	771	417	146	60	61	78	172	189
Clearwater R.	13340000	@ Orofino, ID	40 yrs.	4176	5133	7798	15550	28880	24450	6764	2141	1794	2139	3227	3934
NF Clearwater	13340600	nr. Canyon R.S.	30 yrs.	1837	2374	3222	6168	10910	8408	2684	1160	947	1039	1641	1864
Clearwater R.	13341050	nr. Peck, ID	33 yrs.	9869	11150	15020	21990	38470	34010	13050	6643	6627	4388	7033	9178

Table 13. Magnitude and frequency of instantaneous peak flow at gauging stations in Clearwater River subbasin

Station Number	Station Name	Period of Record	Discharge, in cfs based on the period of record for indicated recurrence interval in years and exceedance probability in percent							
			2 50%	5 20%	10 10%	25 4%	50 2%	100 1%	200 0.5%	500 0.2%
13336500	Selway River near Lowell	1911,1930-99	25,800	33,100	37,500	42,600	46,200	49,500	52,700	56,800
13336900	Fish Creek near Lowell	1958-67	1,710	2,030	2,220	2,440	2,590	2,740	2,880	3,061
13337000	Lochsa River near Lowell	1911-12,38-99	18,800	24,400	28,000	32,500	35,700	39,000	42,100	46,400
13337500	South Fork Clearwater River near Elk City	1945-74	1,940	2,610	3,050	3,610	4,030	4,440	4,870	5,430
13338000	South Fork Clearwater R near Grangeville	1911-20,23-63	5,040	6,800	7,990	9,540	10,700	11,900	13,200	14,900
13338500	South Fork Clearwater River at Stites	1964-99	6,470	9,480	11,600	14,400	16,500	18,800	21,100	24,300
13339000	Clearwater River at Kamiah	1911-65	53,300	67,800	76,500	86,400	93,200	99,700	106,000	114,000
13339500	Lolo Creek near Greer	1980-99	2,220	3,290	3,990	4,870	5,510	6,130	6,750	7,550
13340000	Clearwater River at Orofino	1931-38,65-99	54,300	68,900	77,400	87,200	93,900	100,000	106,000	114,000
13340500	NF Clearwater R at Bungalow Ranger Sta	1945-69	16,300	20,400	23,000	26,100	28,400	30,600	32,800	35,700
13340600	NF Clearwater River near Canyon R.Sta	1967-69,71-99	18,800	24,900	29,000	34,200	38,100	42,000	46,000	51,400
13341000	North Fork Clearwater River near Ahsahka	1927-68	31,100	44,300	53,700	66,100	75,700	85,700	96,000	111,000
13341050	Clearwater River near Peck	1965-97	67,800	87,800	99,900	114,000	124,000	138,000	143,000	155,000
13341300	Bloom Creek near Bovill	1960-71,73-79	58	93	120	159	192	227	266	323
13341400	East Fork Potlatch River near Bovill	1960-71	640	915	1,110	1,370	1,580	1,800	2,020	2,340
13341500	Potlatch River at Kendrick	1945-71	6,160	9,020	11,100	13,900	16,100	18,500	21,000	24,500
13342450	Lapwai Creek near Lapwai	1975-97	798	1,880	2,960	4,800	6,590	8,770	11,400	15,700
13342500	Clearwater River at Spalding	1911-13, 1923-97	79,300	106,000	122,000	141,000	155,000	168,000	180,000	19,600

4.7.3 Modeled Hydrology Data

In 1998, the USGS released a report that modeled monthly and annual discharge for over 1,000 subwatersheds within the Salmon and Clearwater subbasins (Lipscomb 1998). Subwatershed delineations used by Lipscomb (1998) are only roughly comparable to 6th field HUCs used in this assessment, but the data provide a reasonable picture of discharge patterns for general hydrologic characterization. Hydrologic characterization of the Clearwater subbasin relies on this modeled information to present a comprehensive overview of runoff timing, relative runoff quantity, and annual flow variation. Hydrograph patterns derived from Lipscomb's (1998) data are consistent with those described by Maughn(1972), Bugosh (1999), Paradis et al. (1999), Thompson (1999), and the Clearwater National Forest (1997) for smaller areas within the subbasin. It should be noted that because modeled data is based on discharge records from USGS gaging stations, it represents a 'current' situation more accurately than a natural or historic situation.

Advantages and Disadvantages of Using Modeled Flow Data

Although Lipscomb's (1998) data is useful for hydrologic characterization at the subbasin scale, it has both advantages and disadvantages when applied within a decision making process, particularly at smaller scale(s).

Advantages

- Extrapolates from gaged to ungaged subwatersheds allowing for comprehensive characterization of hydrologic condition(s) throughout the entire subbasin.
- Data is compiled by subwatershed, allowing for relatively detailed characterization.

Disadvantages

- Subwatersheds are defined in a manner which does not allow for direct comparison to available hierarchical delineation systems (i.e. USGS HUCs used in this Assessment).
- Basing estimates of ungaged subwatersheds on data from gaged subwatersheds will over- or underestimate discharge where the gaging stations used are impacted by upstream water withdrawls. Impacts of this modeling approach inconsistently influence discharge estimates across the subbasin based on the relative impact of water withdrawls on the gage used in estimation.

Flow Regimes

The hydrology of the Clearwater subbasin varies largely as a result of differences in amount and form of precipitation, which is intrinsically linked to variations in elevation and climatic patterns. Precipitation generally increases from west to east through the subbasin as elevation increases. In areas of similar elevation, precipitation generally decreases from north to south based on the relative influence of maritime (north) or Rocky Mountain (south) climate patterns.

Mean annual discharge is variable throughout the major tributaries of the Clearwater subbasin (Table 14). Mean annual discharge is approximately 1,100 cfs at the mouth of the South Fork Clearwater River, whereas the Lochsa and Selway Rivers produce approximately 2,900 and 3,900 cfs, respectively. Mean annual discharge at the mouth of the North Fork Clearwater is estimated as 5,600 cfs. Mean monthly maximum and minimum discharge follows a similar pattern between major tributaries, with greater discharge occurring from the North Fork, intermediate discharge from the Lochsa, and Selway Rivers, and lowest discharge from the South Fork Clearwater River.

Table 14. Hydrologic characterization of various locations within Clearwater River subbasin Assessment Units (Lipscomb 1998)

Assessment Unit Location	Mean Annual Q (cfs)	Maximum Monthly Q (Month)	Minimum Monthly Q (Month)	Unit Mean Annual Q (cfs/mi.^{2})	Annual Flow Stability [a]
Lower Clearwater AU					
Clearwater R. Mouth	15,000	45,000 (May)	4,000 (August)	1.2 - 1.8	27
Clearwater R. above North Fork	8,800	29,000 (May)	1,800 (September)	1.2 - 1.8	20
South Fork Clearwater R. Mouth	1,100	3,500 (May)	270 (September)	0.8 - 1.2	25
Lower North Fork AU					
North Fork Clearwater R. Mouth	5,600	18,000 (May)	1,300 (September)	1.8 - 2.7	23
Upper North Fork AU					
North Fork Clearwater R. above Dworshak Reservoir	3,300	10,000 (May)	900 (September)	1.8 - 2.7	27
Lolo/Middle Fork AU					
Middle Fork Clearwater R. Mouth	7,000	23,000 (May)	1,500 (September)	1.8 - 2.7	21
Lower Selway AU					
Selway R. Mouth	3,900	14,000 (May)	790 (September)	1.8 - 2.7	20
Upper Selway AU					
Selway/Moose Creek confluence	3,400	13,100 (May)	660 (September)	1.8 - 2.7	20
Lochsa River AU					
Lochsa R. Mouth	2,900	10,000 (May)	570 (September)	1.8 - 2.7	20
South Fork AU					
South Fork Clearwater at lower AU boundary	760	2,800 (May)	160 (September)	0.8 - 1.2	21

(a) Estimated as the percent of mean annual discharge represented by minimum mean monthly discharge

Relative discharge is greatest in the eastern portions of the subbasin, including the upper reaches and tributaries of the North Fork Clearwater and Lochsa Rivers, and some tributaries to the upper Selway River (Figure 16). Unit mean annual discharge in these areas exceeds 2.70 cfs/square mile of drainage area. Relative discharge produced by major tributaries to the Clearwater River is substantially less from the South Fork Clearwater River (0.8-1.2 cfs/sq. mile) than from other major tributaries (1.8-2.7 cfs/sq. mile; Table 14).

Unit mean annual discharge from smaller tributaries typically exceeds 1.20 cfs/square mile in the forested uplands of the five Assessment Units encompassing the North Fork, Lochsa, and Selway Rivers (Figure 16). Lesser discharge is produced from both the South Fork and Lolo/Middle Fork Assessment Units, which produce between 0.60 and 1.19 cfs/square mile from most of the contributing drainage areas. Relative annual discharge produced from smaller tributaries within the Lower Clearwater Assessment Unit rarely exceeds 0.79 cfs/square mile, but may be as high as 1.19 cfs/square mile in portions of the Potlatch River drainage. The lowest relative annual discharges estimated in the Clearwater subbasin are produced from streams within the Camas Prairie area in the southern portions of the Lower Clearwater Assessment Unit, and range from 0.20 to 0.59 cfs/square mile of drainage area.

The timing of peak (monthly mean) stream flow throughout the Clearwater subbasin is variable, occurring from March through June depending on the drainage (Figure 17). Mainstem tributaries throughout the subbasin generally experience peak flows during May, which is later than associated upland areas at lower elevations, and earlier than upland areas at higher elevations. Timing of peak monthly flows from upland areas can be expected in April throughout much of the Lower Clearwater, Lower North Fork, and Lolo Creek/Middle Fork AUs. Mean monthly flows from upland areas within the Upper Selway/Moose Creek and easternmost portions of the Lochsa and Lower Selway AUs typically peak in June. The Upper North Fork, South Fork, and western portions of the Lochsa and Lower Selway AUs typically experience the highest mean monthly flows during May, with the timing of flows from upland areas similar to that in the associated mainstem reaches. The earliest mean monthly peak flows in the Clearwater subbasin (March) occur in Lawyers, Cottonwood, Threemile, and Butcher Creeks which comprise a series of predominantly east-west drainages within the Camas Prairie plateau.

Annual flow variation is greatest in tributaries in the Camas Prairie, where base flows (minimum mean monthly discharge) can be expected to comprise less than 10% of the mean annual discharge in some areas (Figure 18). The most stable annual flows exist in the Lower North Fork AU where base flows make up 37-46% of the mean annual flow in most tributaries flowing into Dworshak Reservoir, with the exception of the Elk Creek system (10-18%). With the exception of the Lower North Fork AU, patterns in annual flow variation follow a similar pattern to other hydrologic regimes, with a gradient from the east (least variable) to the west (most variable).

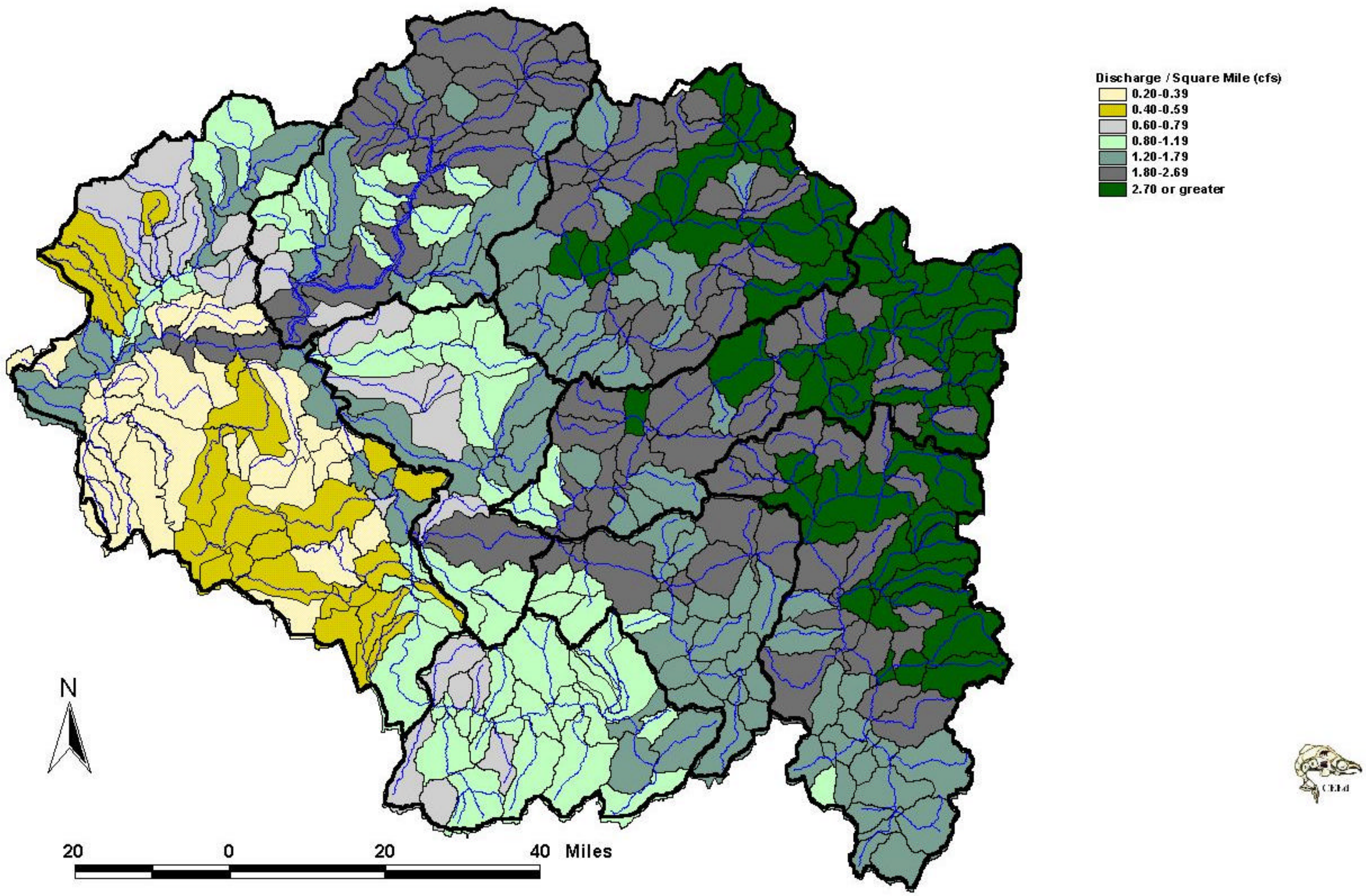

Figure 16. Unit mean annual discharge for the Clearwater subbasin, summarized using subwatersheds defined by Lipscomb (1998)

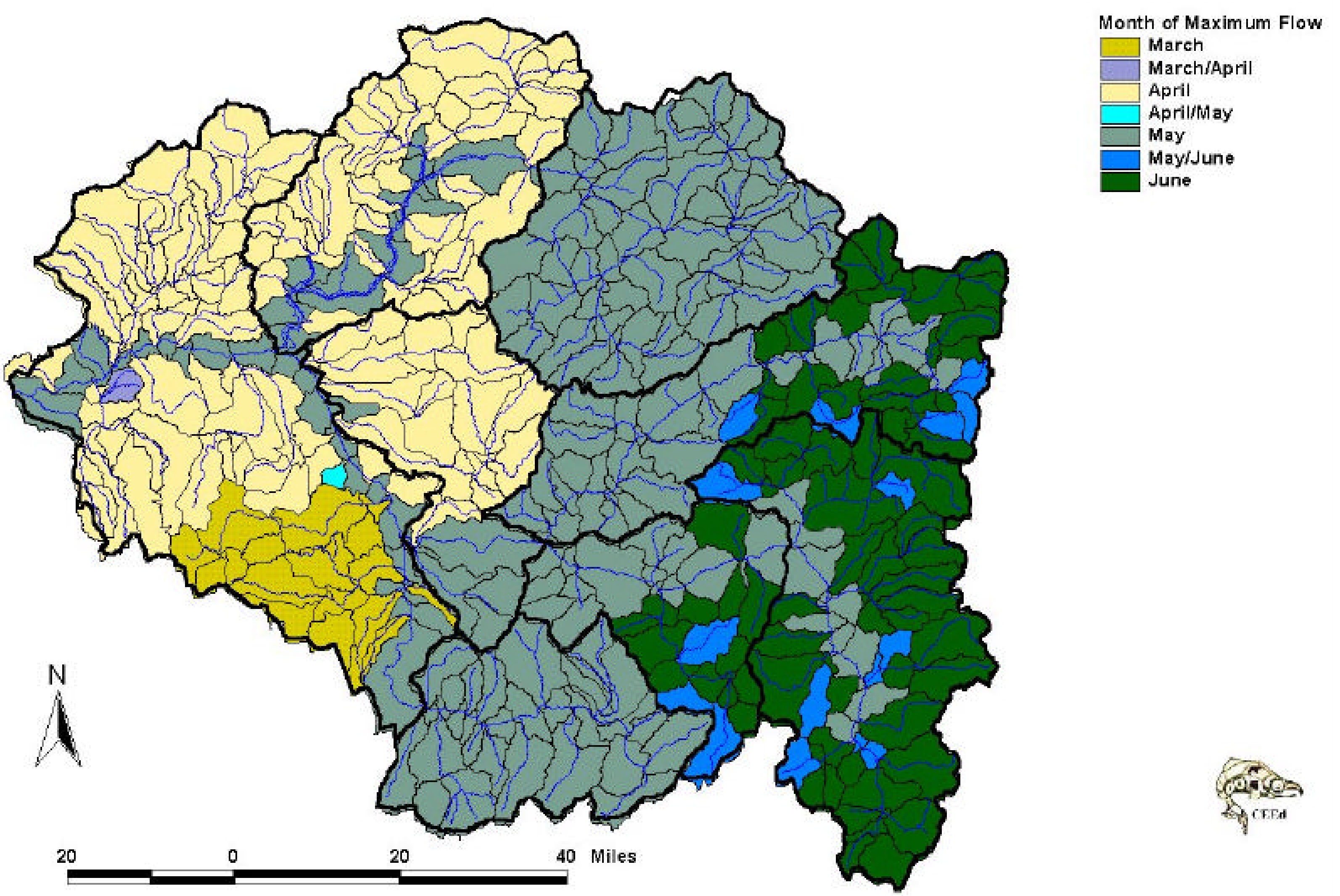

Figure 17. Timing of maximum monthly discharge across the Clearwater subbasin summarized using subwatersheds defined by Lipscomb (1998)

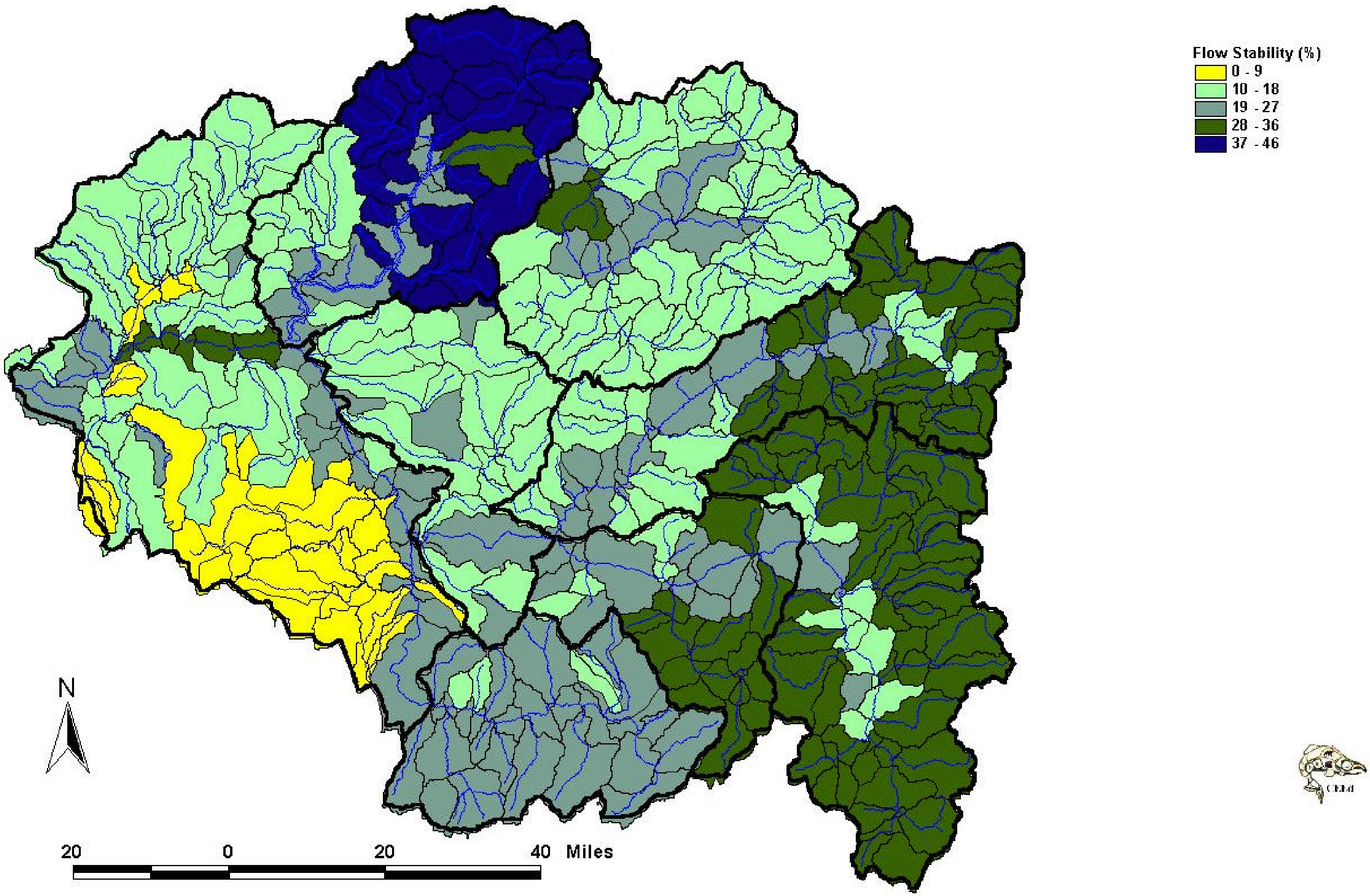

Figure 18. Flow stability for the Clearwater subbasin, summarized using subwatersheds defined by Lipscomb (1998)

4.8 Water Use

No information is available on actual rather than permitted/potential water use across large areas within Idaho. Data regarding potential water use within the Clearwater subbasin was derived from Idaho Department of Water Resources (IDWR) records on both water rights and adjudication claims filed under the Snake River Basin Adjudication (SRBA) process. Since water rights and adjudication data may lead to erroneous information regarding current water use if examined separately, both databases were integrated to produce the most accurate picture of potential current water use. The decision to integrate the two databases was made based on consultation with IDWR Water Rights Supervisor Shelly Keen (personal communication May 23, 2000).

Although water rights existed prior to 1900, the IDWR water rights database underestimates the number of rights existing prior to 1963 for groundwater and 1971 for surface water, when licensing of those rights became formally required. The database also fails to account for changes in water use over time, particularly with regard to abandoned or forfeited claims.

The adjudication claims data supplied by IDWR include only those claims to water rights existing prior to November 19, 1987 filed with the courts as part of the SRBA. The database may include competing claims for the same water right resulting in potential over-allocation of water in some areas, although this was found to be rare within the Clearwater subbasin. In contrast, numerous claims under the SRBA list a lower amount of water than that of the corresponding water right, suggesting that water use diminished over time or the amount licensed under the water right was less than that originally claimed or permitted. In these cases, it was assumed that the amount claimed under the SRBA best represented actual use rather than the amount listed in the water rights database.

To integrate information from both the water rights and adjudication claims databases supplied by IDWR, the following "rules" were applied.

1. Claims filed under the SRBA with illustrated beneficial uses represent real and legal water uses that may not be represented in the water rights database. Such rights may have been in place prior to the current permitting process (1963/1971) or do not require water rights permits under the current process (e.g. small domestic or groundwater uses).
2. Water rights data is assumed to accurately represent water use associated with claims filed after November 19, 1987.
3. Adjudication claims data best represents existing water uses for water rights filed prior to November 19, 1987. Adjudication claims data includes claims to legal non-licensed rights filed prior to 1963/1971 but omits abandoned water rights.
4. Where applicable, reductions in the amount of water claimed (SRBA) provide a more accurate depiction of current water use than information for corresponding water rights.
5. Water rights listed in the water rights database with priority dates prior to November 19, 1987 with no corresponding claim filed under the SRBA are considered abandoned.

Water use for this assessment was summarized as Maximum Allowable Use (MAU) by land section. MAU was determined by summing the maximum legal water use from all water rights or applicable adjudication claims within each section, and is presented in this report as the volume allowed in acre feet per year (AFY). Water use rates (cfs) are presented in this section for comparative purposes only. Water use rates represent the continual (year round) diversion rate necessary to supply the maximal allowable volume, and may differ substantially from those reported in water rights databases if water use is permitted only during a portion of the year. Approximately 724 AFY would be supplied by a source providing 1 cfs continually over the course of one year.

The amount of water available under a water right may be limited by either the rate (cfs) at which water may be drawn under the right, the volume (AFY) allowed to be taken, or both. For determining MAU, the maximum volume allowed (AFY) was compared with the volume that could be drawn under the maximum rate (cfs) limitations of the water right, assuming a constant diversion rate throughout the allowable period of use. MAU was defined as the most limiting (minimum) of these two water use estimates. Where only one factor (rate or volume) limited water use under a particular water right or claim, that factor was used to estimate the MAU for that water right/claim.

Many water rights include numerous points of diversion/take, with no stipulation on how much water can or should be drawn from any single diversion point. Therefore, where water rights or claims have multiple sources included in multiple land sections, the entire amount claimed was included in the MAU for each section. This approach produces an accurate picture of MAU within any single section, but will overestimate the total water use within the watershed if sectional maxima are summed.

Separation of water uses into either instream or out-of-stream uses is difficult, since up to three uses are associated with any given water right or claim. These allowable uses may include both in and out-of-stream uses for the same right, and some uses (e.g. storage for minimum flows) may essentially be both--holding water from the stream at one point in time for release at another time. For these reasons, only information about MAU is presented here. Additional detail about in and out-of-stream uses is available for project planning purposes, but should be examined on a case by case basis as necessary.

4.8.1 Surface Water Use

Surface water use is permitted in all eight AUs within the Clearwater subbasin, but is most prevalent within the Lower Clearwater, Lolo/Middle Fork, and South Fork AUs (Figure 19). With the exception of substantial licensed water rights dedicated to the maintenance of minimum instream flows on the Lochsa and Selway Rivers, surface water use in both of these drainages is limited. Surface water MAU is also substantial at the head of the Middle Fork Clearwater River, the only other stream segment in the Clearwater subbasin with licensed surface water rights designated for maintenance of minimum instream flows. Minimum instream flow requirements have been recommended and applied for on seven additional stream segments in the Lower Clearwater and Upper and Lower North Fork AUs (Figure 19). Surface water rights for these recommended minimum instream flows are yet to be licensed and are therefore not represented in descriptions of MAU presented in Figure 19.

In the Clearwater subbasin, most subwatersheds in which surface water use is permitted contain less than 1,000 AFY (1.4 cfs) of surface water allocation (Figure 19). The highest MAUs (> 400,000 AFY; > 500 cfs) associated with surface water rights are associated with minimum instream flows on the Lochsa, Selway, and Middle Fork Clearwater rivers. Other substantial surface water use (50,000–150,000 AFY; 70-207 cfs) is associated with the Lewiston Orchards Irrigation District's use of water from the Lapwai Creek system (Lower Clearwater AU), and with Elk Creek Reservoir in the Lower North Fork AU. With the exception of areas near Lewiston, Pierce, and Kooskia where MAU ranges from 10,000 to 35,000 AFY (14-50 cfs), water use in other subwatersheds is generally below 5,000 AFY (7 cfs).

4.8.2 Groundwater Use

Groundwater use in the Clearwater subbasin is less substantial than surface water use in both amount and distribution. The overall distribution of allowable groundwater use is predominantly associated with privately owned portions of the subbasin (Lower Clearwater and Lolo/Middle Fork AUs), and is most likely comprised of municipal and domestic (Figure 20). No groundwater use is permitted in the Selway River drainage or the Upper North Fork AU. Allowable groundwater use in the Lochsa, Lower North Fork, and South Fork AUs is both limited and localized.

Maximum allowable use of groundwater uncommonly exceeds 724 AFY (1 cfs) and does not exceed 4,344 AFY (6 cfs) in any individual land section. Maximum allowable use of groundwater does not exceed 5,864 AFY (8.1 cfs) in any individual subwatershed within the Clearwater subbasin. Where groundwater use does exceed 724 AFY, it is typically associated with municipal water supplies and other uses associated with the towns of Grangeville, Kooskia, Lewiston Orchards, Weippe, and Kamiah (Figure 20).

4.9 Water Quality

To provide an overview of water quality throughout the Clearwater subbasin, summaries were made using data collected at USGS gaging sites. The USGS data was selected for use because it provided consistent and widespread sampling sites with relatively long periods of record for multiple parameters. The USGS data is intended for trend monitoring, and does not supply adequate information for detailed analysis (spatial or temporal) of water quality. Substantial amounts of water quality data exist from other sources within the subbasin which are useful for more detailed analyses, although parameters sampled, locations and period of record are often inconsistent, resulting in more localized applicability. A substantial effort to conduct consistent, coordinated temperature monitoring throughout the Clearwater subbasin has been implemented in recent years, and Idaho Department of Environmental Quality maintains information regarding sampling periods and locations.

U.S. Geological Survey (USGS) water quality data for the Clearwater River drainage was gathered from the National Water Information System (NWIS) and EarthInfo, Inc. databases, as well as the annual Water Resources Data reports for Idaho. Fifty-seven gauging stations were identified within the subbasin where water quality data was, or is still being, collected. Individual data sets vary with respect to the number of data points and parameters, as well as the period of record and sampling intensities.

The seven stations with data for the longest period are detailed in Table 15, and can be subdivided into four broad categories. The first category includes the stations at Peck, Orofino, and the North Fork Clearwater near Canyon Ranger Station. Temperature and specific conductance (conductivity) were the most data-rich parameters at these locations. The second category includes the stations at Selway and Lochsa near Lowell, Idaho. These two sites are closer to the headwaters than the other six, and a suite of analytes were evaluated between 1974 and 1980. Although dated, these sites provide important background information , which is useful for comparing reaches at that time or as baseline data if new monitoring programs are initiated. The third category includes the stations at Stites on the South Fork of the Clearwater and Lapwai Creek near Lapwai, Idaho. These stations were also monitored from the mid 1970s to the early 1980s, but sampling was resumed in the early 1990s for many of the same parameters. The final category belongs to the Spalding gauging station on the mainstem of the Clearwater. This station stands out among the others as having the largest number of analytes and the longest period of record. In addition, many of the parameters evaluated by the USGS at this location were analyzed during limnological studies by researchers at the University of Idaho and Washington State University during the late 1970s and mid 1990s.

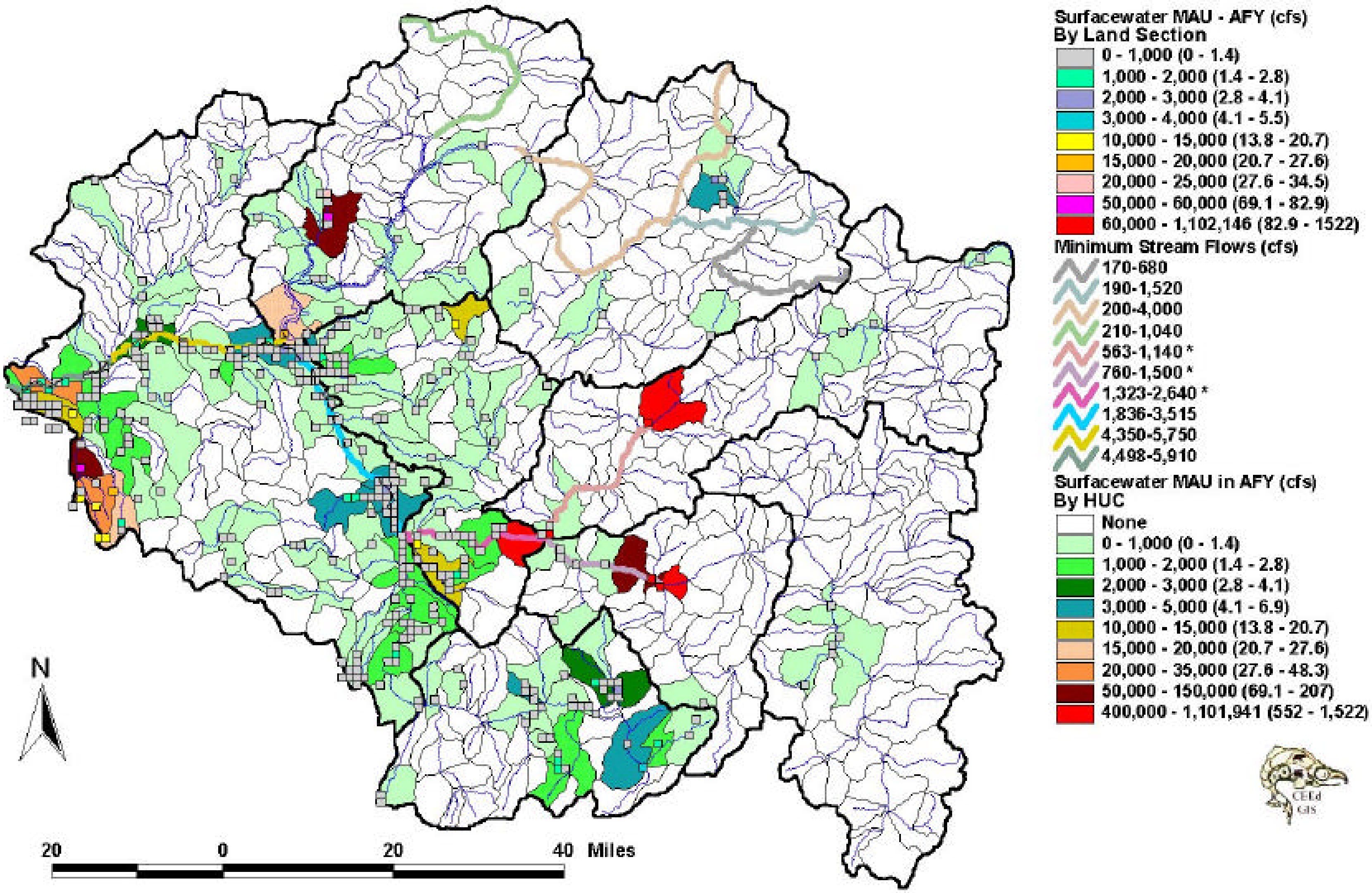

Figure 19. Maximum Allowable Use (MAU) of surface water summarized by both land section and HUC. Minimum instream flows are represented for comparison if either licensed (*) or recommended

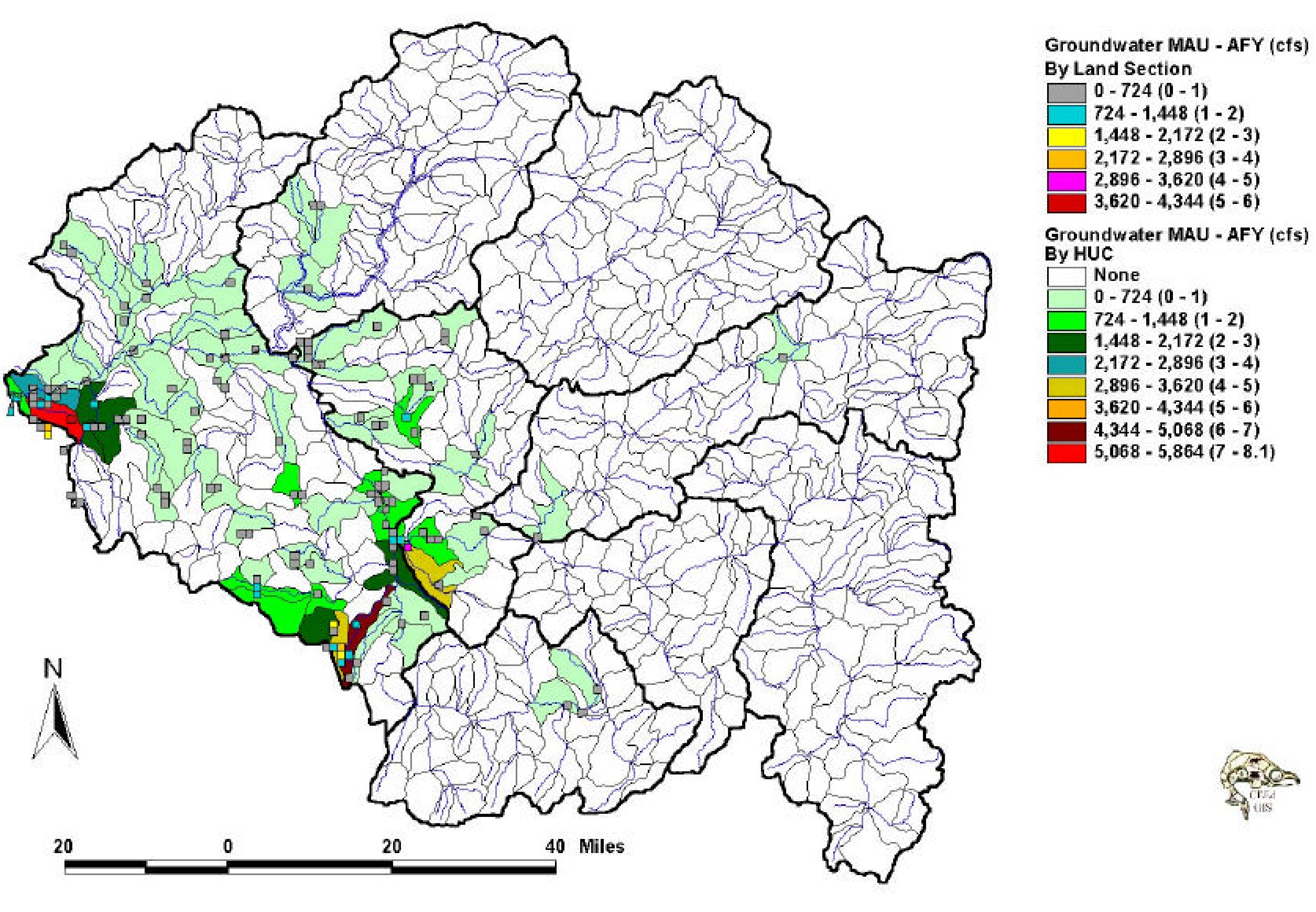

Figure 20. Maximum Allowable Use (MAU) of groundwater summarized by both land section and HUC

Table 15. Median values for selected parameters at seven USGS gauging stations within the Clearwater River subbasin

Station	Period of Interest	Specific Conductance (µS/cm)	NO_2+NO_3-N (mg/L)	Total Phosphorus (mg/L)	Chloride (mg/L)	Fecal Coliforms (CFU/ 100mL)
Lower Clearwater AU						
Stites	1972–1981		0.04	0.030	0.6	
	1972–1996	64			0.8	
	1990–1993					30
	1990–1998					21
Orofino	1973–1996	58				
Lapwai	1975–1996	220				
	1975–1981		0.63	0.095	3.1	
	1975–1997				3.2	
	1991–1993					267
	1991–1998		1.01	0.100	3.7	212
Spalding	1973–1995	44				
	1972–1982		0.11	0.030	0.6	
	1959–1995				0.5	
	1991–1993					13
	1990–1995					8
Lochsa AU						
Lochsa	1973–1996	27				
	1974–1980		0.03	0.015	0.4	
Lower Selway AU						
Selway	1973–1996	24				
	1974–1980		0.04	0.020	0.4	
Upper North Fork AU						
Canyon	1973–1996	33				

4.9.1 Temperature

Daily temperature information is available for only eight gauging stations within the subbasin, and periods of record vary for each one. The most complete long-term data set is from the station at Spalding (RM 11.6) where maximum and minimum temperatures have been recorded daily since October 1959. The second most complete set is upstream at the Peck gauging station (RM 37.4) where over 11,000 average measurements were calculated from October 1964 to the present. Daily temperature data from the discontinued gauging station at Ahsahka and the current one near the Canyon Ranger station provide a relatively long period of record for the North Fork Clearwater. The Ahsahka station at RM 0.4 was operated from October 1958 until December 1970–shortly before Dworshak Reservoir became operational. The current North Fork Clearwater station is located at RM 58, and temperature data is available from February 1970 through September 2000. The daily measurements taken at Kamiah represent the earliest daily USGS temperature data available for the Clearwater system. Information from the latter half of the 1956 water year, along with most of the 1957 and 1959 water years is available and useful from a historical perspective.

Temperature, and total dissolved gas data is also available from monitoring stations operated by the U.S. Army Corps of Engineers (USACE) along the lower reaches of the Clearwater River. This data is collected hourly, allowing the study of diel variability. Three stations are maintained within the Clearwater drainage area. The first is on the right bank of the Clearwater River at about RM 4. Data from this location is available from 1996 through 2000, with monitoring beginning in April or May and continuing through August or September depending on the year. The second site is located approximately 32 miles upstream on the left bank near Peck. This station has also been in place since 1996, but temperature information is available from April 1997 through December 1998, and from March 1999 through August 2000. The final station is in the North Fork Clearwater below Dworshak Dam. The collection schedule at that site was the same as the one at Peck, with the addition of April through September 1994 and July through September 1993. However, the temperature data obtained below Dworshak Dam is not representative of natural conditions. The selector gates at the dam are controlled so that released water is between 10–12^{o}C.

The ability to regulate the outflow temperature at Dworshak has impacts beyond the immediate outlet. Prior to 1992, the facility was operated primarily for flood control. The water level was kept close to full pool through the summer and lowered beginning September 1st. Reservoir water was then used throughout the winter for power production, effectively lowering the pool elevation to provide storage for flood control. Additional water up to about 20 kcfs was spilled in May when additional snow course information became available. This scenario changed in 1992 when up to 25 kcfs was released during parts of July and August to facilitate anadromous fish migration in the lower Snake River. The NMFS, 2000 BIOP calls for an 80 foot summer drawdown of Dworshak Reservoir for flow augmentation and cooling of the Lower Snake River.

This action also changed the thermal regime of the downstream Clearwater River (Figure 21). The primary differences occur between early July and late September. Between 1974-1990, mean temperatures peaked close to 19^{o}C during the last week of July and first week of August before declining towards the winter lows. During the 1993-1998 period, three peak averages of about 17^{o}C occurred during the first weeks of July, August, and September. Two troughs averaging 14^{o}C were recorded during the latter parts of July and August. Water temperatures during September 1993-1998 were 1-3^{o}C higher than during the historical period as a result of the 30% reduction in reservoir discharges (Figure 21).

Another interesting result surfaces when comparing Spalding data to sites higher in the watershed. No comparable long-term daily data is available from stations in the Selway River or Lochsa River, but it does exist for the discontinued station at Ahsahka and near the Canyon Creek Ranger Station on the North Fork Clearwater. When these data are divided into three time intervals, patterns are evident. First, the temperature values for the 1950-1970 Ahsahka and 1960-1970 Spalding data are quite similar (Table 16; Figure 21). The comparison shows that temperatures in all categories increased by about a 1^{o}C between Ahsahka and downstream Spalding; downstream warming is common. Second, statistics for the 1970-1990 and 1992-2000 intervals at the upstream site on the North Fork Clearwater are quite close, suggesting that mean water temperatures have not changed significantly in that 30 year interval. Also, water temperatures at the Canyon Creek Ranger Station site were generally cooler than at the two other (downstream) locations. Finally, the data from the Spalding site provides information that further suggests temperatures in that reach changed as a result of construction and operation of Dworshak Dam. The mean and maximum temperatures decreased slightly in the 1970-1990 period relative to the ten years prior to that. This shift was more noticeable in the maximum values. However, the same trends continued into the 1992-1999 interval. The overall average decreased slightly, but the maximum declined by an additional 2°C after the implementation of summer drawdowns at Dworshak. These shifts are apparent in Figure 21, as is the increase in minimum temperatures.

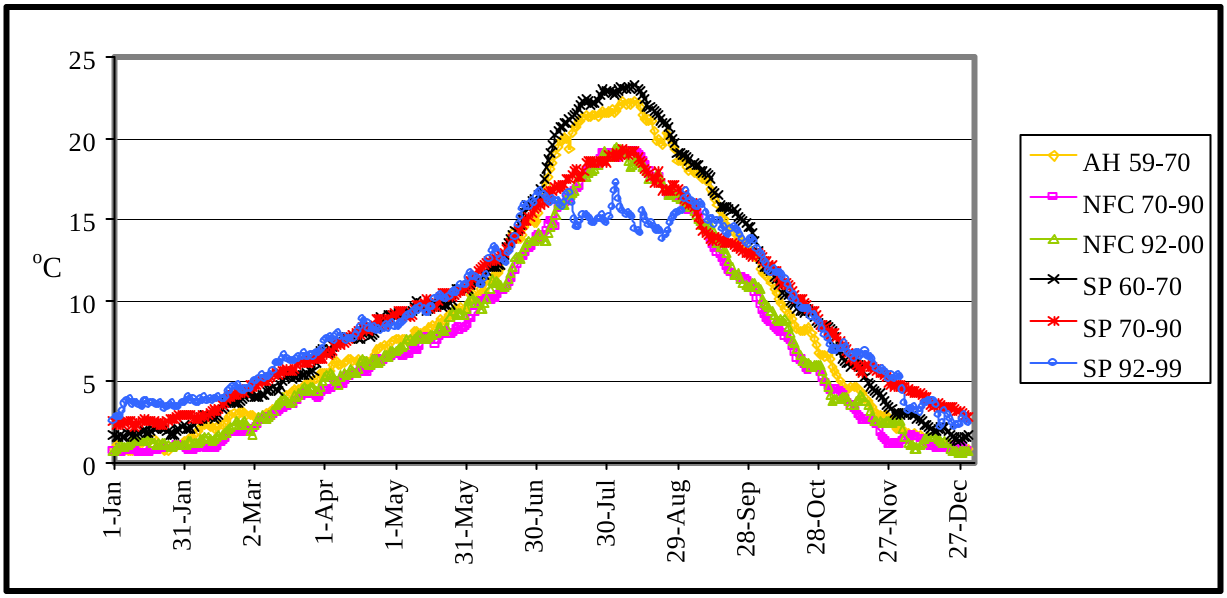

Figure 21. Average temperatures for the USGS gauging stations at Ahsahka (AH), North Fork Clearwater at Canyon Creek (NFC), and Spalding (SP) during various intervals

Table 16. Mean, maximum, and minimum temperatures for the USGS gauging stations at Ahsahka, North Fork Clearwater, and Spalding

Temperature		Ahsahka	NFC		Spalding		
		1959-1970	1970-1990	1992-2000	1960-1970	1970-1990	1992-1999
°C	Mean	8.9	7.4	7.8	9.9	9.5	9.2
	Max	22.3	19.2	19.5	23.3	19.4	17.3
	Min	0.7	0.6	0.6	1.3	2.2	2.1

4.9.2 Water Quality Limited Segments – §303(d)

Water quality limited segments are streams or lakes listed under Section 303(d) of the Clean Water Act for either failing to meet their designated beneficial uses, or for exceeding state water quality criteria. The current list of §303(d) listed segments was compiled by Idaho Department of Environmental Quality (IDEQ) in 1998, and includes 135 defined stream reaches within the Clearwater subbasin. Individual stream reaches are often listed for multiple (up to 11) parameters, making tabular summary difficult. Figure 22 illustrates the distribution of listed stream segments, and Table 17 summarizes listed segments by AU and individual pollutant. Maps delineating stream reaches listed for individual pollutants are included in Appendix B.

The Upper Selway AU lies entirely within the Selway-Bitterroot Wilderness and is the only AU in the Clearwater subbasin without stream segments listed as water quality limited (Table 17). The Lower Selway and Lochsa AUs also have a high portion of wilderness designation and inventoried roadless areas, and reflect a limited number of stream miles (11.7 and 71.1, respectively) listed on the §303(d) list relative to other AUs. Of the 71 miles of §303(d) listed stream in the Lochsa AU, 67 mainstem miles are listed for temperature.

Although temperatures in the mainstem Lochsa River often exceed state standards, Bugosh (1999) concluded that beneficial uses are being met, and the temperature exceedances are a regular and natural occurrence. Gilbert and Evermann (1895) examined temperatures in the lower mainstem Clearwater River (mouth to Potlatch Creek), and found that summer water temperature was highly correlated to air temperature. This work supports the concept that temperatures in larger rivers of the Clearwater subbasin were historically likely to naturally exceed current temperature criteria in some areas, with such exceedances dependent on localized environmental conditions.

4.9.3 NPDES Information

National Pollutant Discharge Elimination System (NPDES) permits are used to track point source discharges for potential impacts to water quality. Point source discharges do not generally present a substantial water quality issue within the Clearwater subbasin, with the exception of the Potlatch Corporation Mill located on the lower mainstem Clearwater River (Terry Cundy, Potlatch Corporation, personal communication, April 18, 2001). Using the online Permit Compliance System (U.S. Environmental Protection Agency 1999), thirty-eight facilities within the Clearwater subbasin were identified as having NPDES identification numbers, and all are described as active. However, only 30 have been issued NPDES permits, and of those only the Dworshak National Fish Hatchery permit is defined as current.

The majority of these units are sewage treatment plants and the amount of monitoring depends on size and type. Baseline monitoring at facilities such as those at Deary, Cottonwood, and the City of Nez Perce typically includes discharge, BOD-5, pH, total suspended solids, and fecal coliforms. Residual chloride analyses are included at Bovill, Elk City, and Kooskia, while the facility at Grangeville also monitors ammonia concentrations. The largest facility in the subbasin is in Lewiston, and is the only wastewater treatment plant in the area that monitors concentrations of heavy metals such as copper, lead, nickel, and zinc. The Potlatch mill in Lewiston also monitors metals in their effluent, and is required to evaluate the concentrations of several organic compounds. The effluents monitored by the fish hatcheries are not identified in the available information, with the exception of the Kooskia National Fish Hatchery that monitors total suspended solids and settlable solids. The requirements for several of the water supply, gold ore, and other facilities are not identified online in the Permit Compliance System.

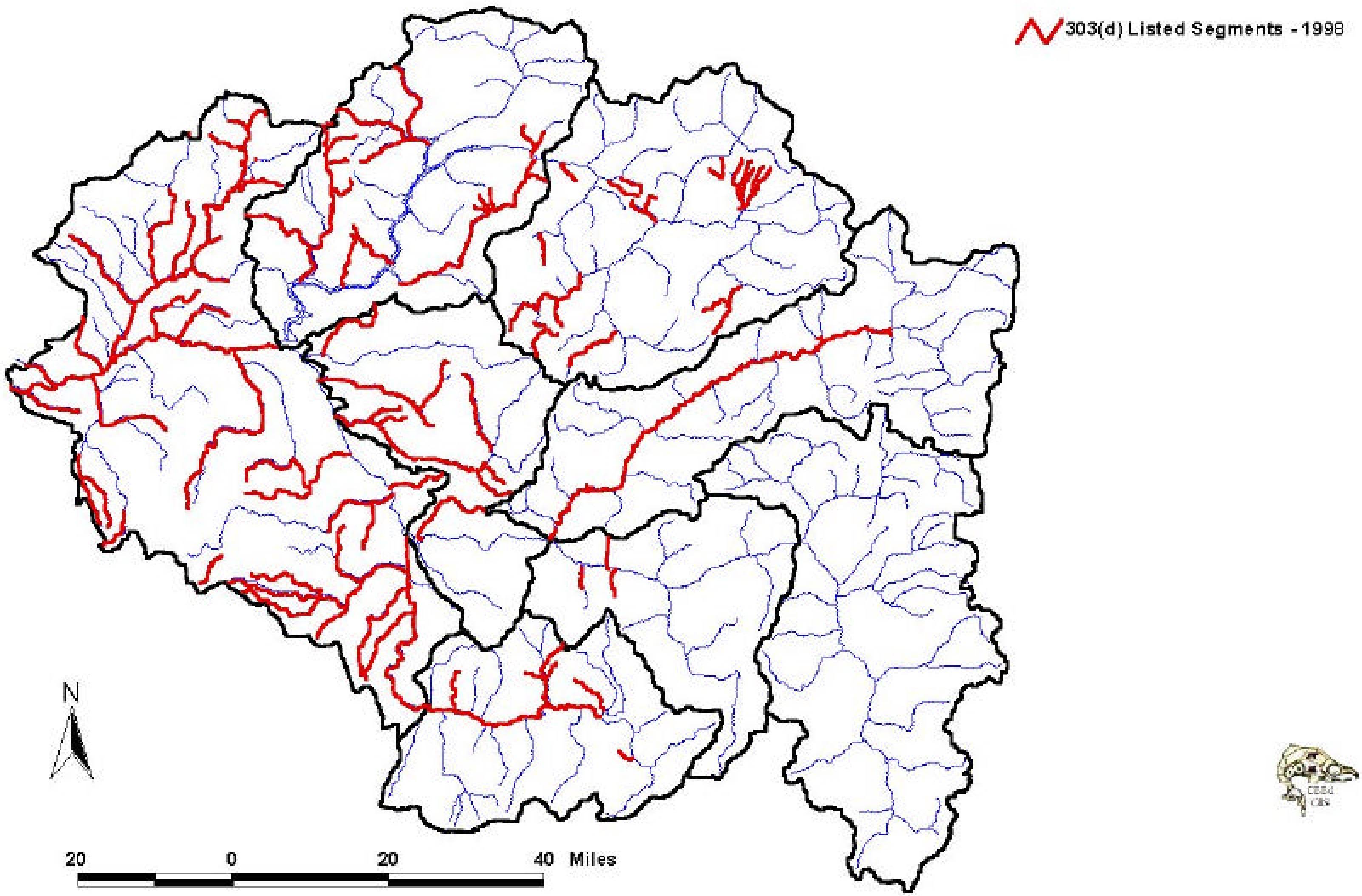

Figure 22. Distribution of water quality limited stream segments on IDEQ's 1998 303(d) list

Table 17. Miles of water quality limited streams on the 1998 §303(d) list within Clearwater subbasin AUs. Numbers in parenthesis represent total miles of stream within each AU

Parameter	Assessment Unit								Total
	Lower Clearwater	Lower North Fork	Upper North Fork	Lolo/ Middle Fork	Lochsa	Lower Selway	Upper Selway	South Fork	
	(432.1)	(149.0)	(110.6)	(101.8)	(71.1)	(11.7)	(0.0)	(45.9)	(822.2)
Temperature	32.2	0.0	0.0	22.8	67.2	0.0	0.0	29.4	151.6
Thermal Modification	269.7	55.6	8.0	74.8	0.0	0.0	0.0	0.0	408.1
Sediment	376.4	149.0	107.2	101.8	3.8	11.7	0.0	45.9	795.8
Bank Instability	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	3.4
Habitat Alteration	357.5	90.9	8.0	74.8	0.0	0.0	0.0	29.4	560.6
Pathogens	331.0	55.6	0.0	74.8	0.0	0.0	0.0	0.0	461.4
Fecal Coliforms	14.9	0.0	0.0	19.1	0.0	0.0	0.0	0.0	34.0
Oil/Grease	46.5	0.0	0.0	0.0	45.3	0.0	0.0	0.0	91.8
Synthetic Organics	74.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.2
Pesticides	74.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.2
Nutrients	311.6	55.6	0.0	74.8	0.0	0.0	0.0	0.0	442.0
pH	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
Dissolved Oxygen	208.8	35.3	0.0	57.9	0.0	0.0	0.0	0.0	302.1
Total Dissolved Gas	43.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.8
Flow	306.9	90.9	8.0	74.8	0.0	0.0	0.0	0.0	480.6

Valuable water quality monitoring data are potentially available from several of these point sources. This information may prove beneficial for development of total maximum daily loads (TMDLs) and other water quality programs within the subbasin, and should be coupled with in-stream monitoring programs.

4.10 Population and Land Uses

Six counties (Clearwater, Idaho, Latah, Lewis, Nez Perce, and Shoshone) make up portions of the Clearwater subbasin. Idaho and Clearwater counties have the greatest land area in the Clearwater subbasin, accounting for roughly two-thirds of the total subbasin land area (Table 18). Five of the six counties making up the Clearwater subbasin have populated areas within the subbasin boundary; portions of Shoshone county within the subbasin are unpopulated.

More than two thirds of the total acreage of the Clearwater subbasin is evergreen forests (over four million acres), largely in the mountainous eastern portion of the subbasin. The western third of the subbasin is part of the Columbia Plateau and is comprised almost entirely of crop and pastureland (Table 19; Figure 23). Most of the forested land within the Clearwater subbasin is owned by the federal government and managed by the U.S. Forest Service (over 3.7 million acres), but the state of Idaho, Potlatch Corporation and Plum Creek Timber Company also own extensive forested tracts (Table 20; Figure 24).

The western half of the subbasin is primarily in the private ownership of small forest landowners and timber companies, as well as farming and ranching families and companies. Some small private inholdings exist within the boundaries of USFS lands in the eastern portion of the subbasin. Nez Perce Tribal lands are located primarily within or adjacent to Lewis, Nez Perce, and Idaho Counties within the current boundaries of the Nez Perce Reservation (Figure 24). These properties consist of both Fee lands owned and managed by the Nez Perce Tribe, and properties placed in trust status with the BIA. Other agencies managing land in the Clearwater subbasin include the National Park Service, U.S. Bureau of Land Management, U.S. Army Corps of Engineers, and Idaho Department of Fish and Game.

Table 18. Relative land area of counties in the Clearwater subbasin (ESRI 1999)

County	Acres in Clearwater Subbasin	Total Acres in County	% of County in Subbasin
Clearwater	1,582,467	1,591,549	99.4
Idaho	3,186,572	5,439,702	58.6
Latah	343,138	688,642	49.8
Lewis	272,775	306,831	88.9
Nez Perce	352,215	547,616	64.3
Shoshone	244,167	1,685,667	14.5

Table 19. Clearwater subbasin land use

Land Use	Acres
Evergreen forest land	4,277,815
Herbaceous rangeland	30,693
Shrub and brush rangeland	393,082
Non-forested wetland	1,123
Bare exposed rock	85,856
Lakes	2,447
Mixed rangeland	199,159
Cropland and pasture	765,926
Strip Mines	1,436
Reservoirs	17,805
Industrial	1,880
Commercial and services	2,660
Residential	6,443
Mixed urban or built up	2,261
Other urban or built up	368
Streams and canals	5,972
Transitional areas	251
Bare ground	2,928
Shrub and brush tundra	2,872
Mixed forest land	182,062
Deciduous forest land	3,057

Table 20. Approximate acreage owned or managed by various entities in the Clearwater subbasin.

Owner/Manager		Acreage (Rounded to nearest 100)
Federal Government		
	U.S. Bureau of Land Management	45,600
	U.S. Forest Service	3,718,700
	U.S. Army Corps of Engineers	31,600
	National Park Service	100
State Government		
	Idaho Department of Lands	320,100
	Idaho Dept. of Fish and Game	3,400
Nez Perce Tribe		
	Tribal Fee Lands	15,200
	Tribal Trust Lands	36,000
	Individual Allotments	44,800
Private Entities		
	Potlatch Corporation	425,000
	Plum Creek Timber Company	64,100
	Other Private Holdings	1,275,300

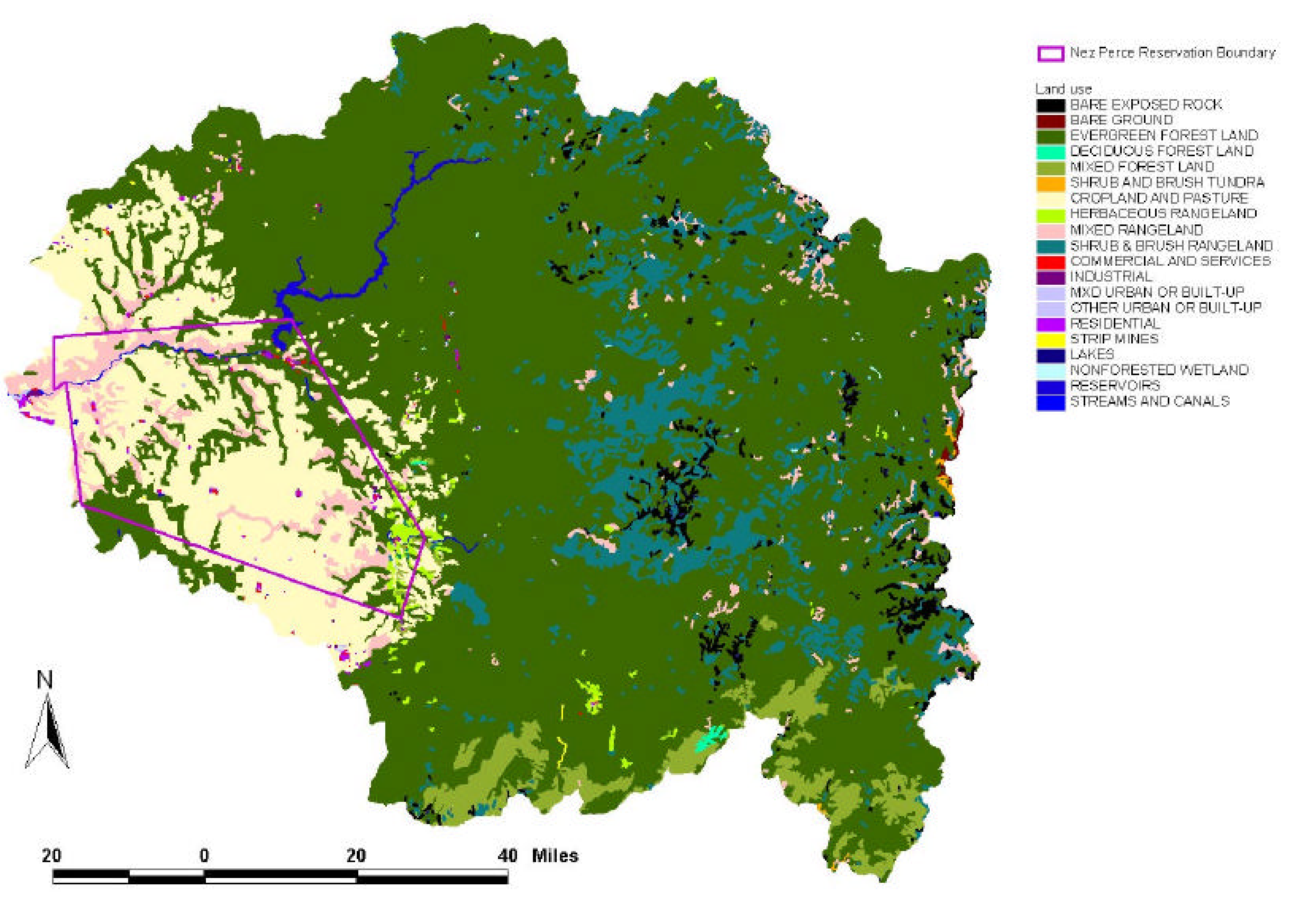

Figure 23. Clearwater subbasin land use

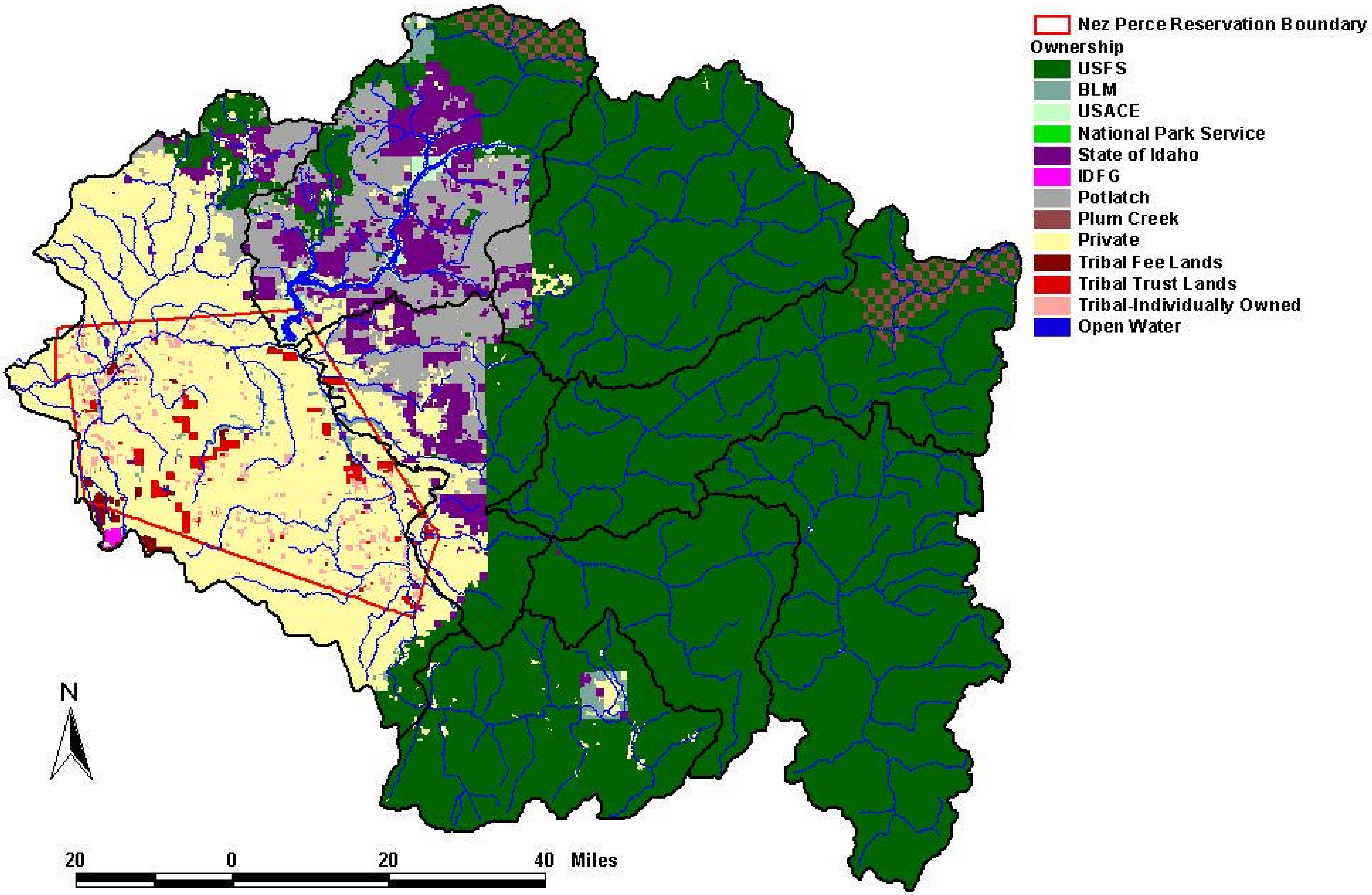

Figure 24. Clearwater subbasin land ownership

4.10.1 Demographics

An estimated population of 60,000 resides within the boundaries of the Clearwater subbasin, the majority within Nez Perce and Latah Counties (Table 21). These counties are considered urban by the U.S. Census Bureau, maintaining an average population density of over 25 people per square mile. The population of Nez Perce County generally resides in the city of Lewiston (30,904 people in 2000). Likewise, the city of Moscow (which lies outside the Clearwater subbasin) accounts for the majority of the population in Latah County (21,291 people in 2000; IDOC 2002). The other four populated counties within the subbasin are classified as either rural or frontier areas, with densities between 0.4-4.9 persons per square mile (McGinnis and Christenson 1996). Between 1990 and 1999, the population of the Clearwater subbasin grew by approximately 8.7% (Idaho Department of Commerce 2000; Table 21).

Table 21. Clearwater subbasin population trends by county (U.S. Census Bureau 2000)

County	1990	1999	# Change 1990-1999	% Change 1990-1999
Clearwater	8,505	9,359	854	10.0%
Idaho	13,768	15,030	1,262	9.2%
Latah	30,617	32,509	1,892	6.2%
Lewis	3,516	3,943	427	12.1%
Nez Perce	33,754	36,913	3,159	9.4%
State Total	1,006,734	1,251,700	244,966	24.3%

The perimeter of the Lower Clearwater AU includes most population centers within the Clearwater subbasin. The Lower Clearwater AU contains 19 towns with a total population of approximately 42,656. This includes the county seats of four of the six counties, and over 80% of the estimated population that reside within the Clearwater subbasin. The largest city is Lewiston, with 30,597 people. The second largest is Grangeville, the county seat for Idaho County, with 3,377 people. The remaining towns in the Lower Clearwater AU each have populations of under 1,000 people, except Kamiah with 1,304 people (Idaho Department of Commerce 2000).

Because county seats are centers for governmental, social, and economic activity, they consistently encompass over 30% of the total county population. They also have the highest growth rate of any of the population loci. Between 1990 and 1998 all of the county seats within the Clearwater subbasin grew by at least 5% (U.S. Census Bureau 2000).

The median age of persons living in the Clearwater subbasin is approximately 35 years old. The distribution of races is broad, with the largest part of the minority community comprised of American Indians (Idaho Department of Commerce 2000).

4.10.2 Socioeconomic Overview

This following overview provides a brief description of economic, social and cultural conditions within the counties of the Clearwater subbasin. It provides an elementary overview of prominent economic activities within each county. Used in conjunction with other information presented throughout Section 4.10, it provides an elementary overview of prominent economic activities in the Clearwater subbasin, connections to natural resources, and levels of related income and employment as called for by the *Recommendations and Guidance for Economic Analysis in Subbasin Planning* (IEAB 2003).

Clearwater County ranks 29th among Idaho counties in population and 10th in area. Over 53 percent of the lands within Clearwater County are publicly owned and managed by federal agencies, primarily the U.S. Forest Service. Forest products manufacturing is the major basic industry, with trade, services and government providing the largest employment opportunities (Figure 25). Major employers include Orofino Joint School District, the U.S. Forest Service, Clearwater County government, Clearwater Valley Hospital & Clinic, Idaho State Penitentiary, Idaho Department of Health & Welfare, DEBCO, and Konkoville Lumber Company, Inc (IDOC 2002).

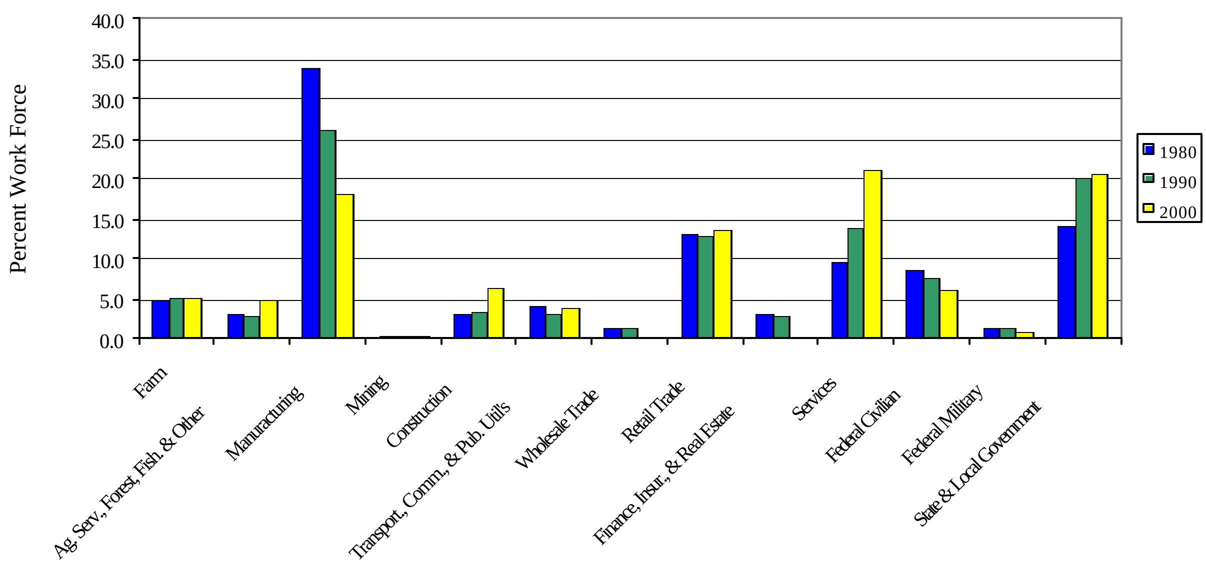

Figure 25. Proportion of workers by industry in Clearwater County (IDOC 2002).

Idaho County ranks 20th among Idaho counties in population and 1st in area (IDOC 2002). The federal government manages over 83 percent of the land within Idaho county. Forest products manufacturing and agriculture are the basic industries, but government is the largest employment sector (Figure 26). Trade and services also provide substantial employment. Major employers include Bennett Lumber Products, Clearwater Forest Industries, Inc., Department of Corrections, Seubert Excavators, Inc., St. Mary's Hospital, Three Rivers Timber, Inc., and the U.S. Forest Service (IDOC 2002).

Latah County ranks 10th among Idaho counties in population and 29th in area (IDOC 2002). The federal government manages about 16 percent of the land within Latah county. Agriculture, forest products manufacturing and the University of Idaho heavily influence the local economy (Figure 27). Major employers include the University of Idaho, Bennett Lumber Products, Wal-Mart, Winco, Gritman Medical Center, the school districts, Latah Health Services, Inc., and Rosauers Super Markets (IDOC 2002).

Lewis County ranks 40th among Idaho counties in population and 41st in area (IDOC 2002). Only 2.6 percent of its land is federally managed, the least of any Idaho county.

Agriculture and forest and wood products manufacturing are important to the local economy, and government provides nearly half the non-farm wage and salary employment (Figure 28). Major employers include the Idaho Department of Lands, Highland and Nez Perce Joint School Districts, Hillco, Inc., Lewiston Grain Growers, U.S. Timber Corporation, Kamiah Mills, Three Rivers Timber Company, Clonningers Thrift, and the U.S. Forest Service (IDOC 2002).

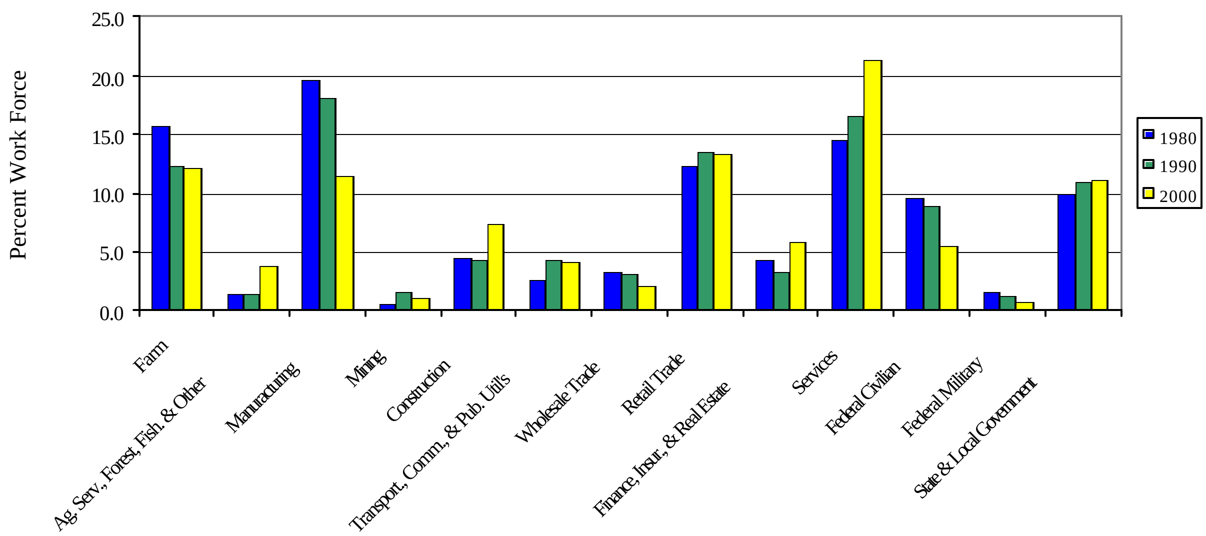

Figure 26. Proportion of workers by industry in Idaho County (IDOC 2002).

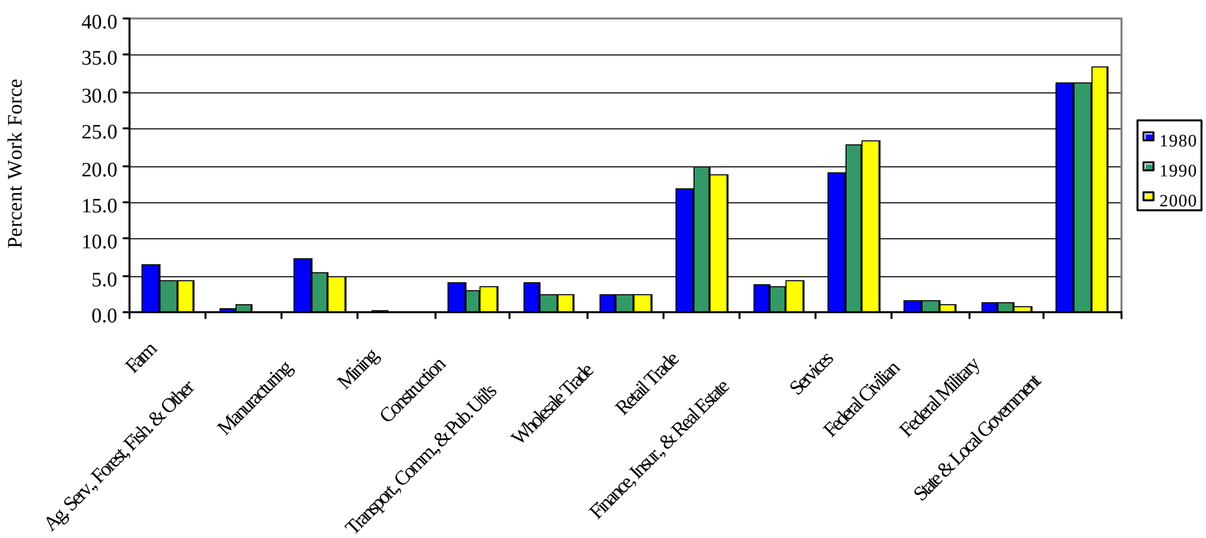

Figure 27. Proportion of workers by industry in Latah County (IDOC 2002).

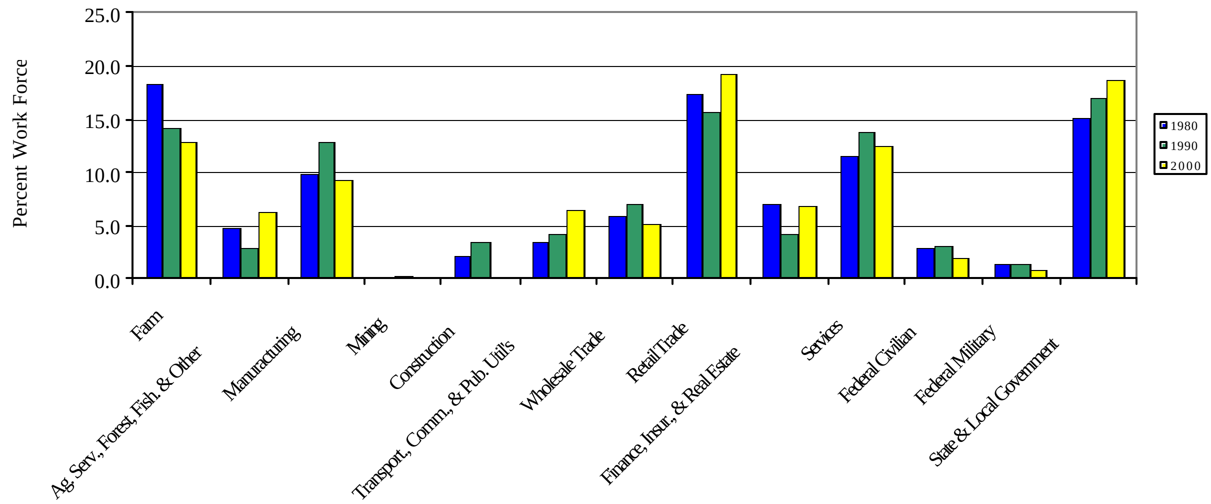

Figure 28. Proportion of workers by industry in Lewis County (IDOC 2002).

Nez Perce County ranks 9th among Idaho counties in population and 33rd in area (IDOC 2002). Only 6.2 percent of the county is managed as federal land, the second lowest of all Idaho counties. Paper and wood products manufacturing form the foundation of the local economy (Figure 29). Trade and transportation are also important due to the influence of the Port of Lewiston, Idaho's only seaport. Major employers include Potlatch Corporation, Albertson's, Inc., Lewis-Clark State College, Alliant Techsystems, Swift Transportation Company, Tribune Publishing Company, Twin City Foods, Inc., Wal-Mart, and Northwest Children's Home, Inc (IDOC 2002).

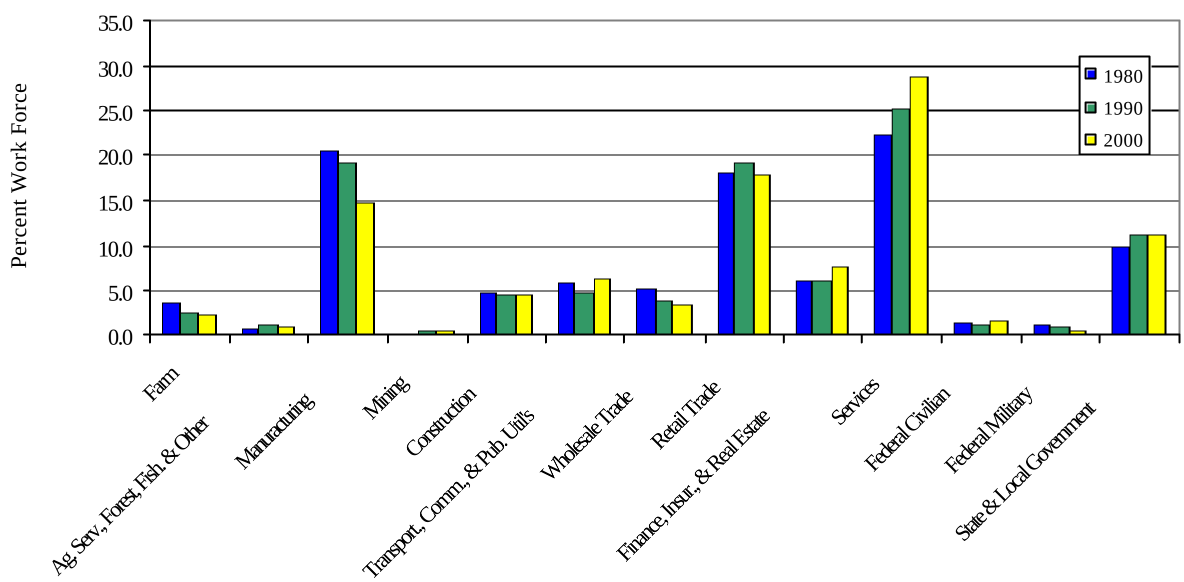

Figure 29. Proportion of workers by industry in Nez Perce County (IDOC 2002) .

The per capita income trends of most counties in the Clearwater subbasin are slightly lower than for Idaho State, with the exception of Nez Perce County. In all counties there has been an upward trend in income from 1980 to 2001 (Figure 30).

The unemployment rates of counties within the Clearwater subbasin have decreased slightly, from 1980 to 2000 (Figure 31). The unemployment rate of the most populous counties in the subbasin (Latah and Nez Perce) was below 4.5 percent in 2000, compared to 4.9 percent in Idaho State (IDOC 2002).

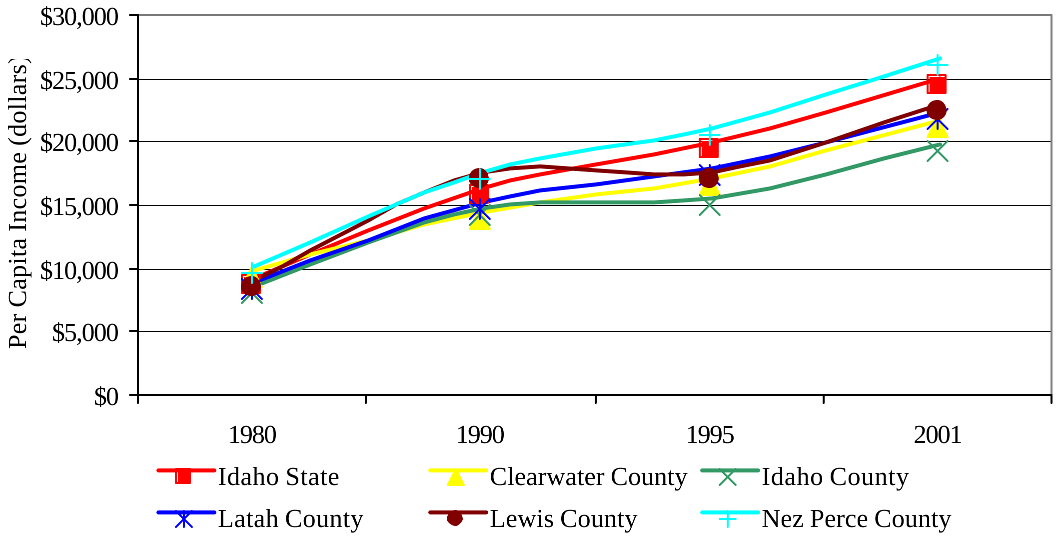

Figure 30. Per capita income trends of counties in the Clearwater subbasin from 1980-2001 (IDOC 2002)

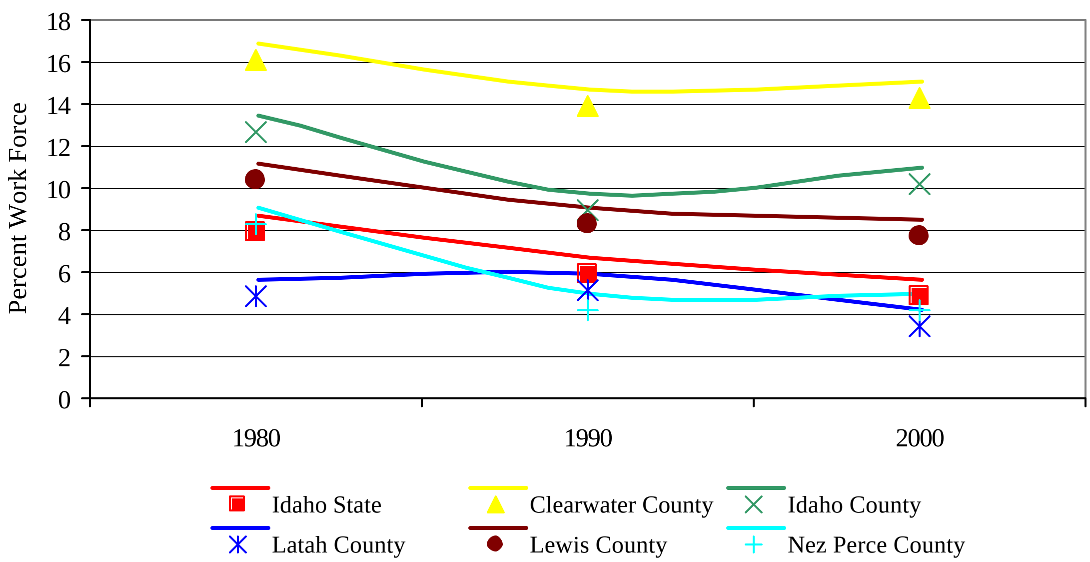

Figure 31. Percent civilian labor force unemployment trends from 1980 to 2000 for the counties within the Clearwater subbasin (IDOC 2002)

The percentage of persons living below the poverty level varied between counties in the Clearwater subbasin (Figure 32). Latah County generally had more people below poverty, while Clearwater County usually had the least. The poverty level of half the counties in the subbasin peaked in 1989, while the other half peaked in 1999.

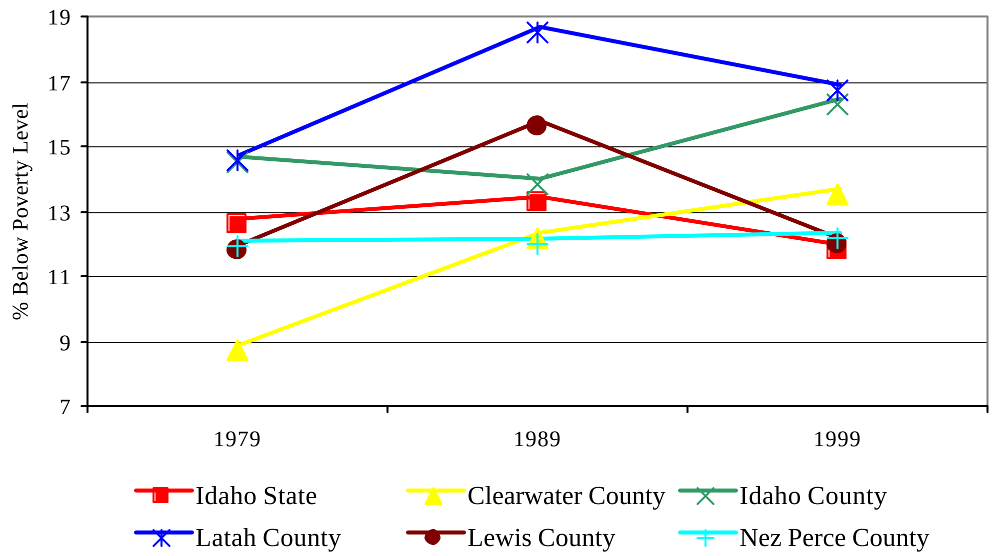

Figure 32. Percent of persons living below poverty in each county within the Clearwater subbasin (IDOC 2002).

The three major industries in the subbasin, with focus on the population centers of Latah and Nez Perce counties, are in manufacturing, retail sales, and education, health, or social services (IDOC 2002; Figure 33). In Nez Perce County, manufacturing supplies nearly 3,000 jobs while education, health, or social services supports nearly 4,000 people. In Latah County retail trade employs over 2,000 people while education, health, or social services provides nearly 7,000 jobs. The number and types of jobs in Latah County is most likely skewed by the city of Moscow and the University of Idaho, which lie outside the subbasin boundary. Clearwater and Idaho counties, which are heavily forested and lightly populated, are supported mainly by industries in two areas: 1) agriculture, forestry, fishing, hunting and mining, 2) education, health, or social services (Figure 33).

The International Association of Fish and Wildlife Agencies estimated the number of jobs created in Idaho from all hunting activities to be 6,197 (Southwick Associates 2002). The number of jobs created from all fishing and wildlife-watching activities was not modeled, but higher expectations could be made based on the high percentage of fishing and wildlife-watching expenditures in Idaho. Rural community economies are generally considered to benefit from hunting and fishing activities, while some are highly dependant on it (Southwick Associates 2002).

4.10.3 Urban Development

Urban land uses comprise only 0.2% of the Clearwater subbasin. The largest urban area is Lewiston, with the largest amount of commercial, residential, and industrial site development in the subbasin. The relative isolation from major transportation corridors such as an interstate or airport, a relatively large proportion of public land in the eastern portion of the subbasin, and rugged topography limit the potential for urban development.

Although currently a minor influence, second homes, immigration by the affluent to rural areas for quality of life factors, and associated development could increase throughout the subbasin in future years. In addition, the potential decline of traditional economies such as forestry may create an incentive for attracting urban industrial land uses to the subbasin to provide employment and revenue for local governments.

Many urban and ranchette developments in the lower Clearwater are located near streams, in riparian areas or on floodplains. Septic systems, stormwater runoff, livestock management, home lawn and garden management, culverts, and roads all impact the natural resources in the area. Direct and indirect impacts of development on wildlife species in these areas include loss of habitat, increased mortality from domestic pets, and increased conflicts with humans. Domestic cats and dogs can have significant impacts on small mammal, bird, and reptile populations and some evidence suggests that rural pets have the greatest impacts (Coleman et al. 1997; See also California Department of Fish and Game 2000 and Tufts University 1999).

Increased rural development also results in higher road densities, which can impact wildlife by acting as mortality agents, movement barriers, and establishment sites for noxious weeds (Trombulak and Frissell 2000; Ferguson et al. 2001). Roads also allow greater human access into wildlife habitat areas, which results in disturbance and can lead to increased poaching or harassment.

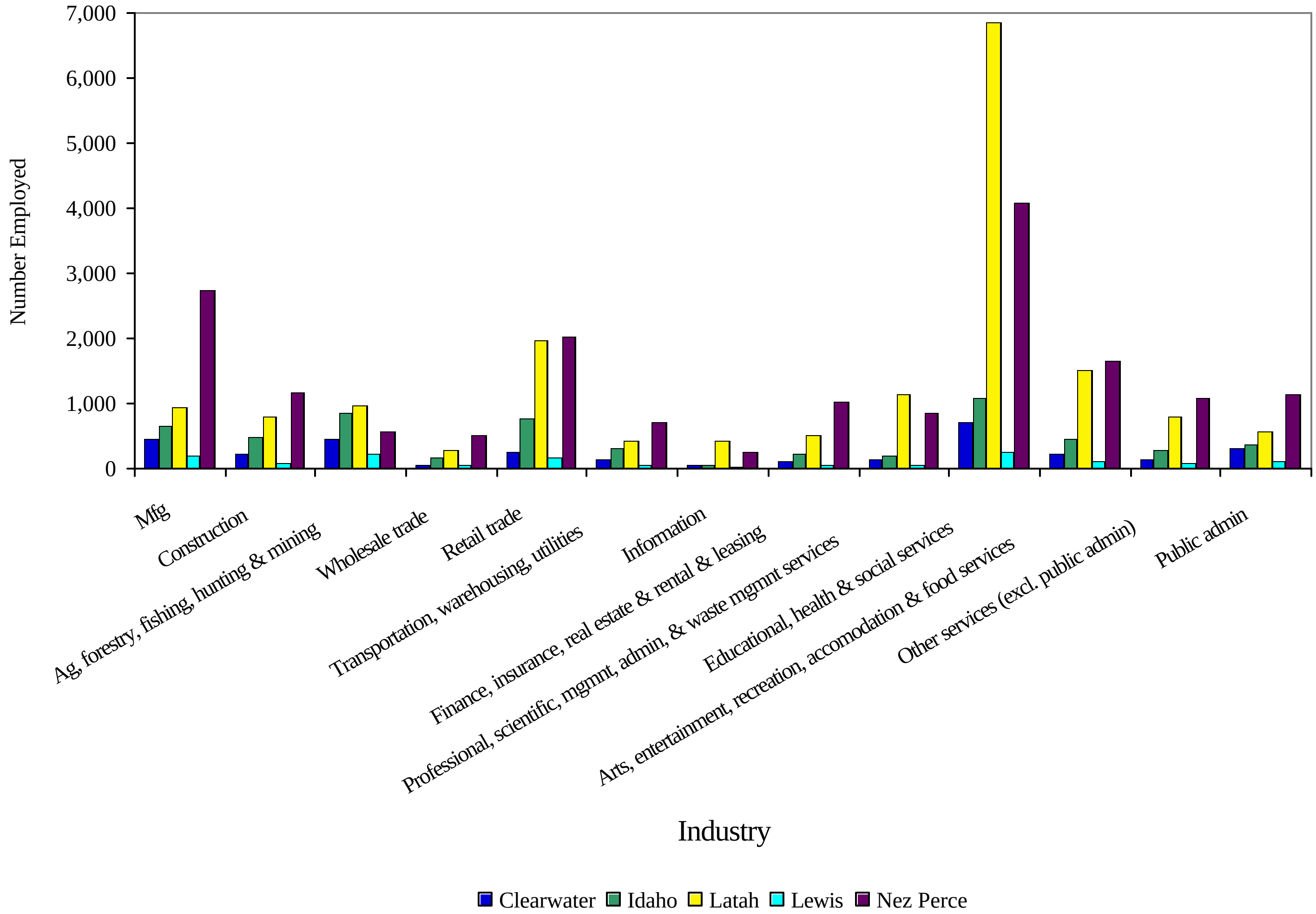

Figure 33. Employment by industry in the Clearwater subbasin by county (IDOC 2002).

4.10.4 Recreation

Recreation has become the dominant use of the Clearwater and Nez Perce National Forests. With the Selway Bitterroot Wilderness Area, wild and scenic rivers, world class big game hunting and trout fishing, and river rafting, the Clearwater subbasin is a recreation resource of national significance. The USFWS and U.S. Census Bureau (2003) found 868,000 Idaho residents and nonresidents (16 and older) spent nearly 983 million dollars in Idaho for wildlife-related recreation during 2001. Of the 983 million dollars spent, 755 million dollars was due to fishing and hunting expenditures and 227 million dollars was due to wildlife-watching expenditures.

The steelhead sport fishery in the Clearwater subbasin attracts anglers both from within Idaho and out-of-state, and is an important component of the local and state economy. During the 1999-2000 season 50,600 angler days (278,317 hours) were expended. Reading (1996) estimated that the average daily expenditure for steelhead anglers in the Clearwater in 1993 was $168.40. Using this figure, over $8,500,000 was generated during the 1999-2000 season.

General season chinook salmon fisheries have not been held since the 1970s. Recently, however, limited seasons were held in the Clearwater in 1997, 1998, 2000 and 2001. Almost 79,000 angler hours were expended in the two month season in 2000. Using an expansion of effort and average daily expenditure of $189.29 from the 1997 fishery (Reading 1999), $5.5 million in direct expenditures and $9.5 million in economic activity resulted from the 2000 chinook season in the Clearwater drainage during that year. Idaho Fish and Wildlife Foundation (2001)estimated that salmon fishing during 2001 contributed 8.8 and 8 million dollars, respectively, to the economies of Lewiston and Orofino (both within the Clearwater subbasin).

Recreational fishing throughout the North Fork, Lochsa, Selway and South Fork Clearwater Rivers also provides tens of thousands of angler hours annually. Fisheries in the North Fork, Lochsa, and Selway Rivers are primarily based on wild native westslope cutthroat trout. These wild cutthroat fisheries are managed with a variety of restrictive harvest regulations applying to non-tribal anglers. Lowland lakes within the Clearwater River subbasin provide approximately 150,000 hours of fishing annually. These fisheries are primarily based on regular stocking of catchable sized hatchery trout. Fishing regulations are generally liberal and allow for consumptive harvest. Revenues generated from the sales of Idaho fishing and hunting licenses provide the necessary funding to produce hatchery trout for these fisheries.

Dworshak Reservoir also provides a recreational resource of regional significance, with documented angler usage near 150,000 angler hours annually (Maiolie et al. 1993). Recreational use of Dworshak Reservoir and other recreational resources throughout the Clearwater subbasin is projected to increase dramatically in coming decades.

Hunting is also an important recreational activity within the Clearwater subbasin. Information regarding hunter locations or expenditures was not readily available. Resident Hunting license sales by county in 2002 were variable, with the highest numbers of licenses sold in the most populated counties. Nez Perce and Latah counties had 11,473 and 8,443 resident hunting licenses sold, respectively in 2002 (Figure 34; IDFG 2002). The 1991 *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* found 49 percent of all hunters and 52 percent of freshwater anglers traveled less than 25 miles to the sites they used most often (USFWS 1993) suggesting that license sale figures by county reasonably represent hunter and angler distributions.

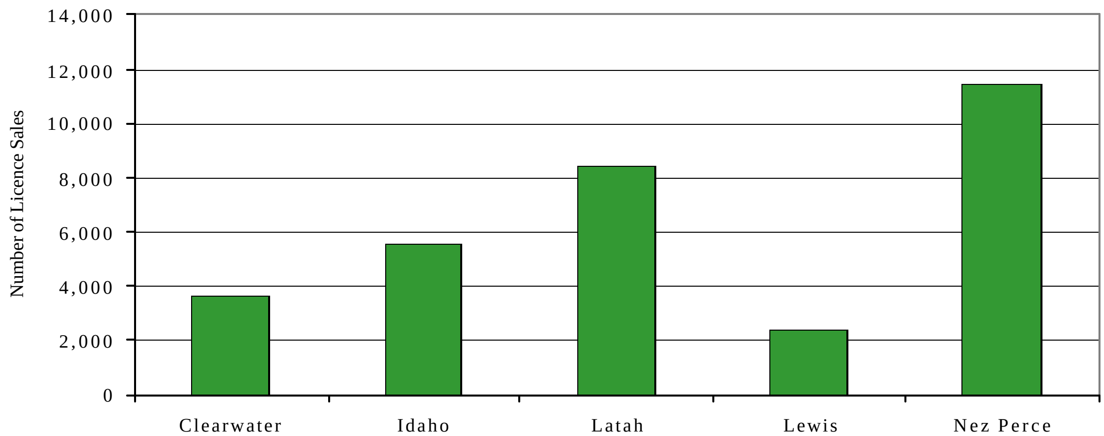

Figure 34. Resident hunting and fishing license sales in 2002 for counties in the Clearwater subbasin (IDFG 2003).

4.10.5 Roads

Road construction is closely tied to land use patterns, and may be dictated by some uses (i.e. timber harvest) and dictate where other uses are likely to occur (i.e. recreational access). Roads on the plateau in the southwestern part of the subbasin are typically rural and access roads for modern agriculture and are easily recognized by their straight north/south and east/west alignment (Figure 35). Road densities are greatest in the central portions of the subbasin where logging roads predominate, commonly exceeding 3 miles/square mile and often exceeding 5 miles/square mile (Figure 35 and Figure 36).

There is relatively little road development in the eastern part of the subbasin. The Selway-Bitterroot and Gospel Hump Wilderness Areas contribute to the lack of road development in some areas, as does the local fire history. The distribution of logging roads in the Clearwater subbasin is tied to fire history, with most currently existing forest roads located in areas that did not burn during major fires of 1910 and 1917.

Roads have become a major cause of forest fragmentation because they divide large landscape patches into smaller ones and convert forest interior habitat into edge habitat (Reed et al. 1996). In addition to disturbance caused by traffic, roads remove about 5 acres of productive habitat per mile (Leege 1984). It has also been found that the richness of plant and wildlife communities decreased as road density within the adjacent 2 kilometers increased (Findlay and Bourdages in press).

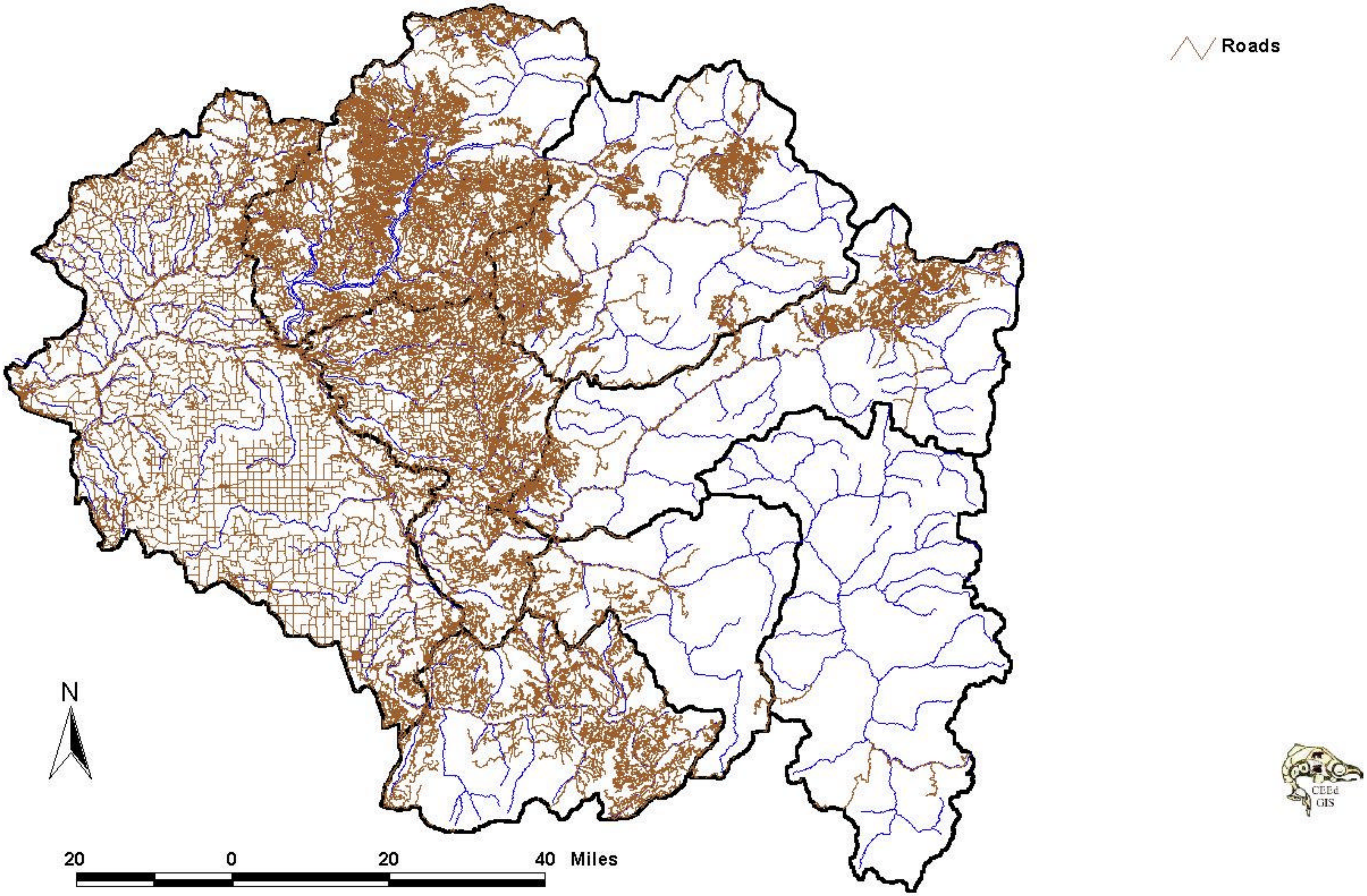

Figure 35. Road distribution throughout the Clearwater subbasin

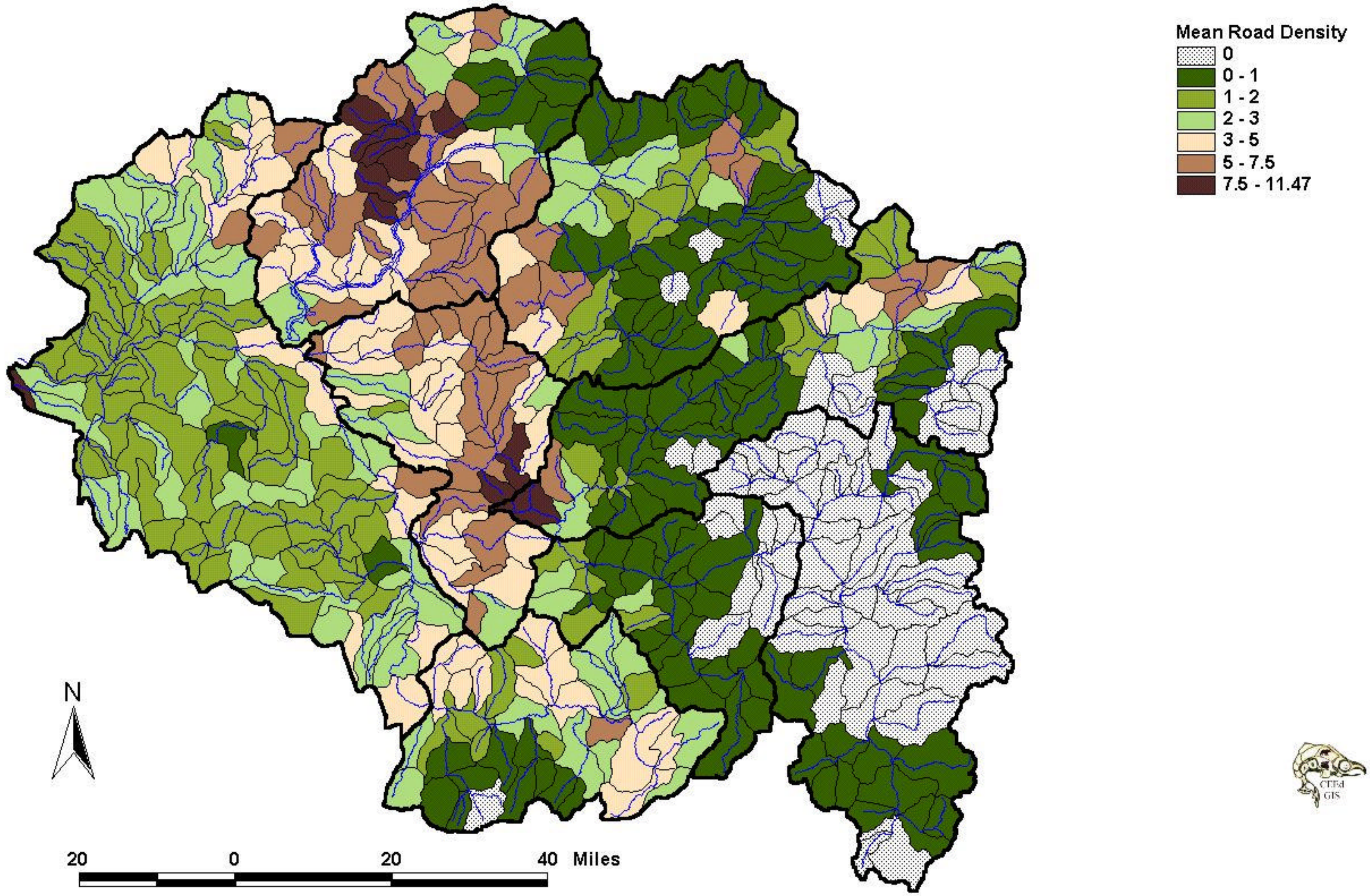

Figure 36. Mean road density within the Clearwater subbasin plotted by 6th field HUC

4.10.6 Timber

Industrial forestry practices have occurred in the Clearwater subbasin since the late 19th century. The first significant commercial logging began in the Clearwater in the 1880s, but did start on a grand scale until Fredrick Weyerhaeuser's Clearwater Timber Company began bringing logs out of the upper Clearwater country by rail to the world's largest electrically driven sawmill, built on the banks of the Clearwater River at Lewiston, Idaho in 1927 (Woods and Horstmann 1994). A Prospectus dated August 1, 1914 advertised 600 million board feet (mbf) of timber for sale within Lolo Creek on the Clearwater National Forest (unpublished Forest Service document). All of this timber was considered good quality sawlogs, with an estimated 126 mbf of white pine, of which 40% was in trees over 30 inches diameter breast height (dbh). Today, forests containing trees of this size would be considered old growth.

Much of the federal forest land in the subbasin was set aside as the Bitterroot Forest Reserve in 1897. Today, the Clearwater, Nez Perce, St. Joe, and Bitterroot National Forests contain most of the forest in the subbasin. Logging on these national forests was minimal prior to WWII: the largest annual cut on the Clearwater National Forest prior to 1946 was 18.0 million board feet (mbf). After the war the annual cut increased dramatically and has been at or above 100 mbf since 1959 (Cooper et al. 1987) until the 1990s. During 1971-1980 the average annual timber harvest on the Clearwater National Forest was 170 mbf (USFS 1987a). The cut has declined through the 1990s, dropping to only 25 mbf (C. Mitchell, Clearwater National Forest, personal communication 1998). Although detailed examination of records was not done for other National Forests within the subbasin, trends in timber harvest were likely similar to those noted for the Clearwater National Forest. Much of the reduction in timber harvest has been due to restrictions related to ESA listed salmon stocks, concerns with resident salmonids, lack of resolution on the management of remaining roadless areas on the forest, and change in Forest Service management policy.

In addition to National Forest timber harvest activities, several commercial logging companies have operated within the subbasin over the years. Currently, Plum Creek Timber Co. operates within the Upper North Fork and Lochsa AUs, and Potlatch Corporation operates primarily (not entirely) within the Lower North Fork and Lolo/Middle Fork AUs. The Nez Perce Tribe also has an active timber management program on tribally managed lands primarily within the Lower Clearwater AU.

Recent timberland ownership and production by county and ownership is presented in Table 22, Table 23, Table 24, and Table 25 for the five principle counties encompassing the Clearwater subbasin (Shoshone county is excluded since only a very small portion of the county in located in the Clearwater subbasin).

4.10.7 Agriculture

Agriculture primarily affects the western third of the subbasin on lands below 2,500 feet elevation, largely on the Camas Prairie both south and north of the mainstem Clearwater River. Additional agriculture is found on benches along the main Clearwater and its lower tributaries such as Lapwai, Potlatch, and Big Canyon Creeks. Hay production in the meadow areas of the Red River and Big Elk Creek in the American River watershed accounts for most of the agriculture in the South Fork Clearwater AU (Clearwater subbasin Bull Trout Technical Advisory Team 1998d). Total cropland and pasture in the subbasin exceeds 760,000 acres (Table 26). Table 26 indicates the scale of agricultural production in the area by county and indicates changes in agricultural activity over a ten year period.

Table 22. Acres of timberland by county and ownership class (1991) - thousand acres (FIA Database Retrieval System 2001)

County	All Ownerships	USFS	BLM	Nez Perce Tribe	State	County and Municipality	Forest Industry	Farmer/ Rancher	Corporation	Individual	Misc. Federal
Idaho	2,497	2,094	53	7	66	0	53	176	6	42	0
Clearwater	1,235	532	0	0	244	0	361	44	0	25	29
Latah	426	175	0	0	36	0	105	92	0	18	0
Lewis	76	0	7	11	0	0	0	58	0	0	0
Nez Perce	96	0	0	7	13	0	0	47	29	0	0
All Counties	4,330	2,800	60	25	359	0	518	417	35	86	29

Table 23. Timber harvest (MBF) by ownership during 1996 for the five principal counties in the Clearwater subbasin (FIA Database Retrieval System 2001)

	National Forest	Other Public Lands	Forest Industry	Other Private Lands	Total
MBF Timber Removed	149,691	115,269	285,274	163,428	713,713

Table 24. Timber harvest (MBF) by county during 1996. (FIA Database Retrieval System 2001)

	Clearwater	Idaho	Latah	Lewis	Nez Perce	Total
MBF Timber Removed	353,537	170,246	149,060	24,732	10,408	713,713

Table 25. Harvest (MBF) of various timber products by ownership removed during 1996 (FIA Database Retrieval System 2001)

	Saw Logs	Veneer Logs	Pulp Wood	Fuel Wood	Post Poles Pilings	Other Products	All Products
National Forest	88,100	5,752	11,903	11,950	2,203	9,352	117,555
Other Public Lands	66,814	7,176	22,525	612	2,515	1,375	89,659
Forest Industry	109,061	59,105	87,209	20,738	0	3,094	226,236
Other Private Lands	104,089	2,602	22,386	19,925	229	567	129,039
Total	368,064	74,636	144,024	53,225	4,940	14,387	562,489

Table 26. Indicators of agricultural production

Year/ County	Farms (#)	Land in Farms (ac)	Total Cropland (ac)	Pasture (ac)	Wheat (bu)	Barley (bu)	Hay (tons)	Beans (100 wt)	Cattle (#)	Grazing Perm (#)	CRP (ac)	Fertilizer (ac)	Pesti-cides (ac)	Herbi-cides (ac)
1987														
Clearwater	216	134,891	40,095	5,910	560,933	296,028	11,262	1 farm	4,852	32	429	16,581	4,798	12,354
Idaho	774	802,746	265,065	502,919	4,304,514	1,971,819	62,271	1 farm	49,736	101	5,999	114,034	21,765	66,719
Latah	644	352,777	263,759	72,141	6,595,679	2,154,124	24,232	10,629	12,385	42	4,788	158,075	93,194	125,654
Lewis	191	222,624	157,551	58,890	3,509,523	1,806,156	12,174	0	6,466	20	6 farms	112,794	48,322	75,962
Nez Perce	405	473,987	216,575	247,886	5,942,291	1,529,791	16,244	24,469	16,082	30	1,463	135,106	74,536	136,514
1997														
Clearwater	210	73,103	41,614	7,327	436,644	331,159	14,101	2,741	3,963	23	2,570	23,215	9013+	10,759
Idaho	661	193,582	225,585	429,546	3,726,933	1,738,752	73,653	2 farms	41,393	117	11,519	120,417	15,955	86,468
Latah	659	325,484	237,543	65,497	5,759,698	1,177,324	34,882	15,890	10,301	43	32,743	134,913	63,277	131,173
Lewis	182	193,582	140,160	46,629	3,497,755	1,292,117	12,191	0	4,723	15	3,697	99,868	23,339	79,263
Nez Perce	383	339,476	208,288	130,778	5,922,902	1,280,687	21,640	74,736	14,168	35	5,874	142,912	47,164	130,443
% Change														
Clearwater	-2.8	-45.8	3.8	19.3	-22.2	11.9	25.2	~300	-18.3	-28.1	499.1	40.0	~87.84	-14.8
Idaho	-14.6	-75.9	-14.9	-14.6	-13.4	-11.8	15.5	~100	-16.8	15.8	92.0	5.6	-26.7	29.6
Latah	2.3	-7.7	-9.9	-9.2	-12.7	-45.3	44.0	49.5	-16.8	2.4	583.9	-14.7	-32.1	4.4
Lewis	-4.7	-13.0	-11.0	-20.8	-0.3	-28.5	0.1	0.0	-27.0	-25.0	~516.7	-12.9	-51.7	4.3
Nez Perce	-5.4	-28.4	-3.8	-47.2	-0.3	-16.3	33.2	205.4	-11.9	16.7	301.5	5.8	-36.7	-4.4

Table 27. Clearwater subbasin CRP practices in acreage from 1986-2001 (U.S. Department of Agriculture 2000a)

County	Conservation Reserve Practice by Activity Acre								
	Established Grass	Introduced Grasses	Native Grasses	Tree Planting	Established Trees	Wildlife Habitat	Wildlife Food Plots	Filter Strips	Riparian Buffers
Clearwater	1,481.9	894.6	1,637.9	257.1	20.0	0	0	0	142.2
Idaho	8,168.6	2,590.5	441.0	623.7	454.6	2,156.1	98.9	37.2	4.0
Latah	20,284.4	16,220.3	4,973.1	1,029.4	1,259.5	677.8	30.4	84.6	25.4
Lewis	1,345.5	2,813.9	799.0	562.3	89.6	239.7	59.6	92.7	316.8
Nez Perce	1,390.4	3,191.3	700.4	214.5	5.4	3,326.9	36.7	170.5	5.6

Agriculture is a large part of the economy in Nez Perce, Latah, Lewis, and Idaho Counties, which have large areas of gentle terrain west of the Clearwater Mountains. Small grains are the major crop, primarily wheat and barley. Landscape dynamics, hydrology, and erosion in these areas are primarily determined by agricultural practices. In recent years programs run by NRCS have made headway in addressing some of the worst erosion problems on these lands.

The Conservation Reserve Program (CRP) as managed by NRCS, assists farmland owners and operators in conserving and improving soil, water, and wildlife resources. Highly erodible and other environmentally sensitive acreage previously devoted to the production of agricultural commodities is converted to a long-term approved cover for 10 to 15 years. CRP enhances habitats, forage, and sediment delivery reduction. Signups have been occurring since the 1985 Farm Bill (Greg Schlenz, NRCS, personal communication January 3, 2001). The CRP has made improvements to over 79,000 acres within the Clearwater subbasin from 1986-2001 (U.S. Department of Agriculture 2000a; Table 27).

4.10.8 Grazing

Historical Grazing in the Clearwater

Before the era of fire suppression, forage availability in forested habitats was much greater. With fire suppression, opportunistic grazing that occurred after natural wildfires has slowly been replaced by grazing openings resulting from timber harvest. Historically, both Native Americans and Euroamerican settlers recognized that forage for domestic livestock was abundant in some forested habitats. Large bands of horses or sheep were moved into previously burned areas to take advantage of the flush of new forage that emerged after fires. The Nez Perce Indians implemented prescribed fire management, in part to create forage for their large horse herds. Use was probably concentrated in areas where forage was abundant and horses were easily gathered. Mountain grazing was probably light. During the gold rush in the mid 1860s, immigrants brought domestic sheep and cattle to the area. As more people moved to remote boomtowns, livestock ranching increased. Stock growers set up livestock operations around major trailheads that led to the mining camps.

By 1908, when the Nez Perce National Forest was established and grazing laws were enacted, combination farm and ranch homesteads on the prairie were common. Stites, a community along the South Fork Clearwater, was the major livestock shipping area for the entire county. Since the mid 1800s, domestic livestock have grazed BLM, State, and Tribal lands. The location, extent, and effects of that early grazing are unknown. Early surveys for some locations indicate poor conditions of riparian zones resulting from both agricultural use and overgrazing.

Historical information on livestock grazing within the Clearwater subbasin is limited in scope and availability, pertaining almost entirely to the Clearwater National Forest. General trends throughout the subbasin were likely similar to those described for the Clearwater National Forest. Although no information is available regarding the earliest numbers of sheep grazed, historical documentation suggests that grazing of sheep on National Forest lands began as early as the 1890s (Space 1964). Due to both increased forage available caused by fires and the end of World War I, numbers of sheep grazed within the Clearwater National Forest increased through the mid 1930s, peaking at about 33,300 in 1933. Intensity of sheep grazing declined sharply in subsequent years to 2,000 by 1949, and remained relatively consistent until the mid 1960s. Permits for cattle grazing were not issued in the Clearwater National Forest until 1937, with 25 head permitted. By 1943, over 400 head of cattle were permitted for grazing in the Clearwater National Forest and although it was suggested that grazing pressure was too heavy even at these levels, it was considered a wartime necessity. Cattle grazing continued to increase, reaching 1,199 head by 1960 (Space 1964).

Current Grazing in the Clearwater

Available data on current grazing distribution is limited to allotments on public lands within the subbasin. Grazing also occurs on much of the privately owned land (without public record of grazing intensity or duration). Data on grazing intensity of public lands is limited to permitted numbers of animal unit months (AUMs) and does not necessarily reflect actual numbers of animals grazed (One AUM is equal to: one bull, steer, or cow with suckling calf, one horse/ mule, or five sheep/goats grazing for one month). This lack of accurate data, especially on private lands, makes summarization of realized grazing intensity impractical for the subbasin as a whole using available information on grazing allotments and associated AUMs.

Current grazing distribution and intensity was estimated in a relative sense for each HUC according to the percent of the total land area defined as grazeable. Using available GIS layers, the distributions of known grazing allotments and other grazeable lands (as defined in the USGS GIRAS database) were combined to estimate the actual area of lands potentially grazed on both public and private lands throughout the subbasin. The grazeable area within each 6th field HUC was summarized as a percentage of the total land area (Figure 37). Subwatersheds with the highest proportion of grazeable area (> 50%) within the Clearwater subbasin are typically associated with USFS grazing allotments in lower elevation management areas. However, the majority of lands managed by the USFS within the Clearwater subbasin are not subjected to grazing by cattle or sheep, including all or nearly all of the Upper Selway, Lochsa, and Upper and Lower North Fork AUs. Subwatersheds outside of the Forest Service boundary typically have less than 25% of the land area defined as grazeable, although this is as much as 75% for some (Figure 37). Privately owned property within the subbasin typically contains a high percentage of agricultural use, with grazeable lands found only in uncultivated areas. In contrast, grazing allotments on Forest Service lands are typically large, often encompassing multiple HUCs, resulting in higher proportions of grazeable area than those contained in primarily privately owned lands. Current descriptions of grazing management entities and areas managed are provided below.

Idaho Department of Lands

In 2000 the IDL leased 15 active allotments within the Lower North Fork Clearwater and the Potlatch drainage systems. Grazing took place from June 1 to November 31, with all allotments running cow/calf pairs. Five allotments on the Lower Clearwater drainage cover 42,433 acres, with 1,970 AUMs. Total range consisted of 107,327 acres supporting 4,758 AUMs. No concerns regarding range condition were noted. State lands often overlap Forest Service properties and allotment use totals.

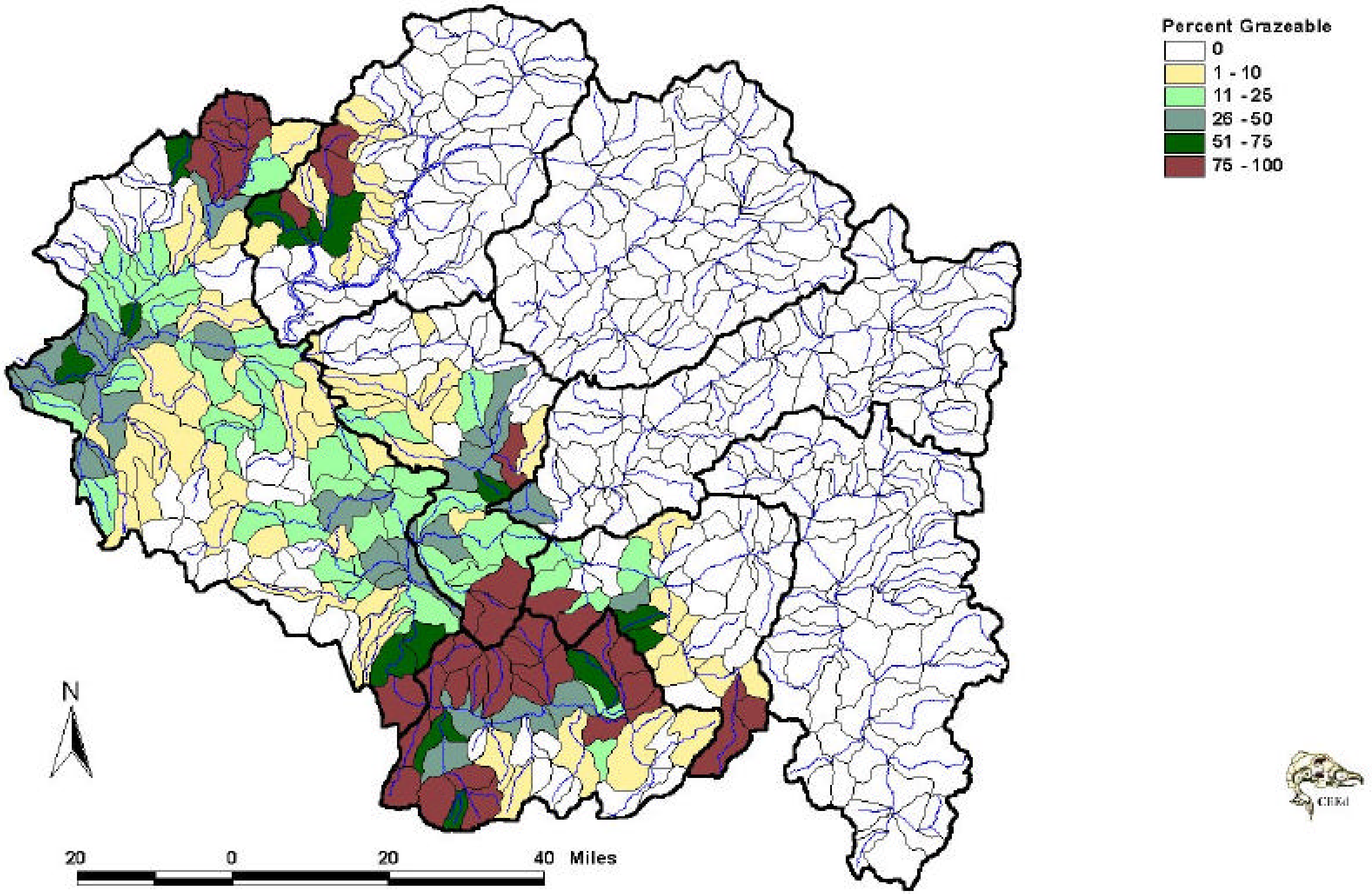

Figure 37. Spatial distribution of probable grazing activities within the Clearwater subbasin and the approximate percentage of each subwatershed defined as grazeable

Nez Perce County

Cattle and horses from 427 animal feeding operations, account for 95% of species and 98% of the AUMs in the county. Livestock grazing occurs predominantly in the spring and summer months, although some rangeland units are grazed for a 12 month period (Nez Perce Resource Conservation Plan 2000). A majority of rangeland acres occur on steep canyon sides, with slopes ranging from 40 to 90 percent, and adjacent to perennial streams or intermittent drainages. Of the feeding areas inventoried, 41% allowed livestock direct access to streams and 46% had less than adequate means of containing feedlot runoff to prevent stream contamination (Nez Perce Resource Conservation Plan 2000). Prescribed grazing plans have been implemented on 1,442 acres (Nez Perce Resource Conservation Plan 2000).

Watersheds were ranked according to risk for negatively impacting water quality due to livestock grazing. Lindsay Creek was listed as the only Very High risk watershed, while High risk drainages listed included Tammany Creek, Middle Potlatch, Pine Creek, Lapwai Lake, Cottonwood Creek, Garden Gulch, Lower Clearwater River, Cedar Creek, and Main stem Lapwai Creek (Nez Perce Resource Conservation Plan 2000).

Plant resource concerns associated with Nez Perce County grazing lands are poor grazing management and noxious weed infestations. Noxious weed invasions onto rangelands have drastically reduced forage production, and aggressive weeds of concern include Yellow starthistle (*Centaurea solstitialis*) and cheatgrass brome (*Bromus tectorum*) (Nez Perce Resource Conservation Plan 2000). Severe soil limitations and low production potential of rangelands cause habitat improvement practices to be very costly and result in small returns on investments.

Bureau of Land Management

Available data for BLM grazing allotments is only partial information and based on incomplete coverage. The BLM manages approximately 32,959 acres of rangeland with a potential grazing capacity of 17,189 AUMs. The actual grazed rangeland in 2000 was approximately 27,400 acres with 3,555 AUMs.

Nez Perce Tribe

The total grazing coverage of Tribal properties totals 33,738 acres with an estimated 10,420 AUMs. Most grazing operations are running cow/calf pairs.

Clearwater National Forest

In 1996 there were 50 permittees with 1,600 cattle, and 2,600 horses for a total of 10,500 AUMs on the Clearwater National Forest. Livestock forage was available and range was in good condition per established allotments (Clearwater National Forest 1996).

Historically, meadow and riparian communities would have contained more riparian shrubs than they did in 1996. Past logging activities and livestock grazing have contributed to a decline of riparian shrub cover. In 1996, cattle utilized 50-60% of the herbaceous material, and shrub cover within the Potlatch allotments has been reduced to 40% or less along stream banks and meadow margins. Desired condition is 80–100% shrub cover in riparian areas, and greater than 30% shrub cover around meadow margins where shrubs naturally occur (Clearwater National Forest 2000).

Currently there are 17 active allotments–14 on the Palouse Ranger District and 3 on the Lochsa Ranger District. Thirty-five permittees have 1,466 cattle and 416 horses with a total of 9,700 AUM (Clearwater Monitoring and Evaluation Report 2000). Noxious weeds were controlled on about 1,400 acres, and certain areas along the Lower Lochsa, North Fork

Clearwater, Cayuse Air Field, and the Palouse Ranger District (Clearwater Monitoring and Evaluation Report 2000).

Nez Perce National Forest

In 1987, 65 permittees ran livestock on 59 allotments for 4-6 months between May and October. Use consisted of approximately 6,600 cattle and 3,400 sheep, while 25 commercial outfitters grazed approximately 350 horses during the hunting season (supplemental feed accounts for ½ of the feeding requirements). Between 1,200 and 1,500 recreational horses grazed the forest periodically (Nez Perce National Forest 1987). Domestic livestock on 316,000 acres of suitable range grazed 42,000 AUMs. An estimated 52,000 acres are transitory range created by timber harvests (transitory range is only available 20-40 years after stand removal until forest canopy closure is reestablished), with the remaining 266,500 acres spread throughout various primary range vegetation types. An additional 2,500 acres of suitable range in wilderness areas were open to commercial outfitters and recreational horse grazing. Grazing occurs in the Gospel Hump Wilderness but not in the Selway-Bitterroot or the Nez Perce National Forest portion of the Frank Church River of No Return Wilderness (Nez Perce National Forest 1987).

Livestock grazing gradually increased to 43,000 AUMs by 1997. Since primary range on the Forest is fully stocked, any increase in future livestock grazing will be on acres of temporary range created by vegetative management activities. The maximum potential for range in 1987, after adjusting for wildlife use, closed allotments, and remote locations, was 59,300 AUMs (Nez Perce National Forest 1987). Range condition and trend surveys in the mid-80s indicated that most riparian areas were stable. Over 58% of the grassland and browse vegetative types were in good or better condition, while the remaining range was in fair condition (Nez Perce National Forest 1987). Livestock grazed elk winter range during the summer months and this use combined with elk grazing in the winter and spring adversely affects grass vigor if combined use is excessive. Reduction in elk wintering range varied from 0-43% (20% across the Forest), and loss in summer range varied from 10–13% (Nez Perce National Forest 1987).

Grazing guidelines have been established to manage the effects of livestock grazing, with the goal of maintaining desirable riparian conditions and restoring degraded streams. Under the new guidelines, forage and shrub utilization would each be 40 percent or less, and stream bank disturbance would be held to 10 percent of the bank distance. Results for this year (2000) suggest that permittees were fairly successful in meeting the new standards. Forty-eight riparian areas were monitored and all but one were within the disturbance limits (Nez Perce National Forest 2000). Noxious weed control program target areas are Moose Creek and Shearer Airstrips, but funding is currently unavailable to implement the program.

There were 33,500 AUMs permitted on the Nez Perce National Forest in 2000, but actual utilization was approximately 32,000 AUMs. Animal composition consisted of 12,266 sheep or goats, and 19,549 cattle or horses (Nez Perce National Forest 2000). There are seven allotments in the Selway drainage at this time: 3 active, 2 closed and 2 vacant. Allotments cover 155,506 acres with 910 active AUMs being currently utilized.

Cattle are the only livestock permitted on USFS lands in the South Fork Clearwater drainage (NPNF 1998). There are 12 active allotments totaling 222,100 acres, and 105,450 acres have suitable forage for grazing. Approximately 8 of those allotments are within the Clearwater subbasin boundaries and total 220,580 acres. About one third of the total allotments in the South Fork Clearwater drainage have documented areas of overuse resulting in damage to stream banks and reduced riparian vegetation (NPNF 1998). Erosion concerns on rangelands are primarily ephemeral gully and stream bank erosion where livestock have direct access to streams for drinking and crossing (Nez Perce Resource Conservation Plan 2000). Riparian areas adjacent to pastures with excessive livestock grazing are degraded from lack of protective wood and perennial grass cover. Lack of protective vegetation along stream channels increases channel erosion during runoff events. (Nez Perce Resource Conservation Plan 2000).

4.10.9 Mining

The South Fork Clearwater drainage in particular has a complex mining history that included periods of intense placer, dredge, and hydraulic mining (see Figure 38) (Paradis et al. 1999b). Within the North Fork drainage, mining activity was widely dispersed and methods used varied by area and included dredging, hydraulics, draglines, drag shovels, and hand operations (Staley 1940).

Mining of placer and surface deposits is more often represented by mining claims than by physical mines. Mine claim density is typically indicative of relatively small-scale placer and dredging operations, and impacts of these operations are often more directly tied to streams than those of mines themselves.

Mines are distributed throughout all eight AUs in the Clearwater subbasin, with the lowest number of occurrences in the Upper and Lower Selway AUs (Figure 40). Ecological hazard ratings for mines (delineated by ICBEMP) indicate that the vast majority of mines throughout the subbasin pose a low relative degree of environmental risk. However, clusters of mines with relatively high ecological hazard ratings are located in the South Fork AU and in the Orofino Creek drainage (Lolo/Middle Fork AU).

Figure 38 Gold Dredge in Crooked River in the South Fork Clearwater drainage (Photo courtesy of Don Morrow)

Mining claims are most widely and densely distributed within the South Fork drainage, although substantial numbers of claims have been staked in other areas as well (Figure 41). Mining claims are also aggregated in a line extending from the upper Middle Fork and lower Lochsa River northward to Orogrande Creek, then along the upper North Fork to its headwaters including Meadow, Long, Osier, and upper Kelly Creeks. Another conglomeration of mining claims exists in the Little North Fork drainage, and includes the Foehl Creek drainage and an adjacent portion of the Little North Fork itself. Within the Clearwater subbasin, mining claim distribution does not correspond well with the general distribution of actual mines, although exceptions to this can be seen in the South Fork Clearwater and Osier Creek (Upper North Fork Clearwater) drainages. Effects of past placer mining activity, including extensive dredge spoils, are still evident, particularly in the South Fork AU.

Figure 39 Hydrologic mining on Leggett Creek in the South Fork Clearwater drainage (photo courtesy of Don Morrow)

4.11 Diversions, Impoundments, and Irrigation Projects

Based on records obtained from the Idaho Department of Water Resources, 70 dams currently exist within the boundaries of the Clearwater subbasin (Figure 42). The vast majority of existing dams occur within the Lower Clearwater AU (56), although dams also currently exist in the Lower North Fork (3), Lolo/Middle Fork (5), and South Fork (6) AUs. Of the 70 dams, descriptive data concerning the size, capacity and ownership is available for only 46 (Table 28). The remainder are thought to be small earthen structures with minimal storage capacity.

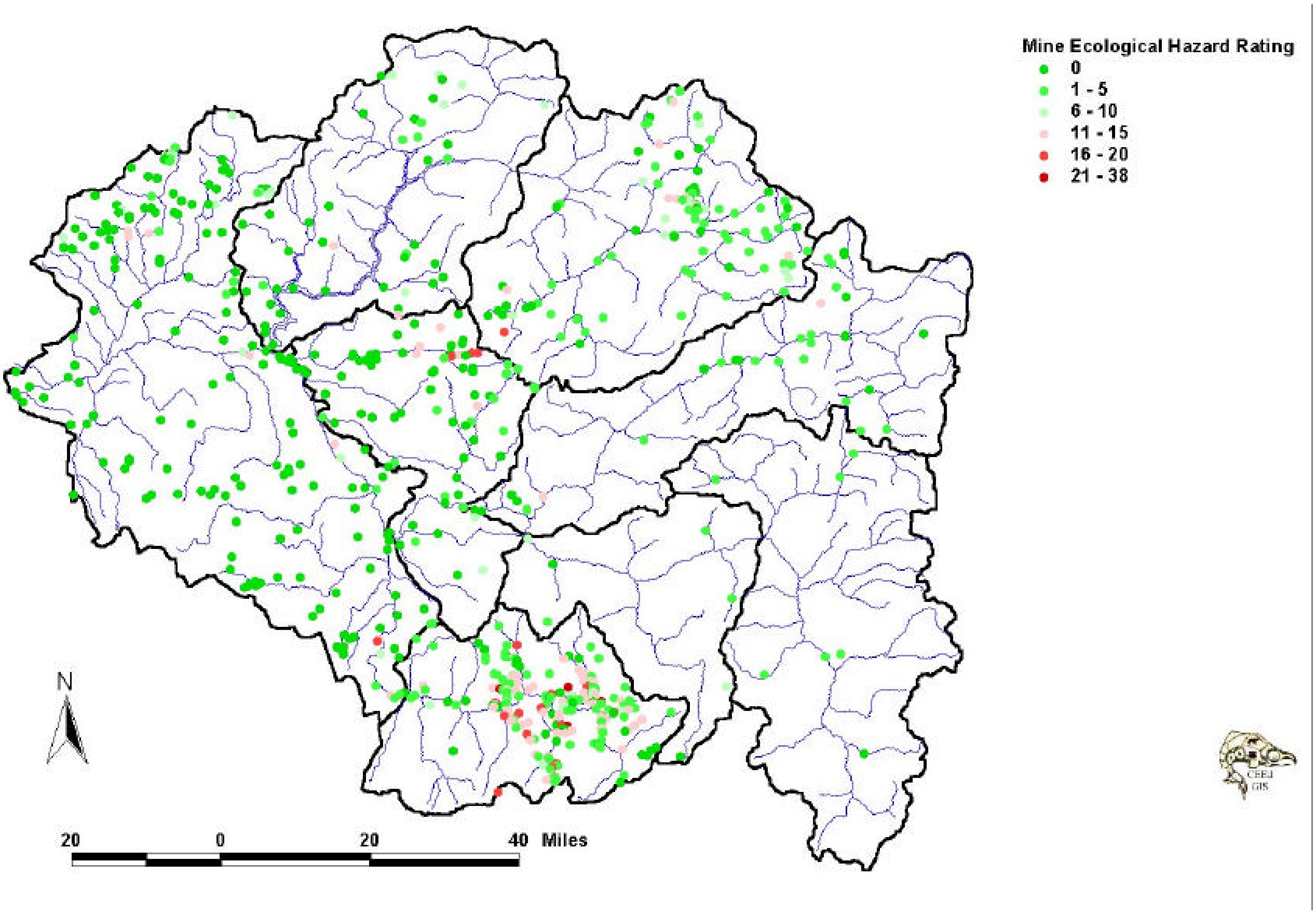

Figure 40. Mine locations throughout the Clearwater subbasin. Color codes signify relative ecological hazard of individual mines as defined by ICBEMP

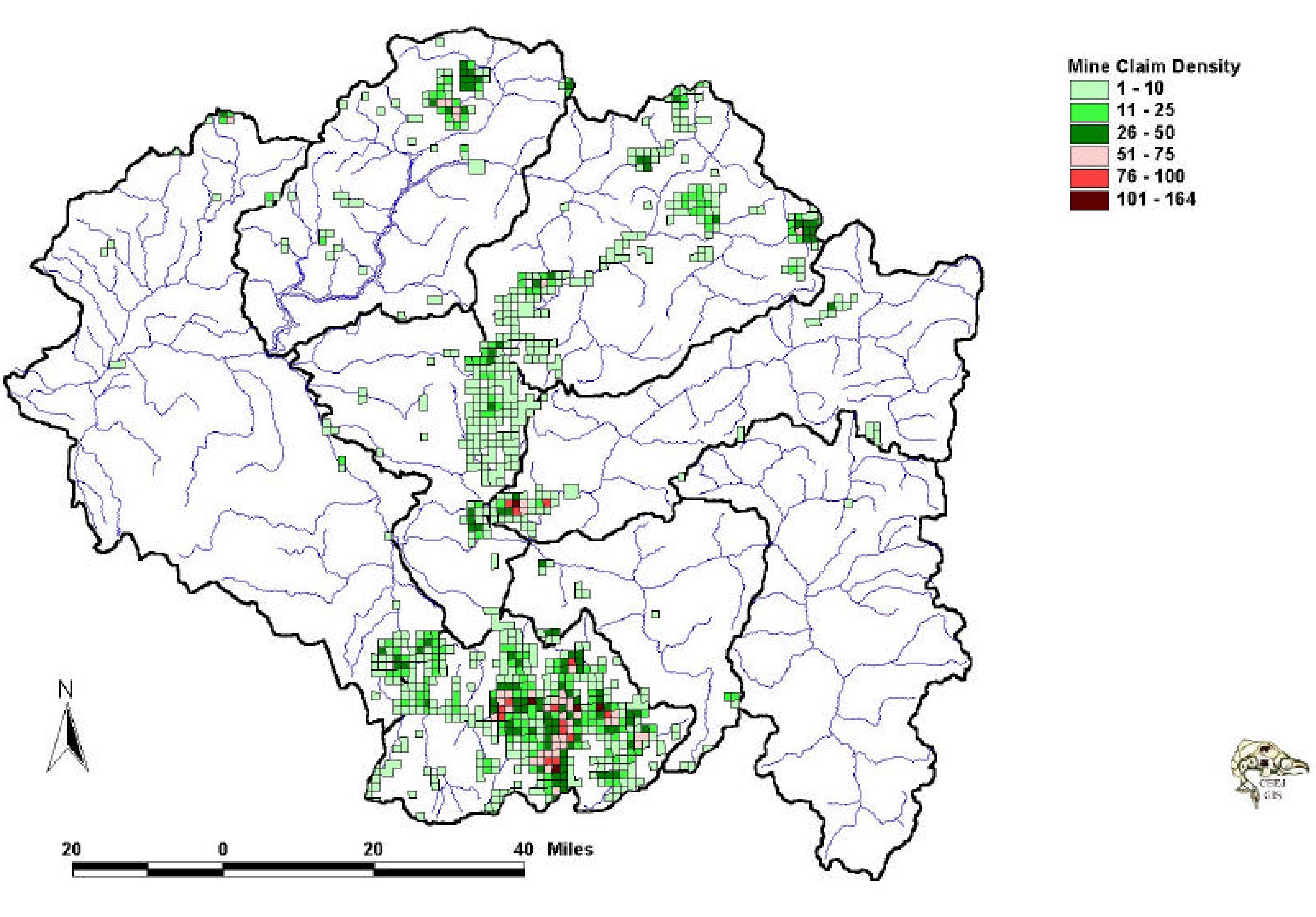

Figure 41. Mining claim distribution and density within the Clearwater subbasin

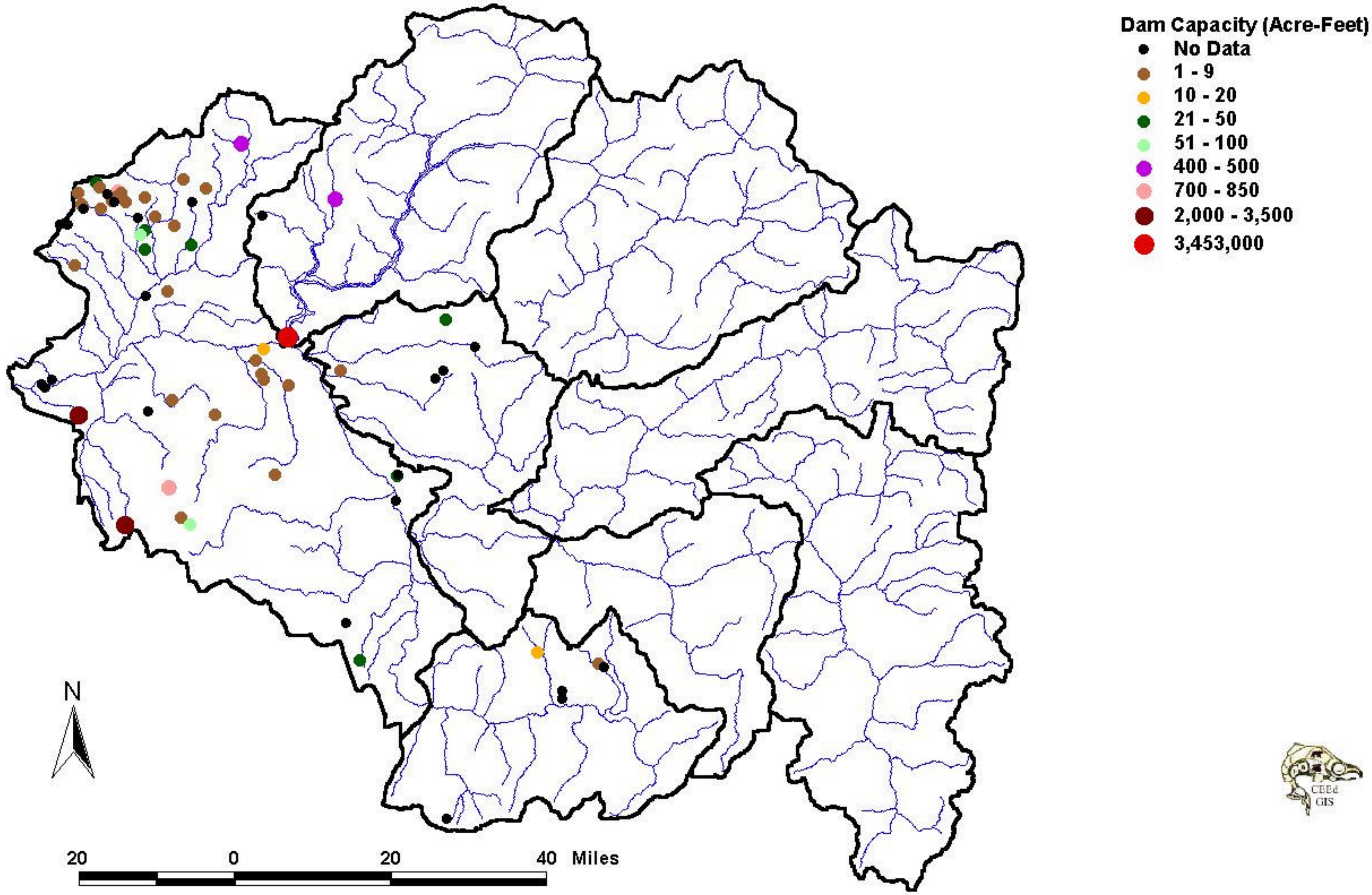

Figure 42. Location of existing dams within the Clearwater subbasin

Table 28. Information pertaining to dams located within the Clearwater subbasin, ordered by reservoir storage capacity

Dam Name	Stream	Type	Storage Capacity (Acre-ft)	Height (feet)	Reservoir Area (Acres)	Year Filled	Owner
Dworshak	N Fork Clearwater R.	Concrete	3,453,000	633.0	16,417	1973	U S Army Corps Of Engineers
Reservoir A (Manns Lake)	Sweetwater Creek (Os)	Earth	3300	57.0	145	1907	U S Bureau Of Reclamation
Soldiers Meadow	Webb Creek	Earth	2370	50.0	121	1923	U S Bureau Of Reclamation
Winchester (Lapwai Lake)	Lapwai Creek	Earth	850	36.0	98	1910	Idaho Fish And Game Department
Spring Valley	Spring Valley Creek	Earth	721	42.3	53	1962	Idaho Fish And Game Department
Elk River	Elk Creek	Earth	481	11.0	61	1951	Elk River Recreation Dist.
Moose Creek	Moose Creek	Earth	420	15.0	70	1960	Idaho Department Of Lands
Nelson	Tr-Big Bear Creek	Earth	65	13.5	9	1907	Maxine Nelson
Talmaks Campground	N Fk Willow Creek	Earth	56	7.0	10		U S Bureau Of Indian Affairs
Mud Springs [1]		Earth					US Bureau of Indian Affairs
Thompson No 1	Tr-Little Canyon Ck.	Earth	54	15.0	7	1967	Tim Craig
Arneberg	Tr-Dry Creek	Earth	45	19.0	6	1952	Arneberg Brothers
Mariposa Foundation	Tr-Pine Creek	Earth	38	19.0	7	Prop	Mariposa Foundation Inc.
Campbells Pond	Hay Creek	Earth	35	19.0	7	1939	Idaho Department of Fish and Game
Spencer	Tr-Threemile Creek	Earth	30	13.0	5	1954	Spencer Ranch Inc.
Reierson	Tr-Little Bear Creek	Earth	30	14.5	5	1901	Paul E Reierson Trust
Troy	Big Meadow Creek	Earth	25	43.0	2	1950	City Of Troy
Rundell	Tr-Tom Taha Creek	Earth	23	14.5	6	1975	Richard Duclercque
Thompson No 2	Tr-Clearwater River	Earth	11	16.0	3	1970	Clint Thompson
Newsome Creek	Tr-Newsome Creek	Earth	10	20.0	1	Prop	U S Forest Service
Ericson Creek	Ericson Creek	Earth	9	16.0	2	1975	U S Forest Service
Stauber	Tr-Little Potlatch Creek	Earth	9	14.3	3	1991	Erik Stauber
Bower	Tr-Pine Creek	Earth	9	15.0	2	Unk.	Charles Bower
Thompson	Tr-Little Canyon Creek	Earth	9	21.0	2	Unk.	George Thompson
Ruckman	Tr-Sixmile Canyon	Earth	9	15.0	2	Unk.	Edward And Thomas Ruckman

Table 28 (Continued)

Dam Name	Stream	Type	Storage Capacity (Acre-ft)	Height (feet)	Reservoir Area (Acres)	Year Filled	Owner
Carlson No 3	Tr-Big Meadow Creek	Earth	8	14.0	3	Unk.	Dave Carlson
Pfeifer	Tr-Lapwai Creek	Earth	8	15.0	1	Prop	Ronald And Judy Pfeifer
Butler	Tr-Cottonwood Creek	Earth	8	18.3	1	1950	Evelyn Bulen
Hofstrnd	Tr-Felton Creek	Earth	7	15.0	1	1996	Mark And Debra Hofstrand
Ewert (Carlson No 2)	Tr-Big Meadow Creek	Earth	6	15.0	1	Unk.	Steve Ewert
Kingery	Tr-Mt Deary Creek	Earth	6	11.4	1	1991	Peggy E Kingery
Henderson	Tr-Holes Creek	Earth	6	18.0	1	1958	Wynne Henderson
Stillman No 1	Tr-Little Canyon Creek	Earth	6	14.0	1	Unk.	Carl Stillman
Stillman No 2	Tr-Little Canyon Creek	Earth	6	16.0	1	Unk.	Carl Stillman
Bowman	Tr-Jim Ford Creek	Earth	5	11.2	1	1994	Dwight Bowman
Olson	Tr-W Fk Little Bear Ck	Earth	5	17.0	1		Lester And Nancy Morfin
Carlson No 1	Tr-Spring Valley Creek	Earth	3	12.0	1	1966	Dave Carlson
Henry	Tr-Wauncher Gulch	Earth	3	14.0	1	1969	Allen Henry
Albers	Tr-Little Canyon Creek	Earth	2	14.0	1	1979	Raymond Albers
Hokanson	Tr-Dry Creek	Earth	2	17.0	1	1972	Kenneth Hokanson
Caldwell No 1	Tr-Randal Flat Creek	Earth	2	19.0	1	1977	Delbert Caldwell
Caldwell No 2	Tr-Randal Flat Creek	Earth	2	14.0	1	Unk.	Delbert Caldwell
Feldman	Tr-Spring Valley Creek	Earth	2	16.0	1	1971	L Gene Feldman
Gilder	Tr-Spring Valley Creek	Earth	2	16.0	1	1971	Glen Gilder
Deters	Tr-Big Meadow Ck.	Earth	1	12.0	1	1978	Don Deters
Winn	Tr-Brush Creek	Earth	1	14.0	1	1971	Mrs Clarence Winn
Kerley	Tr-Dry Creek	Earth	1	12.0	1	1985	Mike Kerley

1 Mud Springs Dam is not included in the IDWR database. Information supplied by Nez Perce Tribe.

The seven largest reservoirs in the subbasin provide recreational and other beneficial uses. Dworshak, Reservoir A, Soldiers Meadows, Winchester, Spring Valley, Elk River, and Moose Creek reservoirs all provide recreational fishing opportunities. Reservoir A and Soldiers Meadows Reservoir are also part of the Lewiston Orchards Irrigation District system. Capacity of other reservoirs within the Clearwater subbasin is limited to 65 acre-feet or less, and in most cases is less than 15 acre-feet (Table 28), limiting their recreational capacity.

Dworshak Dam is the largest straight axis concrete dam in the United States. The project was authorized primarily for flood control (Mehrhoff and Sather-Blair 1985), with other purposes including power generation, commercial navigation and recreation (USACE 1974). Planning for the dam and reservoir was initiated by the USACE in the 1950s. Authority for construction was contained in Public Law 87-874, Section 201 of the Flood Control Act of 1962 in accordance with House Document 403, 87th Congress, 2nd Session (USACE 1975). On September 27, 1971, the river diversion tunnel was sealed and Dworshak Reservoir was formed (Hanson and Martin 1989). Filling of the reservoir was started in 1972 and power generation began in 1973 (USACE 1974). The final environmental impact statement (EIS) was completed in 1985 (Hanson and Martin 1989).

The reservoir behind Dworshak dam is 53.4 miles (86 km) long at full pool, with a surface area of 16,417 acres (6,644 ha). Maximum and mean depths are 636.5 ft. (194 m) and 183 ft. (56 m), respectively. Dworshak reservoir provides 3.453 million acre-feet of storage, making it the largest storage project within the Nez Perce Tribe ceded area and the state of Idaho (IDFG and NPT 1991; USACE 1975). Located two miles (3 km) above the mouth of the North Fork Clearwater River, the dam blocked fish passage for anadromous fish to spawning habitat that could accommodate 109,000 steelhead trout redds and 74,000 chinook salmon redds (USFWS 1962). The dam also inundated 16,970 acres (69 km^2) of terrestrial and riverine habitats at full pool (USACE 1975). The reservoir provides 13,343 acres (5,400 ha) of kokanee habitat (defined as the area over 49 ft. deep) at full pool.

Dworshak reservoir drawdowns for flood control may lower the surface elevation 154 ft. (47 m) and reduce surface area by as much as 52%. The reservoir has a mean water retention time of 10.2 months and a mean annual discharge of 162 m^3/s (Falter 1982). High releases from the reservoir occur during spring runoff, during late summer when water is released for anadromous fish flows, and during the fall/winter when the reservoir is lowered for flood control.

Numerous dams that have been removed had substantial impacts on fisheries resources within the subbasin. Lewiston dam, constructed in 1927 on the lower Clearwater River near the present site of the Potlatch pulp mill (RM 4) and operated by Washington Water Power, virtually eliminated chinook salmon runs and substantially reduced steelhead runs into the Clearwater subbasin (NPT and IDFG 1990). Modifications were later made to Lewiston Dam to facilitate fish passage, and the dam was removed in 1973 as part of the Lower Granite Lock and Dam Project.

A low-head hydroelectric diversion dam on the North Fork Moose Creek (Upper Selway AU) thought to be a partial barrier for anadromous species was removed in the mid 1960s (NPT and IDFG 1990). A dam constructed by Washington Water Power in 1910 on the lower South Fork Clearwater (RM 22) near the town of Harpster blocked anadromous salmon species from the South Fork Clearwater River. The dam formed a complete barrier to fish migration, and anadromous salmonids were excluded from the upper watershed from 1911 to 1935 and from 1949 until 1963, when the dam was removed (Paradis et al. 1999b). A fish ladder was installed in 1935 and was destroyed in 1949 by high flows (Paradis et al. 1999b). Murphy and Metsker (1962) reported that steelhead were able to pass over the dam from 1935-1949, but Siddall (1992) reported that the dam failed to pass significant numbers of fish during this period.

The Dewey Dam was built in about 1895 on the South Fork Clearwater River about 0.1 miles above the mouth of Mill Creek (Gerhardt 1999). The dam washed out after only a few years. The Dewey Dam was approximately 6-8 feet high and no known documentation of fish passage conditions exist, except a photo (Figure 43) which does not show fish passage facilities.

Figure 43 Dewey Dam (Courtesy Don Morrow)

The Kooskia Flower Mill Dam, located on the South Fork Clearwater River about 0.6 miles from its mouth, was built prior to 1910 and was in place until some time in the 1930's (Gerhardt 1999). The dam is estimated to have been about 6 feet high, and although fish passage is not documented, it has been suggested that upstream migration of anadromous salmonids was probably not impaired by this structure (Gerhardt 1999).

Dams in the Clearwater subbasin have also had an effect on resident fishes such as bull trout and cutthroat trout. Free movement was blocked, resulting in fragmentation of metapopulations, especially for the North Fork Clearwater River. The impact due to this is not known (Jody Brostrom, IDFG, personal communication, March 30, 2001).

Small scale irrigation, primarily using removable instream pumps, is relatively common for hay and pasture lands scattered throughout the lower elevation portions of the subbasin, but has not been quantified. The only large scale irrigation/diversion system within the Clearwater subbasin is operated by the Lewiston Orchards Irrigation District within the Lower Clearwater AU. The District's irrigation water supply depends on surface water runoff from the Sweetwater Creek drainage, a tributary to Lapwai Creek. Water is stored in three reservoirs, and delivered through a system of canals and natural streams (Morrison Knudsen Corporation 1992).

The storage reservoirs include two man-made reservoirs (Reservoir A and Soldiers Meadows) and one natural lake (Lake Waha). Water is diverted from Soldiers Meadows, Lake Waha, and Sweetwater Creek to Reservoir A through Webb Creek Canal, Lake Waha Feeder Canal, Sweetwater Canal, and Sweetwater and Webb Creeks.

4.12 Protected Areas

Approximately 47% of the Clearwater subbasin is designated as having some degree of protected status, the majority of which is designated as either inventoried roadless or wilderness area (Table 29). Wild and scenic river corridors and research natural areas are each present in seven of eight AUs in the Clearwater subbasin. Other less abundant protected areas include wilderness study areas, BLM designated areas of critical environmental concern, special interest areas, and areas maintained by the National Park Service.

The vast majority of protected areas are in the eastern half of the subbasin (Figure 44), and on lands managed by the U.S. Forest Service. Of eight AUs in the Clearwater subbasin, four have 75% or more of their total land area included in protected areas; the entire Upper Selway AU is protected, and the Upper North Fork, Lochsa and Lower Selway AUs each have at least 75% of their land area designated as protected (Table 29).

Inventoried roadless areas account for the largest proportion of protected area within the Clearwater subbasin, accounting for 51% of all protected areas. Inventoried roadless areas consist of over 2,200 mi^2, or roughly 24% of the Clearwater subbasin. Roadless areas are primarily located in the Upper North Fork, Lochsa, and Lower Selway AUs.

Portions of the Selway-Bitterroot and Gospel Hump Wilderness exist within the Clearwater subbasin, contributing substantially to the total protected area. The Selway-Bitterroot Wilderness encompasses portions of the upper and lower Selway and Lochsa AUs. The Gospel Hump Wilderness extends into the southern edge of the South Fork AU. Combined, the two wilderness areas encompass approximately 1,950 mi^2 within the Clearwater subbasin, accounting for 21% of the total land area and nearly 45% of the total protected area.

Table 29. Approximate area (mi^2) within each AU with various forms of protected status. Numbers in parenthesis represent approximate percent of total land area

Assessment Unit	Inventoried Roadless	Wilderness Areas	Wilderness Study Area	Wild and Scenic River Corridor	Areas of Critical Environmental Concern (ACEC)	Research Natural Area (RNA)	RNA in Wilderness Area	Special Interest Area	National Park Service	Total
Lower Clearwater	0.0	0.0	0.0	15.9 (0.7)	0.0	0.0	0.0	0.0	0.2 (0.0)	16.2 (0.8)
Lower North Fork	215.4 (18.7)	0.0	5.8 (0.5)	19.2 (1.7)	4.2 (0.4)	6.6 (0.6)	0.0	0.2 (0.0)	0.0	251.4 (21.8)
Upper North Fork	962.1 (74.4)	0.0	0.0	0.0	0.0	2.6 (0.2)	0.0	0.0	0.0	964.7 (74.6)
Lolo/Middle Fork	46.1 (6.0)	0.0	0.0	12.2 (1.6)	5.8 (0.8)	0.7 (0.1)	0.0	0.2 (0.0)	0.0	65.1 (8.4)
Lochsa	514.2 (43.7)	369.3 (31.4)	0.0	38.7 (3.3)	0.0	4.9 (0.4)	1.5 (0.1)	0.0	0.0	928.6 (78.8)
Lower Selway	343.8 (51.9)	216.2 (32.6)	0.0	21.4 (3.2)	0.0	13.2 (2.0)	0.0	0.0	0.0	594.6 (89.8)
Upper Selway	50.1 (3.7)	1,266.8 (94.1)	0.0	30.8 (2.3)	0.0	1.3 (0.1)	0.0	0.0	0.0	1,349.0 (100.0)
South Fork	81.1 (10.2)	101.3 (12.8)	0.0	14.3 (1.8)	0.1 (0.0)	1.6 (0.2)	1.1 (0.1)	0.0	0.0	199.4 (25.1)
Totals	2,212.8	1,953.7	5.8	152.5	10.1	30.9	2.5	0.5	0.2	4,369.0 (46.7)

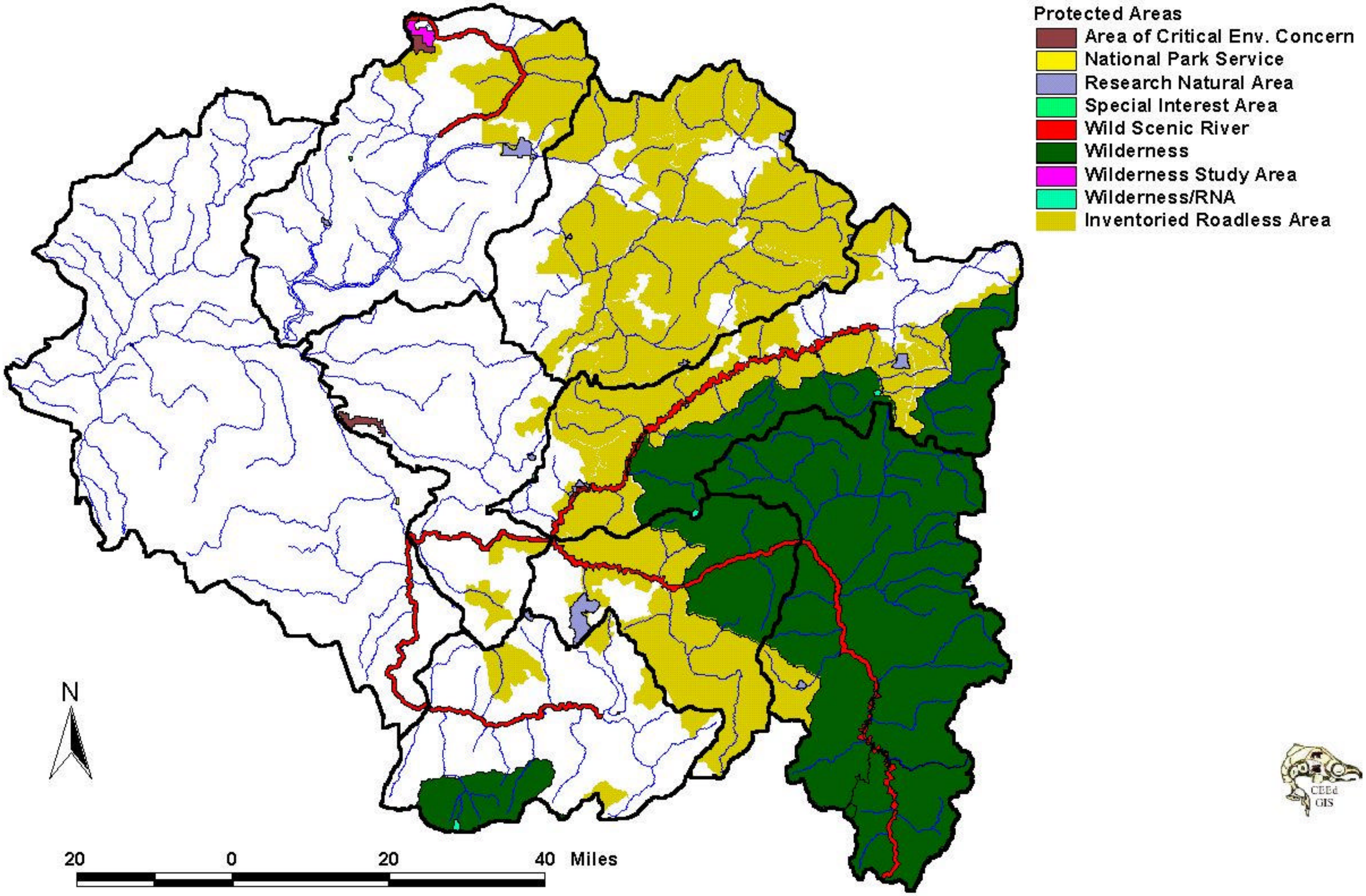

Figure 44. Protected areas within the Clearwater subbasin

5 Vegetative Resources

5.1 General Vegetation Description

Over 70% of the Clearwater subbasin is made up of forested communities (Table 30), generally classified as mesic, xeric, or subalpine. Mesic or moist conifer forests are largely found on mid-elevation montane slopes where precipitation patterns allow the formation of grand fir forests, or along river systems characterized by maritime climatic influences such as occur along the North Fork Clearwater River and parts of the Selway River. Under these unique climatic conditions grand fir gives way to western red cedar and hemlock (*Tsuga heterophylla*) stands. Cedar forests often contain unique plant species, including two focal plant species, crenulate moonwort and mountain moonwort. Xeric or dry forests are characteristically dominated by ponderosa pine at the lower elevations, and grade into Douglas-fir and dry site grand fir as elevation increases (Cooper et al. 1987). Subalpine fir and lodgepole pine dominate forests at middle and high elevations within the subbasin. At the very highest sites, subalpine fir stands also contain whitebark pine (*Pinus albicaulus*), which is an important wildlife food source.

Table 30. General vegetation types in the Clearwater subbasin (grouped Idaho GAP2 data)

Vegetation Category	% Area	Area (km^2)
Forest	71.4%	16,955.58
Agriculture	10.2%	2,425.48
Shrubland	7.7%	1,835.25
Grassland	4.0%	951.21
Other	2.3%	536.88
Subalpine/Alpine Meadow	2.1%	487.02
Riparian	1.7%	407.04
Water/Streamside	0.5%	111.11
Urban	0.1%	31.23

Shrublands and grasslands currently make up 12% of the subbasin's vegetation. The majority of the grasslands occur in the foothills and breaklands as canyon bunchgrass communities. These grasslands provide winter range for big game animals, livestock forage, and habitat for unique plant species. The broadfruit mariposa lily (*Calochortus nitidus*), is a focal species associated with the canyon grassland habitats. These habitats are also utilized by the proposed Threatened Spalding's catchfly. Shrubland communities tend to be warm and mesic in the subbasin.

The Clearwater subbasin contains several unique or disproportionately important plant communities. Most notable are the prairie grasslands, wetland and riparian areas, and coastal disjunct communities. The grasslands are characterized by a rich assemblage of bunchgrasses, forbs, and shrubs (Daubenmire 1942; Davis 1952). Wetter, poorly drained sites supported camas (*Camassia quamash)* meadows with more upland sites containing either Idaho fescue (*Festuca idahoensis*) or a mixture of Idaho fescue and bluebunch wheatgrass (*Pseudoroegneria spicatum*). Camas meadows were important gathering sites for ancestral Nez Perce Indians who dug camas bulbs and prepared them as a winter food staple. Present day Nez Perce continue to gather these edible bulbs for subsistence and ceremonial purposes, although gathering sites are scarce due to conversion of the prairie grasslands for commercial agricultural uses. Conversion to commercial agricultural uses has also contributed to the decline of native prairie forbs such as Jessica's aster (*Aster jessicae*) and Palouse goldenweed (*Haplopappus liatriformis*), both of which are focal plant species in the Clearwater subbasin.

Wetlands and riparian areas cover only a small portion of the subbasin, but offer some of the most diverse and unique habitats available. Wetlands occur as small ponds filled by spring runoff, wet meadows, springs and seeps, bogs, small lakes, and riverine and streamside riparian areas. These are important to the ecologic and economic welfare of the subbasin because they provide high quality wildlife habitat, water storage, flood abatement, pollution filtration, livestock forage, and water for domestic use (U.S. Geological Survey 1996). They also harbor unique plant species such as Clearwater phlox (*Phlox idahonis*), which is endemic to only a few wet meadows within the Clearwater subbasin. Impacts to wetland and riparian communities are difficult to quantify, but some estimates suggest that 56% of Idaho's wetlands have been lost since 1860 (Dahl 1990), largely due to agricultural conversion and urban development (Idaho Department of Parks and Recreation 1987). Within the Clearwater subbasin, large expanses of palustrine wetlands in the Reubens, Craigmont, and Ferdinand areas have been converted to croplands (U.S. Geological Survey 1996). Remaining wetland communities are often degraded by livestock grazing, road development, urban expansion, and altered hydrologic regimes.

Within the North Fork Clearwater and at the confluence of the Selway and Lochsa Rivers are areas containing many plant species more typically found in the Oregon and Washington coastal rainforests. These communities have been referred to as a "refugium ecosystem" because of their unique distribution and species composition (Lichthardt and Moseley 1994). Elements from the moist coastal area intermingle with more typical Rocky Mountain species. Many species associated with this community are considered rare or sensitive (Moseley and Groves 1992). The ecosystem has been impacted by inundation behind Dworshak Dam, recreational development, roads, and timber harvest (Lichthardt and Moseley 1994).

The grand fir mosaic is a unique community type found only in the Clearwater River drainage of northern Idaho and in the Blue Mountains of northeast Oregon. Within the Clearwater, this community type occupies approximately 500,000 acres between the Selway and South Fork Clearwater rivers (Ferguson and Byrne 2000). It occurs on all aspects in all topographic positions between 4,200 feet and 6,000 feet elevation. As the name implies, the dominant tree species is grand fir interspersed with natural openings dominated by Sitka alder (*Alnus sinuata*), bracken fern (*Pteridium aquilinum*), and fool's huckleberry (*Menziesia ferruginea*; Ferguson and Byrne 2000). Managers have become interested in this community because of the lack of conifer regeneration following disturbance. Research has shown that four primary factors contribute to poor conifer regeneration on these sites: competition, allelopathy from bracken fern and western coneflower (*Rudbeckia occidentalis*), acidic soils, and pocket gopher (*Thomomys talpoides*) herbivory (Ferguson and Boyd 1988, Ferguson 1999, Ferguson and Byrne 2000).

5.2 Past and Present Vegetation

Data generated by two GIS vegetation mapping efforts were used to supplement research and site specific findings to characterize the current and historic vegetative communities of the Clearwater subbasin. The Interior Columbia Ecosystem Management Project (ICBEMP) mapped both current and historical cover type and structural stage data across the Columbia Basin at a resolution of 1 kilometer^2. Due to the large areal extent of the project, the coarse resolution of the data and the scarcity of available historic vegetation information the cover type data generated by the ICBEMP project should be viewed as providing a general picture of conditions and not necessarily exact locations or extent of cover type distributions . The Idaho GAP Analysis Program's GAP 2 data is the second iteration of an effort to map the land cover of Idaho as part of the National GAP Analysis Program administered by the USGS. No historic cover type or structural stage data has been generated by the project to date, but the current cover type data is available at a 30 meter^2 resolution, much finer than that available from ICBEMP. For these reasons ICBEMP data was used to illustrate land cover and vegetative community, while GAP 2 data was employed to discuss current conditions. Data use is cited throughout the following discussion and the reader should keep in mind the strengths and weaknesses of each source.

The distribution and abundance of vegetative cover types within the Clearwater subbasin has changed over the last 100 years, in some cases significantly (Figure 45 and Figure 46). Many changes result from European settlement and associated changes in land use practices and management activities: or example, changes have occurred due to fire management, land conversion, and nonnative species introductions. Agricultural coverage has increased approximately 12% compared to the historical condition, while grasslands and early and late seral forests have declined (Figure 47). In some parts of the subbasin, fire suppression has resulted in an absence or reduction of early seral species or communities compared to historical ranges (Thompson 1999). Timber harvest has also impacted the extent and composition of some forest types such as open ponderosa pine (Nez Perce National Forest 1998). The introduction of blister rust caused western white pine, previously dominant in some parts of the subbasin, to largely disappear (Clearwater National Forest 1997). Blister resistant planting stock has the potential to return western white pine to vegetation communities in the Clearwater subbasin (Clearwater National Forest 1997).

The most significant change has occurred in the wetland and native bunchgrass cover types. These two cover types have declined by 98% according to ICBEMP data (Table 31). Other noteworthy changes include a 47.5% reduction in ponderosa pine coverage and a 53.6% decline in Douglas-fir coverage. Some cover types have increased in extent including western larch (2.8 fold increase) and shrub or herb/tree regeneration (13 fold increase).

Mesic forests currently cover slightly over a quarter of the subbasin and historically covered 20% of the subbasin (Table 31). With the arrival of blister rust, grand fir/white fir communities have increased their range to areas previous containing western white pine. Western red cedar communities grade into grand fir communities with decreasing moisture and shade (Cooper et al. 1991). The mesic forest habitats contain greater floristic diversity than other forest habitat in the subbasin (Cooper et al. 1991). The cedar forests provide habitat for two focal plant species: crenulate moonwort and mountain moonwort. The fisher uses grand fir/white fir/western red cedar habitat.

Douglas-fir and mixed conifer forests currently cover 7% of the subbasin. This is over a 50% loss compared to historic vegetation (Table 31). Douglas-fir stands occur on sites with moisture regimes intermediate to the higher moisture environment occupied by grand fir communities and the lower moisture environment occupied by ponderosa pine communities (Cooper et al. 1991). Douglas-fir stands with multiple canopies are one of two kinds of stands regularly inhabited by the flammulated owl (Groves et al. 1997a).

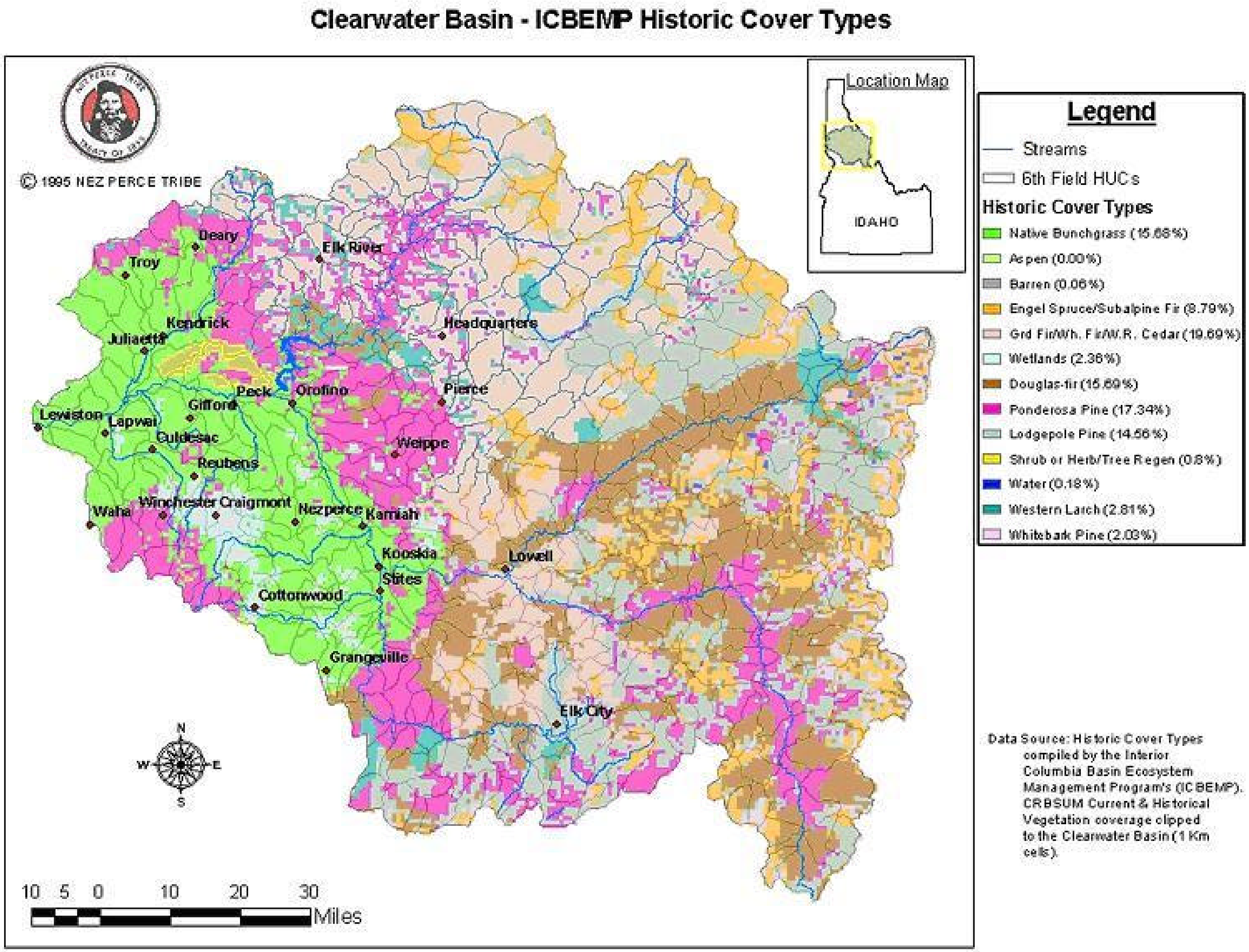

Figure 45. Historic vegetation within the Clearwater subbasin as defined by ICBEMP

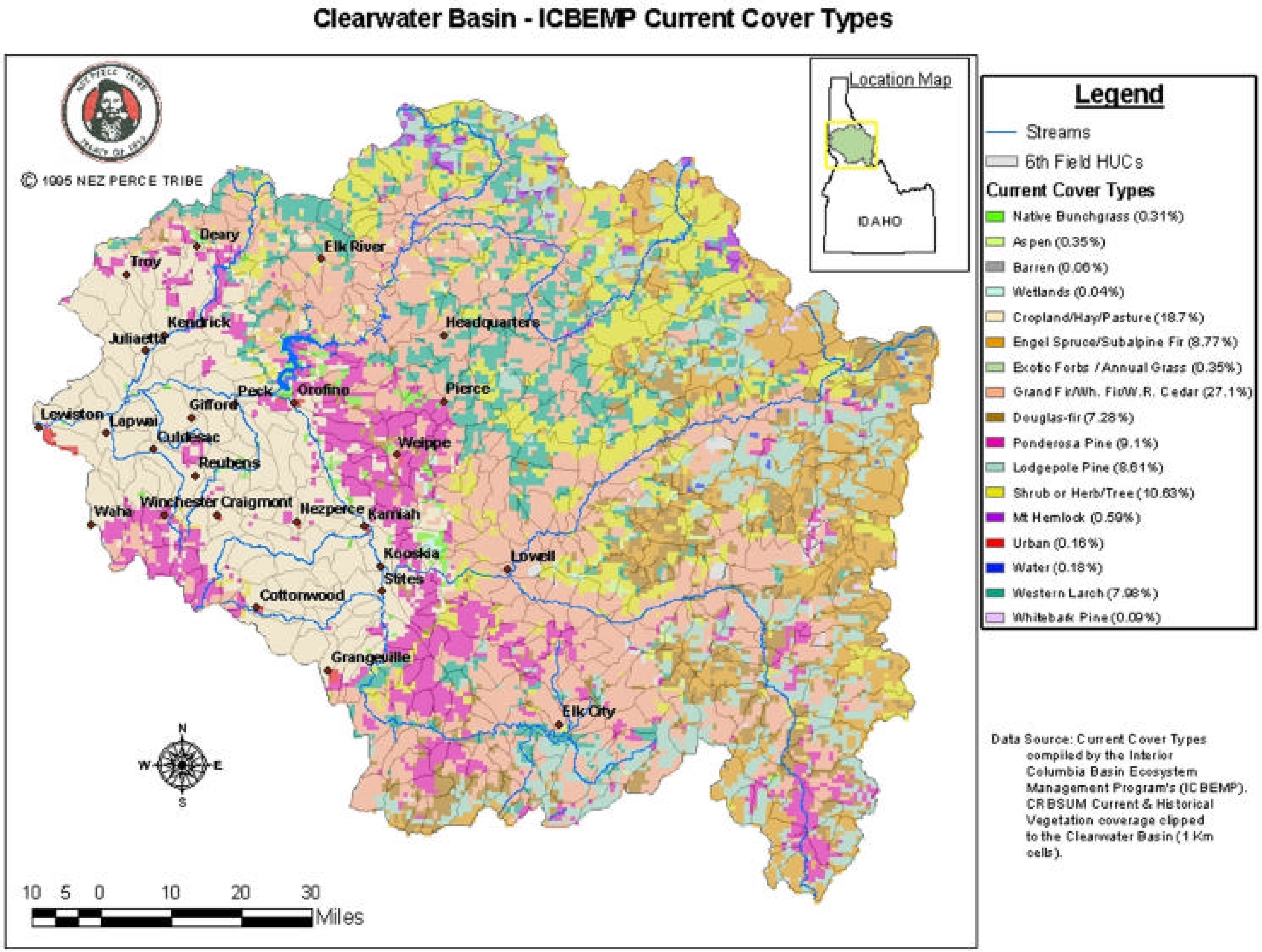

Figure 46. Current vegetation within the Clearwater subbasin as defined by ICBEMP

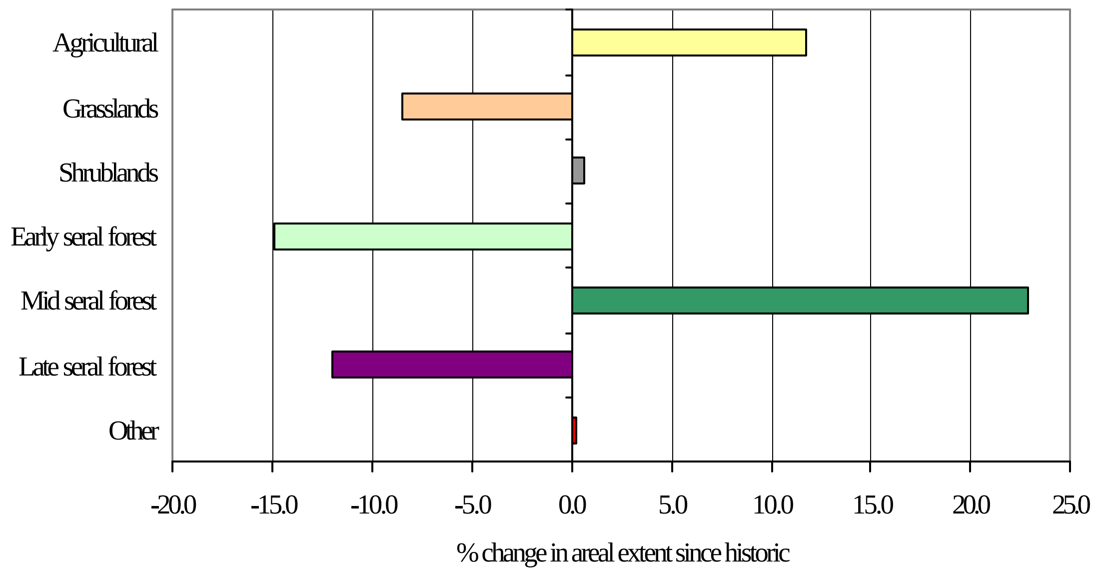

Figure 47. Percent change in specific structural stages (as defined by ICBEMP) from 1900 to 1995 for the Clearwater subbasin

Table 31. Changes in vegetative coverage in the Clearwater subbasin based on ICBEMP data

Cover Type Name	Historic Coverage (km^2)	% Historic Cover of Subbasin	Current Coverage (km^2)	% Current Cover of Subbasin	Change from Historic Cover (km^2)
Grand Fir/White Fir/Western Red Cedar	4,771	19.69%	6,567	27.10%	+1,796
Ponderosa Pine	4,201	17.34%	2,205	9.10%	-1,996
Douglas-fir	3,801	15.69%	1,763	7.28%	-2,038
Native Bunchgrasses	3,799	15.68%	75	0.31%	-3,724
Lodgepole Pine	3,528	14.56%	2,086	8.61%	-1,442
Engelmann Spruce/Subalpine Fir	2,131	8.79%	2,124	8.77%	-7
Western Larch	680	2.81%	1,933	7.98%	+1,253
Wetlands	572	2.36%	10	0.04%	-562
Whitebark Pine	493	2.03%	23	0.09%	-470
Shrub or Herb/Tree Regen	195	0.80%	2,575	10.63%	+2,380
Water	43	0.18%	43	0.18%	0
Barren	14	0.06%	14	0.06%	0
Aspen	1	0.00%	86	0.35%	+85
Cropland/Hay/Pasture	0	0.00%	4,532	18.70%	+4,532
Exotic Forbs/Annual Grass	0	0.00%	12	0.05%	+12
Mt Hemlock	0	0.00%	142	0.59%	+142
Urban	0	0.00%	38	0.16%	+38

Estimates of current ponderosa pine cover range from 4.6% to 9.1% of the subbasin. Either estimate is less than that historically present. Loss has resulted from timber harvest, conversion to agriculture, and encroachment by Douglas-fir and other conifers following fire suppression. Ponderosa pine habitat is very important for three wildlife focal species: flammulated owl, white-headed woodpecker, and black-backed woodpecker (Nez Perce National Forest 1998, Groves et al. 1997b, Marshall et al. 1996).

The Engelmann spruce and subalpine fir cover type occurs on 8.8% of the subbasin (Table 31). This is similar to what was available historically. This kind of habitat exists in colder and higher elevation portions of the subbasin (Cooper et al. 1991). Lynx utilize Engelmann spruce and subalpine fir habitat, requiring a matrix of young and old stands to provide denning and foraging habitat (Nez Perce National Forest 1998).

Whitebark pine communities historically covered 2% of the subbasin, but today cover roughly 0.10-0.15% (Table 31). Tomback et al. (2001) estimate that a 45% decline in whitebark pine cover has occurred in the last 100 years in the interior Columbia River Basin and the Bob Marshall Wilderness Complex. They blame the combination of fire exclusion, blister rust, mountain pine beetles, and succession for the cover decline.

Lodgepole pine habitat is found at middle and high elevation sites in the subbasin. Available lodgepole pine habitat has decreased from 14.6% historically to 8.6% of the subbasin currently (Table 31). Old growth lodgepole pine stands provide habitat for black-backed woodpeckers (Nez Perce National Forest 1998). Early seral stands containing lodgepole pine provide foraging habitat for lynx (Nez Perce National Forest 1998).

Mountain hemlock habitat currently occupies 0.6% of the subbasin. ICBEMP did not recognize it as an historical habitat (Table 31). This type of habitat occurs in high elevation, subalpine environments in portions of the subbasin north of the southern part of the Middle Fork Clearwater watershed (Cooper et al. 1991).

Native bunchgrass habitat historically covered 15.7% of the subbasin (Table 31). Today, little of this habitat remains. Native bunchgrass habitat has decreased the most in area of the 11 habitat groups. Estimates of native grassland cover range from 0.3% to 4.0% of the subbasin. Remnant grasslands are often small in size, and the GAP current cover of 4.0% is likely more accurate than ICBEMP's coarse-scale estimate, although neither database is well suited for examining small areas. Native bunchgrass communities provide habitat for two focal plant species: Jessica's aster (*Aster jessicae*), and Palouse goldenweed (*Haplopappus liatriformis*). The proposed threatened plant Spalding's catchfly (*Silene spaldingii*) also inhabits these habitats. Rocky Mountain bighorn sheep, bison and sharp-tailed grouse historically inhabited grassland habitat.

Both GAP and ICBEMP identify an agricultural cover class occupying the second largest amount of area in the subbasin. The GAP agriculture cover type covers 10.2% of the subbasin (Table 30) and the ICBEMP cropland/hay/pasture cover type covers 18.7% of the subbasin (Table 31). Much land currently in agricultural cover types previously was in the native bunchgrass cover type. Some wildlife species inhabit agricultural areas. One terrestrial focal species, the western toad, is able to inhabit agricultural areas so long as they contain a water source such as an irrigation canal (Csuti et al. 1997).

Riparian and wetland habitat is important for many wildlife species. The ICBEMP data shows a decrease in wetland habitat from 2.36% of the subbasin historically to 0.04% of the subbasin currently (Table 31). The finer scale GAP data, though, shows slightly less than 2% current wetland or riparian cover. Wetlands are an essential component of habitat for two terrestrial focal species—the western toad and the Coeur d'Alene salamander. Open wetland areas provided habitat for an extirpated species, the sandhill crane.

The regeneration cover class historically covered 0.8% of the subbasin; today it covers 10.6% of the subbasin (Figure 47). Regeneration habitat provides forage for wildlife species. Early seral communities and shrubfields provide forage areas required by elk. Regenerating forests with abundant forage also can provide habitat for prey species like snowshoe hare. Predators, like lynx, use young seral stands as hunting habitat.

5.3 Disturbance & Successional Processes

The Clearwater and Nez Perce National Forests are "clearly the regional focus of lightning fires" both in number per unit area and annual area burned," at a rate two to ten times greater than on adjacent forested land (Cooper et al. 1991). Extensive fires occurred in 1889, 1910 (990,000 acres burned on the Clearwater and Nez Perce National Forests), 1919, 1926, and 1934 (Figure 48). Natural (lightning-caused) fires are a primary factor perpetuating natural forest ecosystems and landscape diversity in the Clearwater subbasin (Cooper et al. 1991). Planned and unplanned burning by Native Americans had an extensive impact on maintaining stand composition and structure. The high frequencies in some of the fire-scar samples may have resulted from Indian caused fires (Barrett and Arno 1982 *in* Cooper et al. 1991). Prospectors and settlers also set fires to expose mineral outcrops (Space 1964 in Cooper et al. 1991) and improve range. Field sampling has revealed that only wet sites or unproductive, high-elevation sites occasionally lacked fire evidence (Cooper et al. 1991).

Fire-free intervals can be inferred to some extent by climax tree series and habitat type. *Pinus ponderosa-Pseudotsuga menziesii*/bunchgrass types have a mean fire-free interval of six years compared to *Abies lasiocarpa* habitat types with an interval of over 40 years (Arno and Peterson 1983 in Cooper et al. 1991). The *Tsuga-Thuja* zone, *A. lasiocarpa* habitat types have fire-free intervals of over 250 years. The longest fire-free intervals are 400 to 500 years (Daubenmire and Daubenmire 1984). Modern fire suppression has, however, resulted in plant communities that have greater biomass and less vigorous vegetative growth, with increased susceptibility to pathogens and wildfires of greater severity and size (Johnson 1998).

Years of fire suppression in forested areas, and changes in vegetative composition of grassland areas in the subbasin have resulted in dramatically altered fire regimes (Figure 49). There has been a significant reduction in the extent of the nonlethal and mixed fire regimes. These fire regimes maintained late seral single layer types by thinning shade tolerant tree species in early, mid, and late seral multi layer types. Reductions in fire frequency have increased fuel loads and resulted in hotter burning more intense fires and a shift from nonlethal to lethal fire regimes in many areas (Quigley and Arbelbide 1997).

Successional processes following wildfire and logging have been described for some northern Idaho habitat types (Lyon and Stickney 1976, Arno et al. 1985, Green and Jensen 1991). In general, the composition of postdisturbance plant communities is dependant on environmental site conditions, existing vegetation, severity of disturbance, life history characteristics of individual species, and to some degree chance (Morgan and Neuenschwander 1984). Research by Lyon and Stickney (1976) has shown that immediately following a fire, forest plant communities were composed largely of species present prior to the event. Even five years postdisturbance, species composition was 80% similar to the prefire community, and all species had established during the first year. This suggests that many local plant species are well adapted to surviving and propagating after fires.

The most abundant trees in the Clearwater subbasin are seral species adapted to periodic fire disturbance. Adaptations to fire include thick, corky, fire resistant bark (*Larix occidentalis, Pinus ponderosa, Pseudotsuga menziesii*), light or winged seeds (*L. occidentalis, Pinus ponderosa, P. menziesii, P. monticola*), serotinous cones (*Pinus contorta*), and rapid initial height growth (Cooper et al. 1991). As evidenced by even-aged stand structure, a considerable amount of viable seed survives even catastrophic fires.

Successional processes in riparian areas, shrub fields, and grasslands have been less well studied than in the coniferous forest types of the subbasin. Fire is a common occurrence within low elevation grasslands and shrub fields. Within bluebunch wheatgrass communities, light to moderate fires can enhance cover of wheatgrass but severe fires can be detrimental to bunchgrass survival (Johnson 1998). Cheatgrass and other annual grasses can increase following severe fires in the wheatgrass zone. The timing and intensity of livestock grazing can also influence the composition of successional plant communities following disturbance. Idaho fescue is more sensitive to damage from fire than some other native bunchgrasses (Johnson 1998). Even moderate fires can result in significant decreases in Idaho fescue coverage for several years following the event.

Shrubland plant communities vary widely in their response to fire. Dryland shrub communities like ninebark often respond favorably to moderate fires (Johnson 1998) due to their ability to resprout from root crowns (Lyon and Stickney 1976). Vigorous re-growth following fire can create highly palatable forage for elk, deer, rabbits, and other browsers.

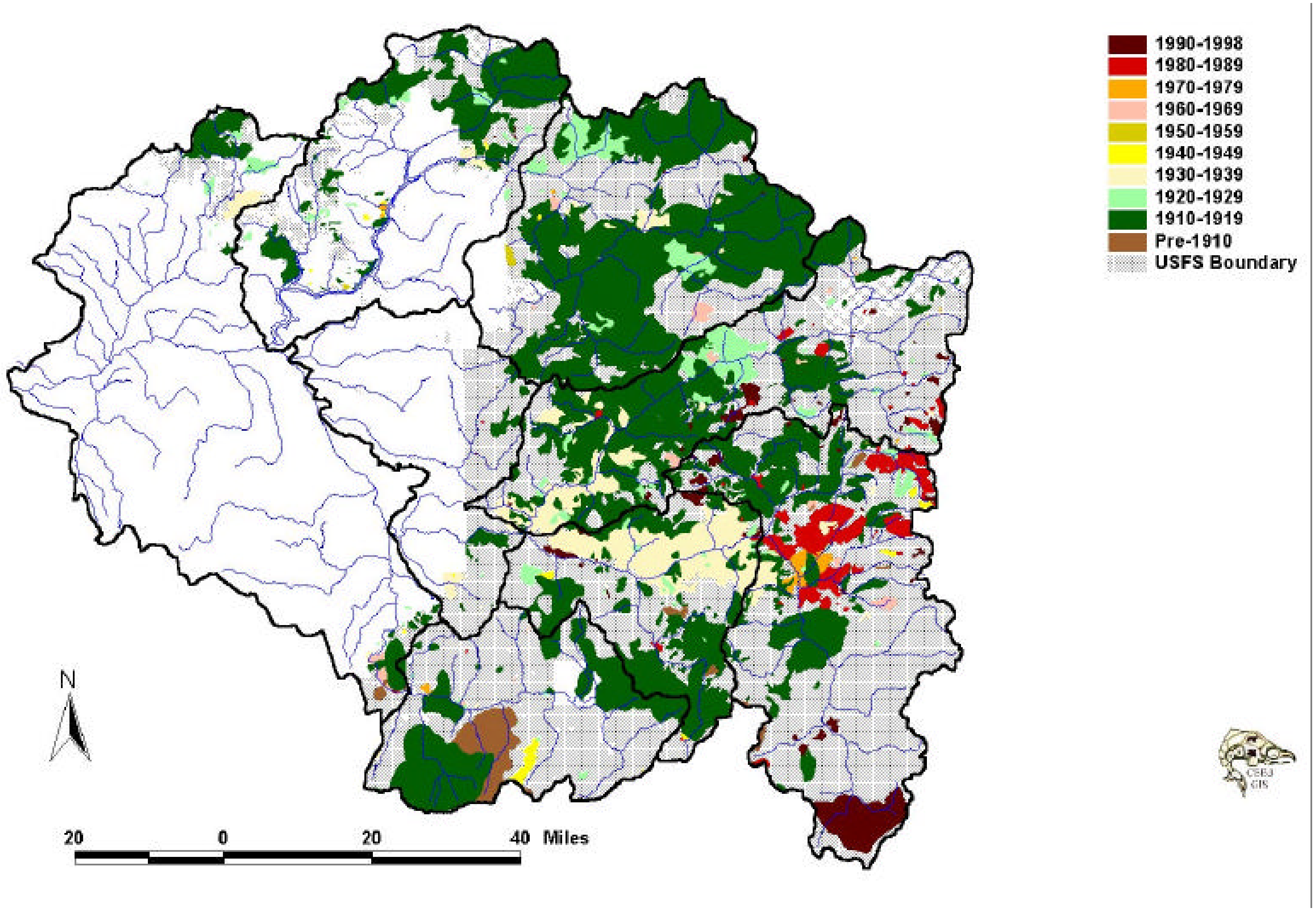

Figure 48. Decadal fire history of USFS lands within the Clearwater subbasin. Decadal information is stacked on the map, resulting in only the most recent burn period being shown

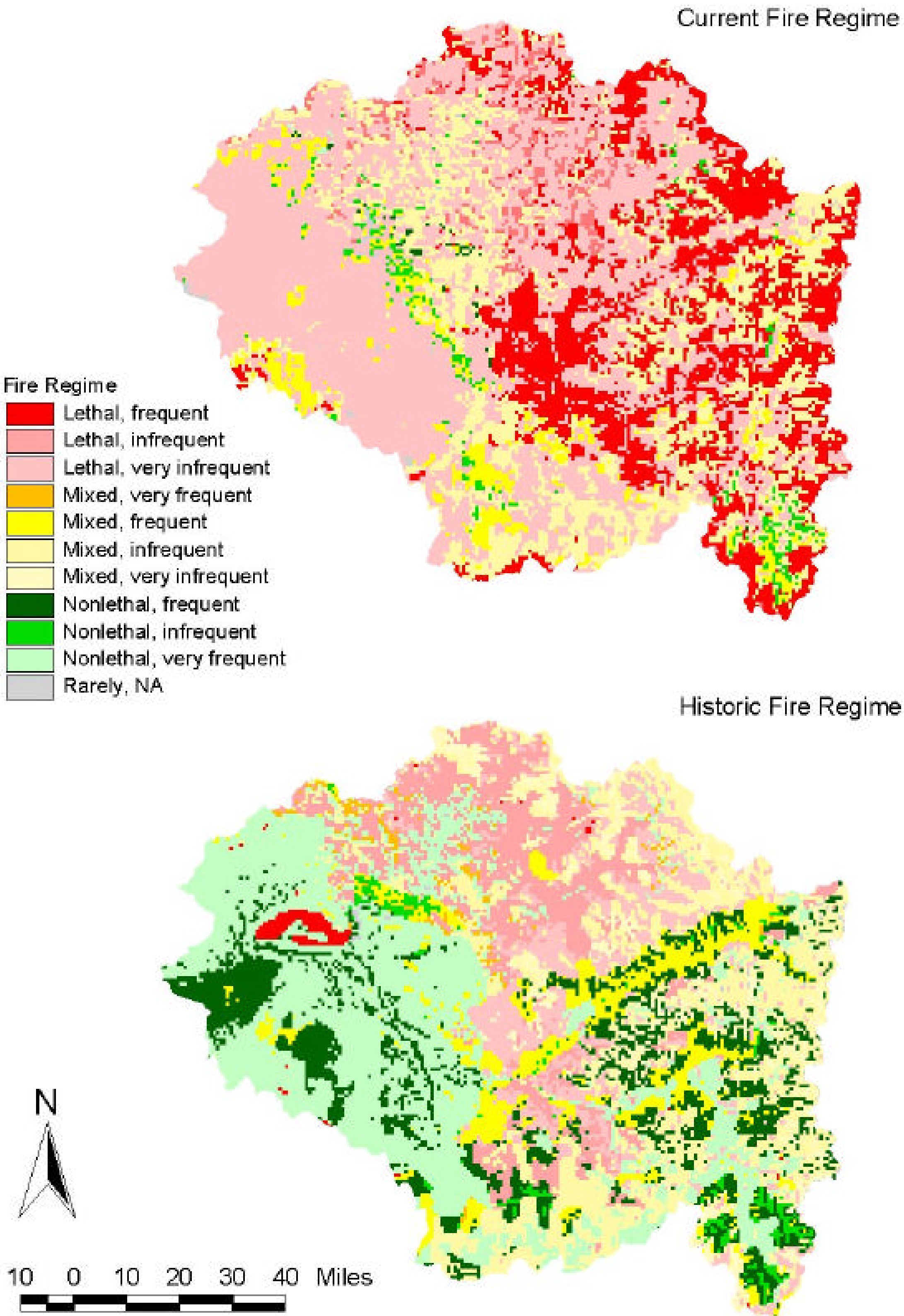

Figure 49. Historic and current fire regimes in the Clearwater subbasin (ICBEMP data)

Table 32. Tree species characteristics and tolerance to fire (Fischer and Bradley 1987)

Species	Bark Thickness of old trees	Root Habit	Resin in old bark	Branch habit	Stand habit	Relative inflammability of foliage	Lichen growth	Degree of fire resistance
Western Larch	Very thick	Deep	Very little	High and very open	Open	Low	Medium to heavy	Most resistant
Ponderosa Pine	Very thick	Deep	Abundant	Moderately high and open	Open	Medium	Medium to light	Very resistant
Douglas-fir	Very thick	Deep	Moderate	Moderately low and dense	Moderate to dense	High	Heavy medium	Very resistant
Grand Fir	Thick	Shallow	Very little	Low and dense	Dense	High	Heavy medium	Medium
Lodgepole Pine	Very thin	Deep	Abundant	Moderately high and open	Open	Medium	Light	Medium
Western White Pine (also Whitebark Pine)	Medium	Medium	Abundant	High and dense	Dense	Medium	Heavy	Medium
Western Red Cedar	Thin	Shallow	Very little	Moderately low and dense	Dense	High	Heavy	Medium
Engelmann Spruce	Thin	Shallow	Moderate	Low and dense	Dense	Medium	Heavy	Low
Mountain Hemlock	Medium	Medium	Very little	Low and dense	Dense	High	Medium to heavy	Low
Western Hemlock	Medium	Shallow	Very little	Low and dense	Dense	High	Heavy	Low
Supalpine Fir	Very thin	Shallow	Moderate	Very low and dense	Moderate to dense	High	Medium to heavy	Very low

Idaho fescue associated with ninebark communities, however, often responds poorly following fire because the greater fuel loads in shrub fields result in hotter, longer duration fires that damage or kill the plants (Johnson 1998).

Shrub species that respond poorly to fire include big sagebrush and mountain mahogany. Both of these species are often killed by even moderate fires, although mountain mahogany seed germination increases following light fires (Johnson 1998). These shrub species are relatively minor components within the Clearwater subbasin.

5.4 Noxious Weeds

The introduction of nonnative plant and animal species to the Clearwater subbasin has reduced the its ability to support native wildlife and plant species. Introduced plants in the subbasin often outcompete native plant species and alter ecological processes, reducing habitat suitability (Quigley and Arbelbide 1997). Introduced plant species reduce wildlife habitat suitability. Spotted knapweed infested range in Montana was used by elk 98% less frequently than an adjacent uninfested area (Sheley and Petroff 1999). Because it completes its growth and dries early in the season, cheatgrass provides less nutrition to herbivorous wildlife species than native species (Quigley and Arbelbide 1997). Eurasian watermilfoil (*Myriophyllum spicatum*) is the only plant on Idaho's Noxious Weed List not yet identified in the Clearwater subbasin. However, since this perennial aquatic grows from 4-12" per day and tolerates large variations in environmental conditions, it has the potential to severely impact the subbasin's waterways (Daniel 2001).

Noxious weeds have infested grasslands and transportation corridors in the subbasin and negatively impacted plant and animal biodiversity, natural ecological processes (fire, hydrology, soil development), and the quality and availability of livestock and wildlife forage (Olson 1999). They may also invade riparian areas, competing with desirable vegetation. The Idaho's Oneplan web site (2001) was used to summarize the distribution of noxious weed species by county throughout the Clearwater subbasin (Table 33).

Table 33. Noxious weeds documented to occur in counties that are wholly or partly in the Clearwater subbasin (Idaho OnePlan 2001, Clearwater Weed Management Group 1999).

Scientific Name	Common Name	Clearwater	Idaho	Latah	Lewis	Nez Perce	Shoshone
Aegilops cylindrica	Jointed Goatgrass			X			
Ambrosia tomentosa	Skeletonleaf Bursage					X	
Cardaria draba	Hoary Cress	X	X	X	X	X	
Carduus nutans	Musk Thistle		X			X	X
Centaurea diffusa	Diffuse Knapweed	X	X	X		X	X
Centaurea maculosa	Spotted Knapweed	X	X	X	X	X	X
Centaurea pratensis	Meadow Knapweed	X		X			
Cenaturea repens	Russian Knapweed		X	X	X	X	
Centaurea solstitialis	Yellow Starthistle	X	X	X	X	X	
Chondrilla juncea	Rush Skeletonweed	X	X	X		X	X
Cirsium arvense	Canada Thistle	X	X	X	X	X	X
Conium maculatum	Poison Hemlock	X	X	X		X	
Convolvulus arvensis	Field Bindweed		X	X		X	
Crupina vulgaris	Common Crupina	X	X		X	X	
Cytisus scoparius	Scotch Broom		X	X			X
Euphorbia dentata	Toothed Spurge		X				
Euphorbia esula	Leafy Spurge	X	X	X	X	X	
Hieracium aurantiacum	Orange Hawkweed	X	X	X	X		X
Hieracium pratense	Meadow Hawkweed	X	X	X			X
Hyoscyamus niger	Black Henbane			X		X	
Isatis tinctoria	Dyer's Woad		X				
Lepidium latifolium	Perennial Pepperweed					X	
Linaria dalmatica	Dalmatian Toadflax	X	X	X	X	X	X
Linaria vulgaris	Yellow Toadflax	X	X	X	X	X	X
Lythrum salicaria	Purple Loosestrife	X	X	X			
Milium vernale	Spring Millet Grass		X	X			
Nardus stricta	Matgrass			X			
Onopordum acanthium	Scotch Thistle	X	X	X	X	X	X
Senecio jacobaea	Tansy Ragwort		X				
Solanum elaeagnifolium	Silverleaf Nightshade		X				
Solanum rostratum	Buffalobur	X	X	X		X	
Sonchus arvensis	Perennial Sowthistle					X	X
Sorghum halepense	Johnsongrass		X				
Tribulus terrestris	Puncturevine		X	X		X	
Zygophyllum fabago	Syrian Beancaper					X	

Weed management goals within the Clearwater subbasin are to prevent introduction, reproduction and spread of noxious weeds. Priority standards have been established to eradicate, control, contain, or reduce noxious weeds while at the same time preventing establishment of potential invaders.

The most pronounced problems occur in lower elevation dry sites where Eurasian invaders have become well established. Some of the more common invaders are cheatgrass, yellow starthistle, spotted knapweed (*Centaurea maculosa*), and common crupina (*Crupina vulgaris*). New invaders include rush skeleton weed (*Chondrilla juncea*), orange hawkweed (*Hieracium auratiacum*), and meadow hawkweed (*Hieracium pratense*). The majority of the noxious weed infestations in the Clearwater subbasin occur in localized patches; two notable exceptions are yellow starthistle and spotted knapweed. Both of these invader species are native exotic plants from the Mediterranean that have thrived in the subbasin due to similarities in climate between the two locations (Quigley and Arbelbide 1997). Current biology and status of the five top noxious weeds in the subbasin are detailed below. These species were selected because of their extremely aggressive habits, extent of infestation, and potential to disrupt ecological integrity of local plant communities (C. Kuykendal, Nez Perce Bio-control Center, personal communication, 2001).

Yellow starthistle is particularly problematic. It will invade overgrazed ranges, abandoned fields, rights-of-ways, and waste areas. It spreads exclusively by seed, which may lie dormant for as long as ten years. Yellow starthistle will grow wherever cheatgrass grows and causes chewing disease and death in horses (Hastings and DiTomaso 1996). Yellow starthistle is widely scattered throughout the U.S., but is a severe problem only in the west. In Idaho, populations have existed for several years south of Lewiston, but recently infestations have been found as far north as Coeur d'Alene. In the Clearwater River drainage, this weed forms near monocultures for thousands of acres (Figure 50). It is very uncommon on Forest Service lands but occasional plants have shown up along Highway 12 and on the Palouse Ranger District. Current estimates suggest that 500,000 acres of starthistle occur in Idaho with the largest infestation centered around Clearwater, Latah, Idaho, Lewis and Nez Perce Counties; the heart of the Clearwater subbasin (Jette et al. 1999). There are 870 square kilometers (214,756 acres) of this noxious weed currently infesting the Clearwater subbasin (Clearwater Weed Management Group 1999). Despite control efforts, yellow starthistle continues to expand at an estimated rate of 6% per year (Jette et al. 1999).

Spotted knapweed, a native to Europe, is now widely distributed in North America. It was introduced as a contaminant of alfalfa and clover seed, and in many areas of the west it ranks as the number one weed problem. In Idaho, it has a wide environmental range and moderate shade tolerance. Each plant can produce up 25,000 seeds that are dispersed by wind, animals and people. The seeds remain viable for eight years. As this species spreads, it causes a drastic reduction in native plant communities. Infected areas often form monocultures. Some evidence exists that knapweeds release chemical substances that inhibit surrounding vegetation. Knapweeds readily establish themselves on any disturbed soil, and their early spring growth makes them competitive for soil moisture and nutrients. The flowering period extends from June to October. The estimated areal extent of spotted knapweeds is 35 square kilometers (Figure 51; Clearwater National Forest 2001).

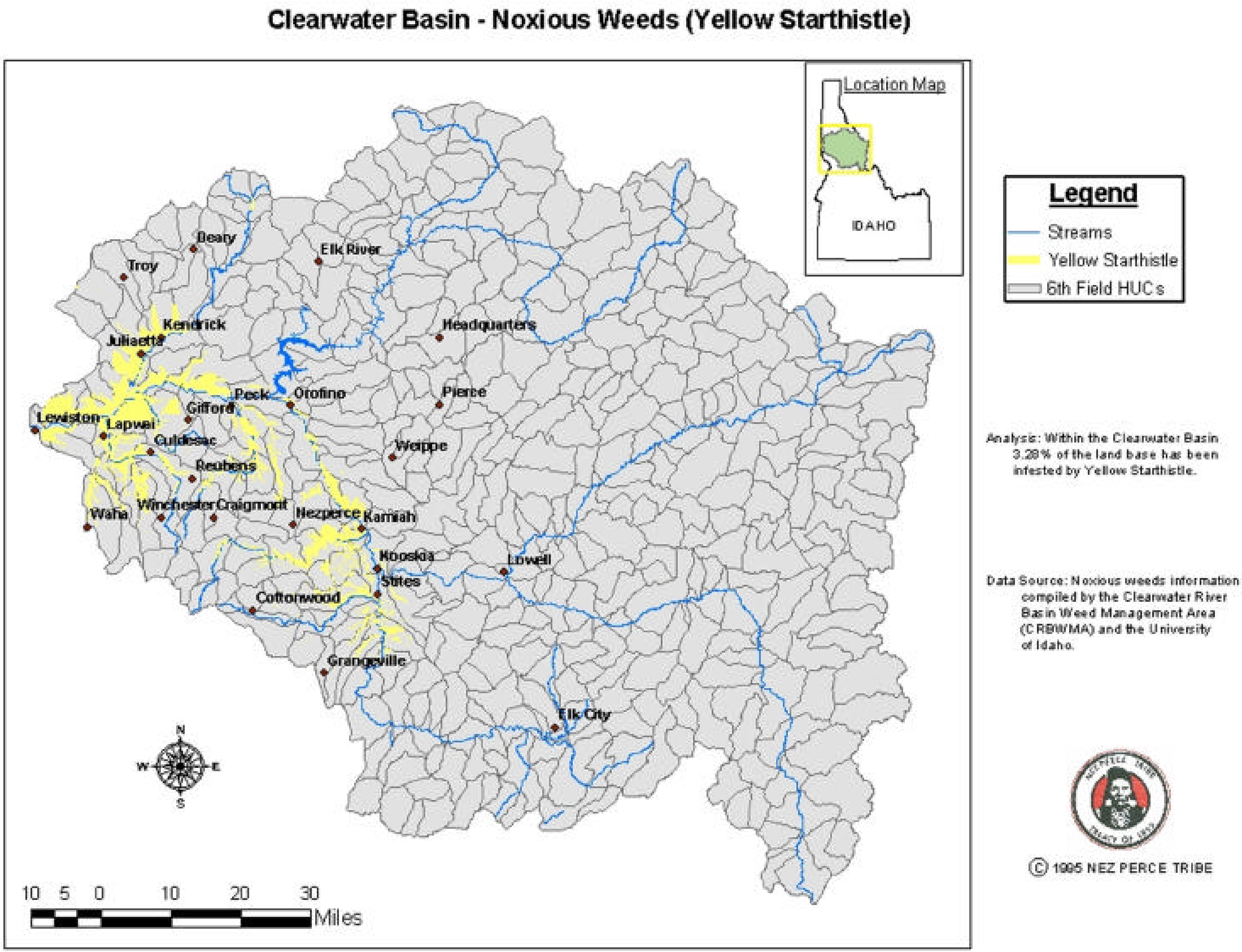

Figure 50 Yellow starthistle distribution within the Clearwater subbasin

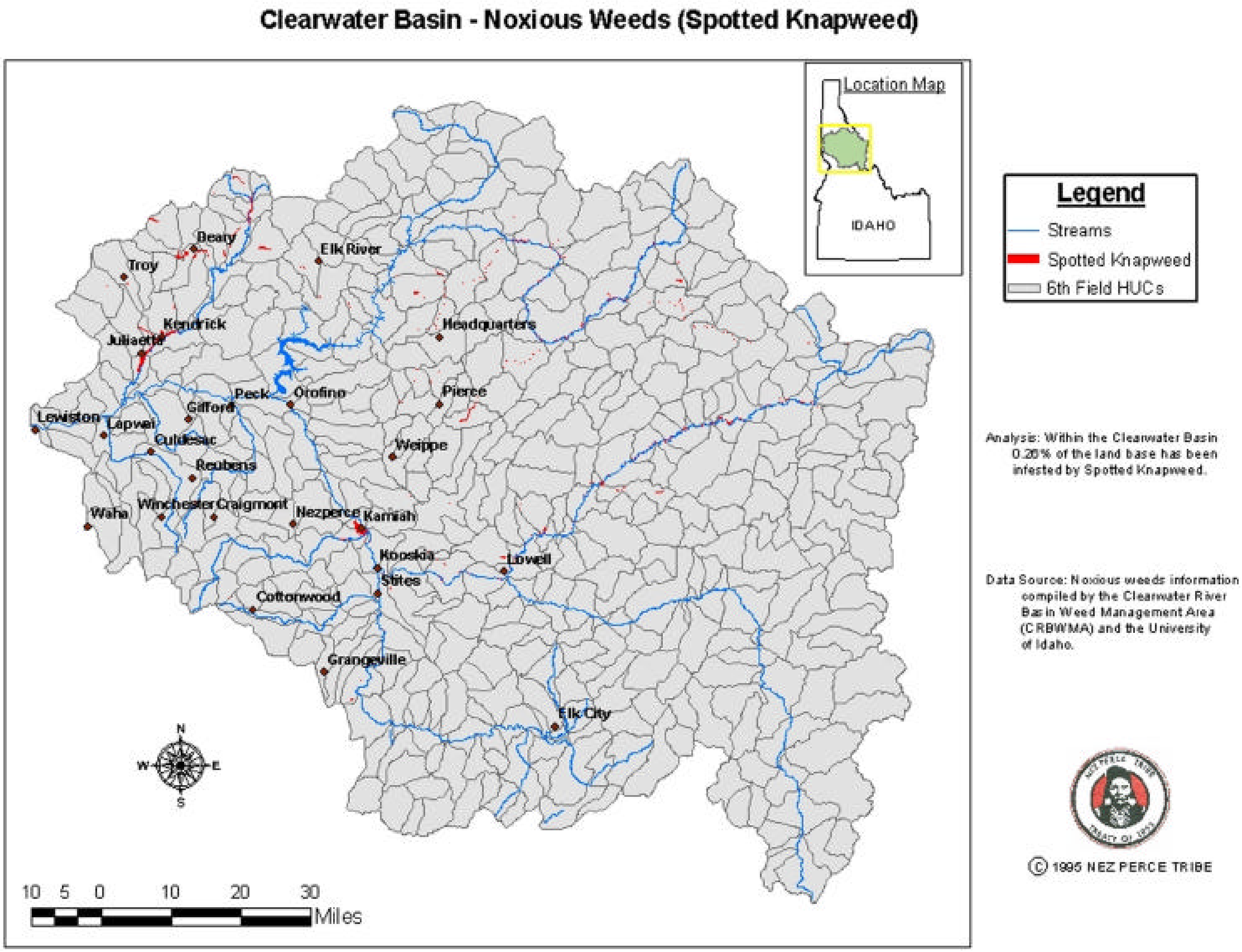

Figure 51. Spotted knapweed distribution within the Clearwater subbasin

Rush skeletonweed (*Chondrilla juncea*) generally prefers well-drained, light soils. The plant spreads primarily by seed, but roots scattered by cultivation can aid in spread. Typical sites include roadsides, railroad beds, logged areas, woodcutting areas, rangeland, grain fields, and pastures. The extensive, deep root system makes skeletonweed difficult to control. Flowering and seed production occur from mid-July through frost. This weed infests several millions of acres in the Pacific Northwest and California, and approximately 3 million acres in Idaho. Rush skeletonweed is not widespread in the Clearwater subbasin (Figure 52), but populations are increasing. It inhabits nearly 500 acres (2 square kilometers), with the bulk of the populations in Latah County (Clearwater National Forest 2001).

Orange hawkweed (*Hieracium auratiacum*) and Meadow Hawkweed (*Hieracium pratense*) spread by seeds, stolons, and rhizomes, and can invade many different habitats, including urban sites, meadows, pasture, hay fields, roadsides, tree plantations and riparian areas. Both invasive weeds form extensive mats that practically eliminate other vegetation. Distribution of orange hawkweed has likely been assisted by flower enthusiasts due to its attractive flowers. Several small outbreaks have occurred on the Clearwater National Forest, almost all along roads (Figure 53). Meadow hawkweed first appeared in Benewah County and rapidly spread to all north Idaho counties. It spread south to the Clearwater National Forest, where it has become widespread in just a few years. Orange hawkweed's distribution range is estimated to be around 8080 acres (33 square kilometers; Clearwater National Forest 2001).

Although not officially recognized as a "noxious" weed, cheatgrass has had a significant impact on the ecological integrity of the canyon grassland ecosystem within the Clearwater subbasin. It quickly invades after disturbance, and once established can outcompete native species. It has some value as forage for wintering big game species (it is often green and palatable when native species are still dormant in early spring) it provides poor forage during mid- to late summer and is an unreliable source of food during drought years (Roberts 1991). It often precedes other invasive species such as yellow starthistle and rush skeletonweed. It can alter fire regimes because its fine textured leaves provide fuel for larger, more frequent fires (Mosley et al. 1999). Shorter fire return intervals in cheatgrass dominated sites can negatively impact other more desirable grasses, forbs and shrubs. No biocontrol agents are available for the species and control options are limited.

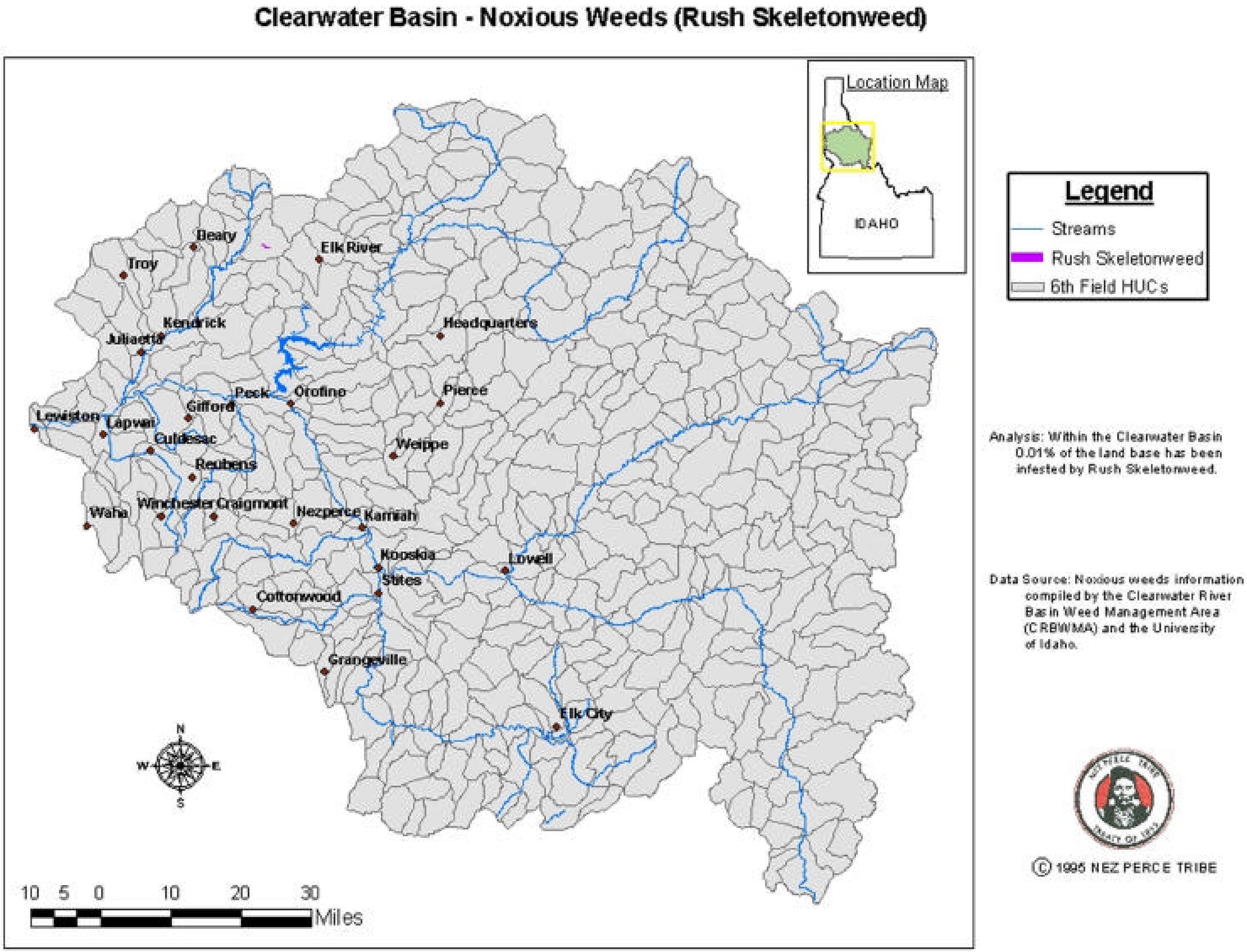

Figure 52. Rush skeletonweed distribution within the Clearwater subbasin

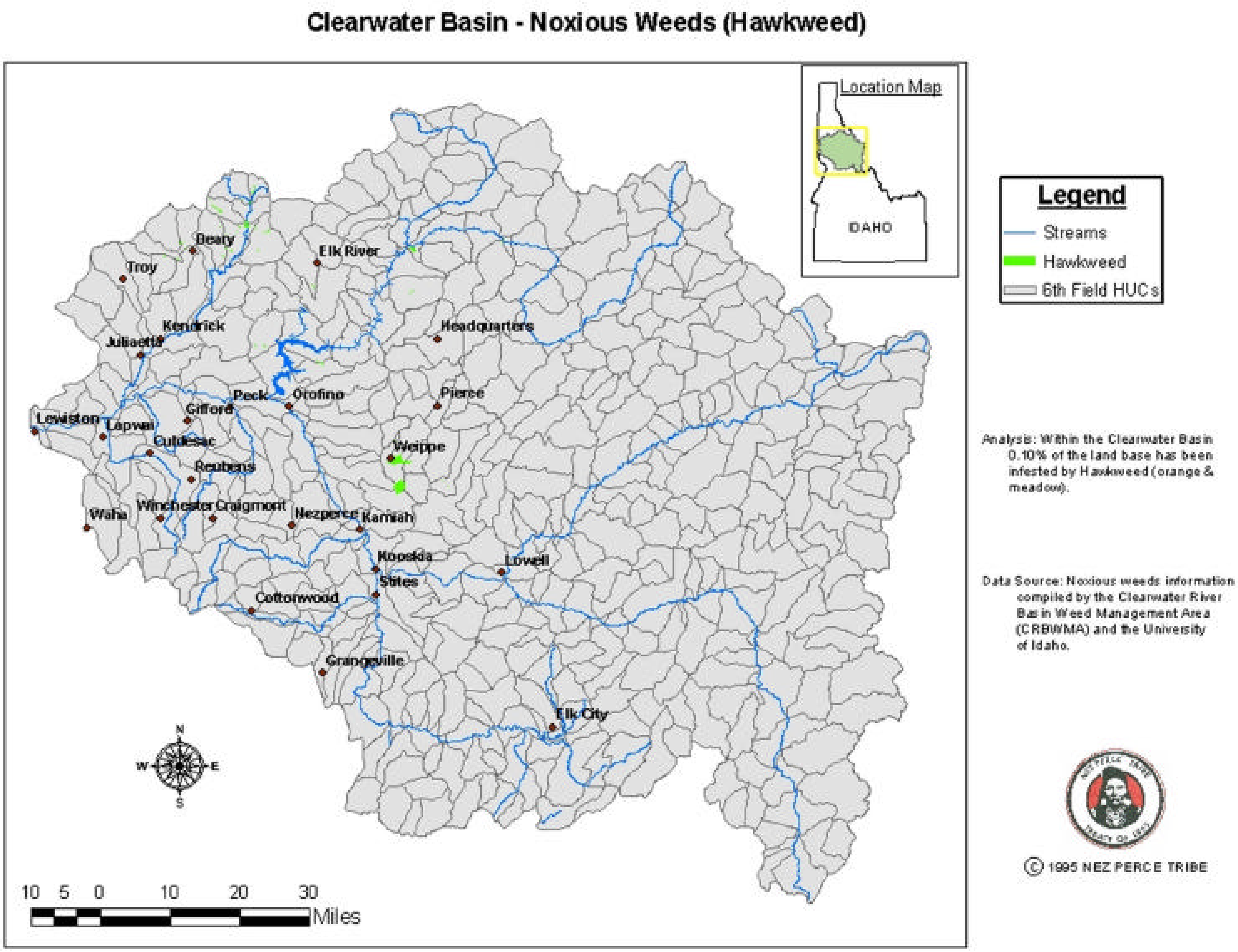

Figure 53. Meadow and orange hawkweed distribution within the Clearwater subbasin

5.5 Cover Types

Vegetation type descriptions are based on *Forest Habitat Types of Northern Idaho: A Second Approximation* by Cooper, Neiman, and Roberts (1991) and on *Plant Associations of the Wallowa-Snake Province* by Johnson and Simon (1987). Spatial representation of cover types utilized the Idaho GAP2 data. To facilitate discussion GAP2 codes have been grouped into cover types based on similar vegetative composition (Table 34). Square kilometers of each cover type within the AUs is displayed in Table 34; refer to Appendix C for acreage in 4th, 5th and 6th HUCs.

5.5.1 Western Hemlock

Physical Description

Tsuga heterophylla has a long slender trunk, frequently becoming fluted when large, and a short, narrow crown of slightly drooping or horizontal branches (Tesky 1992c). Even on large trees, the bark is thin (1 to 1.5 inches [0.39-0.59 cm]). Young trees have scaly bark, old trees have hard bark with furrows separating wide flat ridges. *Tsuga heterophylla* lacks a taproot; roots are shallow and commonly most abundant near the surface. Maximum ages are typically between 400 and 500 years; the maximum age recorded is over 700 years. Diameters of old growth trees can exceed 3.3 feet (100 cm); the maximum is 9 feet (275 cm; Tesky 1992c). Height is typically 160 to 200 feet (49-61 m), though trees up to 259 feet have been reported.

Ecology and Distribution

Tsuga heterophylla is extremely shade tolerant; *Taxus brevifolia* (Pacific yew) is the only other species in the Clearwater subbasin with equal or greater tolerance of shade (Tesky 1992c). *Tsuga heterophylla* is a climax species either alone or in association with other shade tolerant species; it occurs in all stages of succession. Shade tolerance allows this species to invade later seral stages of forest succession. Fast growth in full overhead light and the ability to survive on diverse seedbed conditions make *T. heterophylla* an aggressive pioneer species. If no major disturbances occur over several hundred years, a climax of self-perpetuating, virtually pure *T. heterophylla* can result. *Tsuga heterophylla* rarely replaces *T. plicata* completely; a *Tsuga-Thuja* climax will slowly replace *Pinus monticola* stands. *Tsuga heterophylla* occurs as a dominant or codominant on low- to mid-elevation moist, moderate temperature sites within the maritime influenced climatic zone of the northern Rocky Mountains (Tesky 1992c; Cooper et al. 1991).

In the Clearwater subbasin, *T. heterophylla* occurs north of the North Fork Clearwater River and in the Potlatch River drainage (Figure 54). *Tsuga heterophylla* has the most restrictive environmental requirements of northern Idaho conifers; it grows in areas with a mean annual precipitation greater than 30", is shade tolerant, intolerant of drought or excessive moisture, and not very frost hardy. As a climax dominant, *T. heterophylla* can occur from 2,500 to 5,500 feet (760-1,680 m) on all sites except wet bottomlands where it is codominant with or replaced by *Thuja plicata* (western redcedar). At the lower ends of its elevational range, *T. heterophylla* is replaced by *T. plicata*; at the upper ends it is replaced by *Tsuga mertensiana* (mountain hemlock), or *Abies lasiocarpa* (subalpine fir). Based on GAP data, approximately 102 km^2 of the *T. heterophylla* cover type occurs in the Clearwater subbasin (Table 34).

Tsuga habitat type sites are highly productive (Cooper et al. 1991). Early to mid-seral stands have closed canopies and sparse undergrowth; old growth stands are open, two- or multi-storied. Major seral species include all endemic tree species except *T. mertensiana, Pinus albicaulis, P. ponderosa,* and *Larix lyallii*.

Table 34. Cover type distribution in square kilometers,Clearwater subbasin (based on Idaho GAP 2 data)

Cover Type	GAP2 Codes	South Fork AU	Lower Selway AU	Upper Selway AU	Lochsa AU	Lolo- Middle Fork AU	Upper North Fork AU	Lower North Fork AU	Lower Clearwater AU	Total Subbasin
Western Red Cedar/ Mixed Mesic Forest	4210, 4221, 4226, 4227	497.5	435.0	534.3	643.3	700.0	888.7	897.3	659.9	**5,256**
Douglas-fir/ Mixed Xeric Forest	4212, 4222, 4223, 4225	275.1	319.4	765.6	456.6	479.0	574.2	658.6	663.3	**4,192**
Agricultural	2000	0.0	0.0	0.0	0.0	53.4	0.0	6.5	2,365.6	**2,426**
Subalpine fir/ Englemann Spruce	4201, 4208, 4218, 4220	308.8	242.3	702.1	571.7	16.0	327.7	179.2	1.2	**2,349**
Shrubs	3202, 3301, 3305, 3306, 3307, 3308, 3312	63.6	157.0	108.4	279.3	152.1	541.4	251.4	282.1	**1,835**
Lodgepole pine	4203	254.2	131.4	423.2	407.9	22.3	280.1	79.1	32.6	**1,631**
Grand fir	4207	356.1	150.3	128.4	144.9	201.7	174.8	272.0	137.1	**1,565**
Ponderosa pine	4206	67.1	32.8	105.4	74.0	147.1	101.0	158.5	407.3	**1,093**
Native bunchgrasses	3101	21.3	14.2	46.2	11.8	121.6	26.9	93.3	554.2	**890**
Rock, snow and water	5000, 7300, 7800, 7900, 9100,	32.8	29.6	220.9	85.0	27.4	35.7	99.0	117.6	**648**
Western larch	4215, 4228, 4229	66.8	52.8	112.6	106.2	2.9	119.9	103.0	14.8	**579**
Mountain meadow	3104, 8100	41.5	41.9	151.9	85.4	8.9	69.1	44.0	44.2	**487**
Riparian non-forest	6201, 6202, 6203	14.2	13.6	11.2	22.3	24.9	29.7	24.2	79.0	**219**
Riparian forest	6101, 6102, 6103, 6104	15.7	11.5	19.2	16.7	18.9	21.7	36.0	48.4	**188**
Western Hemlock	4211	0.0	0.0	0.0	0.0	0.0	3.0	49.1	50.3	**102**
Aspen and conifer	4301	1.4	14.8	6.7	21.6	9.1	20.0	8.1	12.6	**94**
Exotic Forbs/ Annual grasses	3102	0.8	0.4	9.2	0.6	2.4	0.9	0.5	46.8	**62**
Cottonwood	4102	14.4	1.0	2.6	7.0	10.5	6.8	6.2	1.4	**50**
Whitebark pine	4217, 4219	3.7	3.5	21.2	10.1	0.0	3.1	0.0	0.0	**42**
Urban	1000	0.0	0.0	0.0	0.0	2.0	0.0	0.1	29.1	**31**
Burnt timber	4401	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	**2**

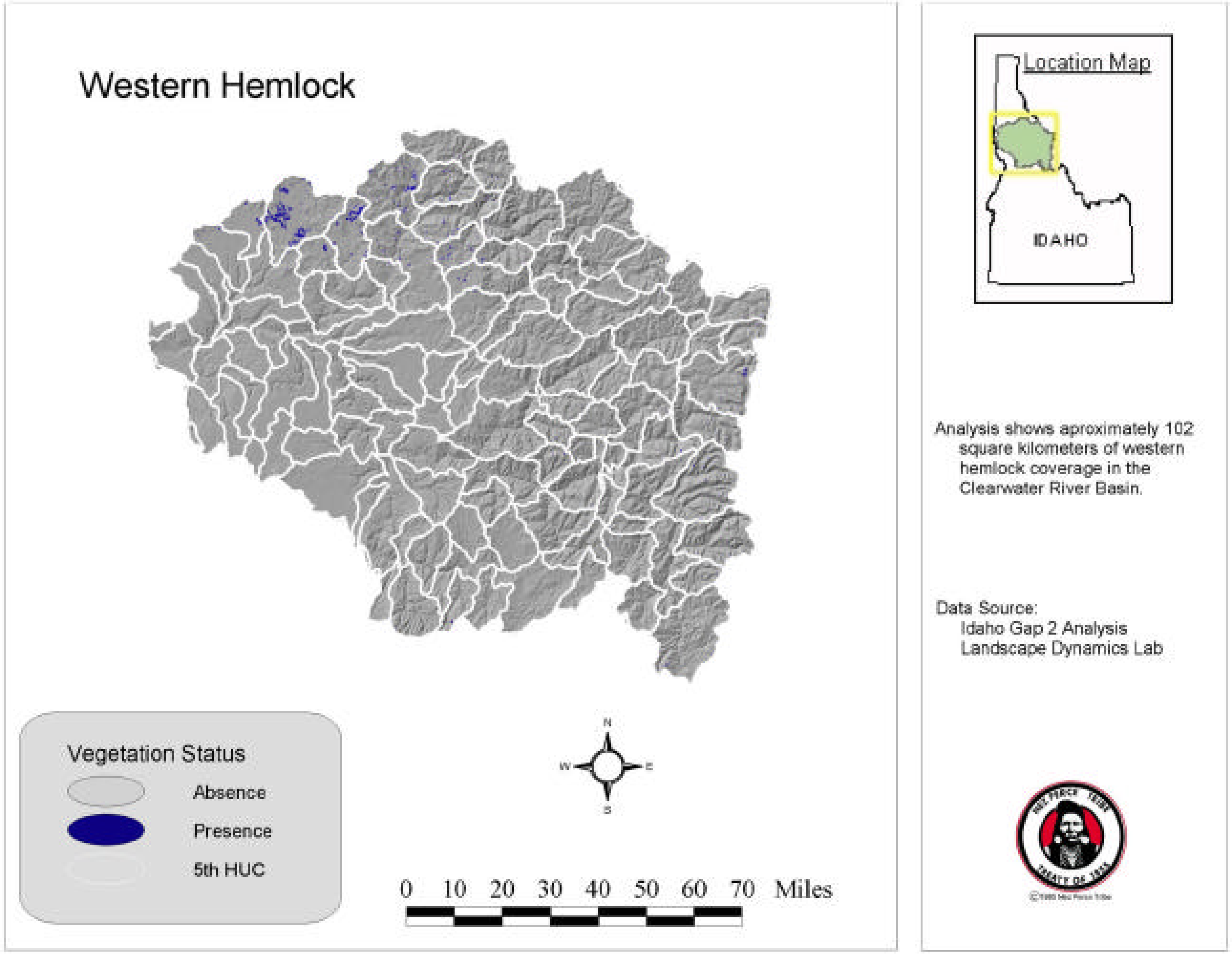

Figure 54. Distribution of the western hemlock cover type within the Clearwater subbasin

Undergrowth vegetation includes four major communities corresponding to a moisture gradient (wet to dry):

1. *Gymnocarpium dryopteris* (oak fern; widespread in the Coeur d'Alene National Forest)
2. *Asarum caudatum* (wild ginger; widely distributed in northern Idaho)
3. *Clintonia uniflora* (queencup beadlily; widely distributed in northern Idaho)
4. *Menziesia ferruginea* (false huckleberry; incidental, occurring above 5000 feet in Selkirk range in Bonner County)

Pachistima myrsinites (myrtle boxwood) occurs in all *T. heterophylla* habitat types along with *Oplopanax horridum* (devil's club), *Athyrium filix-femina* (ladyfern), *Adiantum pedatum* (maidenhair fern), *Coptis occidentalis* (western goldenthread), *Smilacina stellata* (false solomon's seal), *Disporum hookeri* (Hooker's fairybell), *Galium triflorum* (sweet scented bedstraw), and *Viola orbiculata* (round-leaved violet).

Wildlife and Cultural Values

Big game forage production is good in early seral stages, fair in mature stands, and poor in the closed canopy seral stages (Cooper et al. 1991). Stands with high coverages of shrubs (i.e., *T. brevifolia* (Pacific yew) and *Vaccinium globulare* (blue huckleberry)) provide significant habitat for moose, elk and grizzly bear. Old growth stands provide thermal and hiding cover for many wildlife species. In the southern Selkirk Mountains grizzly bear have been reported to use heavily timbered *T. heterophylla* forests (Layser 1978). *Tsuga heterophylla* also provides cavity-nesting birds (e.g., yellow-bellied sapsucker and northern three-toed woodpecker) with nest trees (McClelland 1980). Windthrow provides habitat for species such as goshawk prey species, that utilize downed woody debris.

Threats and Limiting Factors

Shallow roots, thin bark, highly flammable foliage, and a low branching form leave *T. heterophylla* very vulnerable to fire (Tesky 1992c). Dense stands of trees with lichen covered branches are even more susceptible to fire damage. Because *Tsuga* stands are commonly in cool mesic habitats, fire frequency tends to be low. In the Clearwater subbasin, the mean fire interval is 50 to 150 years, with highly variable fire intensity. Stands that occupy steep montaine slopes favor more intense burning and are thus more likely to be destroyed by stand replacing fires. Following any type of disturbance, tremendous regeneration occurs of *T. heterophylla*, *Abies grandis*, and *P. monticola* (Cooper et al. 1991). *Armillaria mellea*, *Heterobasidion annosum*, *Phaeolus schweinitzii*, *Laetiporus sulphureus*, *Inenotus tomentosus*, *Poria subacida*, *Phellinus weiri*, and *Echinodontium tinctorium* (Indian paint fungus) are the dominant root and butt pathogens of *T. heterophylla* (Tesky 1992c). *Arceuthobium campylopodum* (Dwarf mistletoe), a common parasite on *T. heterophylla*, causes mortality in old growth stands.

Lambdina fiscellaria lugubrosa (western hemlock looper), *Tetropium velutinum* (western larch borer), *Acleris gloverana* (western blackheaded budworm), *Melanolophia imitata* (green striped forest looper), *Ectropis crepuscularia* (saddleback looper), *Neodiprion tsugae* (hemlock sawfly), and *Steremnius carinatus* (a weevil), are the primary insects besetting *T. heterophylla* (Tesky 1992c). *Lambdina fiscellaria lugubrosa* causes more mortality of *T. heterophylla* than any other insect pest. Outbreaks on any single site can last two to three years.

Mortality caused by *L. f. lugubrosa* is highest in old growth stands; severe damage can also occur in vigorous 80 to 100 year old stands.

The roots, especially the fine roots, are most abundant near the soil surface and are easily damaged by harvesting equipment and fire. (Tesky 1992c). Top dieback is common on droughty sites, and in especially dry years, whole stands of *T. heterophylla* saplings may die (Tesky 1992c). Following thinning, seedlings and saplings are susceptible to sunscald. Sunscald lesions frequently become infected with decay organisms. Pole-sized and larger stands of western hemlock are prone to severe windthrow. Increased uprooting occurs on sites with an impenetrable soil layer or high water table that result in shallow rooted trees (Te sky 1992c).

5.5.2 Western Red Cedar

Physical Description

Thuja plicata is a prolific seed producer and long-lived (500-1,000 years). Typically, mature *T. plicata* are 70 to 100 feet tall though some reach heights of 130 feet (Tesky 1992a). Tapered trunks are two to four feet diameter, though some exceed six feet diameter.

Ecology and Distribution

Thuja plicata is one of the most shade tolerant species growing in Clearwater subbasin *Thuja-Tsuga* ecosystems (Tesky 1992a). Although typically considered a climax or near climax species, it occurs in all stages of forest succession. *Thuja plicata* invades disturbed sites as broadly distributed seeds; in undisturbed areas it regenerates vegetatively. Soil and moisture conditions strongly influence the successional status of *T. plicata*. In the Clearwater subbasin, *P. monticola* stands are slowly superseded by a *Tsuga-Thuja* climax.

Thuja plicata occurs as a riparian dominant on moist benches, toe slope seepages, and wet bottoms adjacent to streams (Tesky 1992a). *Thuja plicata* habitat types occur between 1500-5500'; this species grows best on toe slopes and bottomlands where soil moisture is high (Cooper et al. 1991). In terms of narrow environmental tolerances, *T. plicata* ranks second to *T. heterophylla*. *T. plicata* tolerates both higher and lower temperatures, excess soil moisture, and short summer drought; thus *T. plicata* dominates on both lower elevational *T. heterophylla* habitat types, and on upper elevation moist sites in the Clearwater subbasin. Wet sites co-dominated by *T. plicata* and *T. heterophylla* are classed within the *Thuja* habitat types. While *T. heterophylla* occurs as far south as the North Fork Clearwater drainage, *T. plicata* occurs as far south as the Selway drainage. There is a direct relationship between the areal extent of *Thuja* habitat types and *Pinus monticola* types in North Idaho; in the Clearwater subbasin, *P. monticola* is most common along moist creek bottoms, lower benches, and northerly slopes.

Psuedotsuga menziesii, *Abies grandis*, *Pinus monticola*, *Picea engelmannii*, and *Larix Occidentalis* are major seral species in *Thuja* habitat types (Cooper et al., 1991). *Abies grandis* and *P. engelmannii* may occur on higher elevation *Thuja* sites; sites with well drained soils may support P. *monticola*. Understory species include *Clintonia uniflora*, *Coptis Occidentalis*, *Smilacina stellata, Disporum hookeri, Galium triflorum* and *Viola obiculata*.

Cooper, et al. (1991) recognizes six different habitat types in the *T. plicata series*.

1. *Oplopanax horridium* (devil’s club; located in valley bottoms in moist conditions)
2. *Athyrium filix-femina* (lady fern; stream terraces, toe slopes, and lower slopes)
3. *Adiantum pedatum* (maidenhair fern; mostly found between St. Joe and Selway
4. Rivers)

5. *Gymnocarpium dryopteris* (oak fern; driest association; mostly found between St. Joe and Selway Rivers)
6. *Asarum caudatum* (wild ginger; common throughout northern Idaho)
7. *Clintonia uniflora* (queencup beadlily; most common habitat type)

Other species most always present in mature *T. plicata* stands are *Coptis occidentalis* (western goldenthread), *Smilacina stellata* (false solomon's seal), *Disporum hookeri* (Hooker's fairybell), *Galium triflorum* (sweet scented bedstraw), and *Viola orbiculata* (round-leaved violet).

A moist, warm variant of the *T. plicata/Oplopanax horridum* (western redcedar/devil's club) habitat type occurs on the north end of Dworshak Reservoir and up the North Fork Clearwater River to Isabella Creek in a coastal disjunct area (Steele 1971 *in* Cooper et al. 1991). *Thuja plicata* and *T. heterophylla* are the major seral and climax species (alone or as co-dominants) on these sites. *T. plicata/Adiantum pedatum* (western redcedar/maidenhair fern) habitat types in this area also support disjunct, relict populations of coastal plant species due to the persistent locally intensified expression of a maritime environment.

Wildlife and Cultural Values

Thuja plicata habitat types provide high value wildlife habitat in terms of food, cover and water. Ungulates eat *Oplopanax* leaves and flower heads in late summer and fall; sites with *T. brevifolia* have very high values for big game year-round, especially moose. Big game, snowshoe hares and livestock have been reported to eat significant quantities of *Thuja* reproduction (Cooper et al. 1991). Minore (1983) reported that *Thuja* foliage made up 5 percent of the total winter diet by weight analysis of 69 elk stomach samples from elk harvested along the lower Selway and Lochsa rivers between January 1 and April 1 from 1960 through 1970.

Old growth stands provide many species with dens in cavities in *T. plicata* (Tesky 1992a). Grizzly bears have been reported using heavily timbered *T. plicata* forests in the southern Selkirk Mountains; cavity-nesting birds (e.g., yellow-bellied sapsuckers, hairy woodpeckers, tree swallows, chestnut-backed chickadees, and Vaux's swifts) also use old growth *T. plicata* trees to nest in. Isolated old growth stands in the wetter habitat types provide valuable recreational and botanical interest sites as well.

Threats and Limiting Factors

Historically, fire was a major disturbance in drier *T. plicata* habitat types. Fire scarred trees are common in the Clearwater subbasin. *Thuja plicata* is less susceptible to fire than *T. heterophylla*, *P. engelmanni*, and *A. lasiocarpa*. Fire frequency of *T. plicata* stands tends to be low; at streamside and seepage sites the mean fire interval is greater than 200 years, while on lower and middle slopes it is 50 to 150 years (Tesky 1992a). *Thuja plicata* has a shallow root system, thin bark, highly flammable foliage, and low, dense branching habit, which make it vulnerable to fire damage (Tesky 1992a). However, because of its large size, *T. plicata* frequently survives fire if not completely girdled by fire (Fisher and Bradley 1987). Roots just under the duff layer are frequently scorched when the duff layer burns, which can lead to death. Fire injury to roots can result in fungal infection and chronic stress (Tesky 1992a). Common causes of fire mortality are crown scorching and root charring. Offsite wind dispersed seeds will readily establish on bare mineral soil seedbeds after fire.

Thuja plicata is a host for several insect species, including *Mayetiola thujae* (gall midge), *Steremnius carenatus* (weevils), *Phloeosinus sequoiae* (bark beetles), and *Trachykele* *blondeli* (western redcedar borer; Minore 1990). Over 200 fungi grow on *T. plicata*, often resulting in large hollow trees. *Didymascella thujina* (a leaf blight) infects second and third year nursery seedlings; up to 97 percent of natural *T. plicata* regeneration may die when this blight reaches epidemic proportion (rare in North America). *Poria asiatioa* and *Phellinus weiri* (root butt and trunk rots) are the most important fungi attacking *T. plicata*.

Thuja plicata is prone to windthrow on wet sites (Minore 1990). Logging in wetter *T. plicata* habitat types can cause considerable damage due to wet, highly compactible soils vunerable to mass wasting (Cooper et al., 1991). Extensive disturbance of bottomland sites may result in irreparable damage (Tesky 1992a). Downed woody material should not be removed because it serves as a seedbed for *Thuja* and *Tsuga* regeneration (Parker 1979 *in* Cooper et al. 1991). On drier *T. plicata* habitat sites, shrub and forb invasion after logging attracts large and small herbivores.

5.5.3 Mountain Hemlock

Physical Description

Open stands of *T. mertensiana* have strongly tapered trunks, slender branches drooping almost to the ground and a narrowly conical crown with a characteristic slender drooping leader (Tesky 1992b). In dense stands, trunks are less tapered; the crown is proportionally shorter, and near the ground the trunk is virtually clear of branches. The bark on young trees is rough and broken, and on old trees it is deeply creased into scaly plates. Roots are shallow and wide spreading.

Ecology and Distribution

Tsuga mertensiana is a shade tolerant dominant or co-dominant in subalpine or high elevation alpine forests, sometimes living to 800 years of age (Tesky 1992b). It often succeeds *P. contorta* when pioneering on drier sites and frequently replaces *P. engelmannii*. *Tsuga mertensiana* is very frost tolerant. At timberline, it reproduces vegetatively by layering, effectively sheltering the saplings by the growth of the parent tree and spreading nutrients via the established root system of the older tree. Prior to 1991, *Tsuga mertensiana* series was included in the *A. lasiocarpa* series (Cooper et al. 1991). However, Cooper et al. (1991) "identified significant acreages where *T. mertensiana* is potentially the climax dominant, making its recognition worthwhile at a higher taxonomic level." Furthermore, *T. mertensiana* seems associated with a maritime influence, (although absent on forests where the inland maritime influence seems the strongest) while also occurring within *A. lasiocarpa* stands as discontinuous tracts. Cooper et al. (1991) state that where the *T. mertensiana* series is widespread it may be locally absent without an apparent environmental explanation.

Within the Clearwater subbasin, *T. mertensiana* habitat types occur as far south as the southern part of the Middle Fork Clearwater River drainage, and White Sand Creek drainage of the Lochsa River (Cooper et al. 1991). It ranges northward, in a fairly continuous zone above 4,800 to 5,100 feet, and uncommonly occurs in frost pockets below 2,800 ft. Specific locations cited in Cooper et al. (1991) include Saddle Camp and an area east of Indian Post Office (on the Lewis and Clark Trail), near Aquarius Research Natural Area, Sheep Mountain Range and an area above Papoose Saddle (on the Clearwater National Forest), Mullan Pass (on the Coeur d'Alene National Forest), and Little Joe Pass (on St. Joe National Forest).

GAP data does not recognize a *T. mertensiana* vegetation type, but rather groups it within the *A. lasiocarpa* vegetation type, (of which there are 548 km^2). ICBEMP data classifies 144 km^2 as *T. mertensiana* cover type (Table 31). No map is available of mountain hemlock distribution within the Clearwater subbasin.

The *T. mertensiana* series is distinguished from the *A. lasiocarpa* series where *T. mertensiana* is at least a climax co-dominant with *A. lasiocarpa* (Cooper et al. 1991). Between 1889 and 1919, much of the *T. mertensiana* zone between Lolo Pass and Thompson Pass was severely burned and is either treeless or still populated by early seral stands, and the habitat type cannot currently be determined.

Cooper et al. (1991) separates the *T. mertensiana* series into five habitat types:

1. *Streptopus amplexifolius* (twisted stalk; contains a *Luzula hitchcockii* and a *Menziesia ferruginea* phase)
2. *Clintonia uniflora* (queencup beadlily; contains a *Menziesia ferruginea* and a *Xerophyllum tenax* phase)
3. *Menziesia ferruginea* (false huckleberry; contains a *Luzula hitchcockii* and a *Xerophyllum tenax* phase)
4. *Xerophyllum tenax* (beargrass; contains *Luzula hitchcockii, Vaccinium scoparium,* and *Vaccinium globulare* phases)
5. *Luzula hitchcockii* (smooth woodrush; high elevation; severe environments)

Seral tree species in order of decreasing importance are *P. engelmannii*, *Pinus contorta* (lodgepole pine), *Larix occidentalis* (western larch), *P. monticola*, and *Pseudotsuga menziesii* (Douglas-fir). Understory species are dominated by *Menziesia ferruginea* (false huckleberry) on cold, moist exposures, *Vaccinium globulare* (blue huckleberry), and *Xerophyllum tenax* (beargrass); the latter an indication that *T. mertensiana* sites have greater protective snowpack, are less windy, and more influenced by the maritime climate than *A. lasiocarpa* habitat types.

Tsuga mertensiana is important for watershed protection (Tesky 1992b). Following overstory removal, water tables rise and restrict timber options in some habitat type phases (Cooper et al. 1991).

Wildlife and Cultural Values

Tsuga mertensiana stands provide summer range for deer, elk and bear, and seeds are a food source for grouse and crows (Tesky 1992b). Sites that border mountain grasslands and herbaceous meadows provide thermal and hiding cover for many wildlife species (Cooper et al. 1991; Tesky 1992b).

Threats and Limiting Factors

Tsuga mertensiana's relatively thick bark provides some resistance to fire, but its tendency to grow in dense groups, low-hanging branches and highly flammable foliage make it very prone to fire injury (Fischer and Bradley 1987). Fire occurrences are low (400-800 years) since *T. mertensiana* sites are usually moist with average precipitation greater than 50 inches (127 cm). In the Pacific Northwest, the pre-logging fire regime is estimated at is 611 years in *T. mertensiana* forest types. Fires thus typically occur as either infrequent crown fires or severe stand-replacing fires. Fire injury makes *T. mertensiana* especially vulnerable to insects and disease (Tesky 1992b). Old growth mountain hemlock stands over 460 years old are quite susceptible to stand-replacing fires.

In the high Cascades *T. mertensia* is most vulnerable to a fungus called laminated root rot (*Phellinus weiri*). Low levels of nitrogen in the forest floor increase the tree's susceptibility to the fungus (McCauley and Cook 1980).

5.5.4 Subalpine Fir

Physical Description

Abies lasiocarpa trees have a very dense and narrow crown with short branches (Uchytil 1991). In open conditions, trees retain their lower branches, which frequently droop and reach down to the ground. Overstory trees may lack lower branches for 20 to 30 percent of the tree's height. At timberline a flag form tree is common; these have an upright trunk growing above a krummholz-like mat, and branches are generally limited to the leeward side of the trunk. Young trees have thin, gray, smooth bark, with numerous resin vesicles; bark on older trees is scaly and shallowly fissured. Root systems are generally shallow; under favorable conditions roots may develop comparatively deep laterals.

Ecology and Distribution

Abies lasiocarpa is a shade-tolerant climax species with long fire-free intervals (Uchytil 1991). Pure stands of *A. lasiocarpa* are common at climax. *Picea engelmannii*, a longer-lived seral species to *A. lasiocarpa*, may also be present as a codominant in climax conditions. Timberline *A. lasiocarpa* often reproduce via layering, which frequently results in clusters of trees. Layering is negligible under closed forest canopies.

In the Clearwater subbasin, the *Abies lasiocarpa* habitat type occurs as a broad subalpine zone (Figure 55). Above the northern portion of the Middle Fork Clearwater River it is somewhat displaced by *T. mertensiana* (Cooper et al. 1991). In the Lochsa, Selway, upper Middle Fork Clearwater, and South Fork Clearwater drainages, the lower limits of the *A. lasiocarpa* series overlap the upper limits of the *A. grandis* series. Either *A. grandis* or *A. lasiocarpa* may occur as the seral or climax component of the opposing series. The relatively moderate climate and scarcity of high elevations limit distribution of the *A. lasiocarpa* series. Based on GAP data, there are 2,349 km^2 of the *A. lasiocarpa* cover type in the Clearwater subbasin (Table 34).

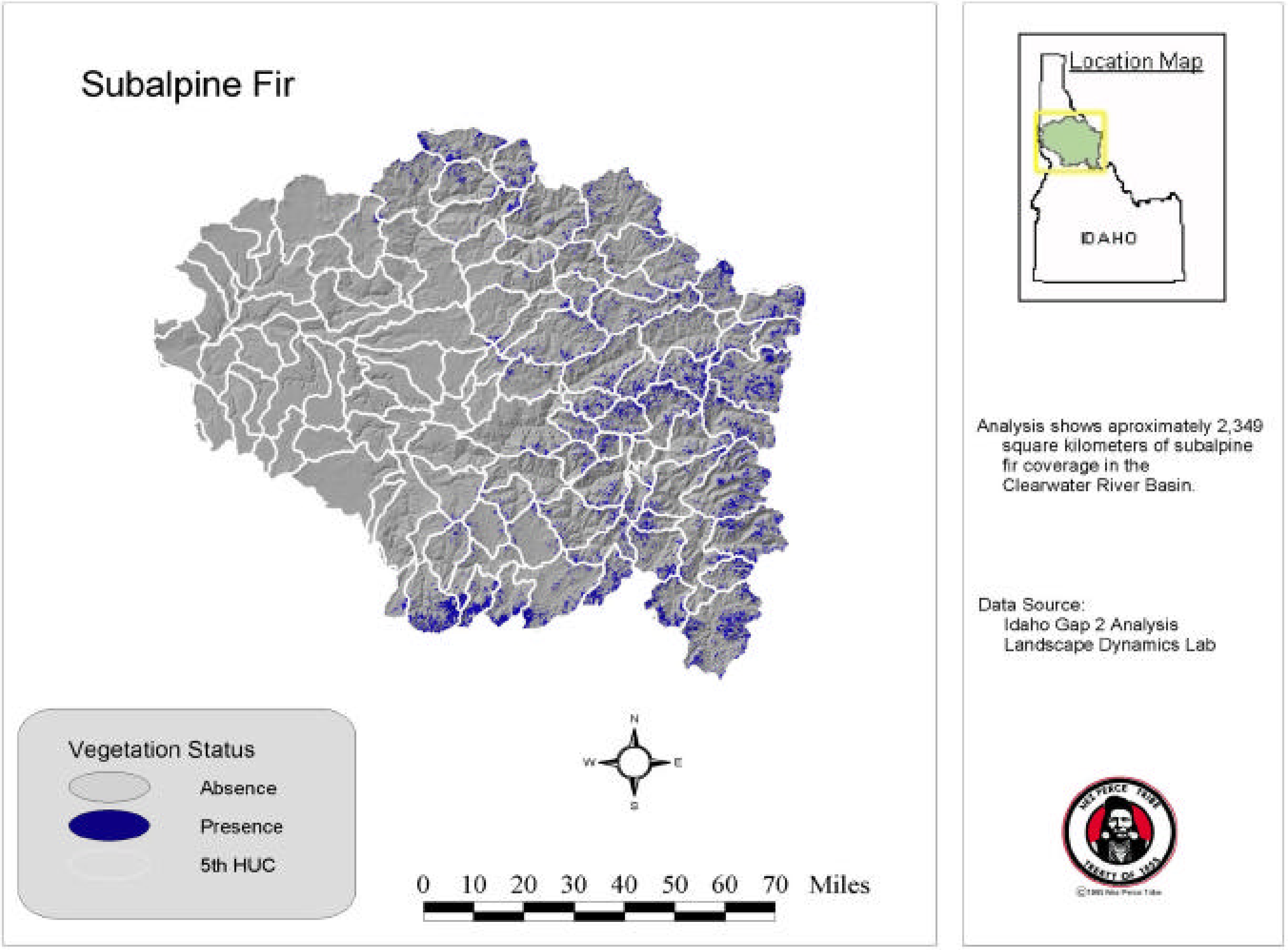

Figure 55. Distribution of the subalpine fir cover type within the Clearwater subbasin

Picea engelmannii is a major, persistent seral component on moist, cool sites; scattered climax stands consisting entirely of *P. engelmannii* are often restricted to wet or cold habitats (Uchytil 1991). *A. lasiocarpa* and *P. contorta* become more dominant on colder and drier sites (Cooper et al 1991). *Larix occidentalis* and *P. monticola* can occur as nearly pure, persisting, even-aged stands given the right conditions. *P. contorta* is more persistent on upper elevation sites than on more productive sites. *Pseudotsuga* develops considerable coverages on lower, warmer slopes with free drainage. *Pinus ponderosa* is rare on all sites. Understory conditions vary from open park-like sites to dense tall shrubs, and from lush forbs (wet sites) to depauperateness (dry sites; Cooper et al. 1991).

A. lasiocarpa habitat types can be classed by elevation range as timberline, upper-elevation, and mid- to upper-elevation (Cooper et al. 1991). Timberline sites are rare in northern Idaho and limited to three vegetation communities: *Pinus albicaulis /A. lasiocarpa*, *A. lasiocarpa /L. lyallii* (uncommon), and *A. lasiocarpa /Luzula hitchcockii* (smooth woodrush; Cooper et al. 1991). Seral species able to become established here are limited to *P. albicaulis*, *P. engelmannii,* and *P. contorta. Abies lasiocarpa* and *P. engelmannii* at the highest elevation are stunted (krummholz form) and typically don't exceed 50 and 65 feet tall respectively. Severe winds and cold temperatures result in dwarfed trees, that are often much broader than tall, forming shrubby mats along the ground (Uchytil 1991). Small tundra-like herbaceous communities, extensive grassy balds, and heaths dominated by *Cassiope mertensiana* (mountain heather) and *Phyllodoce empetriformis* (red mountain-heath) border the highest peaks of *A. lasiocarpa* habitat types (Cooper et al. 1991). Timberline sites are indicative of heavy snow accumulations, drying winds, or excessive subsurface rockiness. Upper-elevation sites are too severe to support *P. menziesii*, *L. occidentalis*, and *P. monticola* (Cooper et al. 1991). *Picea engelmannii* occurs on all sites as a major seral component, and *P. albicaulis* is also common. *Pinus contorta* occurs on warmer, drier sites and *Luzula hitchcockii* is common in the understory. *Abies lasiocarpa* on these sites typically take over 200 years to grow to a height of 50-70 feet. Mid- to upper-elevations *A. lasiocarpa* sites are associated with dry, grassy parks or late-melt areas (Cooper et al. 1991). The parks are dominated by *Festuca idahoensis* (Idaho fescue), *Pseudoroegneria spicatum* (bluebunch wheatgrass), *Festuca viridula* (green fescue), and *Arenaria capillaris* (mountain sandwort); while the late-melt areas have forbs such as *Carex nigricans* (black alpine sedge), *C. tolmiei* (showy sedge), *Deschampsia atropurpurea* (mountain hairgrass), *D. cespitosa* (tufted hairgrass), and *Sibbaldia procumbens* (creeping sibbaldia). Seral species supported on lower-elevation sites include *P. menziesii*, *L. occidentalis,* and *P. monticola*, while the major seral species on wetter sites is *P. engelmannii*.

Within the *A. lasiocarpa* series, there are eight distinct habitat types (Cooper et al.1991).

1. *Calamagrostis canadensis* (bluejoint grass; has *Ledum glandulosum*, *Vaccinium caespitosum*, *Ligusticum canbyi*, and *Calamagrostis canadensis* phases)
2. *Streptopus amplexifolius* (twisted stalk; contains *Menziesia ferruginea* and *Ligusticum canbyi* phases)
3. *Clintonia uniflora* (queencup beadlily; *Menziesia ferruginea, Xerophyllum tenax, and Clintonia uniflora* phases)
4. *Menziesia ferruginea* (false huckleberry; *Luzula hitchcockii, Vaccinium scoparium, Coptis occidentalis,* and *Xerophyllum tenax* phases)
5. *Vaccinium caespitosum* (dwarf huckleberry; south and west Nez Perce National Forest)

6. *Xerophyllum tenax* (beargrass; *Luzula hitchcockii, Vaccinium scoparium, Coptis occidentalis,* and *Vaccinium globulare* phases)
7. *Vaccinium scoparium* (grouse whortleberry; southern Nez Perce National Forest)
8. *Luzula hitchcockii* (smooth woodrush; harshest sites at high elevation)

Wildlife and Cultural Values

Abies lasiocarpa stands provide excellent hiding cover for bear, moose, mountain goats, elk and deer (Uchytil 1991). Dense stands provide summer thermal cover for big game animals. Moose, elk, mule deer, black bear, and grizzly bear use *A. lasiocarpa* habitats as summer range. Many *A. lasiocarpa* habitat types, particularly those containing huckleberry, provide critical habitat for grizzly bears. Moose use mature subalpine fir stands with thick sub-canopies at lower elevation during the winter (Peek et al. 1987). Elk may use low elevation stands during calving, while bighorn sheep use high stands throughout lambing and lamb rearing. Lynx, fisher, snowshoe hare, and several woodpeckers also inhabit *A. lasiocarpa* forests.

Mule deer, elk, bighorn sheep, and snowshoe hares browse on the young growth of *A. lasiocarpa* but it is not an important food item (Uchytil 1991). *A. lasiocarpa* can be a major food source for mountain goats in the winter and spring, as well as an important winter food for moose and blue grouse. Many small mammals and birds eat the high energy seeds.

Small *A. lasiocarpa* trees provide good year-round security cover for many small mammals and birds such as snowshoe hare, flying squirrels, red squirrels, porcupines, pine martens, fishers, lynx, and several species of mice, voles, chipmunks, and shrews (Daubenmire and Daubenmire 1984). Dense thickets of these trees are often nearly impenetrable and provide hiding places for small mammals such as snowshoe hares and porcupines. Blue grouse often over-winter in subalpine trees and rely almost exclusively on them for escape cover. Many cavity nesting birds use *Abies lasiocarpa* snags, but snags of the associated conifers are generally preferable. Birds such as the white-crowned sparrows, woodpeckers, flycatchers, kinglets, nuthatches, juncos, thrushes, chickadees, crossbills, the pine siskin, owls, and grouse are characteristic summer residents which feed or nest on the tree (Scott et al. 1982).

Subalpine fir stands also provide browse and cover for larger wildlife species. Throughout much of Montana, Idaho, and Wyoming, subalpine fir provides important winter food for mule deer, elk, moose (Peek 1974), woodland caribou, black bear, and grizzly bear.

Subalpine fir seeds are eaten by several species of small mammals and birds. Red squirrels eat seeds from cached subalpine fir cones. Fir seeds are also eaten by chipmunks and mice. Several birds, including chickadees, nuthatches, crossbills, pine siskins, and Clark's nutcrackers remove and eat the seeds from fir cones (Halvorson 1986).

Native Americans used various parts of subalpine fir. A hair tonic was prepared by mixing powdered needles with deer grease. Finely ground needles were also sprinkled on open cuts. Sticky resin collected from the bark was boiled and used as an antiseptic for wounds or as a tea for colds. Boughs were placed in rooms for their aroma, and pulverized needles were used as a body scent or as perfume for clothing (Uchytil 1991).

Threats and Limiting Factors

Several factors contribute to *A. lasiocarpa's* very low resistance to fire: thin bark which ignites readily, low growing branches, highly flammable foliage, a tendency to grow in dense stands, moderate to heavy lichen growth, and shallow roots vulnerable to soil heating (Uchytil 1991). The cool, moist environments of *A. lasiocarpa* sites retard the decomposition of organic matter resulting in a rapid accumulation of fuels. Highly destructive crown fires occur at 100 year or longer intervals and are typically stand replacing. Surface fires are usually lethal due to a concentration of fine fuels under mature trees that burn slowly and girdle the thin barked bole. In subalpine habitats, scattered *A. lasiocarpa* trees often escape fire because of discontinuous fuels, broken and rocky terrain, and a moist and cool environment.

Following large fires, *P. contorta* and *P. tremuloides* are the most common seral species, frequently forming pure stands that completely dominate middle and low elevation stands (Uchytil 1991). Following fire and the development of seral *P. contorta* stands, *A. lasiocarpa* may be suppressed for several decades, and 100 year old trees may be only 3 feet (0.9 m) tall. Substantial *A. lasiocarpa* establishment under dense lodgepole pine stands may take 50 to 150 years after a fire. Following fires near treeline, it may take over 100 years to establish seedlings. *P. contorta* frequently forms even aged dense stands, dominating up to 300 years if established immediately after stand destroying fires. Shade tolerance allows *A. lasiocarpa* to establish under the *P. contorta* canopy, normally within 100 years.

Past stand replacing wildfires burned vast expanses, and together with subsequent burns have nearly eradicated seed sources of climax species and postponed succession to shade intolerant conifers (Cooper et al. 1991; Uchytil 1991). Almost pure, fire created stands of *P. contorta* occupy extensive areas within the Clearwater subbasin, especially in the southern portions (Cooper et al. 1991). *L. occidentalis* also occurs similarly as localized pure, even aged stands on old burns. Following disturbance, revegetation and recovery is slow due to a short growing season and low temperatures (Cooper et al. 1991).

Stand replacing fires often result in pure, even aged stands that may be overstocked and potential centers for insect and disease epidemics. Numerous insects attack *A. lasiocarpa*: the most destructive are the balsam woolly aphid, western spruce budworm, and western balsam bark beetle (Uchytil 1991). The western spruce budworm generally attacks low and middle elevation *A. lasiocarpa* forests. Additional pests include the fir engraver beetle, Douglas-fir tussock moth, and western black headed budworm.

Heterobasidion annosum causes annosus root disease in *A. lasiocarpa*, resulting in root and butt decay (Uchytil, 1991). Several other wood rotting fungi that cause heart, trunk, butt, or root rots (e.g., brown stringy rot, red heart rot, red ring rot, shoestring rot, brown cubical rot, white spongy root rot, and white pocket rot) also affect *A. lasiocarpa*. Trees compromised by wood rots frequently become infested with fir engraver beetles, often resulting in windfall and breakage. In *Picea/ A. lasiocarpa* stands fir broom rust is a common problem, causing wind breakage, bole deformation, and spike tops, resulting in trees more susceptible to decay fungi (Uchytil 1991).

Abies lasiocarpa are very vulnerable to heart rots and thus rarely live over 250 years (Uchytil, 1991). Non even aged silviculture practices can pose a problem because residual subalpine fir trees damaged during thinning operations are susceptible to attack by decay fungi.

5.5.5 Grand Fir

Physical Description

Abies grandis typically has a wide crown and a low, dense branching habit (Howard and Aleksoff 2000). Mature tree heights range from 131 to 164 feet (40-50 m) tall with boles usually measuring 20 to 40 inches DBH. (51-102 cm). Young trees have thin bark (averaging 0.9 cm for a 20 cm diameter tree) and mature trees have fairly thick bark (averaging 1.7 cm for a 40 cm diameter tree). *A. grandis* taproots are well developed and on dry sites grow to moderate depths, whereas on moist sites shallow lateral roots may replace the taproot altogether. Older trees often have pervasive rotting fungi, but commonly reach 250 years of age, occasionally living beyond 300 years (Howard and Aleksoff 2000).

Ecology and Distribution

Prior to 1900, repeated underburns maintained open, seral species stands in *Abies grandis* habitat types (Cooper et al. 1991). While disturbance is not required for *A. grandis* to establish and persist on many sites, it needs fire or some other periodic disturbance to maintain itself on sites where either *T. plicata* or *T. heterophylla* is the climax dominant (Howard and Aleksoff, 2000). *A. grandis* does not establish under closed canopies; succession to a *A. grandis* overstory is faster on sites where it developed under an open forest canopy than on shrubfields (Daubenmire and Daubenmire 1984).

Understory composition undergoes major changes with overstory tree canopy closure which initiates the beginning of the "stagnation stage" in the *A. grandis* series(Zamora 1982; Steele and Geier-Hayes 1982; Antos and Habec 1981 *in* Cooper et al. 1991). In this stage shade intolerant species are eliminated, and changes in understory species are limited to changes in relative abundance rather than loss or displacement (Daubenmire and Daubenmire 1984). *Abies grandis* is correlated with an inland maritime climate (Cooper et al. 1991), and indicates productive forest sites (Howard and Aleksoff 2000).

Mature *A. grandis* stands are normally floristically diverse. *A. grandis* habitat types occur beyond the ecological and geographical limits of the more moisture dependent and shade tolerant *Thuja plicata* and *Tsuga heterophylla* habitat types. The Clearwater subbasin contains an area of *A. grandis* importance, specifically the Nez Perce National Forest and the southern portions of the Clearwater National Forest (Figure 56). *A. grandis* habitat types occur between 1,500-6,300 feet elevation in the Clearwater subbasin, grading into *A. lasiocarpa* series on cooler sites and into *Psudotsuga menziesii* series on warmer, drier sites. Based on GAP data, 1,565 km^2 of the *A. grandis* cover type occur in the Clearwater subbasin (Table 34).

Abies grandis is a canopy dominant and major recolonizer on moist sites, although due to slow initial establishment and growth it normally constitutes a subordinate layer to seral species (Cooper et al. 1991). Seral species include *Picea engelmannii* and *Pinus contorta* on colder habitat types, *Pinus ponderosa* on warmer habitat types, *Larix occidentalis* on previously burned sites, and *Psuedotsuga* on almost all habitat types. Depending on disturbance type and degree, time since stand initiation, seed source, and initial composition, a wide variety of seral communities can develop. Within the Clearwater subbasin, fire has been a primary influence, resulting in domination by *P. contorta* on cold sites and *Pseudotsuga* and *P. ponderosa* on warm, dry sites.

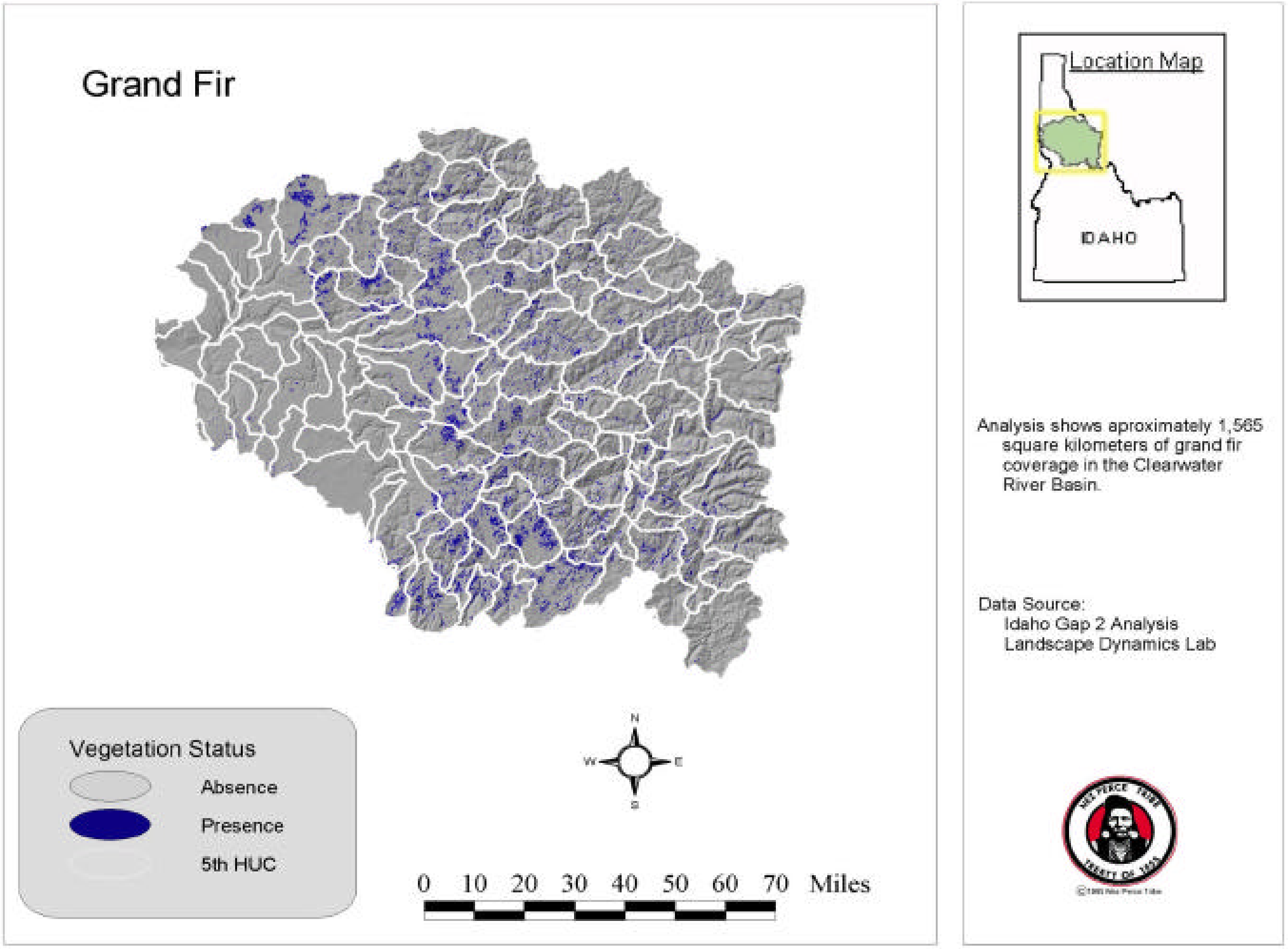

Figure 56. Distribution of the grand fir cover type within the Clearwater subbasin

Abies grandis habitat types are not associated with a unique assemblage of species (Cooper et al. 1991), except in the *Abies grandis*/*Taxus brevifolia* association (Crawford and Johnson 1985) where it is associated with pacific yew (*Taxus brevifolia*). This plant association is unique to the Clearwater subbasin because *T. brevifolia* actually reaches canopy dominance. On most sites, *T. brevifolia* is restricted to the sub-canopy. Approximately 16,000 ha of this association exists in the South Fork AU, with an additional 4,000 ha already eliminated through commercial timber harvest.

Floristic composition is similar to the understories of the *A. lasiocarpa*, *Pseudotsuga*, *T. plicata*, and *T. heterophylla* series. Shrub species in earlier successional stages include *Acer glabrum*, *Amelanchier alnifolia*, *Ceonothus spp.*, *Holodiscus discolor*, *Rubus parviflorus*, and *Symphoricarpos albus*. Forbs range from steppe species such as *Balsamorhiza sagittata* to species typical of saturated soils such as *Athyrium filix-femina* and *Senecio triangularis*. The habitat types for the Abies grandis series are listed below (Cooper et al. 1991).

1. *Abies grandis/Senecio triangularis* (Grand fir/arrowleaf groundsel; occurring on bottomlands
   and toe slopes from 2,600 – 4,600 feet (790 – 1,400 meters)).
2. *Abies grandis/Asarum cadatum* (Grand fir/wild ginger; occupying drainages of the Clearwater
   River)
4. *Abies grandis/Clintonia uniflora* (Grand fir/queencup beadlily; dominant south of the Middle Fork of the Clearwater River drainage)
5. *Abies grandis/Linnaea borealis* (Grand fir/twinflower; occupying Nez Perce National Forest and southern Clearwater National Forest)
6. *Abies grandis/Xerophyllum tenax* (Grand fir/beargrass; occupying eastern Nez Perce National Forest and southeastern Clearwater National Forest)
7. *Abies grandis/Vaccinium globulare* (Grand fir/blue huckleberry; located in central Idaho)
8. *Abies grandis/Physocarpus malvaceus* (Grand fir/ninebark; located throughout northern Idaho)
9. *Abies grandis/Spiraea betulifolia* (Grand fir/birchleaf spirea; found in southwestern Nez Perce National Forest)

Wildlife and Cultural Values

Fisher use old growth *A. grandis* stands for nesting and foraging (Howard and Aleksoff 2000). Young *A. grandis* trees provide good thermal cover, and fir needles are a major dietary item for sharp-tailed grouse (Howard and Aleksoff 2000). Flammulated owls may select large diameter *A. grandis* trees with broken tops and extensive *Echinodontium tinctorium* (Indian paint fungus) decay for nesting (Bull et al. 1990; Thomas 1979). Flammulated owls also forage in mature *A. grandis* stands. Elk prefer early seral, grass or shrub/grass *A. grandis* habitats for spring foraging (Irwin and Peek, 1983). They tend to use adjacent *P. contorta* and *T. heterophylla* stands for shade and resting cover instead of *A. grandis*.

This species provides good thermal and hiding cover for big game species (Howard and Aleksoff 2000). Some early *A. grandis* successional stages provide high quality browse for deer and elk; south slopes and lower elevation sites provide winter range (Cooper et al. 1991). Keay and Peek (1980) found that mule deer avoided mature *A. grandis* stands and white-tailed deer avoided both old seral and mature *A. grandis* sites. Moose, however, prefer old growth *A. grandis* habitat types; using the wetter *A. grandis* stands with *Taxus brevifolia* as critical winter habitat and *T. brevifolia* as a major winter food item (Pierce and Peek 1984). Dense, multistory grand fir forests provide good snow interception as well as ample moose forage in the form of bark and twigs (Peek et al. 1987). Moose prefer mature *Abies grandis* habitats for foraging, while elk and deer use seral stage habitats instead (Howard and Aleksoff 2000). Moose, elk and deer may eat fir needles in winter (Martin et al. 1951).

Young *A. grandis* trees provide cover for grouse, pikas, chipmunks and squirrels (Martin et al., 1951). Thick boughs provide thermal cover and roosting sites for red crossbill, Vaux's swift, pygmy nuthatch, pileated woodpecker, Williamson's sapsucker, and grouse (Thomas, 1979). Woodpeckers typically select *P. ponderosa*, *P. contorta*, *L. occidentallis*, and *P. menziesii* rather than *A. grandis* for foraging and nesting (Bull et al., 1986). Large *Abies grandis* snags and trees are used by weasels, squirrels, spotted skunks, American martens, bushy-tailed woodrats, deer mice, owls, and sapsuckers (Thomas 1979). Downed logs and hollowed trunks provide dens for bears, weasels, squirrels and rats.

Stands of *Abies grandis* containing pacific yew have provided a valuable chemical resource in the fight against cancer. Pacific yew bark contains a chemical formerly used to make the drug Taxol, which is now made primarily through synthetic means.

Threats and Limiting Factors

Due to selective harvesting of *Pinus* spp. and *L. occidentalis* at the turn of the century and fire exclusion, an unprecedented abundance of *A. grandis* exists in the Clearwater subbasin and other areas in the interior west (Turner 1985 *in* Howard and Aleksoff 2000). Fir dominated stands have more disease and mortality than stands dominated by seral species; thus many late-successional stands are dominated by dead, suppressed or diseased *A. grandis* (Mutch et al.1993 *in* Howard and Aleksoff, 2000). Commercial logging has resulted in fragmentation of previously contiguous grand fir forests.

Although *Pinus ponderosa* is the fastest growing seral species on *A. grandis* habitat types, fire suppression and advancing succession currently limit its importance to only the warmest sites (Cooper et al. 1991). Within the Clearwater subbasin, *Pteridium aquilinum* (bracken fern) or *Rudbeckia occidentalis* (western coneflower) invasions and browsing of young trees by northern pocket gopher delayed succession to a woody overstory on some *A. grandis* habitats (Ferguson 1991).

Morphological characteristics of *A. grandis* contributing to its relative flammability include low and dense branching, the tendency toward dense stands, foliage with a higher surface-to-volume ratio than affiliated conifers, and longer retention of needles on the tree (e.g., average of seven years; Howard and Aleksoff 2000).

Moist *Abies* sites may have rampant trunk rots, especially *Echinodontium tinctorium* (Indian paint fungus) (Cooper et al. 1991). Mechanical injury (logging) reactivates dormant infections and is often the reason given against practicing uneven-aged management on moist *A. grandis* sites. Important root rot pathogens are *Poria weirii* and *Armillaria mellea*, which occur on moist, moderate temperature sites.

5.5.6 Douglas-fir

Physical Description

Rocky Mountain Douglas-fir is a medium-sized, coniferous, evergreen tree. Adapted to a drier, colder climate, it grows much slower than the coastal variety, and seldom exceeds 130 feet (40 m) in height and 5 feet (152 cm) in diameter. Trees 200 to 300 years old trees are commonly 100 to 120 feet tall (30-37 m) and between 15 and 40 inches (38-102 cm) DBH. Growth is extremely slow past 200 years of age, and trees rarely live longer than 400 years. Open-grown trees often have branches over the length of the bole, while trees in dense stands lack lower limbs. The bark on saplings is smooth, grayish-brown, and covered with resin blisters; mature individuals have thick, deeply furrowed, corky bark. Bark thickness in the northern Rockies is about 1 inch (2.5 cm) on 12 inch (30 cm) diameter trees, and 2.5 inches (6 cm) on 24 inch (60 cm) diameter trees (Hemstrom et al. 1987 cited in Uchytil 1991).

Ecology and Distribution

Rocky Mountain Douglas-fir grows in lower, middle, and upper elevation forests. It is a shade-tolerant climax species in dry to moist lower and middle elevation forests but is shade intolerant in wetter forests of the upper montane zone. In the absence of disturbance it tends to replace ponderosa pine, lodgepole pine (*Pinus contorta*), and western larch (*Laryx occidentalis*) in the northern Rockies. In the upper montane zone, Rocky Mountain Douglas-fir is less shade tolerant and is replaced by western red cedar, western hemlock, spruces, and true firs. It is often a persistant seral species in grand fir and subalpine fir habitat types in the northern Rockies (Uchytil 1991).

Mature Rocky Mountain Douglas-fir is generally more fire resistant than spruces and true firs, equally or slightly less fire resistant than ponderosa pine, and less fire resistant than western larch. Mature trees can survive moderately severe ground fires because the lower bole is covered by thick, corky bark that insulates the cambium from heat damage. It takes about 40 years for trees to develop fire resistant bark on moist sites in the northern Rockies.

Forests in which *Pseudotsuga menziesii* is the indicated climax are widespread throughout the northern Rocky Mountains and the Clearwater subbasin (Figure 57). The Douglas-fir series forms a broad forest belt between bunchgrass, ponderosa pine (*Pinus ponderosa*), or limber pine (*P. flexis*) habitat types at lower elevations and subalpine fir (*Abies lasiocarpa*) or grand fir (*A. grandis*) habitat types at higher elevations (Tesky 1992). Based on GAP data, there are 4,192 km^2 of the *P. menziesii/* mixed xeric forest cover type in the Clearwater subbasin (Table 34).

Rocky Mountain Douglas-fir exhibits great ecological extent. It grows at lower elevations adjacent to bunchgrass communities and is also found in upper elevation subalpine forests. In Idaho, Douglas-fir is found in all forest habitat types except ponderosa pine. It tends to be most abundant in low and middle elevation forests, where it grows over a wide range of aspects, slopes, landforms, and soils (Cooper et al. 1991).

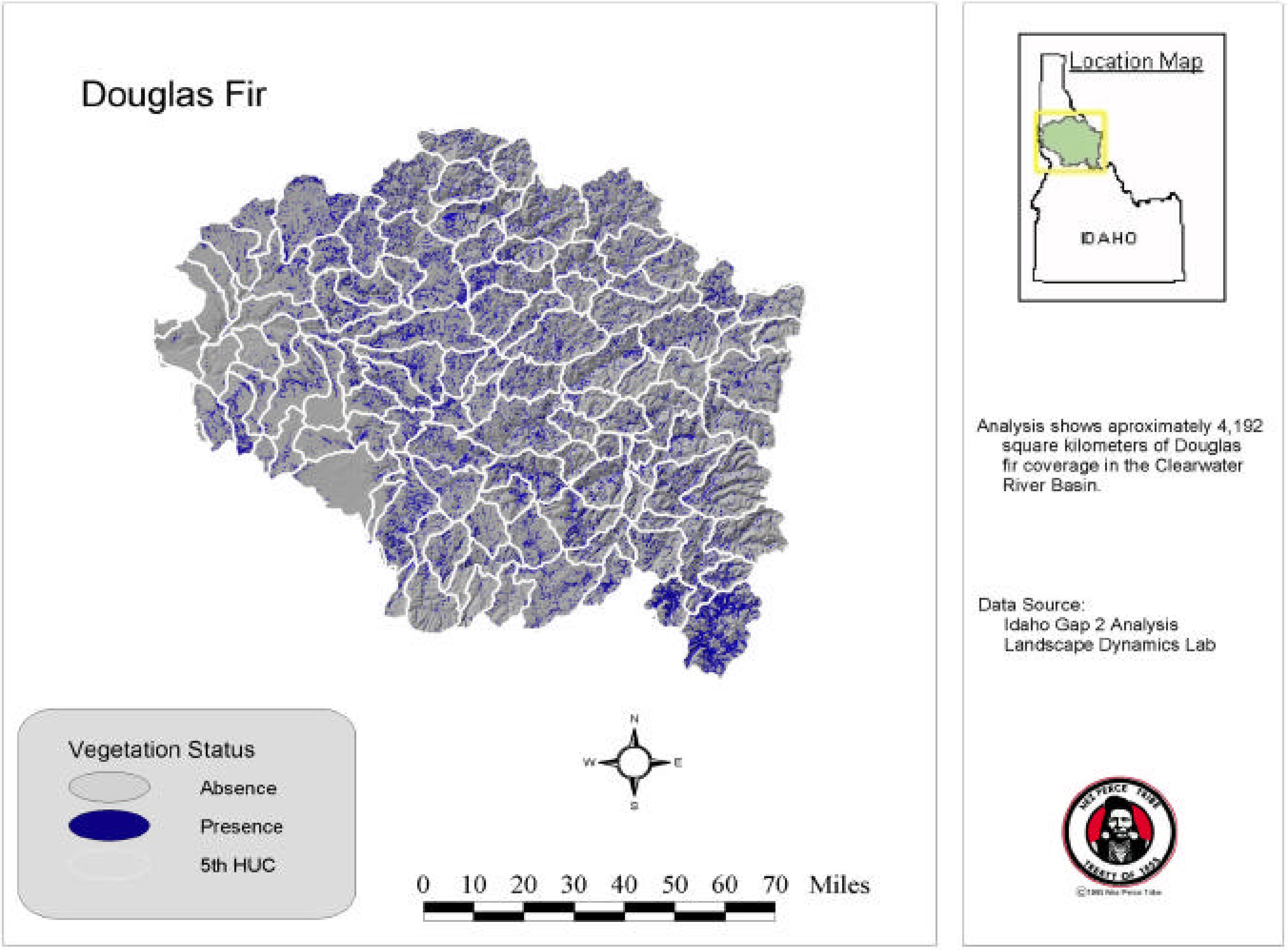

Figure 57. Distribution of the Douglas-fir/ mixed xeric forest cover type within the Clearwater subbasin

Principal habitat types in the Douglas-fir series are (Cooper et al. 1991):

1. *Physocarpus malvaceus* (ninebark; generally occurring on southwest to west aspects at elevations between 2,000 and 3,700 feet (600 to 1,130 meters)
2. *Vaccinium caespitosum* (dwarf huckleberry; occupies frost pocket sites on all aspects)
3. *Vaccinium globulare* (blue huckleberry; South to west aspects on eastern edge of the Red River ranger District on the Nez Perce National Forest)
4. *Symphoricarpos albus* (common snowberry; incidental habitat type with most occurences north of Orofino)
5. *Spiraea betulifolia* (white spiraea; South aspects in northern Idaho; Selway Bitterroot Wilderness)
6. *Calamagrostis rubescens* (pinegrass; high and low elevational phases; has an *Arctostaphylos uva-ursi* phase)
7. *Carex geyeri* (elk sedge; incidental; in minor amounts in Nez Perce National Forest; southern aspects)
8. *Festuca ovina ingrata* (Idaho fescue; incidental; in minor amounts in Nez Perce National Forest)
9. *Pseudoroegneria spicatum* (bluebunch wheatgrass; incidental; limited to Salmon River drainage and lower Clearwater River drainage)

Wildlife and Cultural Values

Rocky Mountain Douglas-fir is valueable to big game as both cover and habitat, and provides excellent hiding and thermal cover for deer, elk, and bighorn sheep (Cooper et al. 1991). Low elevation and south facing Douglas-fir types often serve as deer and elk winter range (Tesky 1992c). Use of Douglas-fir as browse by ungulates is generally light. Use is typically in the winter or early spring when other preferred forage is lacking. Mule deer browse this species more than elk, but it is not important forage for either (Gaffney 1941 from Uchytil 1991). These areas are an important food source for moose (Gordon 1976 cited in Tesky 1992a), and moose will winter in low elevation Douglas-fir where willow thickets (preferred winter habitat types) are lacking. Most livestock avoid eating this species, but sheep occasionally browse young plants (Wasser 1982 cited in Uchytil 1991).

Conifer seeds are the staple food of the red squirrel. These animals cut great quantities of Douglas-fir cones and cache them for later use. Chipmunks, mice, voles, and shrews eat large quantities of conifer seeds from the forest floor (Halvorson 1986 cited in Uchytil 1991). The most common are the Clark's nutcracker, black capped chickadee, mountain chickadee, boreal chickadee, red breasted nuthatch, pigmy nuthatch, red winged crossbill, white winged crossbill, dark eyed junco, and pine siskin (Halvorson 1986 cited in Uchytil 1991). Numerous species of songbirds extract seeds from Douglas-fir cones and forage for seeds on the ground. Crops of seeds and newly germinated seedlings have been decimated locally by migrating flocks of dark eyed juncos (Krauch 1956 cited in Uchytil 1991). Douglas-fir needles are an important winter food of blue grouse (Martin et al. 1951 cited in Uchytil 1991). Many species of songbirds nest in Douglas-fir foliage or cavities within old snags. In central Idaho, the Douglas-fir/pinegrass (*Calamagrostis rubescens*) and Douglas-fir/white spiraea (*Spiraea betulifolia*) habitat types are important to nesting Steller's jays, pine siskins, western tanagers, red-breasted nuthatches, and Cooper's hawks (Stark 1977 cited in Uchytil 1991).

Threats and Limiting Factors

Low growing branches and flammable foliage that make trees susceptible to crowning often offset protection offered by thick bark (Fischer and Bradley 1987). Dry Douglas-fir habitat types in the northern Rocky Mountains experienced low to moderate intensity ground fires at less than 30 year intervals (Arno 1980). Where ponderosa pine is a major associate, fires at 10 year intervals were common (Lotan et al. 1981 cited in Tesky 1992). These frequent ground fires maintained relatively open stands of Douglas fir or, more frequently, seral stands of ponderosa pine since pine saplings are more fire resistant then Douglas-fir saplings (Fischer and Bradley 1987; Arno 1983). Fire suppression has resulted in long fire free periods, which have allowed Douglas-fir regeneration to become well established. In some areas, dense thickets have formed, which provide a continuous fuel ladder to the crown of overstory trees. Thus, fire suppression has increased the potential for severe, stand destroying wildfires. The effects of fire on Rocky Mountain Douglas-fir vary with fire severity and tree size. Surface fires often kill saplings because their low branching habit allows fire to spread to the crown. Photosynthetically active bark, resin blisters, closely spaced flammable needles, and thin twigs and bud scales are additional characteristics that make saplings vulnerable to surface fires (Fischer and Bradley 1987). Rocky Mountain Douglas-fir saplings are more susceptible to mortality from surface fires than ponderosa pine saplings .

Grazing by domestic livestock has contributed to increasingly dense western forests and to changes in tree species composition. Livestock can alter forest dynamics by reducing the biomass and density of understory grasses and sedges which otherwise outcompete conifer seedlings and prevent dense tree recruitment. In addition, livestock reduce the abundance of fine fuels, which previously carried low intensity fires quickly through forests (Belsky and Blumenthal 1997). In northern Idaho, Douglas-fir was more susceptible to fire damage in stands subjected to years of livestock grazing than in ungrazed stands. Ungrazed stands remained open and park-like, and had a nearly continuous distribution of small fuels(Weaver 1968 cited in Uchytil 1991). Prescribed fires had flame lengths up to 36 inches (91 cm) but spread rapidly and only scorched the lower portions of large trees. On grazed sites open stands were converted to dense pole stands with sparse understories and numerous sapling thickets. These stands had a greater accumulation of duff and large woody fuels that contributed little to fire spread. This resulted in a slow spreading fire which was more damaging to trees, probably because of the long residence time, which can kill trees through cambial heating (Peterson and Arbaugh 1986 cited in Uchytil 1991). On the grazed site, numerous trees up to 4 inches (10 cm) DBH, and a few more than 6 inches (15 cm) DBH were killed.

Various species of fungi such as shoestring root rot (*Armillaria mellea*), and laminated root rot (*Phellinus weirii*) have caused significant damage to young Douglas-fir stands in plantations. Trees die or are so weakened that they are blown over. Red ring rot (*Phellinus pini*), a heart rot fungi, is the most damaging and widespread fungi (Foiles 1965). Several needle diseases occur on Douglas-fir. The most conspicuous, a needlecast, is caused by *Rhabdocline pseudotsugae.* The most damaging stem disease affecting Douglas-fir is *Arceuthobium douglasii.* This dwarf mistletoe occurs throughout most of the range of Douglas-fir (Society of American Foresters 1980). The most destructive insects include the Douglas-fir seed chalcid (*Megastigmus spermotrophus)*, which matures in the developing seed and gives no external sign of its presence. The Douglas-fir cone moth (*Barbara colfaxiana*), the fir cone worm (*Dioryctria abietivorella*), the Douglas-fir cone gall midge (*Contarinia oregonensis*), and cone scale midge (*C. washingtonensis*) destroy some seed but prevent harvest of many more by causing galls that prevent normal opening of cones (Foiles 1965).

Consumption of Douglas-fir seeds by small forest mammals such as white-footed deer mice, creeping voles, chipmunks, and shrews, and birds such as juncos, varied thrush, blue and ruffed grouse, and song sparrows further reduces seed quantity. Browsing and clipping by hares, brush rabbits, mountain beaver, pocket gophers, deer, and elk often injure seedlings and saplings. In pole-sized timber, bears sometimes deform and even kill young trees by stripping off the bark and cambium (Foiles 1965).

5.5.7 Lodgepole Pine

Physical Description

Pinus contorta is a small to medium sized, coniferous, evergreen tree. Mature tree heights range from 50 to 100 feet (15-30 m) and bole diameters occasionally reach 24 inches (61 cm; Critchfield 1980). Mature trees have remarkably straight, branch-free boles and small, open crowns on the upper 25 to 60 percent of the tree. The trees are short-lived compared to other conifers. Lodgepole pines older than 200 years are rare (Lotan and Perry 1983).

Ecology and Distribution

Pinus contorta grows across a wide range of environments in montane and subalpine forests of the West. With a broad range of moisture and temperature tolerances, it occupies forests spanning a range of envirnomental conditions from relatively low elevation, warm and dry forests to relatively high elevation, cold and moist forests (Pfister and Daubenmire 1975). In Nez Perce and Clearwater National Forests (Figure 58), lodgepole pine is characterized by nearly pure stands with little evidence of other seral tree species (Cooper et al 1991). Based on GAP data, 1,631 km^2 of the *P. menziesii* cover type occurs in the Clearwater subbasin (Table 34). Three community types associated with *P. contorta* (Cooper et al. 1991)

1. *Vaccinium caespitosum* (Dwarf Huckleberry; higher valley floors of the Nez Perce National Forest)
2. *Xerophyllum tenax* (Beargrass; Nez Perce National Forest at mid to high elevations, incidental)
3. *Vaccinium scoparium* (Grouse Whortleberry; southern and eastern Nez Perce National Forest)

Because of its tolerance of a wide range of environmental conditions, lodgepole pine grows in association with many understory species. The most common understory associates include pinegrass (*Calamagrostis rubescens*), elk sedge (*Carex geyeri*), Ross sedge (*C. rossii*), pachystima (*Pachystima myrsinites*), twinflower (*Linnaea borealis*), beargrass (*Xerophyllum tenax*), huckleberry or whortleberry (*Vaccinium* spp.), serviceberry (*Amelanchier alnifolia*), oceanspray (*Holodiscus discolor*), bitter cherry (*Prunus emarginata*), buffaloberry (*Shepherdia canadensis*), curlleaf mountain mahogany (*Cercocarpus ledifolius*), bitterbrush (*Purshia tridentata*), and juniper (*Juniperus* spp.; Steele et al. 1983). An association between lodgepole pine and *Vaccinium* is especially common, and thrives in cool, moist sites on infertile, granitic soils (Lotan and Perry 1983).

P. contorta is an intolerant, seral species. It possesses several attributes that allow it to aggressively invade and persist in burned areas: these include (1) serotinous cones that contain a large seed bank released by fire; (2) abundant and early seed production; (3) small seeds that disperse efficiently; (4) high seed viability; (5) rapid juvenile growth; and (6) adaptability to a wide variety of sites (Critchfield 1980). Most of the larger lodgepole forests of the Rocky

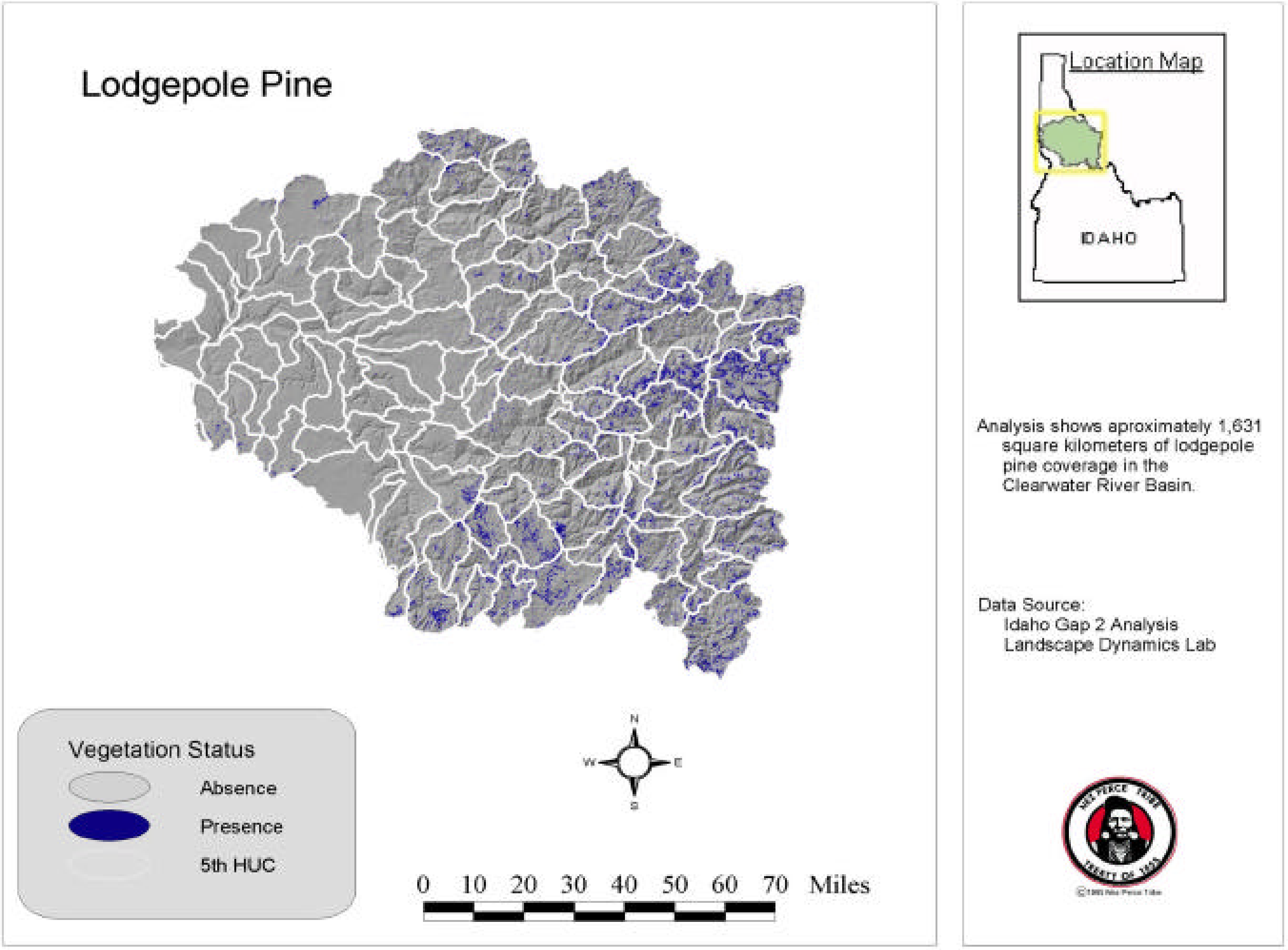

Figure 58. Distribution of the lodgepole pine cover type within the Clearwater subbasin

Mountains are seral and were created by fire. These stands are typically even-aged, establishing within 10 to 20 years after fire (Volland 1985). *P. contorta* cannot reproduce in the shade of its own canopy. Without another fire, lodgepole stands begin to breakup between 100 and 200 years of age and are eventually replaced by shade tolerant conifer associates, most commonly subalpine fir and Engelmann spruce (*Picea engelmannii*) at upper elevations, and Douglas-fir at lower elevations (Day 1972).

Under certain situations, lodgepole forests can be persistent or climax. This occurs where shade tolerant conifers are unable to grow and *P. contorta* remains as the dominant tree. Factors that allow *P. contortus* to be the exclusive tree on a site include (1) frequent, widespread, stand replacing wildfires that eliminate the seed source of shade tolerant competitors (prolonged seral stages), (2) frequent, light ground fires that remove shade tolerant competitors (prolonged seral stages), (3) exclusively dense *P. contorta* stands that competitively exclude the regeneration of shade tolerant competitors (prolonged seral stages), and (4) sites environmentally unsuitable for the establishment of other conifers (Cooper et al. 1991).

Wildlife and Cultural Values

P. contorta is important to big game animals for cover and habitat. *P. contorta* stands cover extensive areas that serve as deer and elk summer ranges. Although these forests typically have sparse vegetation in the understory and provide very little forage, they provide important cover for ungulates that forage in associated nonforested communities (Urness 1985). Wild ungulates seldom browse lodgepole pine, except in winter when it is sometimes used as an emergency food. Lodgepole pine seeds are an important food of pine squirrels, chipmunks, and songbirds. The needles are an important winter food source for blue grouse and spruce grouse (Uchytil 1991). Large *P. contorta* are a critical habitat feature for black-backed woodpeckers.

Grazing appears to benefit lodgepole pine growth by reducing competition from both native and seeded understory species. However, good grazing management is required to ensure even use of forage and to minimize seedling injury by livestock (McLean et al. 1986).

Threats and Limiting Factors

Ocasionally, *P. contorta* stands get too dense or overstocked. These stands are succeptible to stagnation, snow breakage, windthrow, and fire (Fischer and Bradley 1987). Parasitic plants, such as *Arceuthobium americanum* (dwarf mistletoe), can infest these stands causing mortality, and attacks from the mountain pine beetle (*Dendroctonus ponderosae*) occur when the lodgepole stands get large enough to sustain brood populations (Agee, 1993). Fungal pathogens can cause stem cankers leaving the wood virtually useless for lumber, posts and poles (Lotan and Critchfield 1990).

Timber harvest activities in this cover type have fragmenteed previously continuous forest stands. Typically, *P. contorta* has an infrequent, severe stand replacing fire regime resulting in large expanses of even-aged trees. Timber harvest of small patches less than 40 acres in size disrupts this pattern.

Pinus contorta produces serotinous cones that do not open at maturity because they are sealed shut by a resinous bond between the cone scales. These cones remain on the tree for years and require temperatures between 113 and 140 degrees F (45-60 C) to melt the resin and release the seed (Lotan and Critchfield 1990). In nature, only forest fires generate temperatures of this magnitude within a tree's crown.

5.5.8 Ponderosa Pine

Physical Description

P. ponderosa has the potential to achieve large dimensions. Diameters at breast height reach from 30 to 50 inches (76-127 cm) and tree heights of 90 to 130 feet (27.4-39.6 m) are common (Brockman 1979). Trees often reach ages of 300 to 600 years (Oliver and Ryker 1990). Needles are typically in bundles of three. They are 5 to 10 inches (12.5-25.0 cm) long and form tufts at the end of each branch. Cones are oval and 3 to 6 inches (7.5-15.0 cm) long. The bole is typically straight and at maturity is clear of lower branches. The bark of mature trees is composed of broad, irregular scaly plates that fit together like jigsaw puzzle pieces. The crown is conical and composed of stout branches (Lackschewitz 1991).

Ecology and Distribution

Pinus ponderosa stands range from southern British Columbia south through the mountains of Washington, Oregon, to southern California. In the northeastern part of its range it extends east of the Continential Divide in Montana and south to the Snake River Plain in Idaho (Oliver and Ryker 1990). In the Clearwater subbasin (Figure 59), *P. ponderosa* occupies narrow environmental strips between steppe vegetation and Douglas-fir communities. The *P. ponderosa* series is the driest forest zone, occupying elevations generally below 4,000 feet (1,220 meters). At higher elevations it intermixes with *Pseudotsuga menziesii*, and at lower elevations it borders the xeric steppe vegetation (Cooper, et al. 1991). Based on GAP data, there are 1,093 km^2 of the *Pinus ponderosa* cover type in the Clearwater subbasin (Table 34).

P. ponderosa pine forms climax stands that border grasslands and is also a common member in many other forested communities (Steele et al. 1981). *P. ponderosa* is the most drought tolerant tree, and it usually occupies the transition zone between grassland and forest. Climax stands are characteristically warm and dry, and occupy lower elevations throughout their range. Key understory associates in climax stands typically include grasses such as bluebunch wheatgrass (*Pseudoroegneria spicata*) and Idaho fescue (*Festuca ovina ingrata*), and shrubs such as bitterbrush (*Purshia tridentata*) and common snowberry. At higher elevations, Pacific ponderosa pine is seral to trees more shade tolerant and moisture demanding. In the Pacific Northwest this generally includes Douglas-fir, grand fir, and white fir (Howard 2001). *P. ponderosa* associations can be separated into three shrub dominated and three grass dominated habitat types.

Four community types are associated with *P. ponderosa* (Cooper et al. 1991):

1. *Physocarpus malvaceus* (ninebark; limited; northeast to northwest aspects)
2. *Symphoricarpos albus* (common snowberry; sporadic from Coeur d'Alene south along western forest edge in northern Idaho
3. *Festuca ovina ingrata* (Idaho fescue; most prevalent along Clearwater, Snake, and Salmon River drainages)
4. *Pseudoroegneria spicatum* (bluebunch wheatgrass; steep south-facing slopes overlooking the Snake and Salmon Rivers)

Daubenmire and Daubenmire (1984) recognize two more habitat types within the *P. ponderosa* series

1. *Stipa comata* (needlegrass)
2. *Purshia tridentata* (bitterbrush)

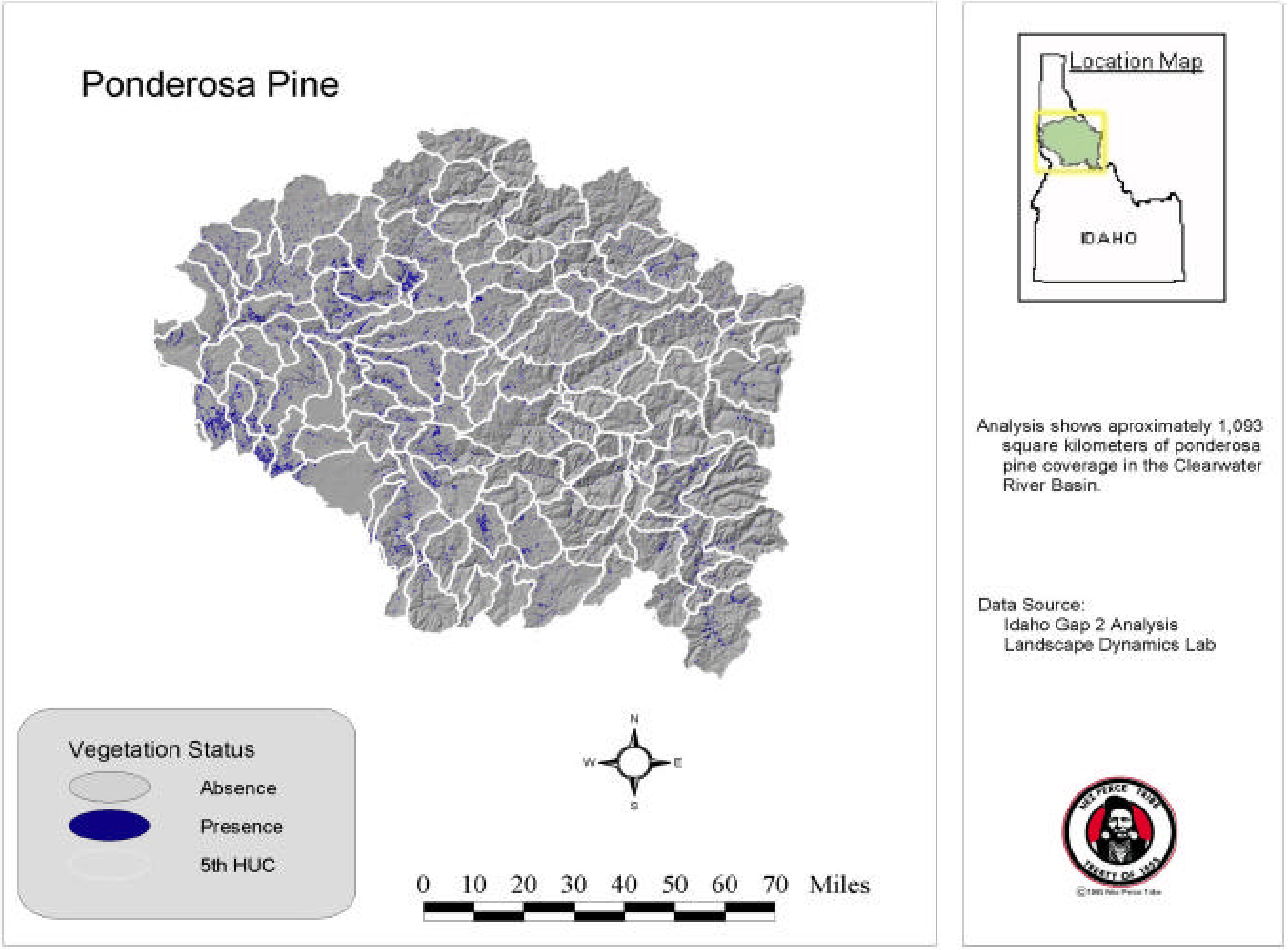

Figure 59. Distribution of the ponderosa pine cover type within the Clearwater subbasin

The successional status of *P. ponderosa* can be expressed by its successional role, which ranges from seral to climax depending on specific site conditions. It plays a climax role on sites toward the extreme limits of its environmental range and becomes increasingly seral with more favorable conditions. On more mezic sites, *P. ponderosa* encounters greater competition and must establish itself opportunistically, and it is usually seral to Douglas-fir and true firs (mainly grand fir and white fir). On severe sites it is climax by default because other species cannot establish. On such sites, establishment is likely to be highly dependent upon the cyclical nature of large seed crops and favorable weather conditions (Steele 1988).

Ponderosa pine has many fire resistant characteristics. Seedlings and saplings are often able to withstand fire. Pole sized and larger trees are protected from the high temperatures of fire by thick, insulative bark, and meristems are protected by the surrounding needles and bud scales. Other aspects of the pine's growth patterns help in temperature resistance. Lower branches fall off the trunk of the tree, and fire caused by the fuels in the understory will usually not reach the upper branches. *P. ponderosa* is more vulnerable to fire at more mesic sites where other conifers as *Pseudotsuga menziesii*, and *Abies grandis* form dense understories that can carry fire upward to the overstory. Ponderosa pine seedlings germinate more rapidly when a fire has cleared the grass and the forest floor of litter, leaving only mineral rich soil. (Fischer and Bradley 1987)

Wildlife and Cultural Values

Pacific ponderosa pine needles, cones, buds, pollen, twigs, seeds, and associated fungi and insects provide food for many species of birds and mammals (Evans 1988). Small mammals that eat stems and roots include deer mice, chipmunks, shrews, voles, and tree and ground squirrels. Large browse mammals including elk, deer, bighorn sheep, porcupines, hares, and rabbits will occasionally browse on stems and bark during times of food or water scarcity. Many bird species eat pacific ponderosa pine seeds. These include the junco, Cassin's finch, pine siskin, evening grosbeak, varied thrush, Clark's nutcracker, and a host of sparrows, chickadees, and other passerines (Howard 2001).

At each stage of growth, *P. ponderosa* provides numerous species of birds and mammals with shelter. As seedlings they provide low ground cover for small birds and mammals. Upon reaching pole size, stands provide good windbreaks and thickets important as hiding cover for larger mammals such as elk and deer. Mature trees and standing snags house arboreal species, while fallen logs and stumps provide many cavity dwelling species with adequate shelter (Hessel 1988).

Threats and Limiting Factors

P. ponderosa is shade intolerant and grows most rapidly in near full sunlight (Franklin and Dyrness 1973; Atzet and Wheeler 1984). Logging is usually done by a selection-cut method. Older trees are taken first, leaving younger, more vigorous trees as growing stock. This effectively regresses succession to earlier seral stages and eliminates climax, or old growth, conditions. Logging also impacts understory species by machine trampling or burial by slash. Clearcutting generally results in dominance by understory species present before logging, with invading species playing only a minor role in post logging succession (Atzet and Wheeler 1984).

Approximately 200 insect species may affect *P. ponderosa* from its cone stage to maturity (Schmid 1988 cited in Howard 2001). The effects of insect damage are decreased seed and seedling production, reforestation failures or delays, and reduction of potential timber productivity (Schmid 1988 cited in Howard 2001). Several insect species destroy seeds before they germinate, the most damaging being the ponderosa pine cone beetle (*Conophthorus ponderosae*) and the pine seed chalcid (*Megastigmus albifrons*). Seedlings and saplings are deformed by tip moths (*Rhyacionia bushnelli*), shoot borers (*Eucosma sonomana*), and budworms (*Choristoneura lambertiana*). Two major lepidopteran pests, the pine butterfly (*Neophasia menapia*) and Pandora moth (*Coloradia pandora*), severely defoliate their hosts causing growth reductions. Extensive mortality in defoliated stands usually results from simultaneous infestations by bark beetles. Bark beetles, primarily of the genus *Dendroctonus* and *Ips*, kill thousands of pines annually and are the major mortality factor in commercial saw timber stands. (Schmid 1988 cited in Howard 2001).

Many diseases affect Pacific ponderosa pine. Parasites, root diseases, rusts, trunk decays, and needle and twig blights cause significant damage. Dwarf mistletoe causes the most damage. A major root disease of pine is caused by white stringy root rot (*Fomes annosus*) and is often found in concert with bark beetle infestations. Western gall rust (*Endocronartium harknessii*), limb rust (*Peridermium filamentosum*), and comandra blister rust (*Cronartium comandrae*) cause damage only in localized areas. Various silvicultural treatments can minimize damage caused by dwarf mistletoe. Clearcutting is used only if regeneration is not a problem. The pruning of branches and witches brooms, fertilization, watering, and the planting of nonsusceptible species also aid in combating dwarf mistletoe (Hawksworth et al. 1988 cited in Howard 2001).

Domestic livestock heavily graze *P. ponderosa* stands at the edge of grassland communities. Heavy grazing induces effects opposite those of fire. Removal of the grass cover by grazing tends to favor shrub communities. Eventually, cheatgrass (*Bromus* spp.) will move in on the disturbed site along with invading shrubs (Agee 1993), eventually changing the fire regime of these stands.

5.5.9 Whitebark Pine

Physical Description

P. albicaulis is a slow growing, long lived, ectomycorrhizal, native conifer and grows on dry rocky sites on high mountains between 6,000 and 10,000 feet (1,800 and 3,030 m). Characteristic of treeline vegetation, it forms dense krummholz thickets and grows in isolated cushions of "alpine scrub" where the trees are usually dwarfed or contorted (Arno and Huff 1990). Cool summers and cold winters with deep snowpack characterize the climate. Trees have high frost resistance and low shade tolerance and often reach 400 to 700 years of age. Trees in well developed stands are 50 to 70 feet (15-20 m) tall and 24 to 36 inches (60-90 cm) in DBH. (Forcella 1978; Forcella and Weaver 1977).

Ecology and Distribution

Pinus albicaulis is a hardy subalpine conifer that tolerates poor soils, steep slopes, windy exposures and treeline environments. Eastern populations occur southward from central Alberta, Canada, and follow the northern Rocky Mountains south into western Montana and central Idaho, and finally into the Wyoming Basin range. Whitebark pine does not occur south of the Wyoming Basin (Tomback et al. 2001). In the Clearwater subbasin, *P. albicaulis* is confined to the higher altitudes and is present in patches on the subbasin's perimeter (Figure 60). Based on GAP data, 42 km^2 of the *P. albicaulis* cover type occur in the Clearwater subbasin (Table 34).

In western North America, *P. albicaulis* is a dominant or co-dominant species in many high elevation forests. In the Rocky Mountains, eastern Cascades, and Blue Mountains, it is a minor component in mixed stands of Engelmann spruce and subalpine fir.

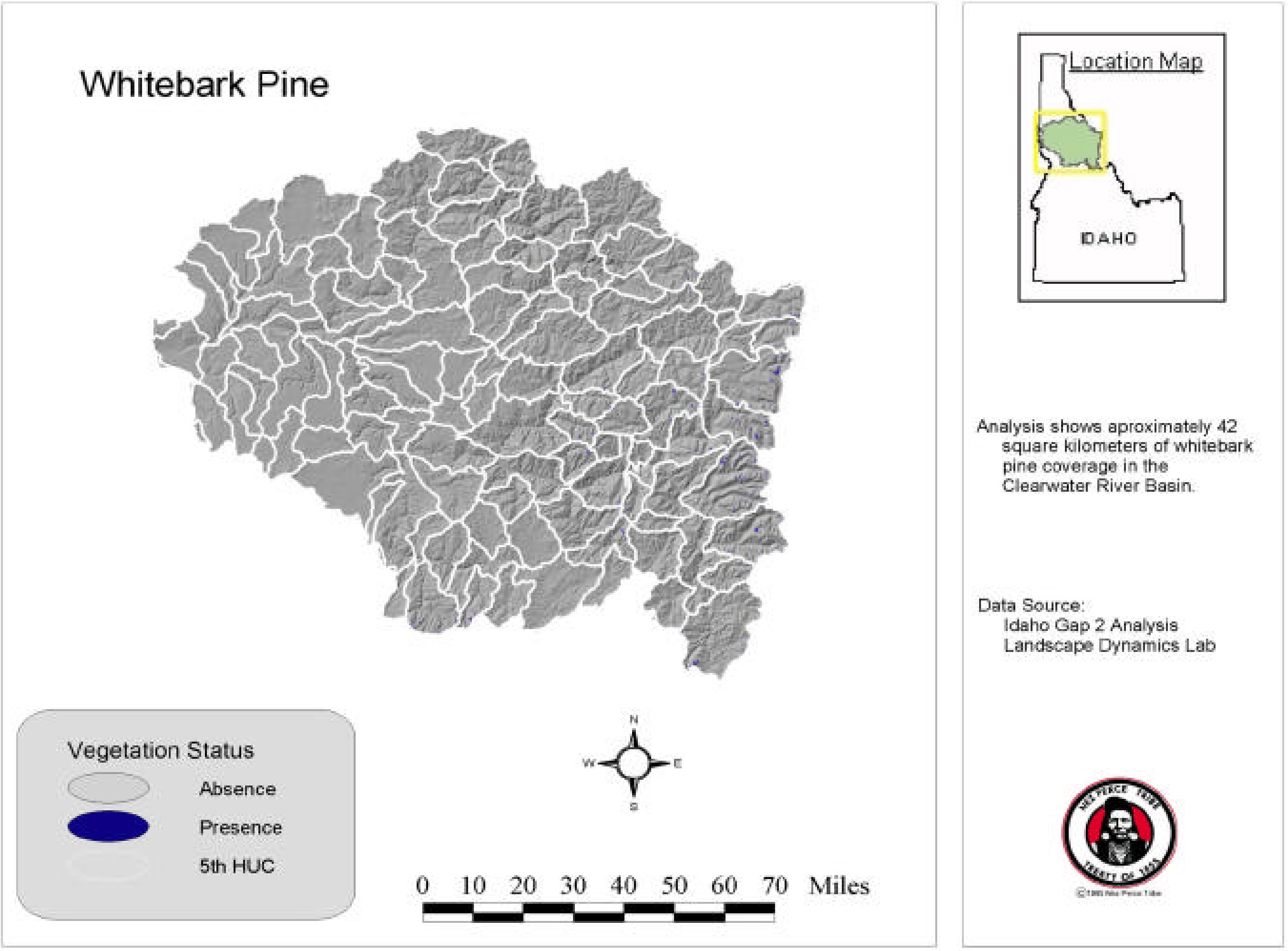

Figure 60. Distribution of the whitebark pine cover type within the Clearwater subbasin

Cooper, et al. (1991) groups *P. albicaulus* with *Abies lasiocarpa* communities because of lack of data. They recognize differences in undergrowth as related to aspect. On windward, dry sites the undergrowth is dominated by grasses, *Juncus parryi* (Parry's rush), and scattered forbs. On sites protected from the wind and moist slopes, the undergrowth consists of *Arnica latifolia* (mountain arnica), *Vaccinium scoparium* (grouse whortleberry), *Luzula hitchcockii* (smooth woodrush), with *Phyllodoce empetriformis* (red mountain heather) and *Cassiope mertensiana* (western moss heather) becoming more dominant north of the Nez Perce National Forest.

In upper elevation subalpine forests, *P. albicaulis* is generally seral and is replaced by more shade tolerant trees. Subalpine fir, a very shade tolerant species, is the most abundant associate and most serious competitor of whitebark pine. Although whitebark pine is more shade tolerant than lodgepole pine and subalpine larch (*Larix lyallii*), it is less shade tolerant than Engelmann spruce and mountain hemlock. Whitebark pine is the potential climax species on high exposed treeline sites and exceptionally dry sites. It sometimes acts as a pioneer species in the invasion of meadows and burned areas. On dry, wind exposed sites, the regeneration of whitebark pine may require several decades, even though it is often the first tree to become established (Ahlenslager 1987).

The resilient seedlings of *P. albicaulis* are more tolerant of exposed sites and droughts than other associated conifers. The seedlings have thick stems and develop deep taproots rapidly. The distribution of seral whitebark pine is strongly affected by the dispersal of seeds by Clark's nutcrackers into disturbed, open areas such as burns and clearcuts. The fact that bird dispersion of seed can occur 8 kilometers from the seed source (Tomback et al. 2001), allows whitebark pine to be widespread as a seral species (Steele et al. 1983).

The vulnerability of whitebark pine to fire is reduced by the open structure of its stands and the dry, exposed habitats with meager undergrowth where it grows. Whitebark pine is favored by severe, stand replacing fires that burn shade-tolerant associated trees. Where succession to shade-tolerant species is relatively rapid, fires are important in moist sites for whitebark pine perpetuation. With the lengthening of fire intervals, older stands become more susceptible to pine beetle epidemics, which advance succession toward dominance by shade tolerant species. In addition, fire may stimulate the growth of currents and gooseberries, the alternate hosts for white pine blister rust, spreading of the rust into whitebark pine trees (Arno 1986).

In the last 100 yrs, there has been a 45% loss of habitat types where whitebark pine is a seral species. Historically, fires used to create the mosaic openings that this species thrives in. In recent times ponderosa pine and whitebark pine communities have burned less than half of presettlement wildfire acreages. In the Clearwater National Forest most of the whitebark pine communities are located in the North Fork Ranger District and in the Powell Ranger District. Two historic whitebark pine sites were destroyed in the Clearwater National Forest after the fire of 1910. The fire was so extensive that not enough trees were left to supply a seed bank for regeneration (USFS 1997). Whitebark pine distribution in the Selway-Bitterroot Wilderness was greatly reduced between 1909 and 1940 due to a mountain pine beetle infestation. A 45% decline has occurred in whitebark pine distribution from historical coverage. About 98% of historical whitebark pine seral cover is now occupied by lodgepole pine and subalpine fir (Keane 1995). Current levels of coverage are estimated at 20-40% of historic levels (USFWS 2000c).

Wildlife and Cultural Values

The distribution of whitebark pine is strongly influenced by Clark's nutcrackers, which are important in the dispersal of seeds and establishment of seedlings (Ahlenslager 1987). Whitebark pine trees commonly have two or more trunks,often partially fused at the base. Electrophoretic evidence reveals that two or more trunks of what appears to be a single tree are indeed separate trees with distinct genotypes. This supports the idea that several mature trees can arise from single seed caches and that seeds cached by Clark's nutcrackers are instrumental in the establishment of trees (Weaver and Dale 1974). Clark's nutcrackers are also effective dispersers of seeds because of the amount of seed they carry. A nutcracker may carry as much as 150 seeds in its sublingual throat pouch and can store 850 seeds per day, usually in caches of four to five seeds. Over a 42 day period one bird may cache 32,000 seeds. They bury the seeds to 1.2 inches (3 cm) in depth, which is suitable for germination. Nutcrackers store three to five times their energetic requirements, so more seeds are buried than are recovered. These seeds, along with abandoned caches, can germinate and produce new trees (Tomback 1981).

Besides Clark's nutcrackers, other vertebrates also harvest, feed on, and cache whitebark pine seeds. However, they do not possess the behavior to systematically disperse and cache the seeds. Rodents disperse fewer seeds than nutcrackers, in shorter distances from parent trees and in sites less suitable for germination. Also, seed caches of rodents are larger and have lower potential for successful tree establishment. In addition, not many seeds are left to germinate from rodent caches because the olfactory sense of rodents allows them to find and use caches more efficiently than nutcrackers (Arno and Huff 1990, Tomback 1981).

Bears in the Yellowstone area regularly eat pine seeds in the spring and fall. Most whitebark pine seed eaten by grizzly and black bears are from red squirrel cone caches. Rodents, such as red squirrels, Douglas squirrels, ground squirrels and chipmunks, store large quantities of intact cones in middens at the base of trees or underground in caches. Although deer mice cannot gnaw the cones, they eat and cache loose seeds (Tomback 1982).

The foliage of whitebark pine is not browsed to any extent by animals. Blue grouse do eat the buds and needles of *P. albicaulis* in the winter (Ahlenslager 1987).

Whitebark pine survives where tree growth is limited and provides hiding and thermal cover for wildlife (Kendall and Arno 1990). Cavity-nesting birds use tree trunks and snags. Mule deer, elk, and predatory animals also use whitebark habitat (Tomback 1981).

Threats and Limiting Factors

Fire exclusion has reduced the frequency of fires in subalpine areas, resulting in the successional replacement of *P. albicaulis* by more shade tolerant tree species. Species of dwarf mistletoe that parasitize whitebark pine can kill healthy trees. Fire exclusion provides the means for dwarf mistletoe to disperse, affecting other trees (Tomback et al. 2001).

Mountain pine beetles attack mature whitebark pine leading to the mortality of healthy trees with inner bark thick enough to support beetle larvae. Infestation occurs from an upward dispersal of beetles after takeover of *P. contortus* stands (Tomback et al. 2001).

White pine blister rust has probably caused heavy *P. albicaulis* mortality in some areas. Extensive “ghost forests” on the wettest sites have weathered, large diameter *P. albicaulis* snags that are likely remnants of the 1911-1942 mountain pine beetle outbreak. Blister rust damage has caused a reduction in whitebark pine populations in Idaho and Washington. The rust kills the branches of pine trees, ending any cone production, and causing widespread mortality (Tomback et al. 2001). Heartrot (i.e., *Echinodontium tinctorium*) is high in stands over 100 years old (Cooper et al. 1991).

Regeneration of whitebark pine is sporadic. Eggers (1986), reported that in the Rocky Mountains seeds that do survive have low germination rates.

5.5.10 Aspen

Physical Description

Quaking aspen is a native deciduous tree. It is small to medium sized, typically less than 48 feet (15 m) in height and 16 inches (40 cm) dbh (Hickman 1993). It has spreading branches and a pyramidal or rounded crown (Gleason and Cronquist 1981). The bark is thin. Leaves are orbiculate to ovately shaped, with flattened petioles (Kay 1993). The fruit is a tufted capsule bearing six to eight seeds. A single female catkin usually bears 70 to 100 capsules. The root system is relatively shallow, with widespreading lateral roots and vertical sinker roots descending from the laterals. Laterals may extend over 100 feet (30 m) into open areas (Jones et al. 1985).

Ecology and Distribution

Quaking aspen (*P. tremuloides*) is the most widely distributed tree in North America (Muegler 1988). It occurs from the eastern coastline to Alaska, and south through the Rocky Mountains. In the west, aspen grows on mountainous and high plateaus in mesic sites, and primarily in riparian areas in more xeric sites. Distribution is patchy, with trees confined to suitable sites, except in Colorado where 75% of all the aspen coverage occurs (Bartos 2001).

In the Clearwater subbasin, aspen intermixes with conifers in various moist sites (Figure 61). Aspen exists in three different conditions. The first is a stable condition, where the aspen sites consist of healthy, reproducing trees called clones. Representative stable sites have mature trees usually surrounded by younger regeneration. In the second condition, aspen are successional to conifers. Because aspen is considered a disturbance species, conifers will eventually take over in the absence of disturbance such as fire or disease. The third condition of aspen existence consists of decadent clones, where little regeneration occurs and the mature trees are deteriorating.

Aspen is a major cover type in North America and it is listed as a dominant species in over 100 habitat, plant community, and vegetation typings. Aspen also occurs in a large number of other forest cover types over its extensive range. In one association occurring in the west, aspen alternates dominance with Douglas hawthorn (*Crataegus douglasii*) and grows through the Douglas hawthorn overstory, resulting in reduced vigor of Douglas hawthorn. Quaking aspen eventually dies back, releasing Douglas hawthorn in the understory (Franklin and Dryrness 1973). Aspen/conifer associations comprise of over 94 square kilometers in the Clearwater subbasin according to GAP data (Table 34).

Quaking aspen forms clones connected by a common parent root system. It is typically dieocious, with a given clone being either male or female. Some clones produce both stamens and pistils, however (Jones et al. 1985). Quaking aspen stands may consist of a single clone or aggregates of clones (Welsh et al. 1987). In the West, quaking aspen stands are often even-aged, originating after a single top-killing event. Aboveground stems may live up to 150 years (Johnston and Hendzel 1985). Clones are generally limited to fringes around meadows or as islands on ridgetops where sufficient moisture sustains them in the growing season (Johnson and Simon 1987).

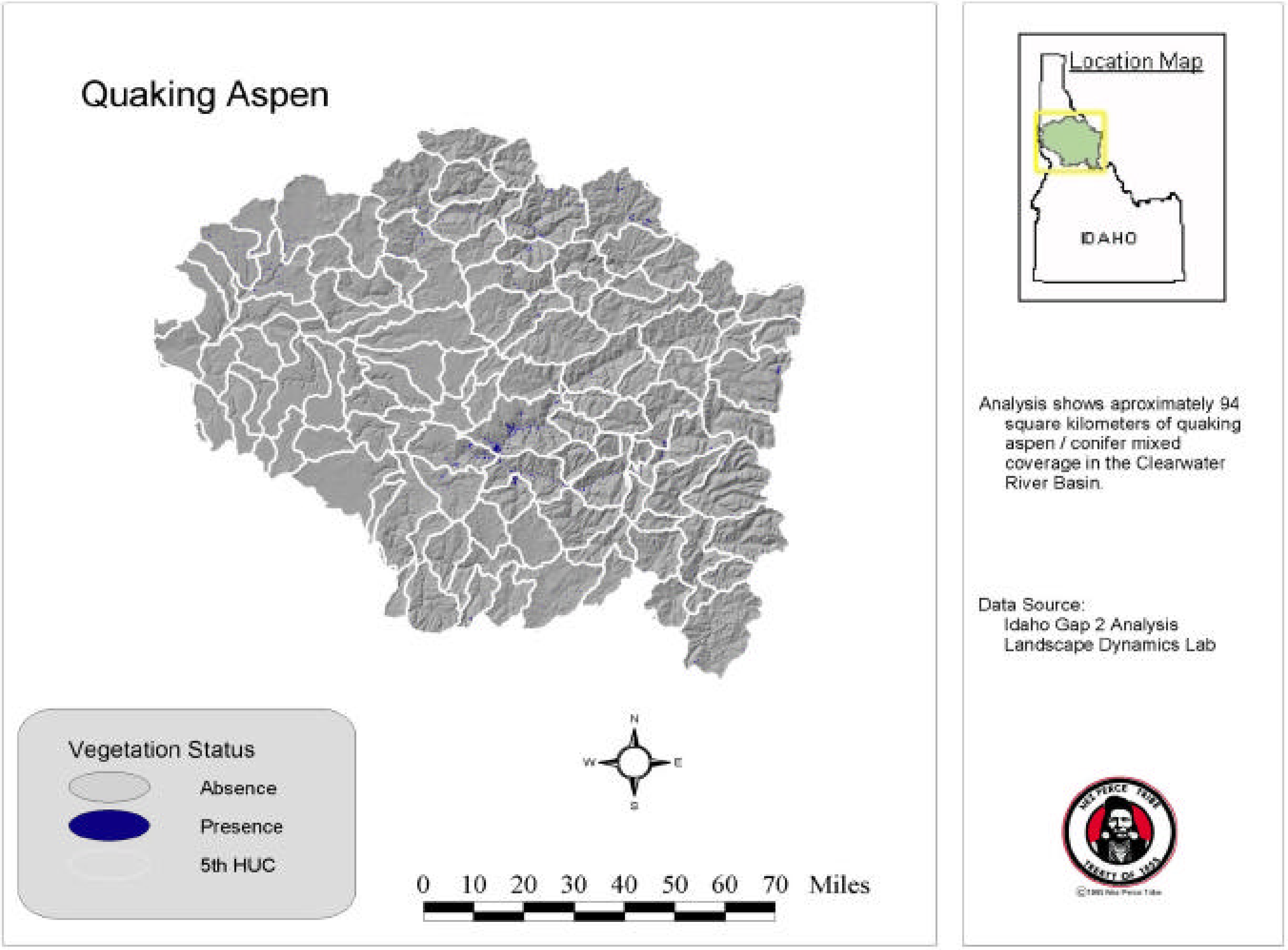

Figure 61. Distribution of the aspen/conifer mixed cover type within the Clearwater subbasin

Aspen is shade intolerant and cannot reproduce beneath its own canopy (Brinkman and Roe 1975). Beyond that, no single, generalized pattern of succession occurs. Quaking aspen is seral to conifers in most of its range in the West, and in some portions of its eastern range. Where it is seral, quaking aspen usually persists as a minor tree in late seral stages (Lavertu et al. 1994). The most apparent climax conditions are stands that occur below the lower limits of conifers and occupy the concave slopes of low hills. These sites can be found in small vicinities bordering the Camas Prairie (Steele et al. 1981).

If quaking aspen does not remain stable, rate of succession to other species varies with with soil, site, and invading species (Harniss 1981). Succession to conifers may occur in a single generation, or take longer than 1,000 years (Mueggler 1985). Quaking aspen is apparently stable on some sites, especially in parts of Canada and the West. Some stands, however, remain stable for decades but eventually deteriorate. Deteriorating stands are often succeeded by conifers, but shrubs, grasses, and/or forbs gain dominance on some sites. Succession to grasses and forbs is more likely on dry sites and is more common in the West than in the East (Harniss 1981). The abundance of aspen in the west is believed to be the result of prevalent, historic fire activity (Muegler 1988). Quaking aspen readily colonizes after fire, clearcutting, or other disturbance (Perala 1990).

Wildlife and Cultural Values

Quaking aspen forests provide important breeding, foraging, and resting habitat for a variety of birds and mammals. Wildlife and livestock utilization of quaking aspen communities varies with species composition of the understory and relative age of the quaking aspen stand. Young stands generally provide the most browse. Quaking aspen crowns can grow out of reach of large ungulates in 6 to 8 years (Patton and Jones 1977). Although many animals browse quaking aspen year round, it is especially valuable during fall and winter, when protein levels are high relative to other browse species (Tew 1970). Aspen is important as cover and forage for elk, moose, mule deer and white-tailed deer. Deer browse quaking aspen year round in much of the West, feeding on bark, branch apices, and sprouts. In some areas, elk use it mainly in winter (Patton and Jones 1987). Moose utilize it on summer and winter ranges for browse and cover. Deer consume the leaves, buds, twigs, bark, and sprouts. New growth on burns or clearcuts is especially palatable to deer (DeByle 1985). Wild and domestic ungulates use quaking aspen for summer shade, and quaking aspen provides some thermal cover for ungulates in winter. Seral quaking aspen communities provide excellent hiding cover for moose, elk, and deer. Deer use quaking aspen stands for fawning grounds in the West (Howard 1996).

Black bears and grizzly bears feed on forbs and berry producing shrubs in quaking aspen understories. Quaking aspen forests in Alberta provide excellent denning and foraging sites for black bear (DeByle 1985).

Rabbits and hares feed on quaking aspen in summer and winter. In winter, snowshoe hare and cottontail rabbits eat quaking aspen buds, twigs, and bark. Snowshoe hare use it for hiding and resting cover in summer (DeByle 1985). Pikas also feed on quaking aspen buds, twigs, and bark. Lagomorphs may girdle suckers or even mature trees (Howard 1996). Small rodents such as squirrels, pocket gophers, mice, and voles feed on quaking aspen during at least part of the year, and can frequently consume quaking aspen bark below snow level, and can girdle suckers and small trees (DeByle 1985). Small mammal populations in quaking aspen generally fluctuate widely with stand age and annual variation in animal population size. Highest densities typically occur in mature quaking aspen stands. Field mice (*Peromyscus* spp.), for example, are most abundant in mature quaking aspen communities (Howard 1996).

Quaking aspen provides food for porcupine in winter and spring. In winter, porcupines eat the smooth outer bark of the upper trunk and branches. Porcupine girdling of quaking aspen can kill large tracts of merchantable trees. In spring, porcupines eat quaking aspen buds and twigs (DeByle 1985).

Beavers comsume the leaves, bark, twigs, and all diameters of quaking aspen branches. They use quaking aspen stems for constructing dams and lodges. At least temporarily, beavers can eliminate quaking aspen from as far as 400 feet (122 m) from waterways. An individual beaver consumes 2 to 4 pounds (1-2 kg) of quaking aspen bark daily, and it is estimated that as many as 200 quaking aspen stems are required to support one beaver for a 1-year period.

Quaking aspen communities provide important cover, feeding and nesting sites for a diverse array of birds (DeByle 1981). Bird species using quaking aspen habitat include sandhill crane, western wood pewee, six species of ducks, blue, ruffed, and sharp-tailed grouse, band-tailed pigeon, mourning dove, wild turkey, red-breasted nuthatch, and pine siskin. Quaking aspen is host to a variety of insects that are food for woodpeckers and sapsuckers (DeByle 1985). Many bird species utilize quaking aspen communities of only a particular seral stage. Research at a northern Utah site suggests that blue grouse, yellow-rumped warbler, warbling vireo, dark-eyed junco, house wren, and hermit thrush prefer mature quaking aspen stands. The MacGillivray's warbler, chipping and song sparrows, and lazuli bunting occurred in younger stands. Bluebirds, tree swallow, pine siskin, yellow-bellied sapsucker, and black-headed grosbeak favor quaking aspen community edges (DeByle 1981).

The ruffed grouse depends on quaking aspen for cover, foraging, courting, breeding, and nesting sites. Through most of its range, it uses quaking aspen communities of all ages. Ruffed grouse chicks find protection in dense, young aspen suckers as early as 1 year after fire or other disturbance. Quaking aspen buds, catkins, and leaves provide an abundant and nutritious, yearlong food source for ruffed grouse (Gullion and Svovoda 1972). Snow tends to accumulate earlier and deeper in quaking aspen than in adjacent conifer stands, and ruffed grouse use the deep snow for burrowing cover in winter (Perala 1977).

Aspen’s undergrowth vegetation is considered prime grazing for domestic livestock. Some sources consider aspen to be a keystone species, suggesting that it is an indicator of range conditions and important for the ecological integrity of a landscape (Bartos 2001).

Threats and Limiting Factors

Aspen regeneration depends on the amount of disturbance and the time between disturbances in a certain area. Fire establishes new stands of aspen by burning forest litter and exposing mineral soil for aspen seeds. In the exclusion of fire, sprouting shoot numbers remain low and most are consumed by domestic and wild ungulates (Manier and Laven 2001). The decline in acreage of aspen in some areas of the western United States is reported to be 50%, and up to as high as 95% in some areas (Bartos 2001, Table 35).

Table 35. Historical/Current acres of aspen in interior west (Rocky Mountain Research Station)

Area	Current Aspen	Historical Aspen	Decline (%)
Colorado	1,110,764	2,188,003	49
Utah	1,427,973	2,930,684	51
New Mexico	140,227	1,141,677	88
Wyoming	203,965	436,460	53
Arizona	29,009	720,880	96
Idaho	621,520	1,609,547	61
Montana	211,046	590,674	64
Nevada	118,768	-	-
Total	3,863,272	9,617,925	60

Abiotic factors, animals, and insects easily wound Aspen's soft bark, allowing disease organisms to invade. In some areas of the Rocky Mountains, for example, elk gnaw extensively on the bark, leading to rapid deterioration of the stand. However, canker diseases are by far the most serious causes of tree mortality. Canker diseases are among the primary agents in creating snags and creating infection sites for decay fungi. In turn, standing "dead and down" woody material provides biological diversity in stands and serves as habitat for cavity-nesting animals and birds. Endemic levels of infection by these organisms are essential to maintaining a balanced ecosystem and serve an important role in the dynamics and ecology of aspen stands (Walters et al. 1982). Some of the major cankers infesting quaking aspen are sooty-bark canker (*Encoelia pruinosa*), cryptosphaeria canker (*Cryptosphaeria populina*), black canker (*Ceratocystis fimbriata*), cytospora canker (*Cytospora chrysosperma*), and hypoxylon canker (*Hypoxylon mammatum*)(Hawksworth et al. 1985).

5.5.11 Black Cottonwood

Physical Description

Black cottonwood (*Populus trichocarpa*) is a native, deciduous tree. It typically has a straight, branch-free trunk for more than half its length and a broad, open crown (Arno and Hammerly 1977). Black cottonwood is the largest American poplar and the largest hardwood tree in western North America. Maximum height and size at maturity (60 to 75 years of age) vary according to geographic location. Heights up to 98 feet (30 m) in the North Central Plains, up to 164 feet (50 m) in southwestern Montana, and up to 197 feet (60 m) in California and the Pacific Northwest have been recorded. Trunks may reach 5 feet in diameter. The grey bark of mature trees is deeply furrowed; young bark is smooth and greenish yellow to grey (Arno and Hammerly 1977).

Ecology and Distribution

The range of black cottonwood extends from Kodiak Island in Alaska, south through Oregon, and into the mountains of southern California and northern Baja California. Its eastern reaches include Utah, Nevada, Wyoming, and North Dakota (Lanner 1983). In the Clearwater subbasin, black cottonwood often forms extensive stands on alluvial sites, riparian habitats, and moist woods on mountain slopes (Figure 62). On riparian and bottomland sites it is often associated with willows, such as Pacific willow (*Salix lasiandra*), Scouler willow (*S. scouleriana*), northwest willow (*S. sessilifolia*), and river willow (*S. fluviatilis*).

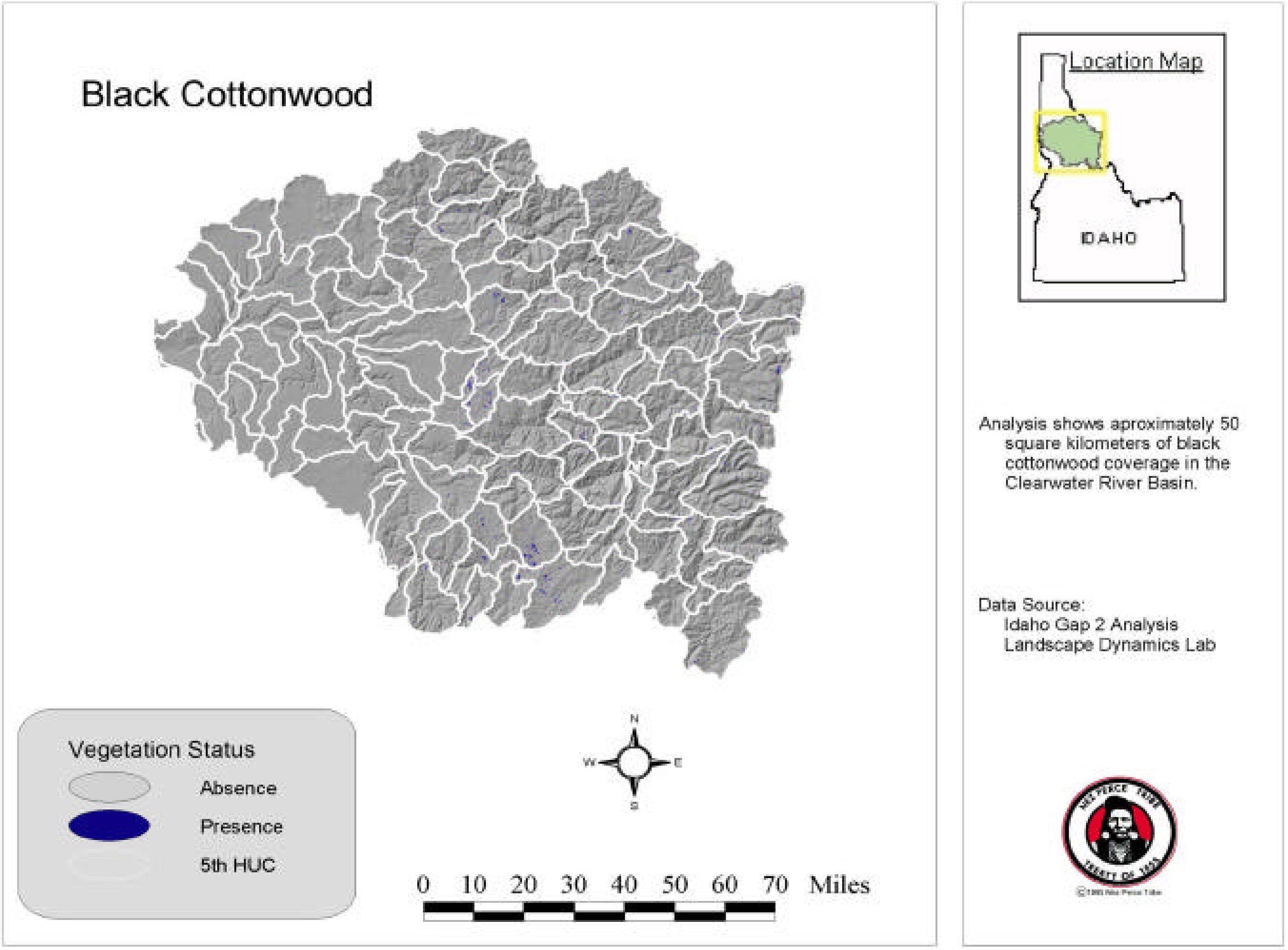

Figure 62. Distribution of the black cottonwood cover type within the Clearwater subbasin

In interior forests, overstory associates may include ponderosa pine, western white pine, white fir, and western larch (Roe 1958). Most black cottonwood sites are characterized by salmonberry (*Rubus spectabilis*), nettles (*Urtica* spp. and *Stachys* spp.), swordfern (*Polystichum munitum*), ladyfern (*Athyrium filix-femina*), beaked hazel (*Corylus cornuta*), and elder (*Sambucus* spp.). Red osier dogwood (*Cornus stolonifera*), honeysuckles (*Lonicera* spp), and common snowberry are common on medium quality sites. Poor sites are usually subject to prolonged flooding with horsetails (*Equisetum* spp.) as a dominant.

Asherin and Orme (1978) suggest that a *P. trichocarpa/Rosa woodsii* community type occurs on the lower Clearwater River and at the mouths of the major tributaries, and intermittently in riparian vegetation between. The tributaries create broad, flat flood plains consisting of a sand and gravel substrate ideal for cottonwood growth. Black cottonwood is the dominant overstory tree with white alder present as a seral species in some areas. The usually disturbed understory can consist of Woods rose (*Rosa woodsii*), poison ivy (*Toxicodendron radicans*), black hawthorn (*Crataegus douglasii*) as a shrubby layer, with grasses such as cheatgrass and Kentucky bluegrass (*Poa pratensis*), and forbs such as stalky berula (*Berula erecta*), miner's lettuce (*Montia perfoliata*), red sorrel (*Rumex acetosella*), and goldenrod (*Solidago canadensis*). Based on GAP data, around 50 square kilometers of *P. trichocarpa* coverage occurs in the Clearwater subbasin (Table 34).

Black cottonwood is a pioneer species that commonly establishes on recently disturbed alluvium. It is classed as very intolerant of shade and grows best in full sunlight. On moist lowland sites, initial growth of black cottonwood is rapid, which allows it to survive competition from slower growing associated species. Maintainence of communities dominated or co-dominated by cottonwood depends on periodic flooding or other types of soil disturbance. In the absence of disturbance, succession proceeds, and black cottonwood is eventually replaced by more shade tolerant species (Maini 1968).

Wildlife and Cultural Values

Black cottonwood stands provide forage for livestock, and provide food, cover, and shade for a variety of wildlife species. Deer and elk use of black cottonwood may be high, depending on site and season (Hansen et al. 1989). The crowns of black cottonwood provide nesting sites for bald eagles, ospreys, and blue herons. Woodpeckers, great horned owls, wood ducks, flying squirrels, raccoons, and a variety of songbirds nest in black cottonwood trunk cavities. Beavers use black cottonwood for food and building materials. The rotten trunks of black cottonwood are also important as wildlife habitat, especially east of the Cascades where other large rotten trees may be scarce (Arno and Hammerly 1977).

Streamside black cottonwoods contribute to favorable fish habitat by reducing streambank erosion and siltation, maintaining low water temperatures through shading, and periodically adding debris to the stream (Hansen et al. 1989). Black cottonwood has been used successfully in the restoration of riparian areas. The roots of established plants are effective soil stabilizers and provide valuable streambank and erosion protection (Hansen, et al. 1988).

Threats and Limiting Factors

Black cottonwood is highly susceptible to fire damage because of its thin bark and shallow root system. After 10 to 20 years, the bark may become thick enough to afford some fire protection. Seedlings and saplings are usually killed by fire of any intensity. Mature trees may survive low-intensity fires, and portions of the plant may survive fires of moderate intensity. Trees of all ages are killed by high intensity fire. Fire wounds on mature trees, acting as points of entry, may facilitate the onset of heartwood decay, which can lead to substantial mortality (Roe 1958). Black cottonwood can sprout from the stump following top-kill by fire. Fire can create conditions favorable for seedling establishment. It thins the overstory, allowing light to penetrate, and exposes bare mineral soil. Postfire establishment via offsite seed is possible if soil moisture is adequate (Roe 1958).

Like most riparian species, black cottonwood is susceptible to grazing impacts. Several insects attack black cottonwood, but none has yet been reported as a pest of economic significance (Furniss and Carolin 1977). At least 70 fungal species cause decay in cottonwood, but only six fungi cause significant losses. Two of these, *Spongipellis delectans* and *Pholiota destruens*, cause 92 percent of the loss (Hepting 1971). A leaf rust (*Melampsora* spp.) has been observed in young plantations and susceptibility to the rust appears to vary greatly across the geographic range of the species. This disease limits photosynthesis and causes leaves to fall prematurely, thus decreasing tree growth and vigor. Black cottonwood is also subject to the condition known as wet wood, which leads to wood collapse during drying. Black cottonwood saplings are often injured and sometimes killed by unseasonably early or late frosts. When dormant, however, it is one of the most frost resistant trees in the northwestern United States. Ice storms, heavy snow, and wind can cause considerable damage to black cottonwood (Roe 1958).

5.5.12 Mountain Meadows

Physical Description

Mountain meadows are found throughout the Pacific Northwest and exist amid mixed conifer forest habitats and alpine regions. In the Clearwater subbasin, meadows can be characterized as either a complex of well-drained areas, or as areas of periodically high water tables (Figure 63). The ground layer consists of low matted subshrubs, grasses and sedges, forbs, or soils covered with moss or lichens. The tree layer can be made up of either one dominant species or a mixture of several different tree species (IBIS 2001). Grasses and grasslike species historically dominated in most meadow cover types. A meadow may consist of bunchgrasses (*Festuca* and *Pseudoroegneria* spp.), alpine timothy, bluegrasses, cheatgrasses, squirreltails (*Sitanion* spp.), and sedges such as the *Carex* species. This results in a forest structure that includes an interspersion of wet meadows with forested stands. Mountain meadow habitats consist of tree overstories between 10-30%. A mountain meadow cover type is not recognized in some literature, identifying it as a seral stage in forest cover types (Franklin and Dyrness 1973).

Ecology and Distribution

Based on GAP data, there are 487 square kilometers of mountain meadow cover type in the Clearwater subbasin (Table 34). The climate is cool in the summer, with cold winters characterized by deep snowpacks (IBIS 2001). Western Red Cedar is the dominant overstory component in some stands (Lichthardt 1997). At higher elevations, extensive moist meadow communities persist intermixed with subalpine fir stands. These communities are often referred to as 'parklands' because of their physical appearance. The composition of grassland species within meadow communities varies with landscape conditions (Table 36). Johnson and Simon (1987) classified meadow associations in the Wallowa–Snake province into four types depending on the meadow's attributes.

1. *Ridgetop meadows.* This meadow type is located on flat plateaus. Idaho Fescue and Prairie Junegrass (*Koeleria macrantha*) normally dominate this meadow type, starting out

moist early and drying in the summer. Meadows are rich with forbs and succeptible to grazing from wild and domestic ungulates. This type of meadow usually does not advance past the early seral stages.

2. *Tufted hairgrass/moist sedge meadows.* Can be found near waterways with a vernal moisture supply to roots underground. Tufted hairgrass (*Deschampsia cespitosa*) meadows are often overgrazed because of their nearness to water and richness in preferred forage species. This meadow type is often difficult to identify because it has lost its native sedges and grasses to disturbance.
3. *Tufted hairgrass/wet sedge meadows.* Can be found near waterways with a surface moisture supply present most of the summer. Several species of sedges dominate, with varying forbs present depending on the elevation.
4. *Wet sedge meadows.* Water is present most of the year with only hydric plants surviving. Grasses are infrequent, as are the presence of forbs.

Table 36. Some common vegetation found in mountain meadows in eastern Oregon and Washington, depending on the type of meadow community (Franklin and Dyrness 1973).

Grasses	Sedges, Rushes and Horsetails	Forbs	Shrubs
Deschampsia caespitosa	*Carex scopulorum*	*Ranunculus populago*	*Artemesia tridentata*
Deschampsia atropurperea	*Carex rostrata*	*Polygonum spp.*	*Potentilla fruiticosa*
Phleum pratense	*Carex aquatilis*	*Aster foliaceus*	*Ribes spp.*
Phleum alpinum	*Carex pachystachya*	*Senecio streptanthifolius*	*Phyllodoce empetriformis*
Pseudoroegneria spp.	*Carex misandra*	*Eriogonum spp.*	*Vaccinium scoparium*
Festuca spp.	*Carex geyeri*	*Potentilla glandulosa*	
Danthonia californica	*Carex hoodii*	*Arnica sororia*	
Poa pratensis	*Carex limnophila*	*Wyrthia spp.*	
Bromus carinatus	*Equisetum arvense*	*Trifolium eriocephalum*	
Stipa lettermanii	*Juncus tenuis*	*Senecio vulgaris*	
Stipa occidentalis		*Veratrum californicum*	
Trisetum spicatum		*Gilia nuttallii*	
		Penstemon spp.	
		Phlox spp.	
		Lupinus spp.	
		Arenaria formosa	
		Hieracium gracile	
		Erigeron speciosus	

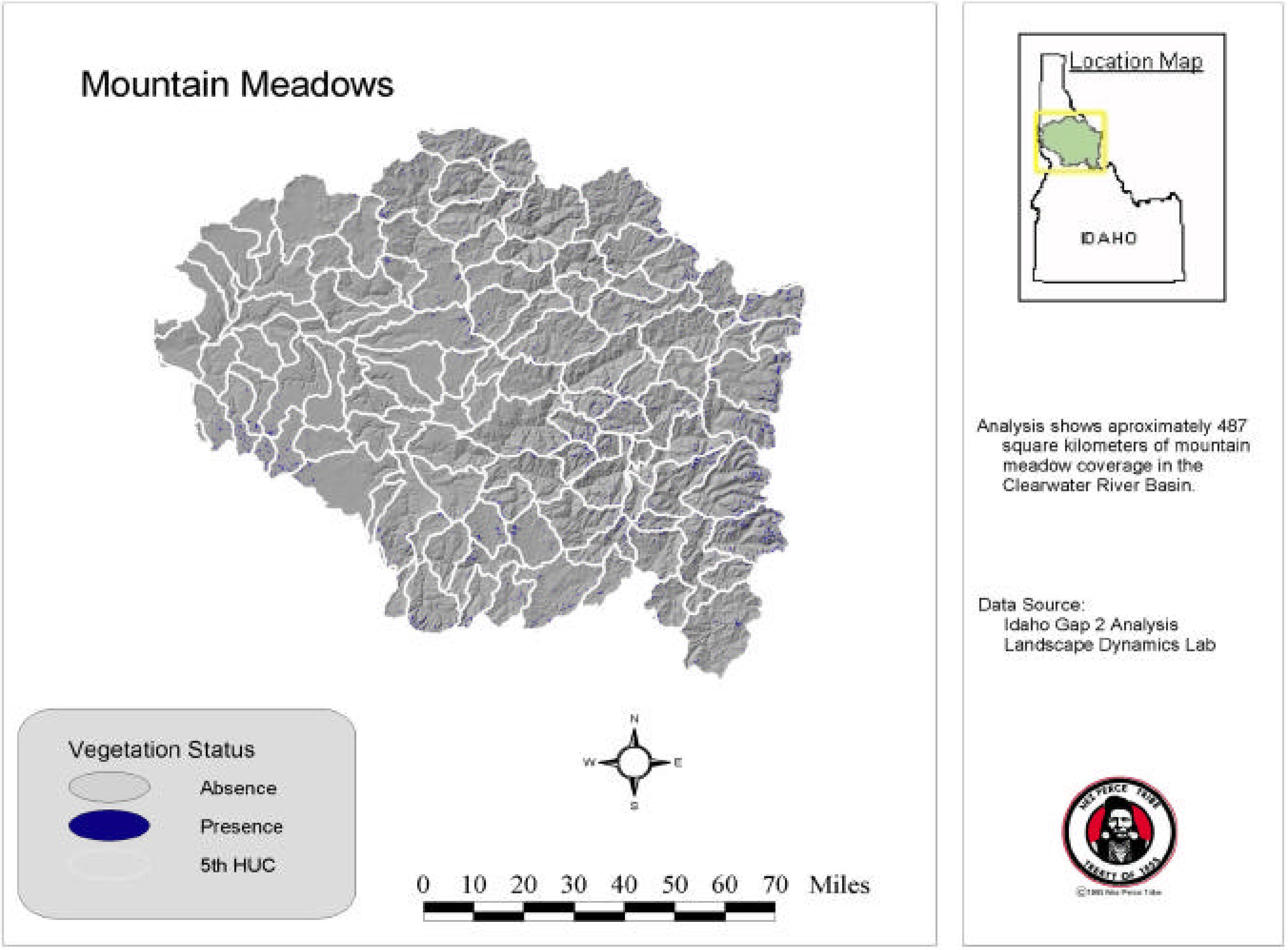

Figure 63. Distribution of the mountain meadow cover type within the Clearwater subbasin

Fire is considered to be an important factor in the creation and maintenance of mountain meadows. Fire can eliminate stands of trees and return the area back to the previous meadow stage. Other historical and environmental factors are also responsible for the present vegetative conditions in mountainous areas (Franklin and Dyrness 1973). Fire is rare in mountain meadow-wetland habitat due to the wet conditions present. The average interval for lethal fires is very infrequent, estimated to be over 300 years, and nonlethal burns occur between 50 to 150 years. Meadow conditions can stop the spreading of severe fires due to their moisture content.

Wildlife and Cultural Values

Mountain meadows provide a rich environment ranging in extent from small glades to extensive grasslands covering thousands of acres, and they provide habitat for a wide range of plant and animal species. High mountain meadows produce abundant wildflowers in late spring and summer. Many insect species take advantage of the tremendous flower bloom. Meadows are rich with forbs and grasses highly palatable to wild ungulates. The largest western mammals such as grizzly bear, black bear, elk, and deer also frequent meadows to forage. Smaller mammals like the meadow mouse (*Microtus* sp.) have populations that sometimes reach densities of several hundred per acre. Predators keeping mice populations in check include hawks, owls, fox, skunks, weasels, minks, badgers, coyotes, and snakes. Yellow-bellied marmots and pikas may be found in and around the outskirts of meadows. Gray wolves utilize mountain meadows extensively for rendezvous sites during mid- to late summer when the pups are still too young to travel great distances.

Threats and Limiting Factors

Succession of meadows occurs gradually through invasion of trees and the upward movement of timberline. The rate of invasion and the overall likelihood of takeover depend on the meadow cover type, as well as climatic factors and disturbance (Franklin and Dyrness 1973). Succession is usually the result of drastic shifts in climate, violent disturbances, and plant species interactions. Changes in temperature, amount of precipitation, and seasonal distribution of precipitation will result in changes in vegetation from year to year (Johnson and Simon 1985).

Most grass dominated meadows have deteriorated due to overgrazing, which leads to mixed grass and weed communities along with a more populated forb layer (Franklin and Dyrness 1973). Leege et al. (1981) found that heavy livestock grazing (season long) resulted in lower productivity and retarded plant succession. The degeneration of meadow vegetation can be expressed in four stages of dominance: perennial grass, mixed grass and forbs, perennial forbs, and annual forbs (Johnson and Simon 1985). Hoof action and compaction may also contribute to long-term changes in hydrology within mesic and wet meadows subjected to overgrazing. Some high elevation meadows have been impacted by recreational activities. Compaction and trampling from camping, recreational vehicle use, and overgrazing by pack and saddle stock have all impacted meadows in heavily used areas.

5.5.13 Herbaceous Wetlands and Riparian Areas

Physical Description

In wetlands, water saturation determines the nature of soil development and the types of plant and animal communities living in the soil and its surface. Wetlands occur as small ponds filled by spring runoff, wet meadows, springs and seeps, bogs, small lakes, and riverine and streamside riparian areas. These areas provide high quality wildlife habitat, water storage, flood abatement, pollution filtration, livestock forage, and water for domestic use (U.S. Geological Survey 1996).

Ecology and Distribution

Wetlands cover only a small portion of the subbasin, but offer some of the most diverse and unique habitats available. They also harbor unique plant species such as Clearwater phlox, which is endemic to only a few wet meadows within the Clearwater subbasin. Historically, the subbasin contained much more herbaceous wetland habitat than it does currently. Analysis by ICBEMP indicated that a large wet meadow complex existed within the Lower Clearwater AU near the present towns of Craigmont, Winchester and Ruebens (Figure 64). These wetlands have been converted to agricultural uses. Present day wetlands are often small and widely scattered (Figure 64).

Wildlife and Cultural Values

Riparian and wetland habitat is extremely important for many wildlife species. The ICBEMP data shows a decrease in wetland habitat from 2.36% of the subbasin historically to 0.04% of the subbasin currently (Table 31). The finer scale GAP data, though, shows slightly less than 2% current wetland or riparian cover. Wetlands are an essential component of habitat for two terrestrial focal species--the western toad and the Coeur d'Alene salamander. Open wetland areas could provide habitat for the extirpated sandhill crane.

Wet meadows provide ideal habitat for camas (*Camassia quamash*), an important staple food for the Nez Perce Indians. Camas bulbs are high in starch and easily stored for winter use. Camas was probably the most widely traded staple food item (besides salmon) among the tribes of the Pacific Northwest (Gunther, 1973). With the loss of wet meadow complexes throughout the prairie grassland region of the Clearwater subbasin, camas has become increasingly difficult to obtain.

Threats and Limiting Factors

Impacts to wetland and riparian communities are difficult to quantify, but some estimates suggest that 56% of Idaho's wetlands have been lost since 1860 (Dahl 1990), largely due to agricultural conversion and urban development (Idaho Department of Parks and Recreation 1987). Within the Clearwater subbasin, large expanses of palustrine wetlands in the Reubens, Craigmont, and Ferdinand areas have been converted to croplands. Remaining wetland communities are often degraded by livestock grazing, road development, urban expansion, and altered hydrologic regimes (U.S. Geological Survey 1996).

Remnant wet meadows are often used as late summer or fall pasture for livestock. Impacts from such use are difficult to qualify but may include soil compaction, reduction in native plant diversity, and noxious weed encroachment.

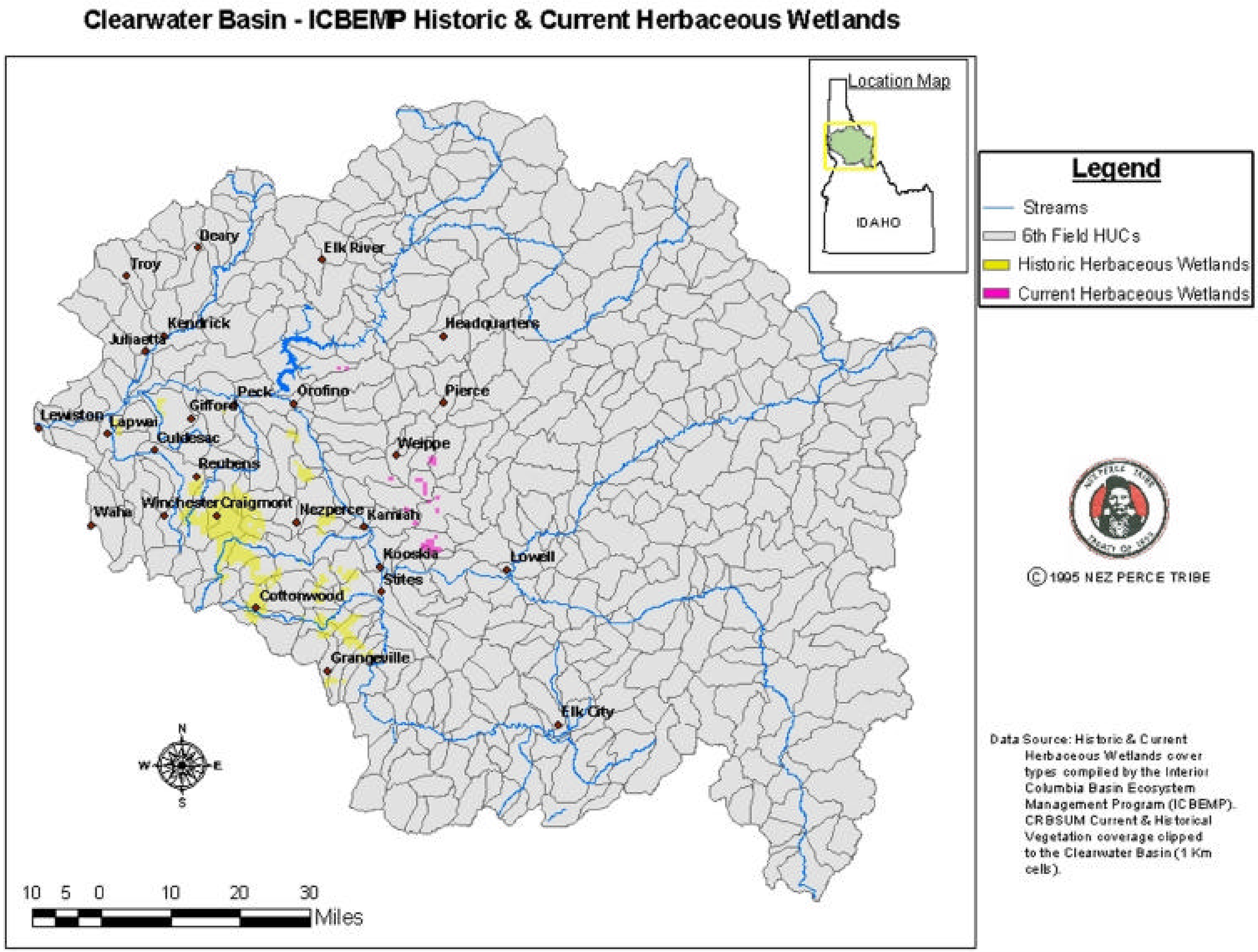

Figure 64. Comparison of historic and current herbaceous wetland cover types within the Clearwater subbasin

5.5.14 Native Bunchgrass

Physical Description

Grasslands are characterized by a rich assemblage of bunchgrasses, forbs, and shrubs (Daubenmire 1942; Davis 1952). The Clearwater subbasin contains two distinct grassland communities. Palouse prairie communities occur on the relatively flat rolling plateaus while canyon grasslands occur in the steeper breaklands of major river canyons. Prairie grasslands have deeper soils with less rock. Plant communities consisted of native bunchgrasses such as bluebunch wheatgrass, Sandberg's bluegrass (*Poa sandbergii*), and Idaho fescue were interspersed with low shrub communities dominated by rose and snowberry. Canyon grasslands contain similar communities, but reside in areas with shallower, rockier soils. These moisture-limited systems have minimal tree encroachment. Daubenmire (1970) speculated that steepe vegetation of this region resulted from climatic and edaphic conditions and not from fire.

Ecology and Distribution

The Palouse Prairie of southeastern Washington, adjacent Idaho and Oregon, has been almost entirely converted to agriculture and is one of the most endangered ecosystems in the United States. Since the turn of the century, 94% of the Palouse grasslands have been converted to crops, hay, or pasture lands. In addition to extensive grasslands and prairie plants, the Palouse also supported wetlands and associated riparian vegetation. Today, only 1% of the original habitats remain. Those remaining areas of original habitat are highly fragmented, with most sites smaller than 10 acres. Based on GAP data, 890 square kilometers of native bunchgrass cover types occur in the Clearwater subbasin (Table 34). Current distribution of grasslands in the Clearwater subbasin is represented in Figure 65.

A recent collaborative effort between the Bureau of Land Management, Cottonwood Resource Area, and the Palouse Land Trust established protection priorities for 308 Palouse or canyon grassland remnants in Idaho, Oregon and Washington. Prioritization was based on the size of the remnant, its proximity to other remnants, the rarity of species and other community elements, and remnant quality. Nine of the twenty sites identified as having a high conservation value are located in the lower Clearwater subbasin (Weddell and Lichthardt 1998).

Native grassland communities, once in climax condition, are slowly being replaced by seral habitat types. Asherin and Orme (1978) suggest alternate cover types for the Dworshak Reservoir area and lower Clearwater River sites that are a product of disturbance. Listed below are some of the native grassland associations pertaining to the Clearwater subbasin (Johnson and Simon 1987).

Festuca ovina ingrata (Idaho fescue) major associations.

1. *Koeleria macrantha* (Prairie junegrass) occurs at low elevations on slopes with deep soil and a northerly aspect, on dissected basalt ridgetops, on raised mounds separated by scabland, or high elevations, where it is the most extensive grassland association. *Symphoricarpos albus* (Common snowberry) is widespread on steeper slopes.
2. *Pseudoroegneria spicatum* (bluebunch wheatgrass); occurs on steep canyon slopes and on ridgetops. *Lupinus sericeus* (silky lupine), *Balsamorhiza sagittata* (arrowleaf balsamroot), and *Phlox idahonis* (Clearwater phlox) are present depending on aridity of the site.

Pseudoroegneria spicatum (Bluebunch wheatgrass) major associations.

1. *Eriogonum heracleoides* (Wyeth's buckwheat) occurs at the highest elevations on low loess levels.
2. *Poa sandbergii* (Sandberg's bluegrass) occurson gravelly, shifting colluvium on steep canyon slopes. *Scutellaria angustifolia* (narrow-leaved skullcap), *Astragalus cusickii* (Cusick's milkvetch), *Erigeron pumilus* (shaggy fleabane), *Phlox colubrina* (Snake River phlox), and *Opuntia polycantha* (prickly pear) can be present depending on soil type and depth, and whether there is a pretertiary granite or basalt substrate.

Grass species will respond differently to fire. Typically, survival of native grasses will depend on the severity of the fire, the moisture present in the soil and duff, and the phenological stage of the plant (Fischer and Bradley 1987). Idaho fescue can survive light-severity fires, but is usually harmed by more severe fires. Fires tend to burn within the accumulated fine leaves at the base of the plant and may produce temperatures sufficient to kill some of the root crown (Agee 1996).

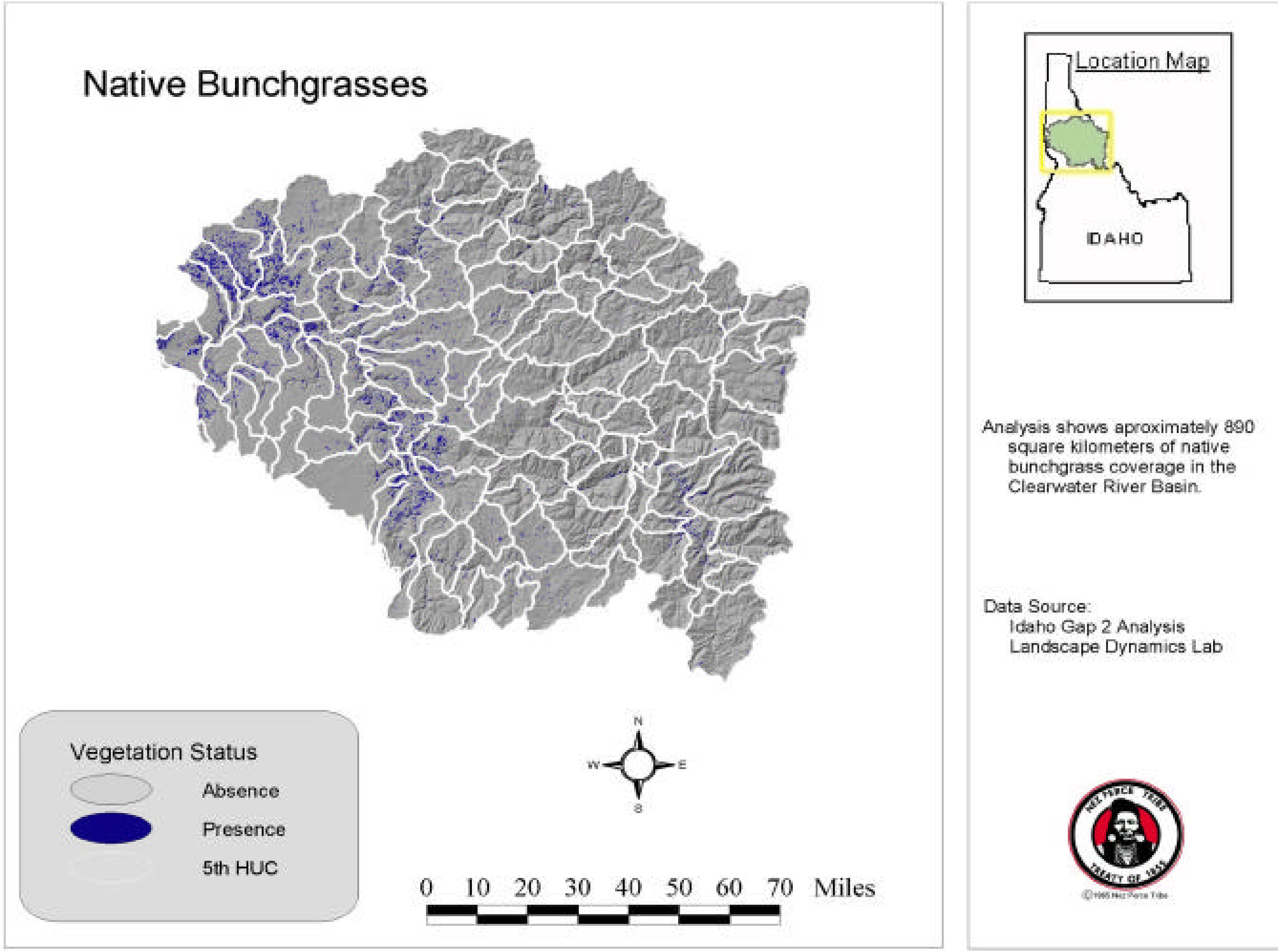

Figure 65. Distribution of the native bunchgrass cover type within the Clearwater subbasin

Bluebunch wheatgrass usually survives fires because its buds are protected by soil and/or plant material (Bunting et al. 1994), and burning will stimulate flowering and seed setting (Agee 1996). In cases where the level of disturbance, whether from heavy grazing pressure or severe fire, is detrimental enough that cover of native grasses decrease, they will generally succeed to various native and nonnative species through successional processes. Some examples of invaders are bluegrasses, sagebrush (*Artemisia* spp.), rubber rabbitbrush (*Chrysothamnus nauseosus*), broom snakeweed (*Gutierrezia sarothrae*), needlegrasses (*Achnatherum* and *Hesperostipa* spp.), lupines (*Lupinus* spp.), phlox (*Phlox* spp.), spotted knapweed, yellow starthistle, timothy (*Phleum pratense*), and cheatgrass (Mack and Pyke 1983).

Annual grasslands, noxious weeds, and exotic forbs have become established on grassland habitat types on low elevation, steep, south facing slopes (Figure 66). This has resulted in loss of bunchgrass community structure, diversity, and habitat for obligate wildlife populations. On the prairie, native bunchgrasses and shrublands have been largely replaced by annual cropland, hay, or pasture. Once extensive camas fields are now generally limited to nontillable areas. Based on GAP data, 62 square kilometers of annual grassland/exotic forb currently in the Clearwater subbasin (Table 34).

Wildlife and Cultural Values

Climax bunchgrass communities are dominant components of winter ranges, and provide important forage for many types of domestic livestock and several wildlife species such as the mountain goat, bighorn sheep, elk, deer, and grizzly bear (Riggs and Peek 1980). Bighorn sheep preferred the open structure of the canyon grasslands where they browsed on the abundant grasses and forbs (Valdez and Krausman 1999). The steep rocky terrain also provides escape cover from predators. Native grasslands also provide cover and forage for ground dwelling animals such as the northern pocket gopher and the sharp-tailed grouse. The availability of water in grass communities determines the ecology and the behavior of associated wildlife (Cederholm et al. 2001). In the Clearwater subbasin, native bunchgrass communities provide habitat for three focal plant species, Jessica's aster (*Aster jessicae*), Palouse goldenweed (*Haplopappus liatriformis*) and broadfruit mariposa lily (*Calochortus nitidus*) and the proposed Threatened species, Spalding's catchfly (*Silene spaldingii*), (Caicco 1988a, b; Lorain 1991a, b).

Threats and Limiting Factors

Most of these grasslands have been lost due to conversion to agricultural grain, hay, and pasture production. Ten percent of the subbasin is currently in agricultural production on areas formerly grasslands and forests (ICBEMP). Only small, scattered parcels remain of the Camas and Weippe Prairie grasslands (Figure 66). The vast ranges of *Festuca* and *Pseudoroegneria* bunchgrasses that dominated the lowland areas of the subbasin have been almost completely converted to agricultural areas. A comparison of coarse-scale historic vegetation with the current vegetation layer compiled by ICBEMP indicates that native bunchgrass coverage in the Columbia Basin has declined by 3,724 km^2 (Table 31).

Grasslands are subject to weed invasions and to drift of aerially applied pesticides (Washington State Department of Natural Resources 1997; Data Source: DNR and GAP Analysis/Univ. of Washington 1997). Dobler et al. (1996) found a negative correlation between the abundance of many native bird species and exotic grass coverage on Washington's shrub steppe grasslands. The massive loss of prairie grasslands in the subbasin has contributed to the decline of many grassland dependent species and the extirpation of the sharp-tailed grouse (Deeble 2000).

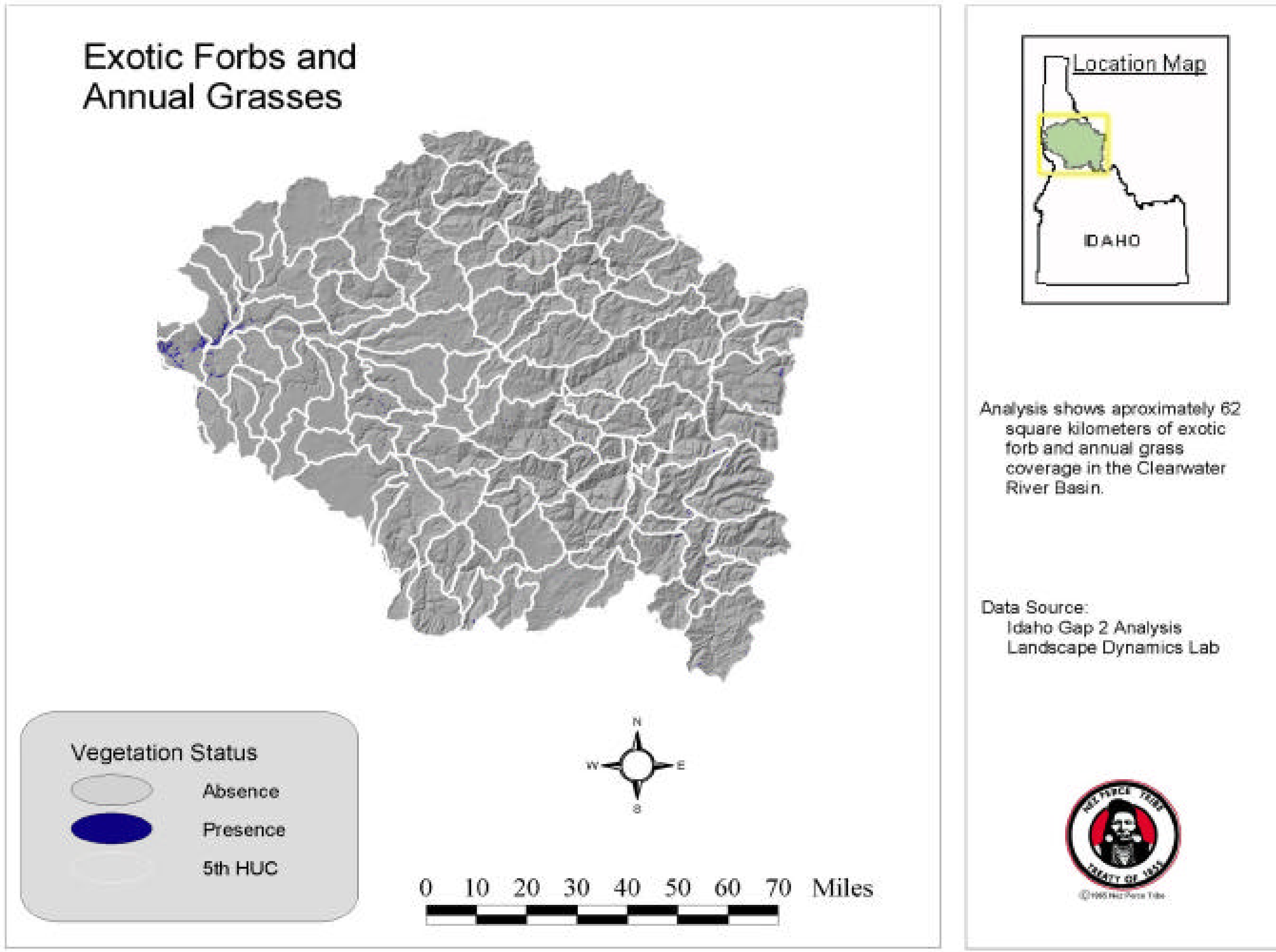

Figure 66. Distribution of the exotic forb/annual grass cover type within the Clearwater subbasin

Native grasslands in the Columbia Basin are thought to have evolved under less intense grazing pressure than those in the Great Plains region of the country, which made them more susceptible to damage when EuroAmerican settlers introduced large herds of sheep and cattle during the late 1800s and early 1900s. Removal of the original perennial grass cover left the soil vulnerable to erosion by wind and water, altered hydrologic regimes, and aided grassland colonization by annual grasses and noxious weeds (Quigley and Arbelbide 1997; Black et al. 1997). Today, grassland remnants continue to be used as livestock pastures.

Grazing in grassland-shrub communities can be used to reduce the decadent portions of perennial grass species. In addition, grazing can reduce closed herbaceous canopies to allow recruitment of forbs and shrubs highly palatable and nutritious to deer and elk, but which cannot compete with tall, established grasses.

5.5.15 Shrublands

Physical Description

Shrublands are characterized by total shrub dominance, without any tree associations or potential tree succession. Cover types and species composition vary depending on geographical elevation and climate. Shrublands include a wide range of different plant communities such as ninebark (*Physocarpus malvaceous*), rabbit brush, sagebrush (*Artemisia tridentata*), and curlleaf mountain mahogany, to name a few. All are generally associated with mesic to dry conditions.

Ecology and Distribution

The cover types listed below are from the Wallowa–Whitman National Forest (Johnson and Simon 1987) and Washington State (Daubenmire 1970). Cover types not pertaining to the Clearwater subbasin were omitted.

1. *Artemesia tridentata* (mountain big sagebrush) associations
    a. *Carex geyeri* (elk sedge)
    b. *Festuca ovina ingrata* (Idaho fescue)
    c. *Purshia tridentata* (bitterbrush)
    d. *Symphoricarpos oreophilus* (mountain snowberry)
2. *Purshia tridentata* (bitterbrush) associations
    a. *Festuca ovina ingrata*/*Pseudoroegneria spicatum* (Idaho fescue/bluebunch wheatgrass)
    b. *Pseudoroegneria spicatum* (bluebunch wheatgrass)
    c. *Stipa comata* (Tweedy’s needlegrass)
3. *Physocarpus malvaceus*/*Symphoricarpos albus* (ninebark/common snowberry)
4. *Symphoricarpos albus*/*Rosa* spp. (common snowberry/rose)
5. *Cercocarpus ledifolius*/*Pseudoroegneria spicatum* (curlleaf mountain mahogany/bluebunch wheatgrass)
1. *Rhus glabra*/*Pseudoroegneria spicatum* (smooth sumac/bluebunch wheatgrass)

Asherin and Orme (1978) describe shrubland types on the lower Clearwater River as suffering from severe disturbances caused by urban sprawl, floods, agriculture, livestock grazing, and development. They describe additional cover types for the lower Clearwater.

1. Shrub steppe
    Chrysothamnus nauseosus/*Bromus tectorum* (rubber rabbitbrush/cheatgrass)

Celtis reticulata/*Bromus tectorum* (Douglas hackberry/cheatgrass)

2. Macrophyllous shrub and vine
   Salix exigua (coyote willow)
   Rhus glabra/*Bromus tectorum* (smooth sumac/cheatgrass)
   Crataegus douglasii/*Montia perfoliata* (black hawthorn/miner's lettuce)
3. *Physocarpus malvaceus*/*Holodiscus discolor* (mallow ninebark/oceanspray)
4. *Philadelphus lewisii*/*Bromus tectorum* (mockorange/cheatgrass)
5. Mesic mixed deciduous shrub
   Example: *Amelanchier alnifolia* (serviceberry), *Acer glabrum* (Rocky Mountain maple), *Rubus parviflora* (thimbleberry), *Spiraea betulifolia* (spiraea)
6. Xeric mixed deciduous shrub
   Example: *Ribes aureum* (prickly currant), *Sambucus cerulea* (blue elderberry), *Rhus glabra* (smooth sumac), *Toxicodendron radicans* (poison ivy).

The composition and density of grasses and forbs in a shrub community varies considerably due to site differences. The effect of fire also varies according to site conditions. Based on GAP data, 1,835 square kilometers of shrubland currently occur in the Clearwater subbasin (Table 34). The extent of shrublands in the Clearwater subbasin is shown in Figure 67.

Wildlife and Cultural Values

Early seral communities and shrubfields provide forage areas critical to elk. Regenerating forests with abundant forage can provide habitat for prey species such as snowshoe hare, and benefit hare predators, such as lynx, that use young seral stands as hunting habitat (ICBEMP 2001). While providing food and cover for wildlife species, shrub fields also serve as a fuel source for wildfires (Gruell 1983). Highly valued big game browse such as the Rocky Mountain maple provide important habitat for ruffed and blue grouse and nesting sites for numerous songbirds.

In the Clearwater subbasin, maple is commonly found with willows, red osier dogwood, blue elderberry (*Sambucus glauca*) and thinleaf alder (*Alnus incana ssp. tenuifolia*). These brush communities provide essential nesting habitat for several perching birds, including the dusky flycatcher, MacGillivray warbler, orange-crowned warbler, broad-tailed hummingbird, white-crowned sparrow, and Lincoln's sparrow (Elliot and Flinders 1984). Less browsed species of shrublike ninebark (*Physocarpus malvaceus*) can form dense thickets that provide good shelter and cover for a variety of wildlife species from small birds to large mammals (Habeck 1992).

Mountain big sagebrush (*Artemesia tridentata)* is highly preferred and nutritious winter forage for mule deer (Johnson 2000). Ceanothus (*Ceanothus velutinus*) provides food and cover for a wide variety of wildlife species. It is eaten seasonally by elk and moose, and has variable forage value for mule deer and whitetail deer. Ceanothus provides good cover for many smaller birds and mammals. Rabbits and snowshoe hares often hide or rest beneath this shrub, and numerous songbirds nest in its dense thickets (Tirmenstein 1990). In some locations, elk find thermal cover in ceanothus, and deer reportedly bed in relatively open stands (Stanton 1974). Antelope bitterbrush (*Purshia tridentata*) is important browse for wildlife and livestock. Pronghorn, mule deer, elk, bighorn sheep, and moose seasonally browse antelope bitterbrush (Zlatnik 1999). Antelope bitterbrush and other shrubs provide important cover for Lewis's woodpeckers (Koehler 1981).

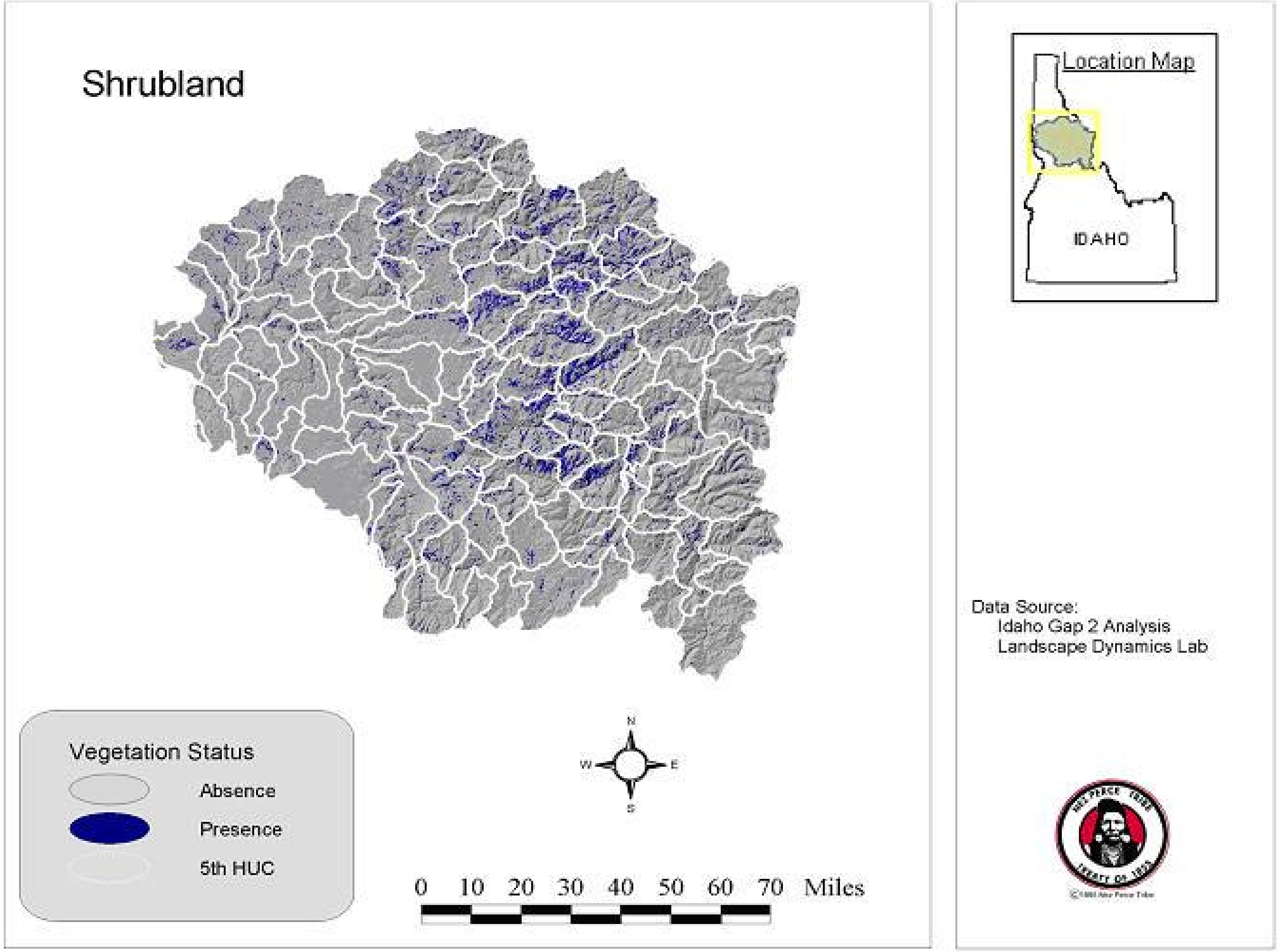

Figure 67. Distribution of the shrubland cover type within the Clearwater subbasin

Native peoples used big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark was woven into mats, bags and clothing (Parish et al. 1996). Native Americans also used Saskatoon serviceberry (*Amelanchier alnifolia*) wood to make arrow shafts, spears, and digging sticks. They made a tea, used for treating colds, by boiling the branches (Halverson 1986).

Threats and Limiting Factors

Shrub communities have been impacted by destruction, fragmentation, overgrazing, and fire suppression. Human habitation and development has had a significant impact on shrub communities at lower elevations, and on the prairies near human settlements. Shrubs were often seen as having little economic benefits and were systematically removed from rangelands and homesteads. Extensive destruction of current (*Ribes* sp.) stands was also undertaken earlier in the century in an attempt to control white pine blister rust (*Cronartium ribicola*), but those efforts proved fruitless (Hagle et al. 1989). Some shrub communities have been lost to successional processes due to fire suppression.

5.6 Focal Plant Species

The concept of a focal species was first described by Lambeck (1997) as a management tool to help people manage large areas and multiple species in a more efficient way. This approach identifies specific groups of species used to define landscape. If the requirements of these focal species are met then most other species will have their requirements met as well. The species with the most demanding requirements are usually selected to define the minimum acceptable values for each landscape parameter. This process was applied to key habitat attributes in the Clearwater subbasin to develop a list of focal plant and wildlife species.

Eight focal plant species have been selected for the Clearwater subbasin. These species are considered the most rare or imperiled taxa within the drainage because of habitat loss, threats, or inherent rarity: Clearwater phlox and spacious monkeyflower represent wet meadow, seeps, and riparian habitats; Jessica's aster and Palouse goldenweed represent prairie grasslands; salmon-flowered desert parsley and broadfruit mariposa lily represent canyon grassland and ponderosa pine habitats; and two moonwort species represent moist cedar-hemlock forests. All focal plant species are considered sensitive by the USFS or BLM and are tracked by the Idaho Conservation Data Center. Maps of species distributions are not provided due to the sensitive nature of that information. Resource managers with a specific need for accurate location information of maps may contact the Idaho Conservation Data Center at http://www2.state.id.us/fishgame/info/cdc/cdc.htm to obtain information. A complete list of sensitive vascular and non-vascular plants within the Clearwater subbasin can be found in Appendix D.

5.6.1 Clearwater Phlox

Life History

Clearwater phlox (*Phlox idahonis*) is approximately two feet tall and bears a cluster of blue, lavender, or pink flowers at the top of the stem, each with a pale yellow "eye". The flowers are about the size of a quarter (Johnson 1976). The rootstock is slender and shallowly buried, curving up at the tip into a simple remaculate stem 50 to 75 cm tall. The leaves are narrow, lanceolate and are up to 60 mm long and 15 mm wide (Wherry 1941). It is the only tall, leafy phlox in western North America (Johnson and Crawford 1978).

P. idahonis occurs in the area influenced by the Pacific storm tract and is associated with several disjunct coastal species (Johnson and Crawford 1978). It is generally found in grasslands surrounded by forest (Packard 1979), on stabilized creek banks, and in meadows (Johnson and Crawford 1978). *P. idahonis* can be found in 3 different habitat types: (1) open meadows dominated by herbaceous plants; (2) shrub communities dominated by *Alnus incana* or *Rhamnus alnifolia*; and (3) coniferous forest sites (Moseley and Crawford 1995). Their habitat elevation ranges from 2,800 to 3,275 feet (Johnson and Crawford 1978).

Threats

Factors affecting this species include destruction, modification, or curtailment of its habitat and range, overutilization for commercial, sporting, scientific or education purposes, disease, grazing, and the inadequacy of existing regulatory mechanisms (Johnson and Crawford 1978). Two rusts infect this species: *Uromycus plumarus* and *Puccinea douglasii*.

Limiting Factors

Phlox idahonis has a small, endemic population that could be subject to extirpation. This species is very specific in its climatic needs.

Historic/Current Distribution

Phlox idahonis is found in 3 sites in Clearwater County, Idaho (Packard 1979). It is the largest and most rare phlox in the Pacific Northwest (Johnson and Crawford 1978). The Clearwater Phlox probably had a wide distribution in the past, apparently having differentiated out of a Miocene species of broader distribution across northern North America (Packard 1979). It is thought that *Phlox idahonis* was part of a flora centering in the Keewatin area of north-central Canada that was exterminated in most of its range by Pleistocene ice sheets. The current range of this species is found south of the ice sheet, only in an area of peculiar climatic conditions. Range restriction in the Northwest probably followed post-Miocene climatic differentiation (Wherry 1941). *Phlox idahonis* is a narrow endemic known only from a series of populations and metapopulations within 2.5 km of Headquarters, ID (Schultz and Elliot 2000). Due to this restricted distribution, *P. idahonis* is considered the most rare member of Idaho's flora (Moseley and Crawford 1995). There are 8 occurrences of this species in the Clearwater subbasin documented in the Idaho Fish and Game's CDC.

P. idahonis is presently a Category 1 candidate for listing under the Endangered Species Act (ESA). It occupies a global rank of one set by the Biodiversity Information Network and International Association of Natural Heritage Programs and Conservation Data (Moseley and Crawford 1995).

5.6.2 Jessica's Aster

Life History

Aster jessicae is a robust, extensively rooted perennial, endemic to the Palouse region of Idaho and Washington. The species will grow to 1.5 meters tall, but averages about 1 meter. The foliage, particularly the upper part, is covered with a dense, uniform, soft pubescence. Leaves are abundant, broadly lanceolate, 6 to 13 cm long and 1.5 to 3.5 cm wide (Heidel 1979). The leaves get smaller as they get closer to the end of the stem (Lorain 1991a). The middle stem leaves generally partially clasp the stem at attachment and lower leaves tend to dry up and wither as the season progresses. Flowers are generally numerous, lavender in color, 1 to 1.5 in. in diameter. The flowers form a broad cluster at the top of the plant. *A. jessicae* flowers from late

July through September (Lorain 1991a). It is generally found in remnant prairie communities and the prairie/forest margins near canyon edges (Heidel 1979). Within these communities, *A. jessicae* grows on shoulders, banks, slopes, and at the top of draws. Such habitats have open or partially open exposures with variable slopes, and elevations vary between 1,600 and 3,850 feet. Substrates consist of productive silt/loams, which are moderately deep and sometimes gravelly (Lorain 1991a).

Threats

Threats to *Aster jessicae* include disease, grazing, collecting, introduced exotic species, and the destruction of its current habitat (Kennison and Taylor 1979).

Limiting Factors

Only small, endemic populations of *A. jessicae* remain after most native prairie habitat was lost to cultivation and grazing, which leaves this species vulnerable to genetic drift and localized extirpation. Small fragmented populations may also be at risk from low reproductive capacity due to poor pollen and seed dispersal.

Historic/Current Distribution

Aster jessicae occurs in the Palouse hills of southeast Washington and adjacent Idaho (Cronquist 1955). It was first collected in 1893 near Pullman, WA., but the species was not collected in Idaho until 1936, when it was found one mile south of Troy (Lorain 1991a). During 1990 a survey was completed to assess the range and extent of *A. jessicae* throughout Idaho. Nine of eleven historical sites were found, and twenty new populations were discovered (Lorain 1991a). Currently, 58 documented populations of *A. jessicae* occur in Idaho within Clearwater, Latah, Lewis, and Nez Perce Counties. Virtually all known populations occur on private land (Lorain 1991a). There are 64 occurrences of this species in the Clearwater subbasin documented in the CDC (2001). Three of these are on the Nez Perce Indian Reservation. In 1975, *Aster jessicae* was listed as a Candidate Threatened species (USFWS 1975), and in 1980 the species was listed as a Category 2 candidate species (USFWS 1990a).

5.6.3 Palouse Goldenweed

Life History

Palouse Goldenweed (*Haplopappus liatriformis*) is a perennial forb, endemic to the Palouse prairie region of Washington and Idaho (Kennison and Taylor 1979). Throughout its range, most communities are small (<100 individual plants) and often located on private property. The healthiest Palouse Goldenweed populations exist in grasslands or along grassland-forest edges. It can be found in stable floral communities dominated by bunchgrass with scattered patches of deciduous shrubs. Associated species are one flower helianthella (*Helianthella uniflora*), Canada goldenrod (*Solidago Canadensis*), prairiesmoke (*Geum triflorum*), and Nootka rose (*Rosa Nutkana*) (WA National Heritage Program 2000). Habitat sites are typically located on moderate slopes with skeletal silt/loams, at 1,900 to 3,000 feet (WA National Heritage Program 2000).

Threats

Existing threats include grazing, herbicide drift, and diminishing habitat quality. Due to small population sizes and occurrence near agricultural developments, much of the Palouse Goldenweed's habitat could be affected by erosion (Kennison and Taylor 1979). *H. liatriformis* is a serious conservation concern in Idaho because of its limited range, the nearly complete conversion of its prairie habitat to agriculture, the fragmented nature of the remaining habitat, the limited conservation options for private lands, and the small size of most populations (Mancuso 1997).

Limiting Factors

Competition with nonnative species may be a limiting factor (WA National Heritage Program 2000). *H. liatriformis* is extremely sensitive to disturbance and could be easily extirpated (Kennison and Taylor 1979). Small isolated populations may be at risk from genetic drift, inbreeding depression, or low reproductive capacity due to poor pollen and seed dispersal.

Historic/Current Distribution

In the early 1900s the taxon was fairly common in the Palouse Prairie and it is now restricted to a couple of relatively undisturbed sites (Kennison and Taylor 1979) within Idaho and Washington. There are 65 extant populations between the two states, with the majority of the communities located in Idaho. Craig Mountain, ID represents the southern range limit of the Palouse goldenweed, and because it is such a large community it is considered vital to the species' long-term conservation (Mancuso 1997). There are 29 reported occurrences of *Haplopappus liatriformis* in the CDC coverage of the Clearwater subbasin.

5.6.4 Spacious Monkeyflower

Life History

Mimulus ampliatus is a slender annual in the snapdragon family, with sticky glandular foliage and yellow flowers (Clearwater National Forest Terrestrial Resources 2001). It occurs in open grassland sites and forest openings. Plants usually grow in microsites with enhanced spring moisture or shade, at 2,600 to 6,900 feet, on volcanic or granitic soils (Clearwater National Forest Terrestrial Resources 2001). This species may be a good indicator of changes in local hydrology or increases in annual grasses (Meinke 1995).

Threats

The only threats likely to affect this species are livestock trampling and weedy invaders (Clearwater National Forest Terrestrial Resources 2001).

Limiting Factors

Spacious monkeyflower requires moist habitats such as wet meadows, trapped precipitation, or seepy rock outcrops (Clearwater National Forest Terrestrial Resources 2001, Meinke 1995).

Historic/Current Distribution

M. ampliatus is endemic to Idaho where it occurs in six scattered locations throughout Lewis, Nez Perce, Idaho, and Clearwater Counties. It is suspected to occur in Latah County (Clearwater National Forest Terrestrial Resources 2001). Historic samples collected in the Waha area of Nez Perce County suggest that this species may have once been locally plentiful, but much of the area is privately owned today, limiting access to conduct current surveys (Meinke 1995). There are 3 recorded observances of spacious monkeyflower in the CDC database.

5.6.5 Salmon-flowered Desert Parsley

Life History

Lomatium salmoniflorum is a perennial, parsley-like plant, 8-25 inches tall. Leaves are glabrous and pinnately dissected. *L. salmoniflorum* is one of the earliest species to begin flowering each year, and flowers are a salmon-yellow color. Flowers can be seen as early as February. Plants produce 1-9 umbels with 10-300 flowers per umbel. Seeds are dispersed by wind in April, followed by the senescence of the leafy, aboveground portion of the plant (Clearwater National Forest Terrestrial Resources 2001).

Habitat consists of steep basalt cliff faces, ledges, and stabilized talus. It occurs on all aspects, but the habitat is always open with very little cover of vascular plants. This species is seldom collected very far from canyon bottoms (Clearwater National Forest Terrestrial Resources 2001). Zonal vegetation of the surrounding areas ranges from lower grassland, shrubland, and ponderosa pine woodlands, to higher grassland, shrubland, and coniferous red cedar dominated forests. Elevations range from 800–2,300 feet in Idaho (Idaho Conservation Data Center 2001). This desert-parsley readily colonizes new ground, often flourishing in new road cuts.

Threats

Most habitats in Idaho occur on private land and the populations need to be better delineated. Many known populations are traversed by state and county right-of-ways and activities significantly impact the species (Clearwater National Forest Terrestrial Resources 2001). Management activities that could adversely affect *L. salmoniflorum* are roadside disturbance and gravel pit/quarry work where the plant is present (Clearwater National Forest Terrestrial Resources 2001).

Limiting Factors

L. salmoniflorum is restricted to basalt substrates rangewide (Idaho Conservation Data Center 2001). This species is attacked by weevils that lay their eggs within developing seeds to allow larvae to feed on the endosperm. Just before the seeds mature, the larval parasites exit by cutting a hole through the seed coat (Idaho Conservation Data Center 2001).

Historic/Current Distribution

L. salmoniflorum is regionally endemic, only occurring along a 100 mile stretch of the Snake and Clearwater Rivers. Idaho populations are found in two disjunct areas of the Clearwater River. The first is in the lower canyons between Lewiston and Cherrylane (Nez Perce County), and along a contiguous segment of the Potlatch River drainage (Latah County). The second population is located near Kooskia (Idaho County) along the Middle Fork and South Fork of the Clearwater River, and in the Clear Creek drainage (Clearwater National Forest Terrestrial Resources 2001). According to the CDC, there are 15 records of *L. salmoniflorum* in the Clearwater subbasin. It is a Global Priority 3 on the Idaho Native Plant Society list of rare flora in the state (Idaho Conservation Data Center 2001).

5.6.6 Broadfruit Mariposa Lily

Life History

The broadfruit mariposa lily (*Calochortus nitidus*) is a perennial herb that grows from a large, deep-seated bulb. The stem stands erect up to 18 inches tall with one reduced leaf near the midpoint of the stem, and a single large flat basal leaf that withers before flowering (Caicco

1992, Caicco 1987). Reproductive plants have between one and four large, showy, lavender to pink flowers with three petals. Each petal has three hairs and a deep purple crescent above a triangular lunate gland (Clearwater National Forest Terrestrial Resources 2001). *C. nitidus* produces most of its food during the growing season from its solitary basal leaf (Caicco 1988).

Threats
Calochortus nitidus and its habitat are threatened by grazing, trampling, land conversion to agriculture, competition with exotic species, and genetic uncertainty (Caicco 1988). Most of the areas where this species is found are used for grazing, and the present *C. nitidus* are at critically low numbers (Caicco 1988). The main factor influencing successful fruit production is herbivory of floral buds, flowers, and immature fruits by grazing animals. Deer and livestock lingering in a *C. nitidus* habitat for even a brief period of time can effectively eliminate a whole year's reproduction (Clearwater National Forest Terrestrial Resources 2001).

Limiting Factors
This mariposa lily reproduces by seed only, and not all plants capable of reproducing do so every year (Clearwater National Forest Terrestrial Resources 2001). *C. nitidus* undergoes great population fluctuations with no relationship between population density and the number of reproductive individuals. This causes population bottlenecks on a regular basis (Clearwater National Forest Terrestrial Resources 2001).

Historic/Current Distribution
Ownby described the historic range of *C. nitidus* as extending from the eastern border of the Palouse Prairie in Whitman County, WA., and Latah County, ID, to the Seven Devils Mts. above Riggins, ID (Hitchcock et al. 1969). Despite the previous extent of its coverage, the descriptions of the lily's former habitat suggest that this species has a diverse ecological range. *C. nitidus* was found in deep loess soils of the grassland prairie, and also in moist bottoms, rocky prairies, and open pine forests. Today it is common only at sites with thin rocky soils derived from a basaltic substrate and in areas within cropland too rocky to plow. In the past, low meadows and moist bottoms seemed to have been preferred locations. The Palouse Prairie, which was its historic habitat, has largely been converted to agricultural uses (Caicco 1988a, b). Presently this species is limited to nonagriculture areas on the periphery of its former range; mainly in open woodlands of the Clearwater River Canyon to the Northern Seven Devils Mountains (Bingham 1987, Caicco 1992). It is known to occur along the Middle Fork of the Clearwater River to within 10 miles of Lowell. These areas are steep, scattered small meadows in the canyon areas of Lewis, Nez Perce, and Idaho Counties (Clearwater National Forest Terrestrial Resources 2001). There are 51 occurrences of this species in the Clearwater subbasin documented in the Idaho Fish and Game's CDC.

Calochortus nitidus has been recommended to the U.S. Fish and Wildlife Service as a Category 1 candidate species for listing under the Endangered Species Act (Caicco 1988). Because sizable populations are extant on public lands, however, it was further recommended that a Habitat Management Plan (HMP) be developed for the species in lieu of formal listing.

5.6.7 Mountain Moonwort

Life History
Botrychium montanum is a small perennial fern with a single above ground frond. The frond varies in height up to about 12cm long, is a dull glaucous gray-green, somewhat succulent, and

divided into two segments which share a relatively short common stalk (Wagner and Wagner 1981). The sterile segment is once pinnatifid with well-separated, irregular, angular, ascending lobes with the entire or toothed margins. The fertile segment is longer than the sterile segment, is branched and bears grape-like sporangia (Vanderhorst 1997).

This species almost always grows in organic substrates composed of cedar leaves or decomposed wood. It is usually associated with small hydrological features such as seeps, rivulets, draws, and swales. *B. montanum* is often the only plant growing in the dense litter of cedar leaves in deep shade, but also grows among mosses. It has been known to grow at elevations ranging from 2,960-6,000 feet (Vanderhorst 1997).

Threats

Threats to this species include timber harvest or any activity impacting or altering the hydrology of a habitat (Vanderhorst 1997).

Limiting Factors

B. montanum has an obligate mycorrhizal relationship with a fungus, and it cannot complete its life cycle without fungal infection. Nutrition supplied through a fungal symbiont may allow the fern to withstand repeated herbivory or prolonged dormancy (Vanderhorst 1997).

Historic/Current Distribution

The geographical range for *B. montanum* includes most of western North America: British Columbia, California, Montana, Oregon, Washington, and Idaho (Wagner and Wagner 1993). There are no occurrences of this species in the Clearwater subbasin documented in the Idaho Fish and Game's CDC.

The U.S. Forest Service currently lists *Botrychium montanum* as a sensitive plant. Most of the larger populations are in management areas designated as suitable timberland or are on forested slopes or at topographical and hydrological microfeatures not protected by standard riparian guidelines (U.S. Forest Service 1994).

5.6.8 Crenulate Moonwort

Life History

The crenulate moonwort is a thin, delicate, perennial plant with a pale yellow-green color that grows to about 10 cm tall. Plants arise from a single stem that divides into a single fertile frond and a sterile frond, which are attached near the middle of the plant from a 3-5 cm long common stem (Lorain 1990). The sterile leaf is attached to the main stem by a short (5mm) stalk, and singly divided into 2-5 pairs of lateral segments (pinnae) that are strongly flabellate with entire to shallowly scalloped outer margins. The fertile portion ranges from 2.5-9.5 cm long (Wagner and Wagner 1981; Wagner and Devine 1989; Lellinger 1985).

This species inhabits wet, swampy, low elevation sites near climax western red cedar communities (Lorain 1990). Plants are generally rooted around tress or shrubs or in depressions at the edges of marshes that dry out during the summer. It may occur either in sun or shade but does prefer partial shade (Clearwater National Forest Terrestrial Resources 2001). The nearest relative of crenulate moonwort is *B. lunaria*, which is frequently found growing in the same habitat (Lellinger 1985; Wagner and Devine 1989).

Threats
Timber harvest or any activity impacting the moisture of a site is expected to have a detrimental effect on the species, but these habitats are generally protected today (Clearwater National Forest Terrestrial Resources 2001).

Limiting Factors
Crenulate moonwort has an affinity for old growth western red cedar groves, and the rare distribution of this species leaves it in danger of localized extirpation (Clearwater National Forest Terrestrial Resources 2001).

Historic/Current Distribution
Botrychium crenulatum is very rare and localized, but demonstrates a rather extensive range. It is known to occur as far north as Oregon, Montana, and Alberta, and as far east as Utah (Wagner and Devine 1989). Two historical sites in northern Idaho have been identified - one in Boundary County, and the other in Clearwater County (Lorain 1990). The Clearwater site is located near Washington Creek on land between Potlatch Corp. property and the Clearwater National Forest (Clearwater National Forest Terrestrial Resources 2001). There is 1 occurrence of this species in the Clearwater subbasin documented in the Idaho Fish and Game's CDC. *Botrychium crenulatum* is a Category 2 candidate for federal listing (Lorain 1990).

5.7 Threatened & Endangered Plant Species

5.7.1 Spalding's Catchfly

Life History
Silene spaldingii is a long lived perennial herb with four to seven pairs of lance-shaped leaves and a spirally arranged inflorescence consisting of small greenish-white flowers. The stem is stout and the foliage is lightly to densely covered with sticky hairs (USFWS 1999a). The lower leaves are oblanceolate and the upper leaves are lanceolate (Atwood and Charlesworth 1987). Reproduction is by seed only (Lesica 1988). *S. spaldingii* is approximately 8-24 inches in height (Siddall and Chambers 1978). Spalding's catchfly is unusual in that it blooms late (July-August). Plants are extremely glandular and tend to be covered in wind blown fruits or spiderwebs (Lorain 1991b). The foliage is an unusual, pale green that tends to stand out against the straw colored grasses of last summer and early fall (Kagan 1989).

S. spaldingii grows on undisturbed slopes or flats in swales and drainages and in small, undisturbed vegetation strips surrounded by cultivated fields (Lorain 1991b). It is primarily restricted to mesic grasslands that make up the Palouse region in southeastern Washington, northwestern Montana, and adjacent portions of Idaho and Oregon (USFWS 1999a). Elevations range between 2,800 and 4,200 feet and the average temperature of the warmest month is less than 22 degrees C. The substrate is almost exclusively productive silt/loams (loess) that are moderately deep and sometimes gravelly (Lorain 1991b).

Threats
Spalding's catchfly and its habitat have been, and continue to be, threatened by a number of human-related factors. These include the invasion of nonnative species; the destruction, modification, or curtailment of its habitat and range; herbicidal drift; changes in land use, grazing practices, agricultural development and urbanization; disease and predation; and overutilization for commercial, recreational, scientific, or educational purposes (USFWS 1999a). The invasion

of yellow star thistle has highly impacted this species and locally extirpated small populations (USFWS 1999a).

Limiting Factors

This species is primarily restricted to slopes, flats, or swales in mesic grasslands (USFWS 1999a). The small populations of Spalding's catchfly are vulnerable to disturbances and may lose a large amount of genetic variability due to genetic drift.

Historic/Current Distribution

Spalding's catchfly was first collected by the missionary Spalding near Lapwai between 1836 and 1847 (USFWS 1999a, K. Gray, Idaho Native Plant Society, personal communication, June 10, 2002). It is currently known from a total of 52 populations in the United States and British Columbia, Canada. Of the 51 *S. spaldingii* populations in the U.S., 7 occur in Idaho (Idaho, Lewis, and Nez Perce Counties). The Nez Perce county population is one of the largest, containing more than 500 plants (USFWS 1999a).

Action by the federal government to protect *S. spaldingii* was initiated in 1975 when the Smithsonian Institute reported that this plant was considered threatened or endangered. The species' listing was found to be warranted in 1984, but was precluded by other pending listing actions. In 1995, a petition was received by the Service to list Spalding's catchfly as endangered. On October 22, 1999, the Federal Register published the Listing Priority Guidance to clarify the rule making in setting priorities with this species (USFWS 1999a). Spalding's catchfly was formally listed as Threatened by the USFWS in November 2001.

There are no known occurrences of this species in the Clearwater subbasin recorded by the CDC, although historical records suggest that a population once inhabited the Lawyer Creek drainage, but it is now thought to be extirpated (L. Lake, Nez Perce National Forest, Personal communication, April, 2001). Additional populations may be found if a concerted effort is made to survey suitable habitat within the Clearwater subbasin.

5.7.2 Macfarlane's Four O'Clock

Life History

Mirabilis macfarlanei is a long lived perennial plant with a deep-seated thickened root. The leaves are opposite and somewhat succulent, green above and whitish below (USFWS 1996). The flowers are conspicuous, up to 1 inch long by 1 inch wide (USFWS 2000b). The flowers are striking due to their large size and showy magenta color (USFWS 1996). They are funnel shaped in form with a wide expanding limb (USFWS 2000b). *M. macfarlanei* flowers from early May to early June, with mid-May being the usual peak flowering period (USFWS 1996).

M. macfarlanei is found on talus slopes in canyonland corridors where the climate is regionally warm and dry with precipitation occurring mostly in the winter and spring. It generally occurs as scattered plants on open steep (50 %) slopes of sandy or talus soils and generally having west to southeast aspects (USFWS 1996). *M. macfarlanei* populations range from approximately 300 to 900 meters (1,000 to 3,000 feet) in elevation (USFWS 2000b).

Threats

M. macfarlanei and its habitat have been, and continue to be, threatened by many factors such as: herbicide and pesticide spraying, landslides and flood damage, insect damage and disease, exotic plants, livestock grazing, off road vehicles, and possibly road and trail construction and maintenance.

Limiting Factors

The collecting of *M. macfarlanei* has been determined to be a limiting factor, as well as mining, competition for pollinators, and inbreeding depression (USFWS 2000b).

Historic/Current Distribution

M. macfarlanei was first described in 1936, and its historical distribution before that time is unknown (USFWS 1996). At the time of the original listing (USFWS 1979), *M. macfarlanei* was known from only three populations along the Snake River Canyon in Oregon and the Salmon River Canyon in Idaho, totaling approximately 25 plants on 10 hectares (USFWS 2000b). Currently, eleven populations of *M. macfarlanei* are known. Three of these populations are found in the Snake River Canyon area (Idaho County, Idaho and Wallowa County, Oregon), six in the Salmon River area (Idaho County, Idaho), and two in the Imnaha River area (Wallowa County, Oregon; USFWS 1985, USFWS 1996). There are no known occurrences of this species in the Clearwater subbasin recorded by the CDC.

The US Fish and Wildlife Service, after reviewing the species, initiated action to protect *M. macfarlanei* in 1975 by the publishing of a notice in the Federal Register. In 1979 the USFWS published a final ruling listing *M. macfarlanei* as an endangered species, and a recovery plan was developed and approved in 1985. In 1993 the USFWS proposed to reclassify *M. macfarlanei* from endangered to a threatened species. The number of individuals has increased two hundred sixty-fold: from 27 plants when listed, to approximately 7,212 plants in 1991 (USFWS 1996).

5.7.3 Water Howellia

Life History

Howellia aquatilis is an aquatic annual plant that grows 10-60 cm in height (USFWS 1994a). It has extensively branched, submerged or floating stems with narrow leaves 1-5 cm in length. It grows mostly submerged in the sediments of ponds and sloughs (Shelly and Mosely 1988). Two types of flowers are produced: small, inconspicuous flowers beneath the water's surface, and emergent white flowers which are 2-2.7 mm in length (USFWS 1994a). The plant is predominantly self-pollinating, and each fruit contains up to 5 large brown seeds (Shelly and Mosely 1988).

H. aquatilis grows in a firm blend of clay and organic sediments that occur in wetlands associated with brief glacial pothole ponds and former river oxbows (Shelly and Mosely 1988). These wetland habitats are filled by spring rains, snow runoffs, and depending on temperature and precipitation, exhibit some drying throughout the growing season (USFWS 1994a). Seed germination occurs in the fall in portions of the wetland edge where the water has receded (Shelly and Gamon 1996). The plants overwinter as seedlings (Lesica 1990).

Threats

H. aquatilis and its habitat have been, and continue to be, threatened by a number of human-related factors. These include timber harvest activities, livestock grazing, invasion by nonnative plant species, outright conversion of habitat to other uses, road construction and maintenance, military training exercises, and the overutilization for commercial, recreational, scientific or educational purposes (Shelly and Gamon 1996).

Limiting Factors

Seeds of *H. aquatilis* only germinate if its habitat dries out periodically and exposes the seed to the air. Climatic patterns of successive wet or dry years have a profound influence on abundance in any given year (Shelly and Gamon 1996). This species exhibits metapopulation characteristics. A metapopulation is a collection of interdependent populations affected by recurrent extinctions and linked by recolonization. The existence of multiple *H. aquatili* populations is critical for this species, because it inhabits patches in a shifting mosaic of habitats (Shelly and Gamon 1996).

Historic/Current Distribution

Water howellia historically occurred over a large area of the Pacific Northwest, but today is only found in specific habitats. It is currently known on a total of 13 sites: one in Idaho (Latah County); three in Washington, and nine in Montana (Shelly and Gamon 1996). The Idaho occurrence, currently under private ownership, has been willed to a conservation organization (Shelly and Mosely 1988). This species is believed to have been extirpated from at least one historical location in Idaho (Shelly and Mosely 1988). There are no known occurrences of this species in the Clearwater subbasin recorded by the CDC.

Action by the federal government to protect *H. aquatilis* was initiated on December 15, 1980 when the species was designated as a Category 2 candidate species (USFWS 1980). In 1990, the species category was changed to Category 1 (USFWS 1990b). In October 1991, the USFWS received a petition to list the species as endangered. The Service subsequently published a listing proposal in 1993 and a final rule listing the species as threatened in 1994 (USFWS 1994a).

5.7.4 Ute Ladies' Tresses

Life History

Spiranthes diluvialis is a perennial, terrestrial orchid with stems 20 to 50 centimeters tall arising from thick, tuberous roots. The flowers consist of 3 to 15 small white or ivory colored flowers clustered into a spike arrangement at the top of the stem (USFWS 1992). The species is characterized by stout, whitish, ringent (gaping at the mouth) flowers. It typically blooms from late July through August, in some cases through September (USFWS 1992). Blooms have been recorded as early as July and as late as October (Sheviak 1984).

S. diluvialis occurs primarily in areas where the vegetation is relatively open and not overly dense, overgrown, or overgrazed (Coyner 1990). Soils may be inundated early in the growing season, normally becoming drier but retaining subsurface moisture through the season (USFWS 2001a). Populations of *S. diluvialis* occur in relatively low elevation riparian meadows (USFWS 1992).

Threats

The riparian and wetland habitats that support this species have been heavily impacted by urban developments that degrade natural stream stability and diversity (USFWS 2001a). The conversion of riparian/floodplain land to agricultural uses has destroyed habitat for *S. diluvialis* in many places. Threats include grazing, changes in hydrology, recreation, exotic species invasions, pollinator impacts, herbicide and pesticide use, and habitat conversion.

Limiting Factors
S. diluvialis is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams.

Historic/Current Distribution
Historically, the species was known to exist in Colorado, Utah, and Nevada. Currently, *S. diluvialis* is found in its original habitats in addition to Idaho, Montana, Nebraska, Washington, and Wyoming (although it is possibly extirpated from Nevada). In Idaho, approximately 1,170 plants are known from a total of 20 occurrences in eastern Idaho along the South Fork of the Snake River (USFWS 2001a). These occurrences range in size from one plant to a few hundred individuals. Most of the Idaho sites are very small (less than one acre in size, based on the amount of occupied habitat), although additional potentially suitable habitat exists along the South Fork of the Snake River and elsewhere in the state (USFWS 2001a). There are no known occurrences of this species in the Clearwater subbasin recorded by the CDC.

Federal action on this species began on September 27, 1985 (Coyner 1990). On November 13, 1990, the Service published a proposal to list *S. diluvialis* as a threatened species (USFWS 1992).

5.8 Culturally or Economically Important Species
Many native plants have cultural and/or economic value to humans. While impossible to cover the vast number of species or uses of such plants in this document, we felt it was important to highlight a few of the more significant species within the Clearwater subbasin. Huckleberries were selected because of their commercial and cultural significance and because fire suppression activities may be posing a threat to healthy populations. Camas was once plentiful within the subbasin and was a staple food source for the Nez Perce people. Today, camas habitat has been significantly reduced due to agricultural land uses but the roots of the plant are still used by Nez Perce in feasts and ceremonies. The lomatiums are another important group of plants found in the subbasin.

5.8.1 Huckleberry
Life History
Big huckleberry (*Vaccinium membranaceum*) is a native, rhizomatous, frost-tolerant shrub. It occupies moist, moderately deep, well-drained soils and is rarely found in valley bottoms. Although tolerant of moderate shade, big huckleberry does best on cool mesic sites with minimal overstory, acidic soils, and a 25-40% slope. It may occur in early to late seral stages and is usually an understory dominant in subalpine climax communities. Big huckleberry is an early seral species in western red cedar-western hemlock communities, and in high elevation grand fir communities on north facing slopes. In spruce-fir forests big huckleberry has a significant presence 1-5 years after disturbances (Simonin 2000).

Reproduction through seed is rare, and populations are usually maintained through lateral expansion of vegetative clones. Big huckleberry is moderately tolerant of moisture deficiencies, but germination is extremely reduced by water stress (Simonin 2000). Some berry patches are considered the result of wildfires that occurred before recent fire suppression policies. Plants subjected to regular low intensity burns may be better suited to surviving fires than individuals that grew without frequent fire activity (Simonin 2000).

Threats/Limiting Factors
Big huckleberry can occupy a wide ecological range of moisture, acidity, slope and soil type, but lack of disturbance and an increase in canopy cover will eventually lead to the loss of the huckleberry component. Light grazing by sheep has been shown to be beneficial to huckleberries by reducing competition from understory grasses and adding nitrogen to the soil. Overgrazing by sheep caused a reduction in berry production for two years, but production increased the third year after treatment (Minore et al. 1979).

Wildlife/Historic Values
Native Americans used big huckleberry extensively and the patches were burned annually in the autumn, after berry harvest, to reduce encroachment by trees and shrubs (Simonin 2000). The yield of each site varied from season to season, and density of tribal camps would depend on abundance (Ames and Marshall 1980). Huckleberry stems, leaves and fruit are an important food source for bears, ungulates, small mammals and birds. Huckleberries serve as a primary food source for grizzly bears in the summer.

Historic/Current Distribution
Current fire suppression strategies have increased shrub and tree cover over many old huckleberry sites. Big huckleberry is usually an early seral plant and is moderately shade tolerant, but closed canopy cover has eliminated many historic huckleberry habitats.

5.8.2 Camas

Life History
Camas (*Camassia quamash*) grows in moist prairies and glades of pine forests in the Pacific Northwest. It is a liliaceous bulb one to two inches in diameter with narrow basal leaves and bright blue flowers (Scrimsher 1967). Camas prefers deep, rich soils, and grows best when the soil has been slightly broken up (Ames and Marshall 1980).

Threats/Limiting Factors
Tilling, grazing and agricultural practices have greatly reduced the abundance of this species on the Camas Prairie.

Wildlife/Historic Values
Lewis and Clark noted camas as being the leading staple of the Nez Perce diet and likened it to a sweet potato. It is harvested in mid-July through September, after the flowers and seeds have dropped. Only the younger bulbs are harvested and either eaten raw or prepared for later consumption. If the prepared camas is stored free of moisture it will keep almost indefinitely, and it was a major food source during the winter months when few plants were available (Scrimsher 1967).

Historic/Current Distribution
The Camas Prairie is bounded on the north and east by the Clearwater River, on the south by the Salmon River, and on the west by the Snake River. It covers approximately 200,000 acres and was once a major harvesting ground for camas bulbs by Native Americans. Before extensive tilling, the entire prairie would look like a blue lake when the camas was in bloom.

5.8.3 Lomatium Spp.

Life History

Lomatium (*Lomatium* spp.) is classified in the family Apiaceae and related to anise, hemlock, carrot, and celery. In general, this genus is characterized as a native perennial with thick taproot, pinnately dissected leaves, and umbel shaped inflorescences (Lackschewitz 1991). Various species of the genus Lomatium are found throughout the Clearwater subbasin, and the most widely used by Native Americans and local wildlife were *L. canbyi* (wild potato), *L. cous* (cous, kouse, or biscuitroot), *L. grayi* (wild celery) and *L. macrocarpum* (large-fruit lomatium). Common names vary by region and are not always given to the same species. Both *L. macrocarpum* and *L. cous* occur on rocky, dry soils on the open, flat slopes of foothills (Lackschewitz 1991).

Threats/Limiting Factors

Lomatium survives on scattered, barren patches of lithosol habitats by means of nutrients stored in a thickened root (Hunn and French 1981). Livestock grazing, intensive agricultural practices, and the widespread use of herbicides have negatively impacted this genus (Nez Perce National Historic Park 2001).

Wildlife/Historic Values

In the winter, the Nez Perce traditionally settled in lower elevations along drainages and subsisted on stockpiles of dried salmon and stored roots. The appearance of cous roots (*L. cous*) in early May was of critical importance as the first fresh food of the spring. While traveling down Alpowa Creek, Lewis and Clark noted that in early May many Nez Perce were distributing themselves throughout the plain to collect cous (Sappington 1989). Lewis and Clark mentioned the use of cous repeatedly as one of the main food sources of the Nez Perce and described it as being very valuable (Sappington 1989). Native Americans used many types of Lomatium as food or medicinal resources, and used approximately 10 species commonly. The average tuber of *L. canbyi* weighs 11g and provides 1080KCal/kg of energy. *L. cous* averages 10.5g and provides 1270KCal/kg of energy. In addition to providing an energy source, *L. nudicaule* stems provide vitamin C in the form of 66mg of ascorbic acid per 100g of stem material (Hunn and French 1981). Biscuitroot (*Lomatium cous*) is extremely important as a fall food source for both humans and grizzly bears because it is almost 30% starch and easily digestible (Mattson 1997)

Historic/Current Distribution

Historical distribution is unknown, but many species have become scarce due to farming, grazing, and pesticides (Nez Perce National Historic Park 2001).

5.9 Vegetation Limiting Factors

The driving force behind the decline of plant species in the Clearwater subbasin is due to destruction, degradation, and fragmentation of habitats. Loss of habitat occurs through a variety of environmental and anthropogenic processes that limit plant species' abundance. Limiting factors that restrict or hinder vegetation can be subdivided into three broad categories: physical, biotic, and human cultural limiting factors.

5.9.1 Physical Limiting Factors

Physical limiting factors encompass environmental aspects such as sunlight, temperature, and water. The amount of sunlight a species needs can limit the range of suitable habitat. In the conifer forests of the subbasin, some trees are intolerant of shade, thereby restricting their distribution. Ponderosa pine is shade intolerant, only growing in less dense and drier habitats (Cooper et al. 1991). Grand fir is also shade intolerant and does not establish itself under closed canopies (Daubenmire and Daubenmire 1984). Quaking aspen and black cottonwood stands do not persist in the absence of sunlight and are usually replaced by more shade tolerant species (Howard 1996), such as western hemlock and western red cedar. These species are very shade tolerant and their growth is correlated with valley bottoms and close growing stands (Tesky 1992 a,c). These same trees are also subject to temperature and water constraints, limiting their appearance to certain elevational gradients, where an increase in elevation correlates to a decrease in temperature. Species such as whitebark pine and subalpine fir occupy high elevations where deep winter snowpacks and cool summer temperatures are characteristic. If temperature and water gradients were to decrease, other species will eventually compete and take over (Tomback et al. 2001)

Understory vegetation is just as susceptible to physical limiting factors as the associated tree species. Shrubland and grassland cover types, as well as forbs, are respectively limited to growing in certain soil, moisture, and temperature regimes. Slight changes can affect the composition of an ecosystem. For example, mountain moonwort requires very moist, shady conditions to survive (Vanderhorst 1997). It is closely associated with western red cedar. Loss of cedar stands to logging result in a decreased canopy cover that directly affects populations of moonwort and similar understory vegetation by increasing the amount of sunlight, thereby altering temperature and moisture levels.

Duration, timing, frequency and intensity of climatic factors such as flooding and drought, have serious affects on vegetation. Some examples of vegetation limited by these factors are grasslands, which are impacted by debris accumulation, sediment deposition and scour erosion caused by flooding. Kentucky bluegrass is intolerant of prolonged flooding, high water tables, or poor drainage (Wasser 1982). Shrubs such as alder are sensitive to prolonged flooding above the root crown and disturbance from flooding seems to inhibit normal growth in black hawthorn (Habeck 1991). Chokecherry is intolerant of poor drainage and prolonged flooding. White alder seeds germinate rapidly on sunny, wet mineral sites exposed from receding flood waters. Alternately, black cottonwood persists on flood plains and has a low tolerance to drought (Holifield 1990).

5.9.2 Biotic Limiting Factors

Biotic limiting factors include natural processes such as herbivory, competition, disease, and insect damage that reduce a species' viability and hinder population growth. Consumption of vegetation by wildlife or livestock limits populations. Understory components are most vulnerable to herbivory, but certain tree species such as aspen are used as forage for many animals (Shepperd et al. 2001). High densities of deer have a detrimental effect on the regeneration of some conifer species, resulting in the growth and dominance of deciduous tree species (Augustine and McNaughton 1998). Grasslands are especially vulnerable to and limited by grazing impacts. The productivity, frequency, and cover of perennial bunchgrass species such as Idaho fescue and bluebunch wheatgrass have been reportedly reduced 50-100% in the Bitterroot Mountains because of grazing (Belsky and Blumenthal 1997).

Interspecific and intraspecific competition between plant species is a part of any natural habitat. Certain species are limited because they are not good competitors. Their living requirements are so specialized that any changes in habitat could lead to invasion of another species. Some tree species, such as the Douglas-fir, are good competitors, and are able to exist within a variety of tree cover types (Cooper et al. 1991). Cheatgrass is an aggressive competitor, and has displaced native perennial grasses over much of the Clearwater subbasin. In areas of disturbance, nonnative plant species compete with native species, resulting in the colonization of annual grasses and noxious weeds, which alter the makeup of a landscape (Quigley and Arbelbide 1997; Black et al. 1997). Idaho fescue and bluebunch wheatgrass are susceptible to competition from diffuse (*Centaurea diffusa*) and spotted knapweed (*C. maculosa*). Even under good range conditions, bunchgrasses offer little resistance to knapweed invasion (Agriculture Canada 1979). The distribution of whitebark pine is somewhat limited and strongly influenced by Clark's nutcrackers, which are important in the dispersal of seeds and establishment of seedlings (Tomback et al. 2001).

Firs are susceptible to several wood rotting fungi that cause heart, trunk, butt, or root rots,including brown stringy rot, red heart rot, red ring rot, shoestring rot, brown cubical rot, white spongy root rot, and white pocket rot (Fowells 1965). Hemlock dwarf-mistletoe (*A. tsugense*) infects grand fir occasionally (Noble and Ronco1978). The most important fungi attacking western red cedar are root, butt and trunk rots. *Poria asiatioa* and *Phellinus weiri* are problem fungi for cedar in the subbasin. Just as firs and cedar are susceptible to fungi, pines suffer from white pine blister rust, which kills the upper cone bearing branches of large trees and less commonly, the entire tree. Blister rust has a severe impact on saplings, often preventing regeneration. (Minore 1990). Dwarf mistletoe (*Arceuthobium campylopodum*) is a common parasite on western hemlock which decreases growth and increases mortality in old growth stands (Tesky 1992c). A common pathogen attacking aspen stands is stem canker (*Hypoxylon mammatum*). Several other types of canker are also detrimental to tree growth (Shepperd et al. 2001). Bluebunch wheatgrass seeds are susceptible to soilborne pathogens such as *Podosporiella verticillata* (Zlatnik 1999).

Trees weakened by wood rots often become infested by fir engraver beetles and usually succumb to windfall and breakage. Firs are attacked by numerous insects. The most destructive include western spruce budworm, western balsam bark beetle, and balsam woolly aphid (Alexander et al. 1986). The western spruce budworm generally attacks low and middle elevation fir forests, but is largely absent from high elevation forests. Other insect pests include the Douglas-fir tussock moth, western black-headed budworm, and fir engraver beetle. Pine trees are also killed by the mountain pine beetle (*Dendroctonus ponderosae*), usually after being weakened by blister rust. Western red cedar has several insects that cause harmful damage. The gall midge (*Mayetiola thujae*) attacks the seeds of cedar. Seedlings are occasionally damaged by weevils (*Steremnius carenatus*), and larger trees are often killed by bark beetles, (*Phloeosinus sequoiae*) and the western red cedar borer (*Trachykele blondeli*; Minore 1990). The western hemlock looper (*Lambdina fiscellaria lugubrosa*) has caused more mortality of western hemlock than any other insect pest. Bluebunch wheatgrass seeds are susceptible to wireworm damage (Zlatnik 1999).

5.9.3 Human Cultural Limiting Factors

Cultural limiting factors include urbanization, farming, logging, grazing, mining, road building, damming and channelizing of streams, pollution, the introduction of nonnative species, fire suppression, and recreation. All of these activities have contributed to the decline of forests, rangelands and aquatic habitats. Most of Idaho's rare, endangered, or focal plant species are threatened by various factors, including habitat destruction and fragmentation from agricultural and urban development, grazing and trampling by domestic livestock and wildlife, herbicide treatment, and competition from nonnative plant species.

Urbanization can fragment or entirely remove native habitats. Population growth and urban sprawl also affect plant species within the subbasin. As population size increases, so does the amount of land required for residential and commercial needs. Within the Clearwater subbasin, large expanses of palustrine wetlands in the Reubens, Craigmont, and Ferdinand areas have been converted to croplands. Remaining wetland communities are often degraded by livestock grazing, road development, urban expansion, and altered hydrologic regimes (U.S. Geological Survey 1996). Since the turn of the century, 94% of the Palouse grasslands have been converted to crop, hay or pasture lands, including areas of the lower Clearwater subbasin (Washington State Department of Natural Resources 1997, Data Source: DNR and GAP Analysis/Univ. of Washington 1997).

Roads promote the spread of invasive nonnative plants (Sheley and Petroff 1999) via three mechanisms: providing habitat by altering conditions, making invasions more likely by stressing or removing native species and allowing easier movement by wild or human vectors (Trombulak and Frissell 2000).

Livestock grazing changes the species composition of native ecological communities and significantly impacts riparian areas. Grazing can strip the banks of rivers and streams, leading to erosion and degradation of aquatic ecosystems. In Idaho's forests, grazing has been shown to negatively impact open forest and meadow vegetation. Heavy, season-long grazing by cattle changed species composition and lowered herbage production on dry and moist mountain meadows (Zlatnik 1999). While livestock grazing may lead to reduced plant cover, it also leads to the compaction of soil. Runoff from summer storms increases, as does erosion, resulting in the loss of sediment needed to sustain vegetation (Belsky and Blumenthal 1997).

Logging activities account for most of the fragmentation in the subbasin's forested areas. Fragmented habitats result in decreased species density. Fragmentation of habitat creates a barrier between intraspecific species and restricts plants that reproduce by pollination from spreading. Besides deforestation, roads built to access logged areas also serve as a source for fragmentation. Logging also causes erosion by destabilizing the soil. Past logging practices have triggered large landslides within the Clearwater subbasin, accounting for loss of native vegetation and the potential for invasion of noxious weeds. Logging can drastically alter native vegetation by decreasing canopy structure, thereby increasing the amount of aggressive sun tolerant species that will eventually outcompete shade tolerant species.

One of the most logged and cultivated tree species is Douglas-fir. This tree is a good competitor, which makes it valuable as a commercial resource. Ponderosa pine is the most commercially valuable and productive timber tree in the western United States. Western hemlock is valued for its qualities as a pulpwood for paper and paperboard products. Western red cedar wood is harvested for utility poles and fence posts. Harvest of pacific yew for Taxol production has impacted some grand fir forests.

Mining can impact ecosystems by destroying habitat, and polluting and degrading streams and waterways. Mining affects the turbidity levels and substrate quality of a stream, which affect nutrient levels for streamside vegetation. Mining disturbances may lead to invasion of noxious weeds and other nonnative plant species. Mining can lead to detrimental affects on vegetation through the disposal of wastes into streams or on land, the transport of ores, and pollution from refinement. Mining pollution damages ecosystems through the introduction of sulfur compounds, ozone, pesticides and heavy metals. Airborne pollutants such as ozone and acid precipitation often impact natural communities miles away from the source. A common process derived from the disturbance of ground materials through mining that results in dispersion of elements from a mining site is acid drainage, which is the formation and movement of highly acidic water rich in heavy metals. This acidic water forms through the chemical reaction of surface water (rainwater, snowmelt, pond water) and shallow subsurface water with rocks that contain sulfur-bearing minerals, resulting in sulfuric acid. Heavy metals can be leached from rocks that come in contact with the acid and the resulting fluids may be highly toxic. When mixed with groundwater, surface water and soil, they can have harmful effects on plants, as well as wildlife (EPA 2001).

Dams impact wildlife through the loss of vegetation, especially valuable riparian areas. They also affect the ability of drainages to support past and present animal species (USFWS 1962). The construction of Dworshak Dam formed a long, narrow lake nearly 54 miles long and inundated 16,970 acres. The vegetation existing before flooding consisted of open coniferous timber (7,300 acres), dense coniferous timber (6,100 acres), brush (1,190 acres), grass (510 acres), agricultural crops (170 acres), along with 1,700 acres of water and streambed (USFWS 1962). The open conifer woodland was composed mostly of Douglar-fir and pine associations. The dense conifer stands consisted largely of Douglas-fir and cedar-hemlock associations. Grand fir tended to replace western hemlock, and ponderosa pine replaced white pine in the lower or more exposed sites. Where little or no overstory occurred, deciduous trees, brush, and forbs assumed greater importance. A few of the drier slopes did not support trees and were covered with weeds, grasses, or shrubs, such as hawthorn and serviceberry. Shrub species occurring in the brush and open coniferous types at low elevations included willows (*Salix* sp.), redstem ceanothus (*Ceanothus sanguineus*), mountain maple, serviceberry, cascara (*Rhamnus* sp.), elderberry (*Sambucus* sp.), redosier dogwood, rose, spirea (*Spirea betulifolia*), snowberry (*Symphoricarpos* sp.), oceanspray (*Holodiscus* sp.), thimbleberry (*Rubus parviflorus*), ninebark, and syringa (*Philadelphus lewisii*; USFWS 1962).

Fire suppression has caused the ecological decline of grasslands, shrublands, and open forests. Fire is an integral part of many ecosystems, maintaining natural vegetation. Some plant species require fire to trigger the release of their seeds, such as lodgepole pine, which aggressively invades and persists in burned over areas. Fire also clears out the underbrush in forests, and the prevention of all forest fires actually leads to fires that burn hotter and longer due to the accumulation of underbrush. Grand fir stands need fire or some other periodic disturbance to maintain itself on sites (Howard and Aleksoff, 2000). Quaking aspen needs fire, clearcutting, or other disturbances to persist (Perala 1990). In the exclusion of fire, sprouting shoot numbers remain low and most are consumed by domestic and wild ungulates (Manier and Laven 2001). Fire suppression creates thick even-aged Douglas-fir stands that increase the potential for severe, stand destroying wildfires. For meadows, fire suppression likely will result in the extensive invasion of trees, and the upward movement of timberline (Franklin and Dyrness 1973). Fire suppression can also impact local populations of rare, endemic taxa.

Recreation affects vegetation by trampling, which initially bends and weakens leaves and branches and ultimately breaks them. Trampling directly damages plants by reducing photosynthetic surface area and loss of seed production, and eventually kills some vegetation species, changing the community composition (Luckenbach and Bury 1983). Trampling damage can occur from shrub steppe habitat, to meadows and forest by hikers, horses, motorcycles, and other off road vehicles, resulting in the destruction of habitat and the harassment of wildlife. Dale and Weaver (1974) showed that grass communities are more resistant to trampling than shrub communities. Significance of impact is related to rarity of the vegetation type, and to the value of the vegetation to wildlife species that depend on it (Cole and Landres 1995). A rare species in the Clearwater subbasin, the Clearwater phlox, resides in isolated locations subject to trampling from livestock and off-road vehicles.

Road building associated with agriculture, logging, mining, recreation, and urban development causes erosion, landslides, and degrade water quality in streams and rivers. Roads also contribute to the major threat to biological diversity: habitat fragmentation. Plant populations are then vulnerable to all the problems associated with rarity such as environmental catastrophes, and fluctuations in habitat conditions. Roads facilitate the invasion of weeds, pests, and pathogens, many of which are exotic. A road transforms the physical conditions of the environment, creating edge effects.

An overview of limiting factors for the major vegetative cover types within the Clearwater subbasin is provided in Table 37.

Table 37. Limiting factors of vegetative cover types within the Clearwater subbasin

LIMITING FACTORS	Western Hemlock	Western Red Cedar	Mountain Hemlock	Subalpine Fir	Grand Fir	Douglas-Fir	Lodgepole Pine	Ponderosa Pine	Whitebark Pine	Aspen	Black Cottonwood	Mountain Meadows	Herbaceous Wetlands	Native Bunchgrass	Shrublands
Habitat loss/ destruction/ modification															
Grazing						X		X		X		X	X	X	X
Agriculture								X					X	X	X
Urban sprawl								X			X		X	X	X
Human construction projects	X	X			X	X		X			X		X	X	X
Fire suppression							X	X	X	X				X	X
Logging/ forest fragmentation	X	X			X	X	X	X							
Erosion/ noxious weeds								X			X	X	X	X	X
Recreation											X	X			
Physical Factors															
Shading					X			X		X	X				
Moisture	X	X								X	X	X	X		X
Climate				X					X			X	X		
Biotic Factors															
Succession								X	X	X		X			
Limited/ specialized reproductive capabilities							X		X		X				
Herbivory/ Insect Damage		X	X		X	X		X	X	X					
Natural Processes															
Subject to/ dependent on natural disasters							X	X	X	X	X				X
Global or regional limitations			X							X			X		

6 Wildlife Resources

The Clearwater subbasin is inhabited by approximately 340 terrestrial wildlife species (Appendix E). The list of wildlife species present in the subbasin is based upon GIS data for wildlife ranges from ICBEMP. Species present on the list can be year-round residents of the subbasin or transients who inhabit the subbasin for only small portions of their life cycle. Most of the species diversity in the subbasin results from the presence of over 200 bird species (Appendix E). In addition to birds, approximately 73 mammal, 13 amphibian, and 13 reptile species occur in the subbasin.

There are 37 species of concern in the Clearwater subbasin (Appendix F). These species are listed as threatened, endangered, candidate, sensitive, of concern, or of special concern by the United States Fish and Wildlife Service, the state of Idaho, the Bureau of Land Management, or the United States Forest Service Region 1. Six species have been recently extirpated or greatly reduced from their historic abundance in the Clearwater subbasin, and four species within the subbasin are considered endangered or threatened at the state or federal level.

Twelve species have been identified as focal wildlife species within the Clearwater subbasin. These species were chosen because of their ability to serve as indicators of larger communities, as representatives of larger wildlife guilds, as management species, or because of their own status as species of special concern. Many of the focal wildlife species are tracked by the Idaho Conservation Data Center and occurrences recorded by the CDC are incorporated below. The information presented contains reported occurrences, many of which have not been documented. For some species, the number of reported occurrences seems exceptionally high to scientists familiar with the species and the subbasin. For other species, the number of occurrences seems exceptionally low, perhaps due to a lack of reported sightings rather than a lack of species occurrence within the subbasin.

6.1 Species-Habitat Matrix

A species/habitat matrix intended to depict broad relationships between specific species and general vegetative cover types was developed as part of this analysis (Appendix E). This matrix displays all vertebrate species known to occur within the Clearwater subbasin and their relationship to major vegetative cover types. These data are displayed as square Km of habitat by vegetation type. Cover types include urban, agricultural land, foothills grassland, disturbed grassland, riparian nonforest, riparian forest, mountain meadows, shrubs, cottonwood, aspen and conifer, western hemlock, western red cedar/mixed mesic forest, subalpine fir, grand fir, lodgepole pine, ponderosa pine, Douglas-fir/mixed xeric forest, western larch, whitebark pine, burnt standing timber, water, barren land, and perennial ice or snow (cloud or cloud shadow). These cover types were derived by lumping GAP 2 cover values into larger groupings for analysis.

6.2 Species with Strong Relationships to Salmon

A wide variety of invertebrate and vertebrate predators and scavengers feed on salmon. Some species are not totally dependent upon salmon for their survival, but take advantage of it when availabile. Other species rely on the salmon seasonally as a primary food source. There are 137 wildlife species influenced by salmon abundance (Cederholm et al. 2001). These predator/scavenger-prey relationships are separated into five categories. *Strong-consistent*: salmon directly affect the distribution, viability, abundance, and population status of another species. Nine species have a strong-consistent relationship with salmon. Seven of the nine species are indigenous to Northern Idaho, and they include common mergansers, harlequin ducks, osprey, bald eagles, river otters, black bear, and grizzly bear. *Recurrent*: routine, occasional, and localized relationships. Fifty-eight species have a recurrent relationship. *Indirect*: secondary consumer relationships. Twenty-five species have an indirect relationship. *Rare*: a species diet consisting of usually less than 1% salmon. Sixty-five species have a rare relationship. *Unknown*: relationship may or may not exist, but there is no available data (Cederholm et al. 2001).

Cederholm et al. (2001) also separated the 137 species by the different salmon life cycle stage that each prey on. The stages of a salmon's lifecycle consists of spawning and egg incubation, freshwater rearing, seaward migration, ocean rearing, return migration, spawning, and finally the carcass stage (Lichatowich, 1999). Twenty-three species prey on salmon during the egg incubation stage. Some waterfowl, macroinvertebrates, and other fish such as char, trout, and juvenile salmon will eat salmon eggs. Forty-nine species prey on salmon during the freshwater rearing stage. Herons, other fish eating birds, and larger fish capitalize on the vulnerable fry and smolts heading downstream. Sixty-three species, such as sea lions, harbor seals, and orcas take advantage of the salmon during the saltwater, ocean rearing stage. While spawning, 16 species such as the black bear, grizzly bear, river otter, raccoon, and the bald eagle prey on salmon on their migration upstream. During the carcass stage, 83 species will eat dead salmon. Black bear, grizzly bear, river otters, raccoons, coyotes, bald eagles, ravens, gulls, and macroinvertebrates scavenge salmon during this post-spawning period (Cederholm et al. 2001).

Throughout their life salmon feed on a wide variety of prey, including many kinds of freshwater and marine invertebrates and fishes (Cederholm et al. 2001). After the adult salmon spawn and die, macroinvertebrates such as caddisflies, stoneflies, and midges are responsible for the breakdown of salmon carcasses. This process delivers much needed nitrogen and other nutrients to the water, sustains macroinvertebrate populations and provides energy for the long-term health of ecosystems (Bilby et al. 1996). Juvenile salmon are known to feed directly on salmon carcass flesh, salmon eggs, and aquatic macroinvertebrates that may have previously fed on salmon carcasses.

Salmon are important in the transport of energy and marine-derived nutrients between the ocean, estuaries, and freshwater environments in which they reproduce. The flow of nutrients such as carbon, nitrogen, and phosphorus back upstream by spawning salmon plays a vital role in determining the overall productivity of both watersheds and salmon runs, now and into the future (Wilson and Halupka 1995). Isotopic analyses indicate that trees and shrubs near spawning streams derive approximately 22 - 24% of their nitrogen from spawning salmon (Helfield and Naiman 1998). Ocean reared salmon ingest saltwater nutrients, migrate to their spawning grounds, and then die. The nutrients are spread to vegetation by decomposition or digestion. Decomposing salmon can be left at streamsides or carried inland. Digestion of salmon by predators can also occur by the stream or transported inland. Nutrients are transferred through the digestion process by urination and defecation to plants in the ecosystem (Weddell 1999). This fertilization process serves to enhance riparian production.

The United States Department of Energy has recently conducted a site management plan for bald eagles in the Hanford Reach area. Their studies have shown that changes in the eagles populations have generally corresponded to changes in the number of returning fall chinook salmon, a major fall and winter food source for eagles. The research on the Hanford Reach during the 1998-99 winter was consistent with reports from the upper Columbia River at

Rocky Reach Reservoir and Rock Island Reservoir, the Clearwater River in Idaho, and the lower Snake River and Columbia River areas of Oregon and Washington.

Other studies have revealed that in the recent past, the salmon – grizzly bear relationship was significant to both bears and trees in Pacific Northwest ecosystems. Chips of grizzly bear bones from museums specimens dating between the 1850s and the 1930s were examined, and 100% of the bone chips contained nitrogen, phosphorus, and carbon derived from the ocean. Salmon was evidently a large part of the bear's diet, and the nutrients which were transported to terrestrial vegetation by the bears and other predators was significant as a fertilizer. This natural fertilizer from the excretions of mammals is more readily absorbed and utilized by vegetation, and the phosphorus provided by excretions supplements the low levels of this nutrient in moist forests in which it tends to leach away. These findings support the philosophy of maintaining healthy forests through conservation of the processes and species that have sustained them in the past (Weddell 1999).

6.3 Focal Wildlife Species

Similar to selection of focal plant species described earlier, focal wildlife species were selected for detailed consideration in this assessment. The requirements of these focal species are such that if their basic needs are met, those of other species will also be met.

The fisher and wolverine were selected to represent small to mid-sized forest carnivores. The fisher is also considered an old growth forest obligate along with the northern goshawk. Fringed myotis was selected because of its dependance on interior forests and snags for roosting habitat. The flammulated owl and the white-headed woodpecker represent open ponderosa pine forest habitats. The black-backed woodpecker was selected to represent fire-dependant species. Three species were selected to represent those dependants on riparian and wetland habitats: harlequin duck, western toad, and Coeur d'Alene salamander. The Townsend's big-earred bat was selected to represent the unique habitats offered by caves, and the peregrine falcon represents cliff-dwelling species. The peregrine was also selected because it has only recently been removed from the Endangered Species Act list (USFWS 1999b).

6.3.1 Fisher

Life History

The fisher (*Martes pennanti*) is a solitary, territorial carnivore that preys upon birds and small mammals, and has been known to regularly kill porcupines (Powell 1993). The snowshoe hare is a common prey source, and deer and moose carcasses make a significant contribution to the diet (Powell and Zielinski 1994, Nez Perce National Forest 1998, Marshall et al. 1996, Powell 1993). Fishers inhabit mesic, coniferous forest between 3,500-6,000 feet elevation, although habitat preference changes with season, age, and sex (Marshall et al. 1996). Fishers avoid open ground (Buskirk et al. 1994; Powell 1993) and have a preference for structurally complex areas with multiple canopy layers, including understory shrubs and large amounts of woody debris (Nez Perce National Forest 1998, Marshall et al. 1996, Powell 1993). Ruggiero et al. (1994) concluded that riparian zones, high elevation old growth grand fir, and subalpine fir stands are important habitat components (Powell 1993). A study in the southern part of the subbasin by Jones and Garton (cited in Buskirk et al. 1994) found that fishers preferred old growth and mature forest stands in the summer, but in the winter had no preference for or against these habitat types. Home ranges are estimated at a mean of 40 km^2 for males and 15 km^2 for females (Ruggiero et al. 1994). According to GAP 2 data, the potential breeding habitat for the fisher comprises of approximately 14,888 square kilometers in the Clearwater subbasin (Figure 68).

Threats

Clearcutting and reductions of late successional forests have caused habitat fragmentation that threatens fisher conservation. Forest fragmentation isolates existing populations and limits colonization of unoccupied habitat (Ruggiero et al. 1994). Isolated or small populations are prone to extirpation following population fluctuations in their prey base, and may need to be augmented with fishers captured elsewhere (Ruggiero et al. 1994). Translocated fishers appear to be subject to predation, but mortality may be lower with summer reintroductions.

The value of fisher pelts continues to limit fisher populations (Powell 1993). Fishers are readily trapped and are frequently caught in traps set for other furbearers (e.g., bobcats, foxes, coyotes). This trapability may significantly affect populations where fishers are scarce. Overtrapping may bias populations toward young fishers, and the inability of yearling males to breed effectively may further delay recovery.

Limiting Factors

Fisher avoidance of open areas results in restricted movement between habitat patches and decreased colonization of unoccupied habitats. Lack of large, contiguous areas capable of containing multiple home ranges, and naturally slow reproductive rates limit fisher population growth. Most fisher populations require immigration to increase, and high survival and reproductive rates to be self-sustaining. Two important fisher habitat components are maternal den sites and resting sites, both requiring large diameter trees, snags and logs (Ruggiero et al. 1994).

The significance of competition between pine marten and fisher may be a limiting factor. Managing for both fisher and pine marten in the same area may not be as successful as managing exclusive areas for each species.

Historic/Current Distribution

Historically fishers were distributed throughout the forests of North America at the time of European settlement. Populations declined or were extirpated in much of North America between 1800 and 1940 due to habitat destruction from timber harvest and overtrapping (Groves et al. 1997b, Ruggiero et al. 1994, Powell 1993). Fishers from British Columbia were successfully reintroduced to northcentral Idaho in the early 1960s to help control the porcupine population (Groves et al. 1997b; Powell 1993), and there have been over 170 fisher occurrences documented in the Clearwater subbasin (Nez Perce National Forest 1998). In 2000 a fisher was sighted within the Nez Perce National Forest (Dixon 2001). Fisher populations remain low in the Pacific Northwest and the Northern Rockies in spite of habitat recovery programs, closed trapping seasons, and reintroduction programs that have reestablished the fisher in portions of its original range. Although population numbers are reduced, fishers are now distributed throughout most of their historical territory in the Clearwater drainage (Buskirk et al. 1994).

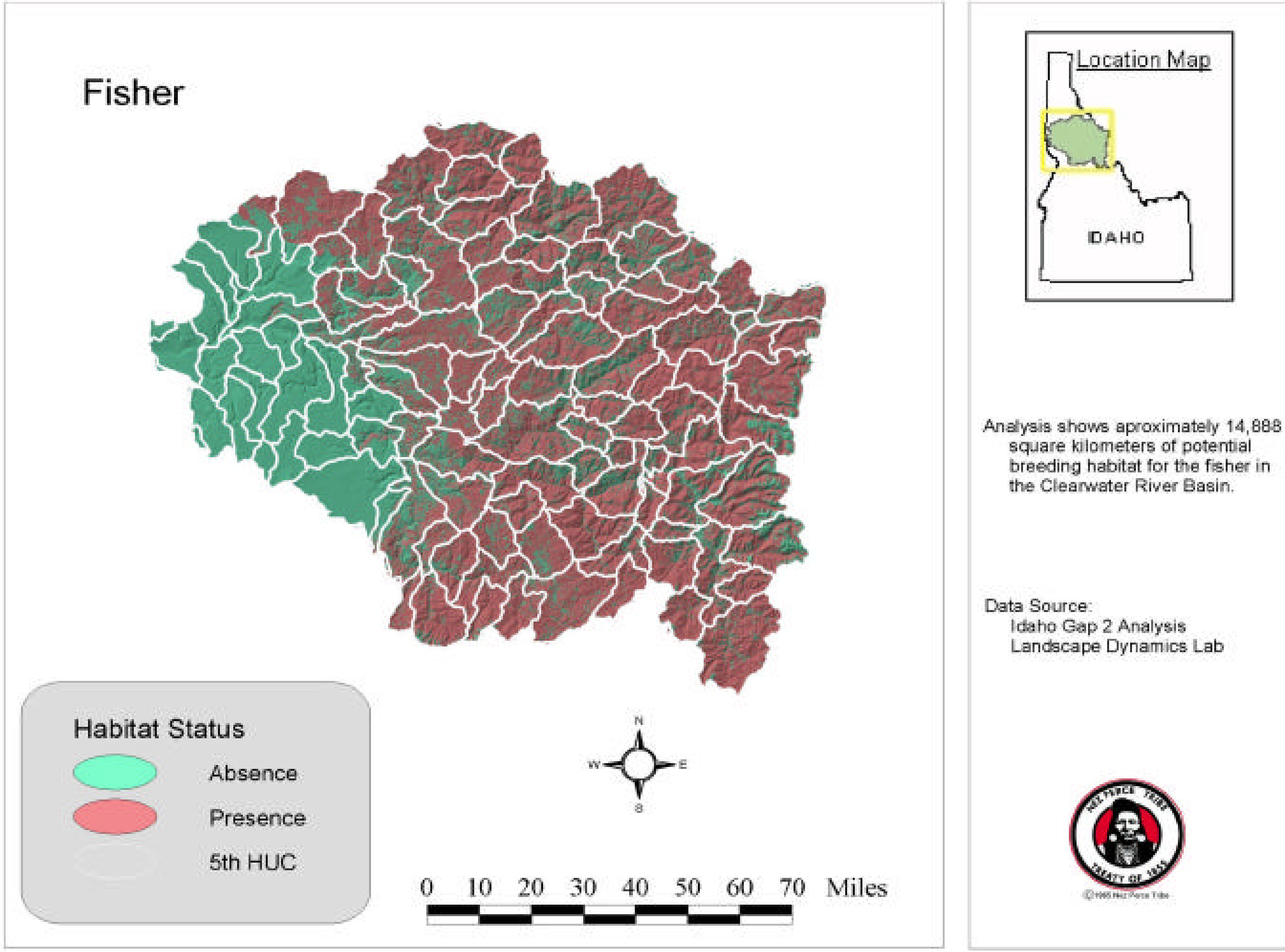

Figure 68. Potential breeding habitat for the fisher within the Clearwater subbasin

6.3.2 Wolverine

Life History

The wolverine (*Gulo gulo*) is an opportunistic scavenger that feeds predominantly on ungulate carrion, as well as small rodents, insects and vegetation (Copeland 1996). The skull of the wolverine is robust, and powerful dentition enables it to forage on frozen meat and bone. The wolverine is capable of killing large ungulates, but their presence in the diet is usually a result of carrion scavenging (Copeland 1996). In summer their diet is widely varied, and is dominated by ungulate carrion in the winter (Weaver 1993, Wisdom et al. 2000, Copeland 1996).

Den sites in Idaho were typically associated with large boulder talus, caves, rocks, or down logs. They were most commonly found on northerly aspects, in subalpine cirque basins with little overhead canopy cover, and above 8,000 ft elevation. The den entrances are located in soft snow near trees or rocks, with a vertical tunnel extending 1-5 meters to ground level (Copeland 1996). Females often access dens by burrowing through deep snow into the natural gaps between boulders (Csuti et al. 1997; Magoun and Copeland 1996; Wisdom et al. 2000; and Wolverine Foundation 2001). Lateral tunnels may extend for up to 50 meters along the ground surface (Copeland 1996).

Wolverines tend to travel widely and subsist on low quality and infrequent foods (Weaver 1993). Resident male wolverine home ranges in Idaho were larger than those exhibited by Alaska or Montana populations, with the average for Idaho being 588 mi^2. According to GAP 2 data, the potential breeding habitat for the wolverine comprises approximately 10,605 square kilometers in the Clearwater subbasin (Figure 69). Idaho wolverines tend to remain associated with their rearing area, and the presence of young are tolerated through maturity in the second year. The extended association of subadults and adults may be related to the highly dispersed nature of food resources and may account for the large home range sizes of resident females (Copeland 1996). Wolverines in Idaho are reported to prefer medium to scattered timber, and are usually associated with montane coniferous forests.

Habitat fragmentation and displacement by humans may have forced the wolverine into less desirable habitats than it historically occupied. Excessive hunter harvesting, loss of ungulate wintering areas, displacement of ungulate populations due to excessive timber harvest, and urbanization may all adversely affected wolverine populations (Copeland 1996). High road densities, timber harvesting, or housing development near subalpine habitats may reduce potential foraging habitat and kit rearing, along with increasing the probability of human-caused mortality (Copeland 1996). Forest alteration may isolate subpopulations, thereby increasing their susceptibility to extirpation (Copeland 1996). The reduction of wilderness "refugia" through human actions may be the greatest threat to local population viability (Copeland 1996). Providing large contiguous refuge areas of varied habitats may be the most important factor in protecting wolverines (Weaver 1993; Wisdom et al. 2000).

Limiting Factors

Denning sites need to have at least one meter deep snow cover throughout the denning period (Magoun and Copeland 1996). The characteristic of wolverine habitat most readily apparent is its isolation from the presence and influence of humans. This is demonstrated by their preference for higher elevation habitat during summer months. Protection of natal denning habitat from human disturbances is critical for the persistence of wolverines in Idaho (Copeland 1996). Aside from human-caused mortality, starvation and predation appear to be primary causes of death in weanlings. The role of more efficient carnivores as producers of carrion may

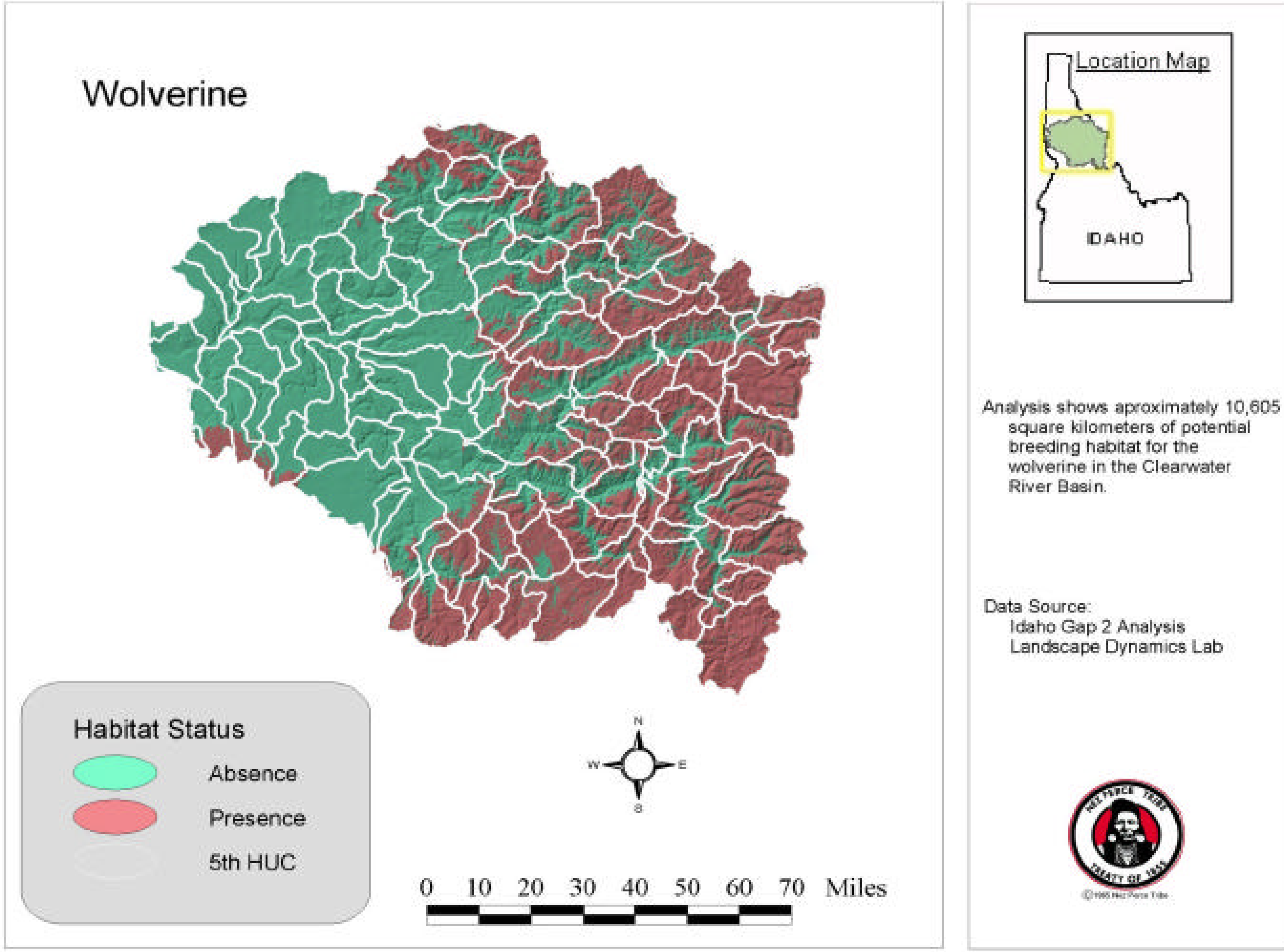

Figure 69. Potential breeding habitat for the wolverine within the Clearwater subbasin

be essential to wolverine survival in some areas, and systems lacking large predators such as gray wolves reduce the opportunities of carrion caches (Weaver 1993; Wolverine Foundation 2001). However, ungulate mortality from hunting and livestock losses on public grazing allotments also provide a carrion source (Copeland 1996). Both wolves and mountain lions may kill wolverines, and encounters may be more common when wolverines scavenge from other predators' kills.

Historic/Current Distribution

Historically the wolverine had a circumpolar distribution that extended south along the Sierra-Cascade axis, down through the Sierra Nevadas, and into the Rocky Mountains of Arizona and New Mexico. The wolverine has since been extirpated from the northern plains states east of Montana (Wolverine Foundation 2001). There is fossil evidence of extant representatives in Great Basin habitats of southern Idaho, but human encroachment may have forced the wolverine into its current distribution (Wolverine Foundation 2001). Present distribution of the wolverine in the western U.S. appears to constitute several peninsular extensions of Canadian populations, and only Idaho and Montana report populations of known extent (Wolverine Foundation 2001). In Idaho, wolverines are distributed from the state's northern border to the South Fork of the Boise River (Ruggiero et al. 1994). There have been forty-five wolverine observations reported to the CDC in the subbasin. A single set of tracks was recorded during 1990 near Mussleshell work center in the Clearwater National forest (Koehler 1990). In addition, there have been 12 reports of wolverine sign and 7 actual sightings within the Clearwater and Nez Perce National Forests between 1975 and 1995 (Dixon 2001). Records suggest very low wolverine densities in Idaho from the 1920s to 1950s (Wisdom et al. 2000). One third of wolverine reports have occurred since 1990 and mirror a general trend of increased sightings in Idaho since the 1960s (Edelmann and Copeland 1998).

6.3.3 Flammulated Owl

Life History

The flammulated owl (*Otus flammeolus*) is a small, nocturnal, insectivorous owl that preys on grasshoppers, moths, and beetles (Groves et al. 1997a, Nez Perce National Forest 1998). It is an obligate cavity nester (Reynolds 1989), and strongly associated with mid-elevation old growth ponderosa pine forests (Reynolds 1989; McCallum 1994). Home ranges vary between 6 and 24 ha, and some owl populations may be semicolonial (McCallum 1994). Habitat is characterized by open, multiple canopied, fire climax, old growth Ponderosa pine or Douglas-fir forests (Groves et al. 1997a). These habitats offer both suitable nesting cavities (usually excavated by northern flickers or pileated woodpeckers) and a high density of prey. Open forest is used for foraging while dense foliage is preferred for roosting. According to GAP 2 data, the potential breeding habitat for the flammulated owl comprises approximately 7,262 square kilometers in the Clearwater subbasin.

Threats

Late successional forest is preferred foraging and roosting habitat, and its loss would directly affect owl viability. Secondary roads can affect flammulated owls by increasing the likelihood of snags being removed for the use of fuel wood (Wisdom et al. 2000). Loss of winter habitat in Mexico, via massive harvest without reforestation, may be the single-most important factor in long-term survival of the flammulated owl (McCallum 1994).

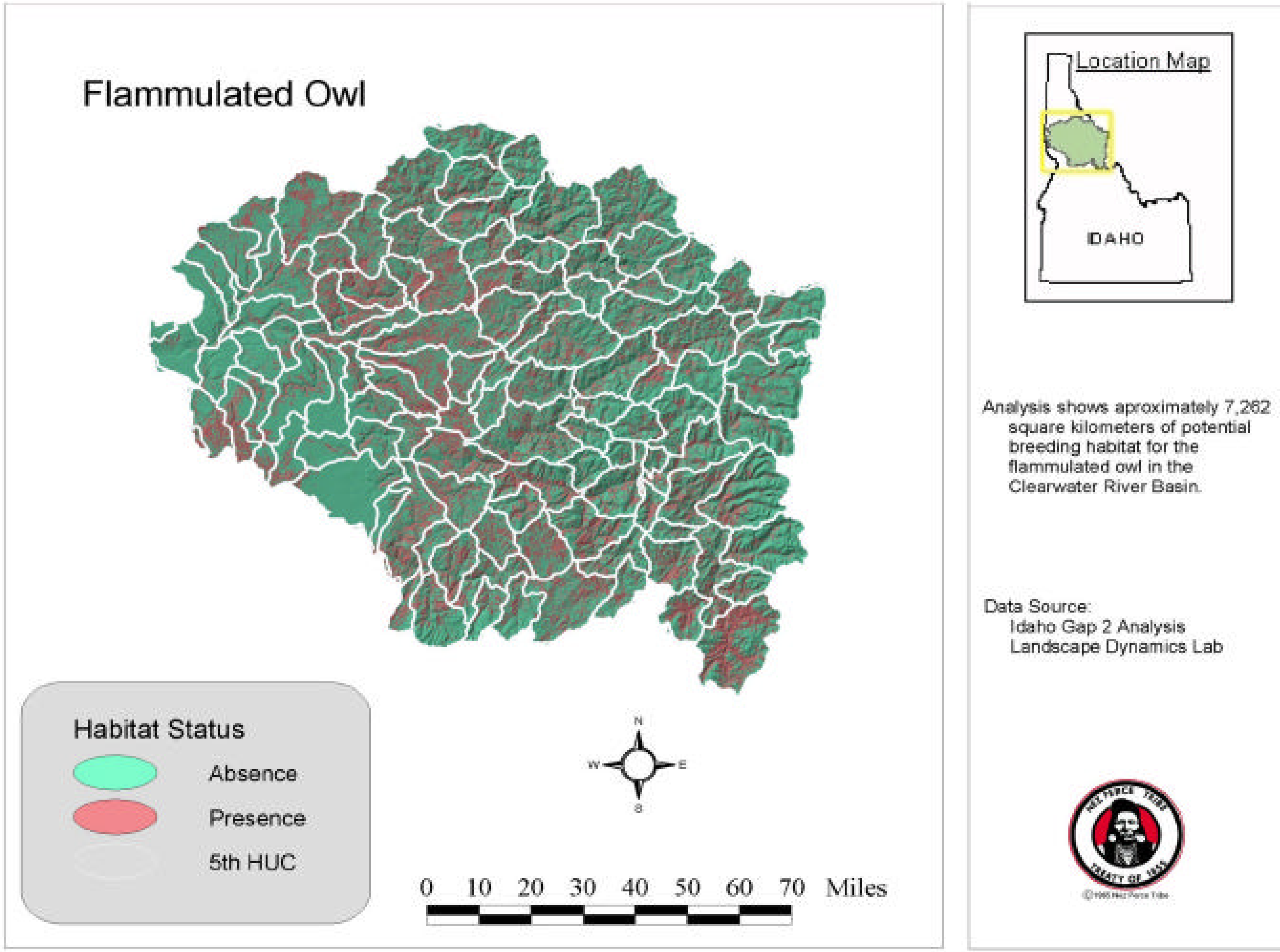

Figure 70. Potential breeding habitat for the flammulated owl within the Clearwater subbasin

Limiting Factors

Due to low fecundity and long life spans, the flammulated owl has an intrinsically low rate of natural population increase. Limited nest site availability and foraging habitat may hinder reproduction (McCallum 1994). Loss of old growth due to logging and firewood gathering in the *P. ponderosa* and *P. menziesii* cover types (Nez Perce National Forest 1998), as well as snag removal are limiting factors affecting (Wisdom et al. 2000; McCallum 1994). For breeding habitat, flammulated owls' dependence on nest cavities excavated by pileated woodpecker requires the well being of pileated woodpecker populations, and thus late successional forest habitat (McCallum 1994).

Some researchers have indicated that this owl may exhibit metapopulation or semi-colonial dynamics. Alteration of stand structure by removing large trees, hollow snags, or dense roosting vegetation, may be more deleterious than fragmentation for non-colonial populations. However, if the owl were found to be semi-colonial, fragmentation that hinders dispersal would exacerbate the effects of small population sizes.

Historic/Current Distribution

Flammulated owls are widely distributed but occur only in yellow pine forests (*Pinus ponderosa* and *P. jeffreyi*) from southern British Columbia in Canada through the highlands of Mexico and Guatemala. As a neotropical migrant, it occurs within the US in the breeding season and winters south of the border. Overall, its breeding range in the U.S. has probably remained constant throughout the last century (McCallum 1994). Approximately 61% of the original habitat is available for flammulated owl use in the Columbia River Basin and half of that likely retains the open understory characteristics of fire-climax forest. Current habitat is concentrated along the Clearwater River corridor (Nez Perce National Forest 1998). Columbia Basin wide, there is moderately or strongly declining habitat trends in nearly 70% of watersheds within the range of the flammulated owl (Wisdom et al. 2000).

Population trends are not known for flammulated owls in the Clearwater subbasin (Groves et al. 1997a), but between 1992 and 1998 there have been 15 personal accounts of heard or sighted observations of this species (Dixon 2001). Surveys have been conducted in the South Fork Canyon, Meadow Creek, Mill Creek, and Silver Creek ERUs in the Nez Perce National Forest, and flammulated owl has only been verified in the Granite Creek drainage (Nez Perce National Forest 1998). A site in the Nez Perce National Forest surveyed in 1992 had a population density of 0.25-0.98 owls/40 hectares (Groves et al. 1997a). Most vegetation plots associated with owl locations at this site were dominated by ponderosa pine and Douglas-fir (Groves et al. 1997a). In the study by Groves et al. (1997a), flammulated owls were not detected along the South Fork Clearwater River. The Idaho Conservation Data Center (CDC) records four reported occurrences of flammulated owl in the subbasin.

6.3.4 White-Headed Woodpecker

Life History

The white-headed woodpecker (*Picoides albolarvatus*) is a pine-loving species most commonly associated with mature pine and fir forests. This species was listed as sensitive due to the rate at which stands of these trees were being harvested (Engle and Harris 2001).

During the breeding season white-headed woodpeckers can be found between 4,000 to 9,000 feet, dropping to lower elevations in the winter. They forage on trunks and branches of coniferous trees, looking for bark-burrowing insects and their eggs. Common insectivorous food sources are ants, spiders, grubs and boring beetles. They also feed extensively on the seeds of pines. Early spring is the most critical time for foraging as pine seeds are largely depleted and it is still fairly cold for insect activity (Ligon 1973). In Nez Perce county white-headed woodpeckers were observed consuming pine seeds during the winter then switching to various insect species in the summer (Ligon 1973).

White-headed woodpeckers do not hammer at the bark like most woodpeckers, but instead use their beaks as a prybar to flake off layers of bark (Bent 1992). It is a primary cavity nester of soft, well decayed snags (due to their poor excavating abilities) with an average dbh of 30 inches (Marshall et al 1996). Nests are often built in ponderosa pine snags. Preferred habitat is in open canopy forests of mature trees or along the edge of wet meadows (Milne and Hejl 1989). Large diameter ponderosa pine trees are a habitat requirement for white-headed woodpeckers (Marshall et al. 1996). Bull et al. (1986) found that white-headed woodpeckers only used larger diameter (>25 cm dbh) ponderosa pine trees in ponderosa pine forest types for foraging. According to GAP 2 data, the potential breeding habitat for the white-headed woodpecker comprises of approximately 2,735 square kilometers in the Clearwater subbasin (Figure 71).

Threats

Habitat degradation due to logging and forest fragmentation is the major threat to white-headed woodpeckers (Engle and Harris 2001). The most important habitats are late-seral forests with large-diameter ponderosa pine snags (Wisdom et al. 2000). Road construction indirectly affects these woodpeckers, as roaded areas tend to have had snags reduced or eliminated. (Wisdom et al. 2000).

Limiting Factors

The white-headed woodpecker is strongly dependent upon large diameter, live ponderosa pines as a source of seeds for overwinter survival. It has very specific nesting preferences for snags with moderate decay (Engle and Harris 2001).

Historic/Current Distribution

There are eight recorded sightings in the IDFG CDC of white-headed woodpeckers in the Clearwater subbasin. Most of these sightings are 10-20 years old and could represent extirpated populations (Engle and Harris 2001). Current source habitats cover approximately the same amount of geographic area as they did historically, but many patches are now disjunct (Wisdom et al. 2000).

6.3.5 Black-Backed Woodpecker

Life History

Stands inhabited by black-backed woodpeckers (*Picoides arcticus*) are typically old growth lodgepole pine or recently burned forests with standing dead trees (Nez Perce National Forest 1998; Groves et al. 1997b). The species' diet contains large numbers of bark beetles and wood-boring beetle adults and larvae (Nez Perce National Forest 1998; Marshall et al. 1996). Foraging typically occurs on live or recently dead (<2 year) lodgepole pines (Bull et al. 1986). Nests are located in the body of dead or dying pine snags that have pronounced decay and are infested with beetles and beetle larvae (Bock and Bock 1974; Wisdom et al. 2000). Source habitats for black-backed woodpeckers include old subalpine fir, montane forests, and riparian woodlands, in addition to young stands of lodgepole pine (Wisdom et al. 2000). According to GAP 2 data, the potential breeding habitat for the black-backed woodpecker comprises approximately 16,419 square kilometers in the Clearwater subbasin (Figure 72).

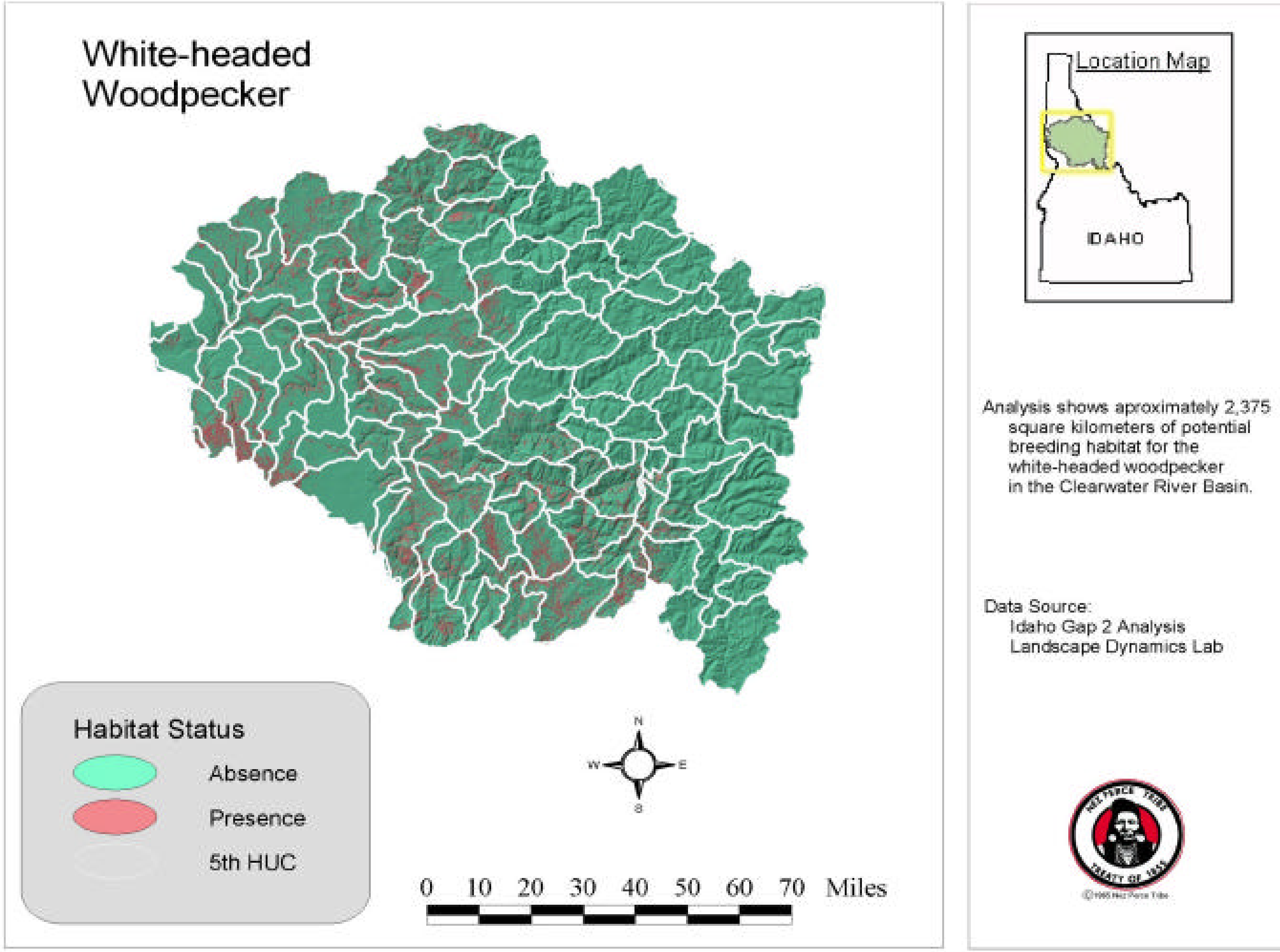

Figure 71. Potential breeding habitat for the white-headed woodpecker within the Clearwater subbasin

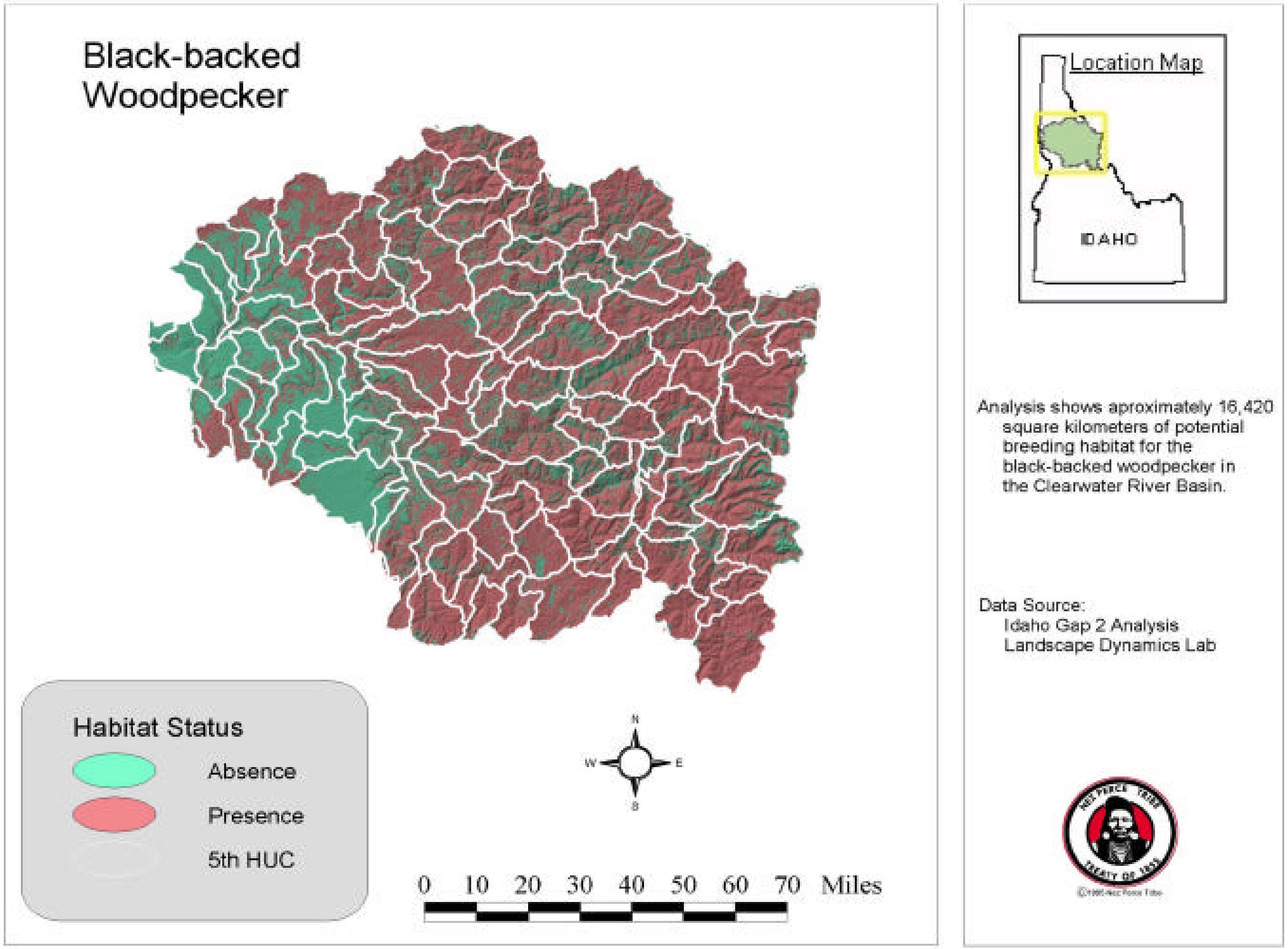

Figure 72. Potential breeding habitat for the black-backed woodpecker within the Clearwater subbasin

Threats

Recent fire suppression strategies have altered the pattern of beetle outbreaks and snag-producing fires. Salvage logging and removal of snags for firewood has decreased the occurrences of beetles in some areas, and roads have lead to increased ability to remove snags (Wisdom et al. 2000). Usurpation of nesting cavities by hairy woodpeckers and Lewis' woodpeckers causes stress and excessive energy costs in territorial competition (Wisdom et al. 2000).

Limiting Factors

Suppression of fires and post-fire logging as well as the threat of large, severe wildfires that reduce numbers of decaying snags serve as limiting factors for the black-backed woodpecker (Dixon and Saab 2000). Black-backed woodpeckers require habitats with dead or dying trees that contain adult beetles or their larvae (Nez Perce National Forest 1998). Research by Bull et al. (1986) indicates that this species requires recently dead (<5 years) small diameter trees for nesting (<50 cm DBH).

Historic/Current Distribution

The range of the black-backed woodpecker extends north to central Alaska, east to Newfoundland, south to New Hampshire and west to California (Bent 1992; Nez Perce National Forest 1998; Marshall et al. 1996). This species occurs throughout northern Idaho, where they are uncommon to rare (Burleigh 1972). Habitat for black-backed woodpeckers is primarily in the eastern portion of the subbasin and along the South Fork Clearwater River (Groves et al. 1997b). Black-backed woodpeckers have been documented in the Lochsa and Salmon drainages, as well as on the Clearwater, Payette, and Bitterroot National Forests, indicating that they are likely residents within the subbasin in low numbers (Clearwater National Forest 1998). Surveys conducted in the South Fork Clearwater River failed to find black-backed woodpeckers, but the species can be hard to detect (Nez Perce National Forest 1998). There has been one occurrence of the black-backed woodpecker in the subbasin reported to the CDC, and one reported sighting in 1995 up the East Fork Potlatch River (Dixon 2001).

6.3.6 Harlequin Duck

Life History

Harlequin ducks (*Histrionicus histrionicus*) winter in rough surf along the rocky arctic coasts of Siberia and Alaska and only come to Idaho in the summer to breed. According to GAP 2 data, the potential breeding habitat for the harlequin duck comprises approximately 2,580 square kilometers in the Clearwater subbasin (Figure 73). It has a shy, solitary nature and is found in rugged, inaccessible habitats. Occasionally nests have been found in tree cavities or in cliffs, but most often harlequins nest on the ground near turbulent mountain streams (Cassirer 1993). Average clutch size is 5 eggs, and the female incubates assiduously, with feeding breaks only once every 48 hours (Bellrose 1978). Nests were usually found in western red cedar-western hemlock riparian associations at elevations of 900 to 3,600 feet (Cassirer 1991). Much of the harlequin duck's diet is comprised of stream animals such as crustaceans, mollusks, insects, and fishes (Bellrose 1978).

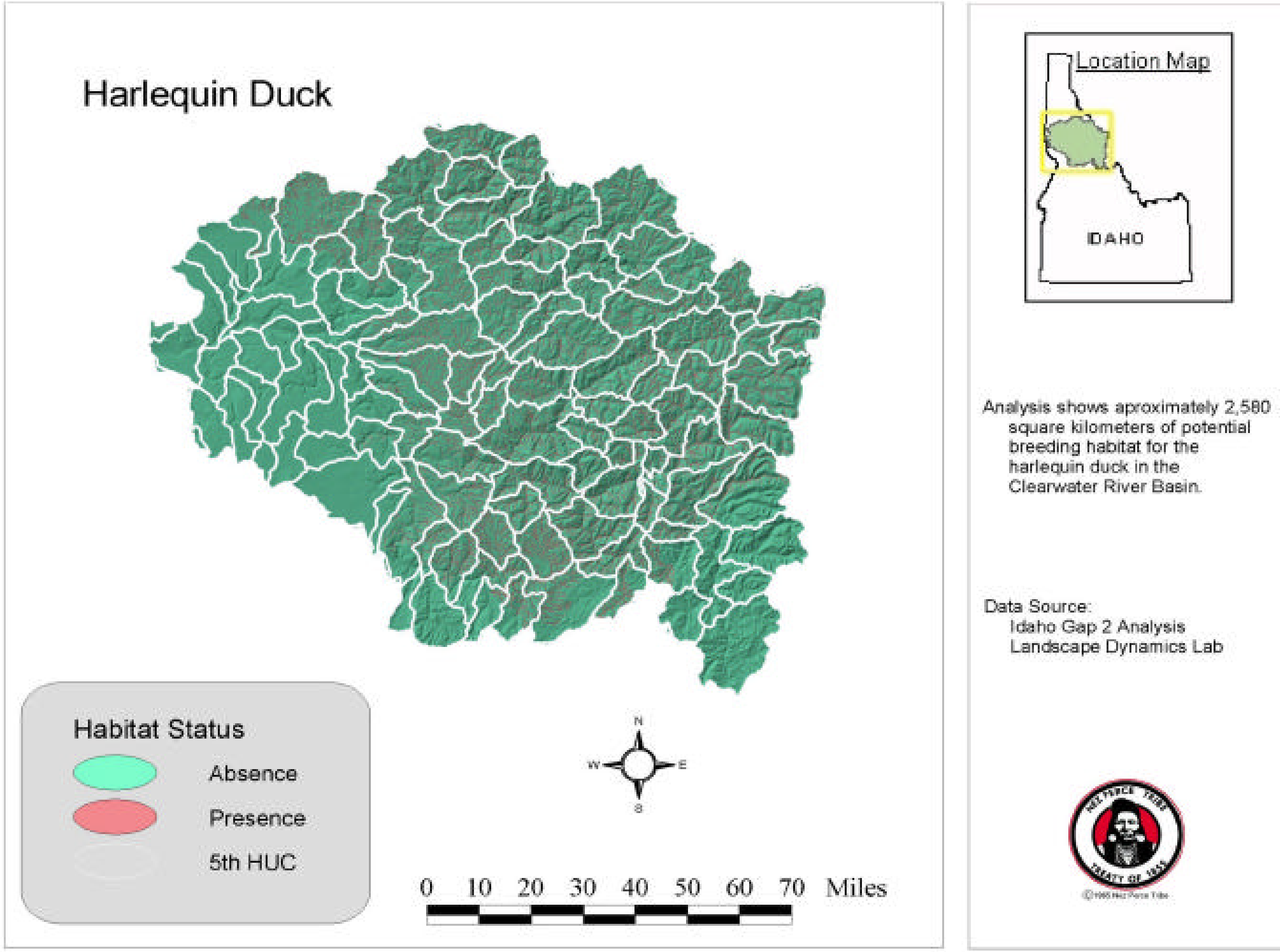

Figure 73. Potential breeding habitat for the harlequin duck within the Clearwater subbasin

Threats

Logging, road construction, destruction of riparian areas, mining, impoundment of breeding streams, and destruction of prey by pesticides have all had detrimental affects on the habitat and distribution of harlequin ducks. Disturbance by recreational anglers and hikers in breeding areas disrupts breeding activities. While incubating, female are very reluctant to leave the nest and hens are so intent that people have sometimes been able to touch them (Bellrose 1978). This nest loyalty can be detrimental in areas of high-intensity human activity.

Limiting Factors

Conservation of nesting and brood-rearing habitat along streams may be critical to harlequins' continued existence in Idaho (Cassirer 1991). Logjams and overhanging vegetation are important security cover along streams. Mid-stream loafing sites, shrubby streambank vegetation, and a stream gradient less than three degrees are important habitat components (Wallen and Groves 1989). Climatic conditions may severely impact recruitment if high spring runoffs wash out nests or make streams unnavigable for young chicks (Wallen and Groves 1989). Harlequins are very loyal to breeding and wintering sites and will return to the same drainages annually. They are relatively unproductive due to a high nonbreeding rate, and not all streams where breeding takes place produce broods every year. (Cassirer 1991). Much of the harlequin duck's habitat lies in remote areas and they have not been greatly affected by human activities (Bellrose 1978), but both breeding and wintering abundance appear to be declining in western North America (Engle and Harris 2001). Harlequin ducks in Idaho may be subject to local extirpation due to small breeding populations, and the declining harlequin populations worldwide limit their chances for recolonization of drainages once they have been eliminated (Engle and Harris 2001).

Historic/Current Distribution

The range of the harlequin duck is divided into two distinct and separate regions: eastern and western. The western population migrates from the Arctic Circle south through the Aleutian Islands down to northwest Wyoming, Idaho and central California. Harlequins are uncommon summer residents of Idaho, and surveys indicated that populations stayed the same between 1995 and 1996 for all of northern Idaho. During a 1987 – 1990 survey, Cassirer (1991) found that 73% of all harlequin ducks in Idaho are found between the Lochsa and Priest Rivers. There is an estimated 42-44 pairs in northern Idaho, and both the Lochsa and Selway river drainages have had confirmed sightings (Engle and Harris 2001).

Wallen and Groves (1989) found that within the Clearwater National Forest, harlequin ducks were observed on the Lochsa River, Kelly Creek, Hansen Meadow, Orogrande Creek, and Crooked Fork, but further studies need to be conducted on many other streams that contain good nesting habitat. There have been 6 Harlequin duck sightings reported at various locations throughout the Nez Perce National Forest between 1990 and 2001 (Dixon 2001).

6.3.7 Townsend's Big-eared Bat

Life History

Townsend's big-eared bats (*Corynorhinus townsendii*) are characterized by a horseshoe shaped lump on the nose and large rabbit-like ears. They are found in a wide variety of habitats including desert shrublands, high elevation coniferous forests, and riparian woodlands. According to GAP 2 data, the potential breeding habitat for Townsend's big-eared bats comprises approximately 5,337 square kilometers in the Clearwater subbasin (Figure 74).

These bats hunt along forest edges and are often found in association with mesic forests (Cassirer 1995). They emerge later in the evening than most bats, and tend to stay high above the ground until full dark. Townsend's feed 95% on moths and 5% on true bugs, and although some sources have observed *Corynorhinus* picking insects off of leaves, likely most prey is taken in flight (Verts and Carraway 1998).

They do not roost in crevices like many other species, but use caves and abandoned mine shafts as colonial day roosts and hibernacula (Wisdom et al. 2000). In the spring and early summer the females will form a maternity colony, while males remain solitary. Females will often return to the same maternity roost each year between March and April, and a single pup is born between May and July (Verts and Carraway 1998; USFS 1995). Townsend's big-eared bats are fairly sedentary and do not migrate long distances. In the winter they will hibernate singly or in small groups up to several dozen individuals (Verts and Carraway 1998). More than half of the autumn body weight can be lost during hibernation and rising out of torpor requires a large caloric output (USFS 1995). Frequent human disturbance that brings a bat out of its torpor state can drain winter energy reserves and lead to starvation (Wisdom et al. 2000).

Threats

Townsend's big-eared bats are extremely sensitive to human disturbance and will entirely abandon a roost site if disturbed. High visibility at colonial roosts has lead to purposeful killing of roosting bats. Negative folklore leads some to destroy bats and Townsend's have suffered high mortality and sometimes loss of entire colonies. Because of their patchy distribution and limited migration patterns, loss of a whole colony can have a significant impact on a region's bat population (Wisdom et al. 2000). Other disturbances or negative impacts to bat habitat include mining, logging, road construction, grazing, insecticides that destroy prey, and removal of old buildings.

Limiting Factors

Caves, abandoned buildings, and abandoned mine shafts are considered critical habitat for Townsend's big-eared bats (Verts and Carraway 1998). They have fairly specific roosting requirements preferring open, airy roosts with good air flow and moderate, stable temperatures. They also have a low reproductive rate and high juvenile mortality that hinders their ability to recolonize habitats once they have been extirpated.

Historic/Current Distribution

During the 1980s thousands of abandoned mines were closed resulting in unknown losses of established roosting sites, and current distribution of this species is patchy due to restrictive roosting requirements. In addition, many states funded eradication programs that destroyed bat colonies to protect the public from rabies outbreaks (USFS 1995). The current extent of suitable habitat is similar to historic distribution, but some habitat loss has occurred due to transitions from sagebrush to agriculture (Wisdom et al. 2000). An increase in human recreation and vandalism has caused widespread abandonment of caves by Townsend's big-eared bats. Between 1993 and 1994 Townsend's bats were captured at 5 of 12 netting sites at Craig Mountain, Idaho (Cassirer 1995), but there is only one occurrence of this species noted by the CDC in the Clearwater subbasin. There is one personal observation of a Townsend's big-eared bat recorded in 2000 near Dworshak resevoir (Dixon 2001).

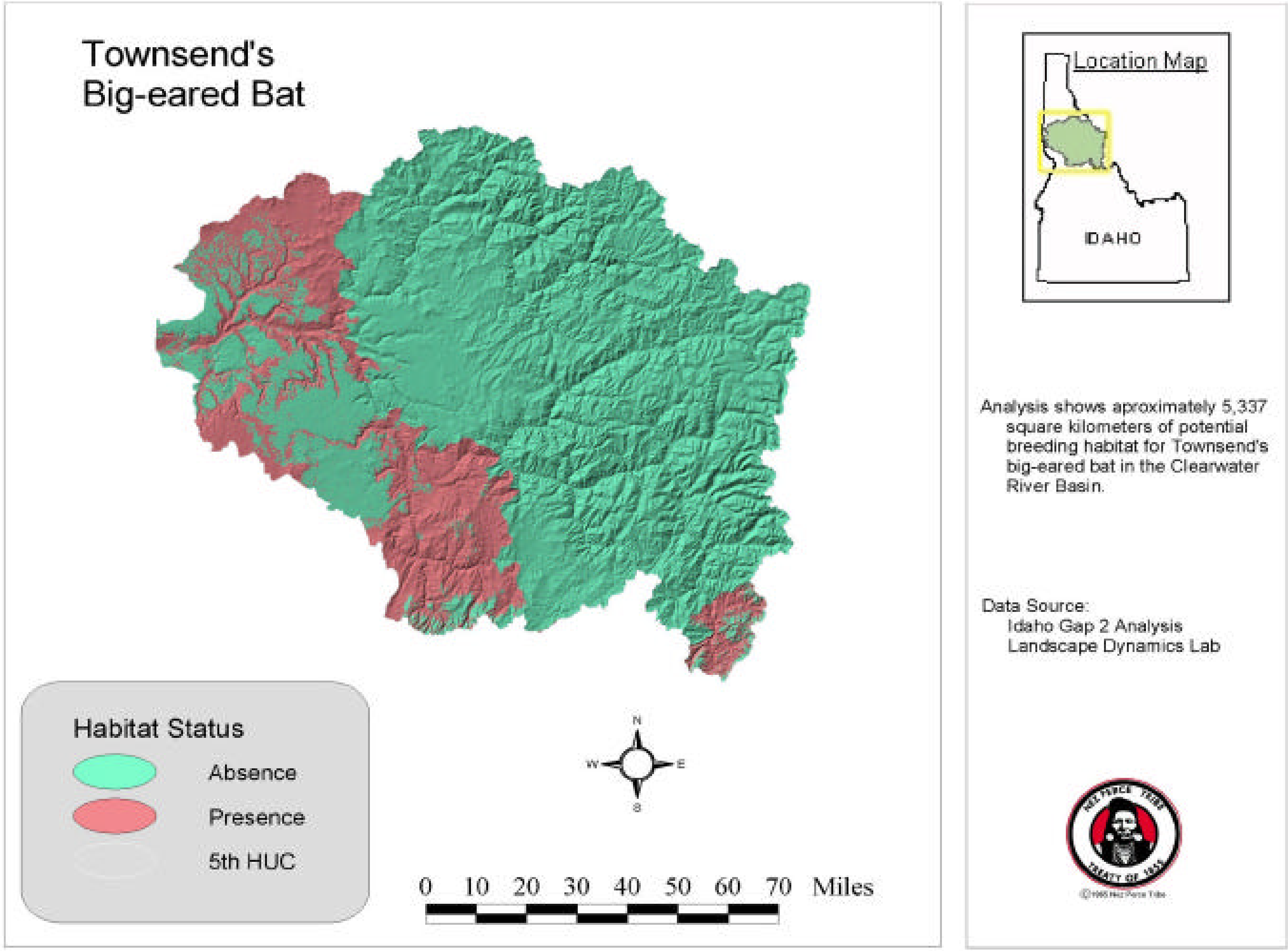

Figure 74. Potential breeding habitat for the Townsend's big-eared bat within the Clearwater subbasin

6.3.8 Fringed Myotis

Life History

The fringed myotis (*Myotis thysanodes*) is named for the fringe of short hairs along the free edge of the tail membrane. It can be found from low elevation deserts to coniferous forests, but appears to be most common in open woodlands (Cassirer 1995). The fringed myotis is gregarious and will form nursery colonies of several hundred individuals. Roosts may be located in buildings, caves or abandoned mines. According to GAP 2 data, the potential breeding habitat for the fringed myotis comprises approximately 1,243 square kilometers in the Clearwater subbasin (Figure 75).

The fringed myotis is a hovering gleaner that grabs its prey off of vegetation while in flight. Once considered a beetle specialist, recent studies have found that diet may be more a function of availability instead of selection. Common prey, in addition to beetles, may consist of moths, spiders, flies and leafhoppers (Verts and Carraway 1998). Although several authorities suggest that this species migrates in winter, the evidence seems largely circumstantial (Verts and Carraway 1998).

Threats

Human disturbance of roost sites, especially maternal colonies, through recreational caving and mine exploration has lead to permanent abandonment of some sites (Engle and Harris 2001). Loss of large diameter snag habitat through timber harvest, firewood cutting, and land conversion can also impact roost sites.

Limiting Factors

Large trees and snags are a critical habitat component for the fringed myotis (Engle and Harris 2001).

Historic/Current Distribution

Little data is available on the historic abundance of the fringed myotis in Idaho. There is one account of a fringed myotis being caught near Moscow, Idaho in 1967 (Larrison and Johnson 1981). Specimens were caught during mist netting at Craig Mountain, Idaho, during 1993 – 1994 and were seen using abandoned mines as roosts (Cassirer 1995). There is one occurrence in the Idaho Department of Fish and Game's CDC of a fringed myotis in northeastern Idaho County (Engle and Harris 2001), and one personal account of a fringed myotis sighting at a mine in 2001 (Dixon 2001).

6.3.9 Northern Goshawk

Life History

Northern Goshawks (*Accipiter gentilis*) are forest-dwelling raptors distributed across Canada, northwestern United States, and Mexico. They are usually quite silent except during the breeding season, when various screaming, shrieking, and wailing calls are uttered (Crocker-Bedford 1990). Goshawks initiate courtship behavior in late March or early April (Warren 1990), and it is thought that pair bonds are life long (Brown and Amadon 1968). Goshawks frequently use the same nest for more than one year (Reynolds and Wight 1978).

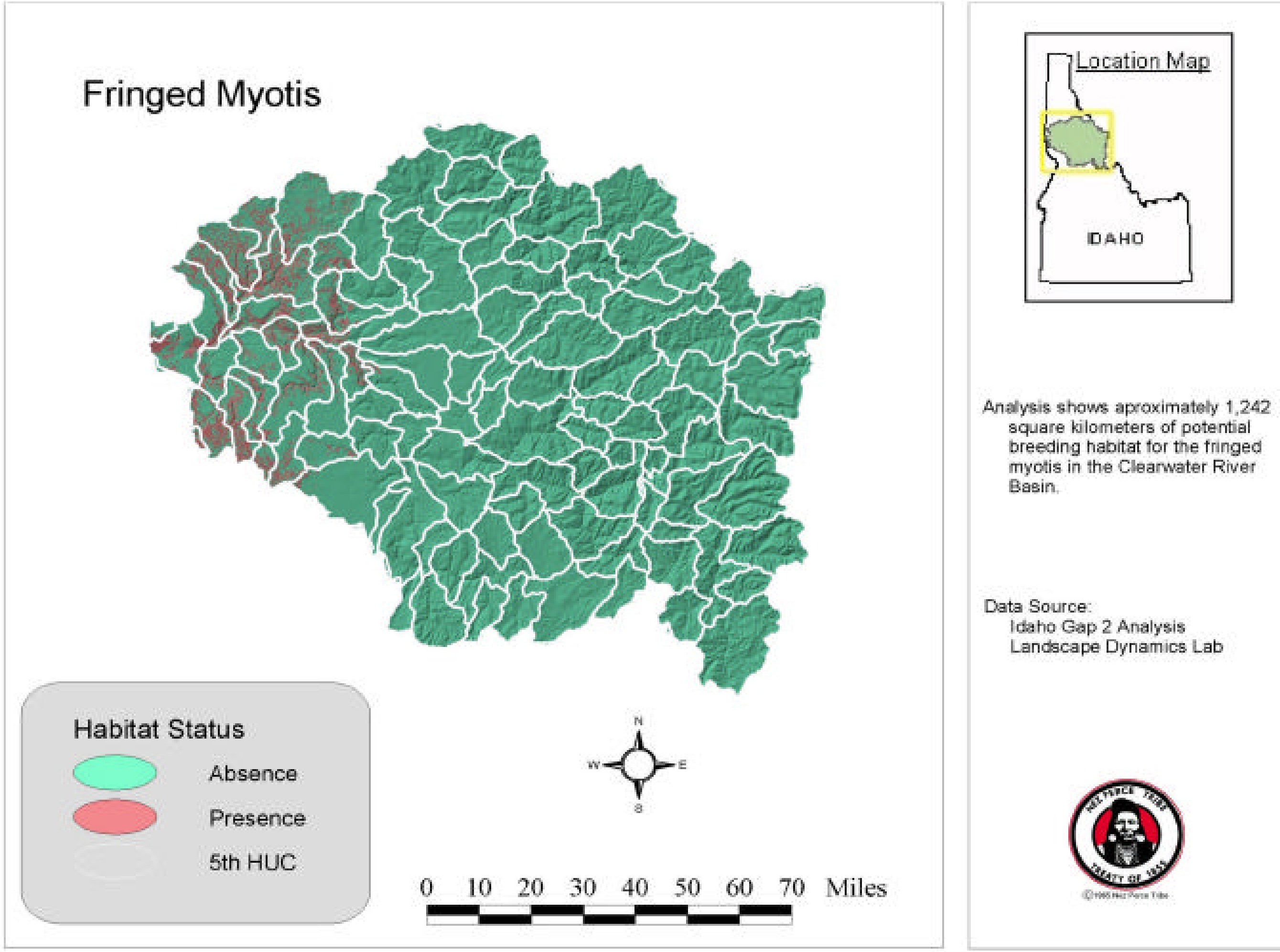

Figure 75. Potential breeding habitat for the fringed myotis within the Clearwater subbasin

Throughout its broad distribution, the goshawk varies in its preferred nesting habitat, but nearly all can be described as consisting of a combination of tall trees having intermediate to closed canopy coverage and small, open clearings for foraging (Johnsgard 1990). They will inhabit coniferous, deciduous or mixed forests (Reynolds et al. 1991). In Idaho, it is typically found in montane coniferous forest, but prefers mature or old growth timber stands for nesting (Nez Perce National Forest 1998). According to GAP 2 data, the potential breeding habitat for the northern goshawk comprises approximately 17,160 square kilometers in the Clearwater subbasin (Figure 76).

Goshawks' typical prey consists of tree squirrels, ground squirrels, snowshoe hares, and various bird species (Wisdom et al. 2000).

Threats

The northern goshawk has been negatively impacted by human activities such as timber harvesting, and disturbances during the nesting period (Reynolds 1983). Fire suppression, logging and grazing all reduce the complex canopy structures favored by goshawks (Wisdom et al. 2000).

Limiting Factors

Goshawks require quality habitats for prey that contain snags, downed logs, woody debris, large trees, herbaceous and shrubby understories, and a mixture of stand structural stages (Wisdom et al. 2000). Little is known about goshawk population dynamics, though it is thought that a large prey base plays an important role in nesting success (Wisdom et al. 2000).

Historic/Current Distribution

The northern goshawk's distribution is circumpolar (Knopf 1977). Year round range in North America extends from northern Alaska and Canada south to northern Mexico (Scott 1987). Goshawks are generally uncommon to rare throughout northern Idaho (Burleigh 1972), but have been recorded within the Nez Perce National Forest (Nez Perce National Forest 1998). During 2001, four goshawks were observed within the subbasin on Idaho State lands (Dixon 2001). A petition was filed with the Forest Service in 1991 to list the northern goshawk as threatened or endangered west of the 100th meridian, but the Service found that while the goshawk typically uses mature forest or larger trees for nesting, it appears to be a generalist in terms of the variety of types and age-classes of forest habitats it needs (USFWS 1998).

6.3.10 Peregrine Falcon

Life History

The peregrine falcon (*Falco peregrinus anatum*) has an almost worldwide distribution, with three subspecies recognized in North America (Brown and Amadon 1968): the Peale's falcon (*F. p. pealei*), the Arctic peregrine falcon (*F. p. tundrius*), and the American peregrine falcon (*F. p. anatum*). The American peregrine occurs throughout much of North America from the subarctic boreal forests of Alaska and Canada south to Mexico (USFWS 1999b).

Peregrine falcons generally reach breeding maturity at 2 years of age. The nest is often a scrape or depression dug in gravel on a cliff ledge. Rarely, peregrines will nest in a tree cavity or an old stick nest. Predominately they choose open shelves that are protected from above by rocky overhangs (Johnsgard 1990). According to GAP 2 data, the potential breeding habitat for the peregrine falcon comprises of approximately 5,728 square kilometers in the Clearwater subbasin (Figure 77).

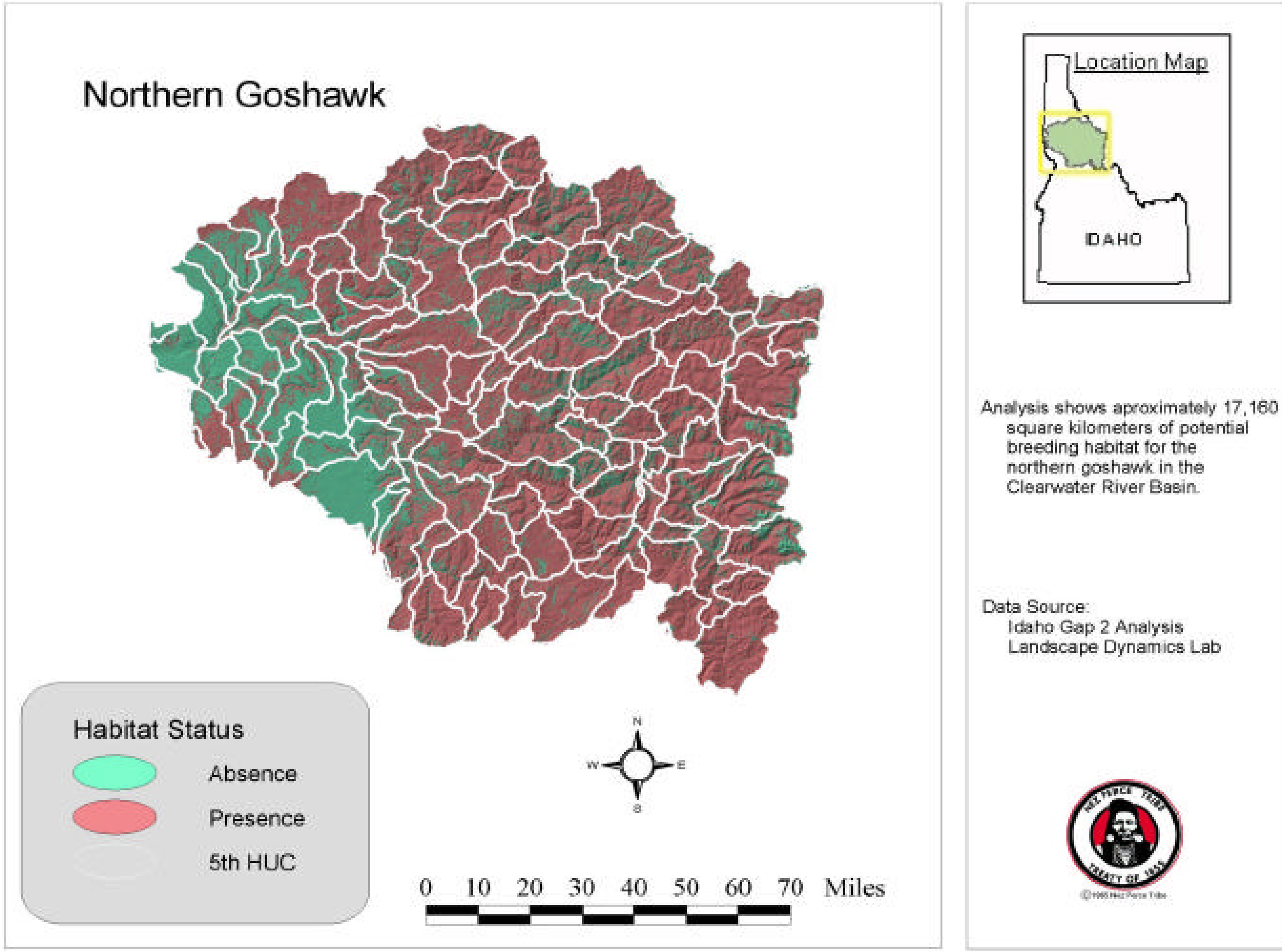

Figure 76. Potential breeding habitat for the northern goshawk within the Clearwater subbasin

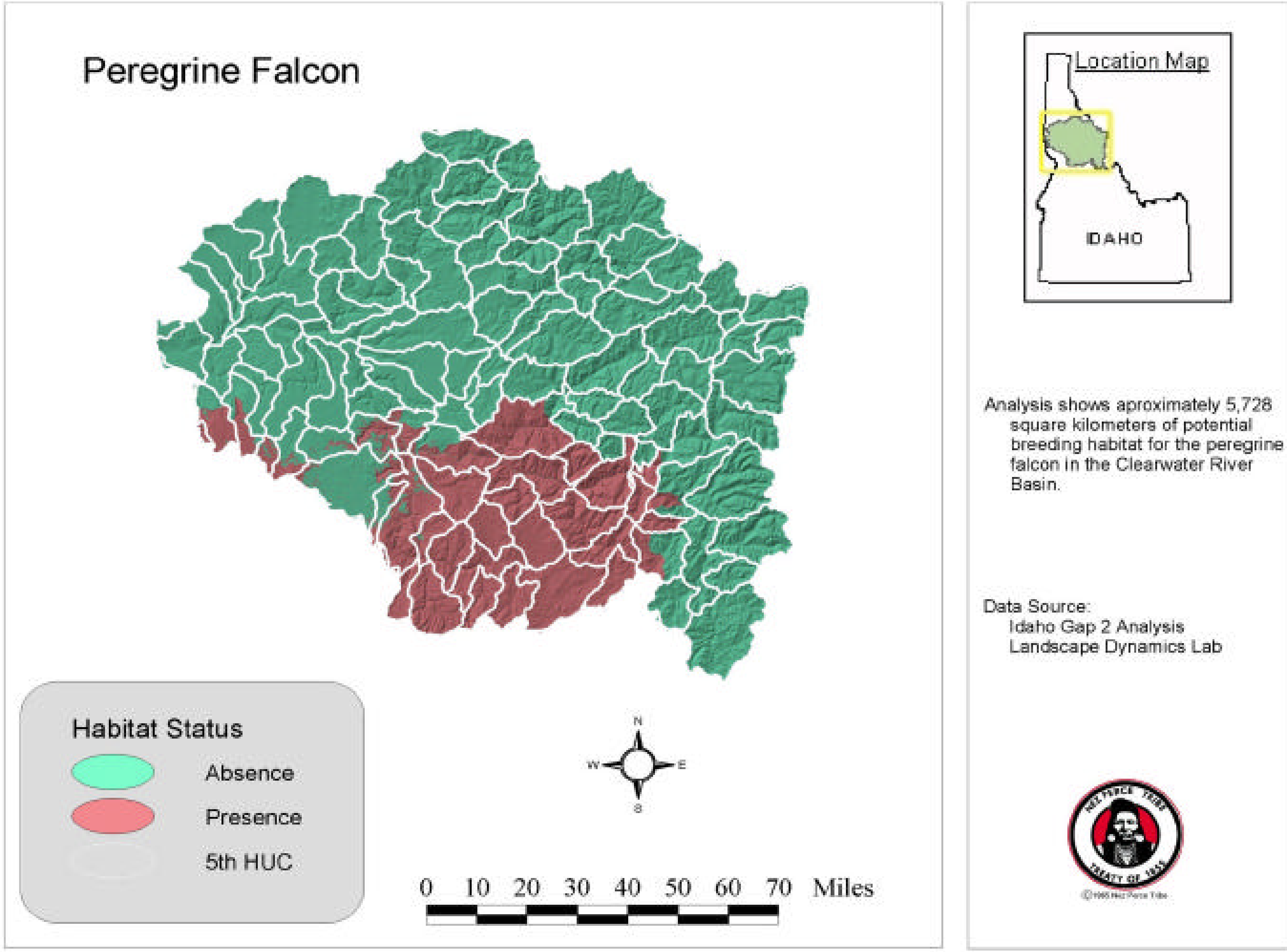

Figure 77. Potential breeding habitat for the peregrine falcon within the Clearwater subbasin

Unlike many other animals that cannot coexist with urbanization, some peregrines have readily accepted human-made structures as breeding habitat (USFWS 1984). Peregrine falcons primarily feed on songbirds, shorebirds, ducks, and in urban areas, starlings and pigeons (USFWS 1999b). The great majority of these prey are taken while in full flight, either being struck dead after a nearly vertical stoop or being seized in the air while fleeing (Johnsgard 1990). It has been estimated that the speed of a diving peregrine can be more than 200 miles per hour (USFWS 1999b).

Threats

Factors that may threaten the peregrine falcon include destruction of habitat, diseases such as Botulism and Trichomoniasis, and juvenile predation by raccoons and great horned owls. Other natural or humanmade factors such as shooting, egg collecting, disturbance by rock climbers, and climate changes also impair peregrine productivity (USFWS 1999b). Peregrine eggshell formation is compromised by pesticides such as DDT, which were once sprayed in wetland areas to control mosquitoes (Hickey and Anderson 1968).

Limiting Factors

Mortality for juvenile falcons is high due to inexperience in hunting, poor flying coordination, and a tendency to expend excessive amounts of energy on prey they can't catch (Snow 1972). Some peregrines are extremely sensitive to disturbance and will refuse to breed if humans have been anywhere near their eyries (Snow 1972).

Historic/Current Distribution

Peregrine falcons have never been very abundant. Studies in the 1930s and 1940s estimated about 500 breeding pairs of peregrines in the eastern U. S. and 1000 pairs in the western U. S. and Mexico (USFWS 1999b). The population declined precipitously in North America due to the extensive use of pesticides, which hindered eggshell formation and drastically reduced hatchling recruitment (USFWS 1984). Historically, peregrines nested in northern Idaho (USFS 1989), but they were essentially extirpated by 1974 (Bechard et al. 1987). In 1982, peregrine population restoration was initiated through the release of captive-produced young (Heinrich 1987). This effort was an extension of an existing national program begun in 1970 by the Peregrine Fund, Inc., in cooperation with state and federal agencies (Cade 1985). Within the Clearwater subbasin, one pair is known to nest in the Nez Perce National Forest (IDFG 2001a).

In 1970 the American and Arctic peregrine falcon subspecies were listed as endangered under the Endangered Species Conservation Act of 1969. A recovery program was initiated in the mid 1970s, and on August 25, 1999 the Service published the final rule to delist the peregrine falcon as no longer endangered or threatened (USFWS 1999b).

6.3.11 Western Toad

Life History

The western toad, or boreal toad (*Bufo boreas*) is largely terrestrial and will bury itself in loose soil or rodent burrows during the day. The toad emerges in the evening to feed on ants, spiders, sowbugs, earthworms, crayfish, and nearly any type of flying insect. Boreal toads can be found from dry grasslands to moist subalpine forests, but optimal habitat is found in humid areas with moderate undergrowth (Nussbaum et al 1983). According to GAP 2 data, the potential breeding habitat for the western toad comprises of approximately 20,024 square kilometers in the Clearwater subbasin (Figure 78). Breeding activity begins in June or July and sexually mature toads begin to congregate in groups of several hundred or more in shallow bodies of water. Females produce an average of 12,000 eggs per clutch, and lay them in two gelatinous strands. Even though they secrete toxins from their skin, mortality for young boreal toads is well over 99% due to predation by birds, garter snakes, and predacious insects (Nussbaum et al 1983).

Threats

The most significant diseases threatening the boreal toad are Chytrid fungus and Red-leg. Other possible threats include increased ultraviolet radiation and predation by ravens and crows (Engle and Harris 2001). Habitat loss and degradation due to water retention projects, nonnative species predation and competition, trout introductions, livestock grazing, timber harvesting and recreational uses have continued to negatively impact toad populations. The boreal toad is declining for unknown reasons, even in areas considered pristine habitat.

Limiting Factors

Boreal toads require unpolluted, pooled water for breeding, such as ponds, lake shallows, or slow moving sections of streams.

Historic/Current Distribution

Boreal toads occur from southern Alaska to New Mexico, and from California east to Colorado. Population trends in Idaho are difficult to track due to a lack of baseline information, but they are well distributed (Engle and Harris 2001). Asherin and Orme (1978) found the western toad to be very abundant along the lower Clearwater River and Dworshak reservoir, and Bowers and Nadeau (2000) conducted surveys in the Dworshak area and located western toads at 6 monitoring sites. The boreal toad occurred commonly at Craig Mountain, Idaho in 1993-94 and was well distributed throughout the study area (Cassirer 1995). Throughout their range the boreal toad has experienced population declines, often for unknown reasons, and similar reductions have been reported in states neighboring Idaho.

6.3.12 Coeur d'Alene Salamander

Life History

The Coeur d'Alene salamander (*Plethodon vandykei idahoensis*) is usually associated with seepages, splash zones and streamsides near talus, but may also be found in talus away from water if the site is located on a protected north-facing slope (Nussbaum et al. 1983). These salamanders can often be found under forest litter, bark or logs. The Coeur d'Alene salamander occurs in harsher and colder climates than other related salamanders because of their close association with spring water. According to GAP 2 data, the potential breeding habitat for the salamander comprises of approximately 2,027 square kilometers in the Clearwater subbasin (Figure 79). Seeps offer a stable habitat temperature and a high local humidity that allows Coeur d'Alene salamanders to extended foraging opportunities during cold or dry weather. *P. idahoensis* has been referred to as the most aquatic *Plethodon*, and they will enter water to avoid capture (Wilson and Larson 1988). They are mostly nocturnal and will forage at the edge of seeps or move away from the water zone if the surrounding area is saturated by rain.

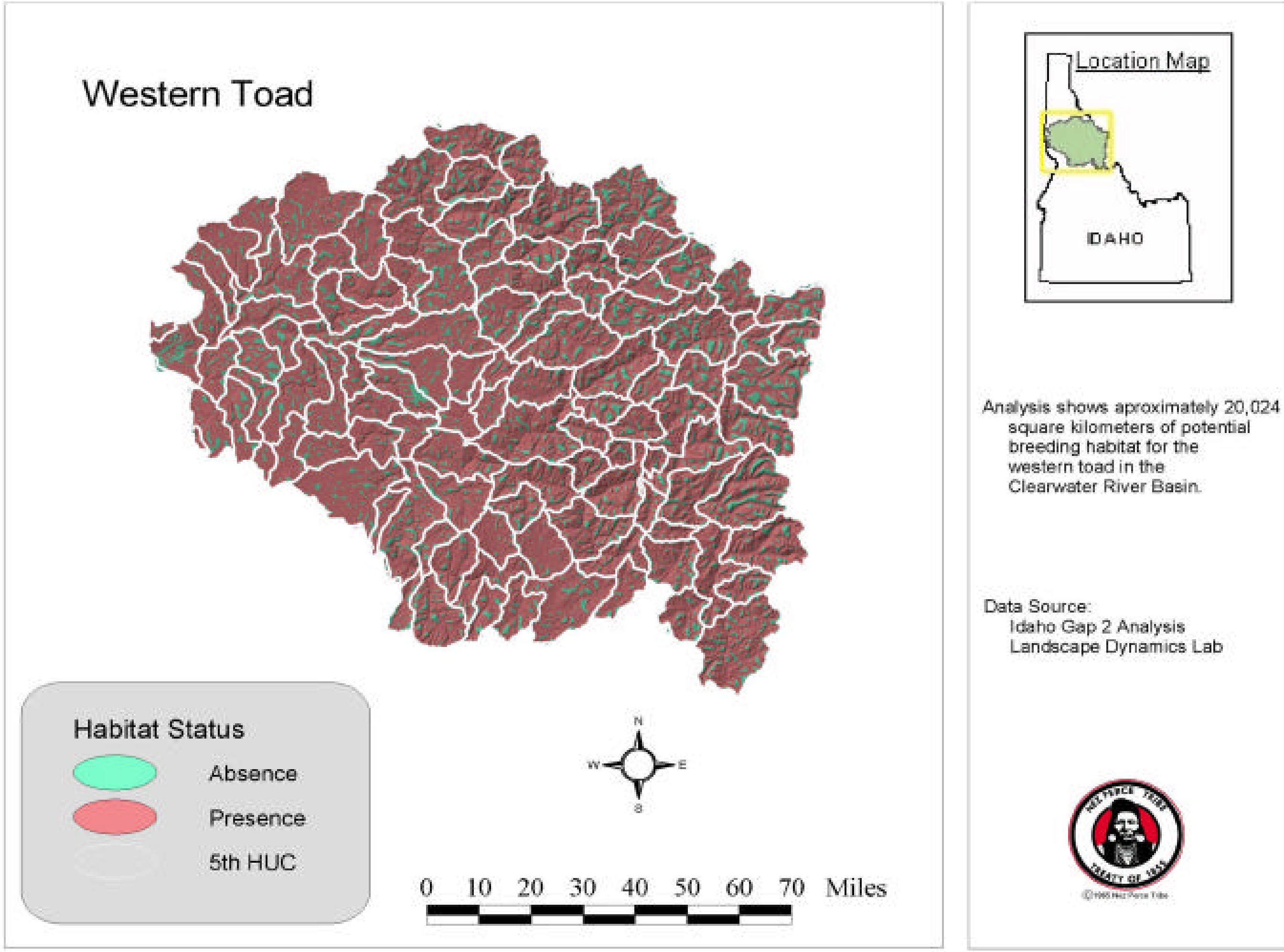

Figure 78. Potential breeding habitat for the western toad within the Clearwater subbasin

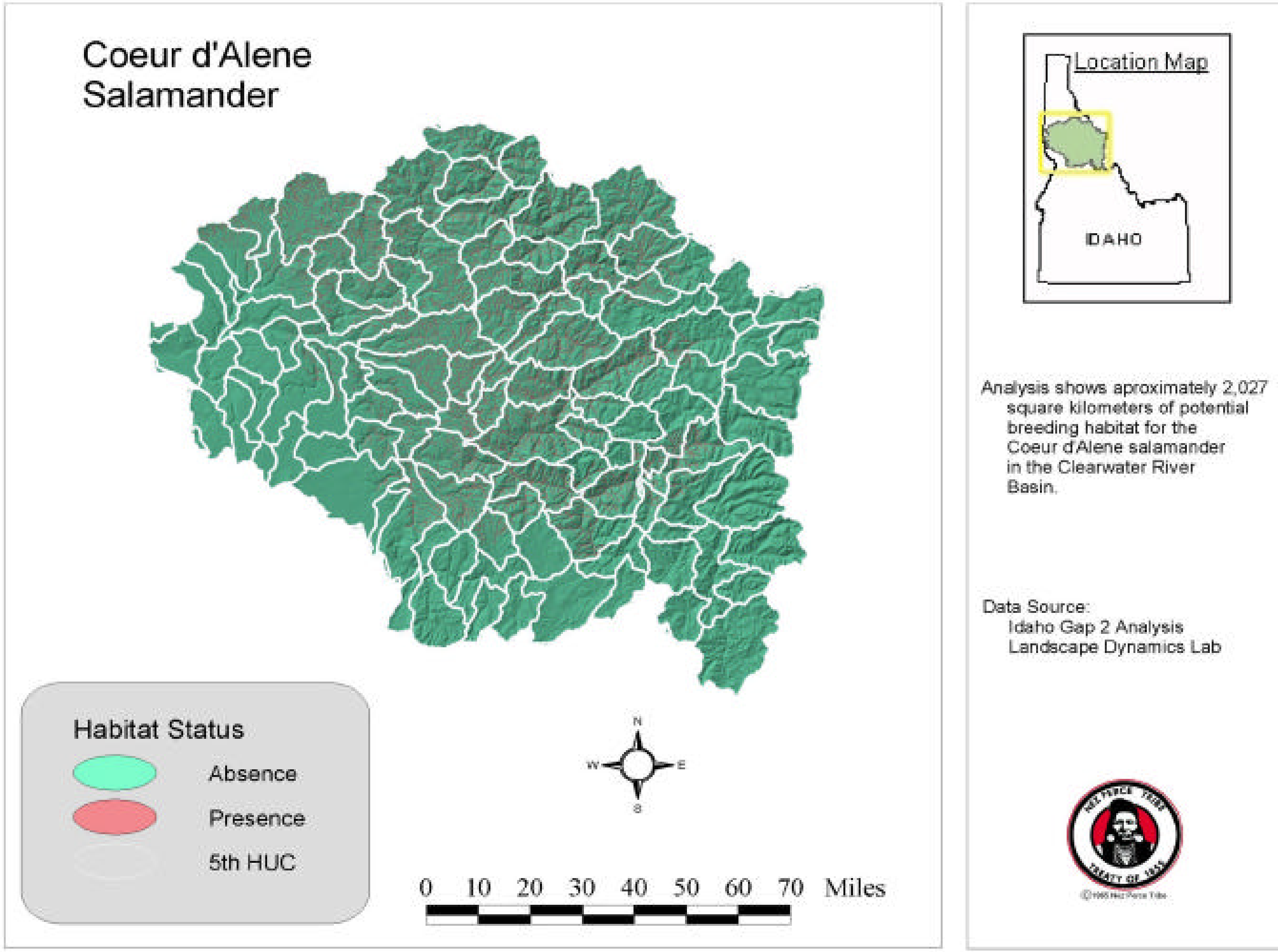

Figure 79. Potential breeding habitat for the Coeur d'Alene salamander within the Clearwater subbasin

The main prey species of *P. idahoensis* are aquatic insects such as Diptera (larvae and adults), and Collembola. These benthic insects are probably caught at the waters edge when they move onto dry land to molt (Wilson and Larson 1988). In northern Idaho this salamander emerges from hibernation in late March and is active through May. Salamanders not near water will retreat underground until mid-September, emerge during the autumn rains, and return to hibernation in late November. Females probably oviposit every other year and will lay eggs in the spring in a grape-like cluster. Brooding takes place throughout the summer and hatchlings emerge in the fall (Nussbaum et al. 1983).

Threats

Possible threats to *Plethodon idahoensis* are logging, road construction, water diversion or pollution, exotic species, fire, and illegal collection.

Limiting Factors

Restricted mobility and habitat fragmentation make this species susceptible to local extirpation and deleterious genetic effects (Engle and Harris 2001).

Historic/Current Distribution

The North Fork Clearwater drainage is the core distribution area for Coeur d'Alene salamanders in the Clearwater subbasin, and the Selway drainage is the southern limit of their known range. Many populations are small isolated communities with little genetic influx from other populations, and high temperatures and lack of moisture (Engle and Harris 2001) likely limit distribution. Nineteen of Idaho's 77 observed occurrences were documented prior to 1981. A single juvenile salamander was observed on Orogrande Creek in 2001 (Dixon 2001). In the most recent surveys, six of the previous occurrences had no observed *Plethodon* salamanders and their populations are considered unknown and possibly extirpated (Engle and Harris 2001).

6.4 Threatened & Endangered Species

6.4.1 Gray Wolf

Life History

The gray wolf (*Canis lupus*) is the largest member of the dog family (Mivart 1890), with adult males averaging 90 to 110 pounds and adult females, 80-90 pounds. Coloration is variable ranging from black to nearly white (Jimenez and Mack 1995). In most wolf populations, reproductive packs occupy exclusive territories, and nonbreeding lone animals live in the buffer zones between territories (Mech 1972). Most packs include a pair of breeding adults, pups and often yearling and/or extra adults (Murie 1944, Mech 1970). Wolf packs are highly organized and all members of the pack contribute to the raising of the pups (Mech 1970). Wolves become sexually mature at 22 months and the usual dispersal age is 9 to 28 months (Packard and Mech 1980). According to GAP 2 data, the potential breeding habitat for the gray wolf comprises approximately 17,903 square kilometers in the Clearwater subbasin (Figure 80).

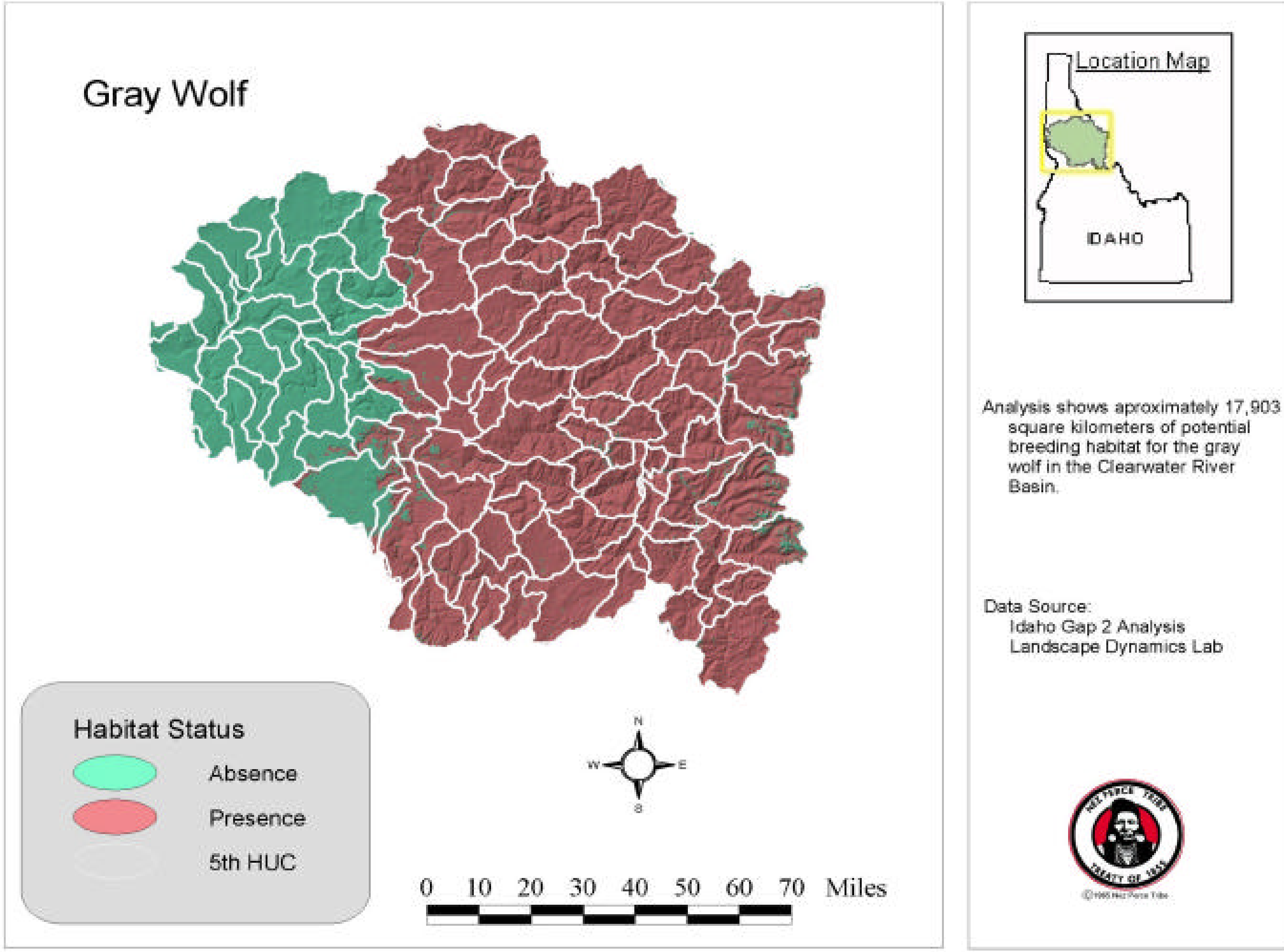

Figure 80. Potential breeding habitat for the gray wolf within the Clearwater subbasin

Dens are commonly located on southerly aspects of moderately steep slopes, usually about 400 yards from a water source (USFWS 1987). The wolf pack will usually move from the natal den to the first rendezvous site when the pups are 6-10 weeks of age. The first rendezvous site is usually within 1-6 miles from the den site (Carbyn 1974; Fritts and Mech 1981). Rendezvous sites include areas of meadow complexes and adjacent hillside timber, with surface water nearby. These rendezvous sites are characterized by matted meadow vegetation and a system of well used trails through the adjacent forest and across the meadow (Joslin 1967).

Threats

Threats for the gray wolf include canine diseases such as parvovirus, distemper and rabies, habitat loss and human predation (USFWS 1987).

Limiting Factors

Wolves require large home ranges with enough food to support a group of 5-8 pack members. Habitats must contain mesic meadows for denning, low occurrences of human interactions, and high quality habitats for big game prey species (Groves et al. 1997b; Nez Perce National Forest 1998).

Historic/Current Distribution

Wolves have occupied nearly all habitats in the Northern Hemisphere except for true deserts (Mech 1970). Wolf packs were first recorded in 1812 in the Clearwater River drainage and were distributed from the Canadian border south (USFWS 1987). The prairies and foothills of Idaho supported large herds of ungulates and buffalo that were hunted extensively by miners and pioneers. The vast herds of bison that supported the wolf population were decimated by 1890, and elk were all but eliminated by 1900. As the ungulates decreased, buffalo hunters began shooting wolves for their pelts (Hansen 1986). Until the early 1900s, gray wolves were common over much of the northwestern United States (Young and Goldman 1944), but by the 1930s federal and public control efforts essentially eliminated wolves from the west, including Idaho (Hansen 1986; Kaminski and Hansen 1984). The Secretary of the Interior federally listed wolves as an endangered species in 1973.

In the 1970s a recovery plan was developed for the Northern Rocky Mountain gray wolf. The plan recommended a combination of natural recolonization and the reintroduction of wolves to recover the populations in the greater Yellowstone ecosystem, central Idaho and northwest Montana. The identified goal of recovery would be to establish 10 breeding pairs in each of the recovery areas for three consecutive years. The plan recommended the use of the 10(j) section of the Endangered Species Act, which designated the reintroduced populations as experimental nonessential (USFWS 1994b). This meant that wolves could be managed to minimize conflicts and meet public concern (Mack and Laudon 1998).

In 1995-96, 35 gray wolves from Canada were released into central Idaho, forming the Central Idaho Wolf Recovery Area (CID), one of three recovery areas in the western United States. Each wolf was fitted with a radio collar so that biologist could monitor the status of the recolonizing population (Mack and Laudon 1998). In 1996, three pairs produced the first wolf litters born in Idaho for over 60 years (Mack and Laudon 1998). Currently 261 wolves are know to inhabit the CID, a 750% increase over the original 35 (Figure 81). These wolves inhabit 22 different packs, including five whose home range is partially contained by the Clearwater subbasin (USFWS et al. 2002). Four of these, the Marble Mountain, Bighole, Kelly Creek and Selway packs have established the home ranges mapped in Figure 82; the territory of the newly formed Gospel Hump pack has not yet been mapped. The Marble Mountain pack maintains a territory in the Marble Creek drainage in the Panhandle National Forest (Mack 2001), and a small portion of their most southeastern territory lies within the subbasin. The Kelly Creek wolf pack has produced pups since 1996. They have maintained a territory largely within the roadless areas of the Clearwater and Lolo national forests (Mack 2001). The Big Hole pack produced their first litter in 1998 and maintains a territory on the Idaho/Montana border. The Selway group produced their first litter in 1996. Their territory is within the Selway Bitterroot Wilderness, the Bitterroot and the Nez Perce National Forests and includes the high elevation mountainous country between the mainstem Salmon and Selway rivers. The Gospel Hump pack, one of four new packs formed in the CID in 2001, was formed by a female wolf from south of the Salmon River. The new pack, whose home range is in the Gospel hump wilderness of the South Fork AU, produced a litter of 7 in 2001 (USFWS et al. 2002).

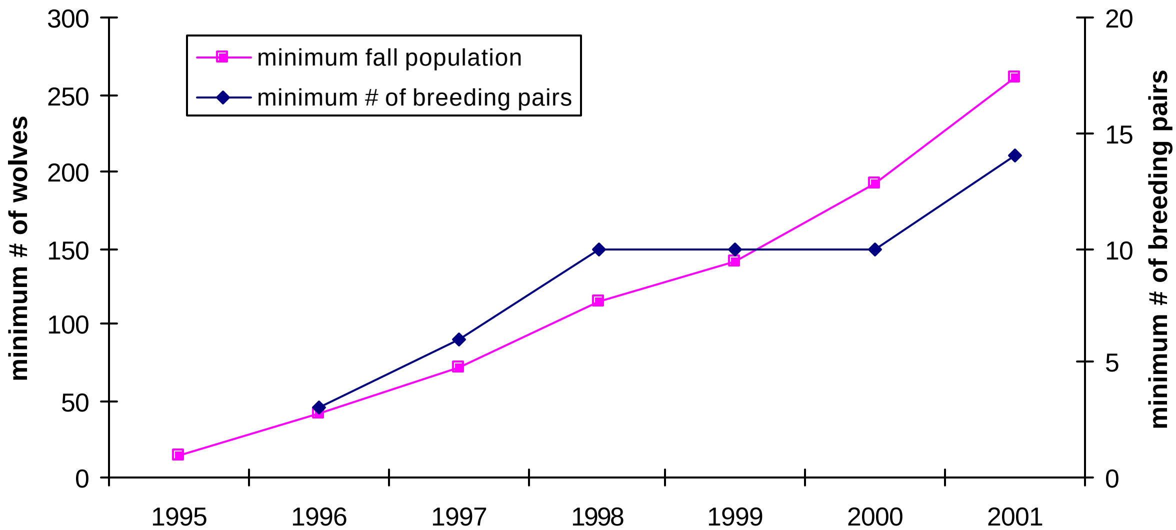

Figure 81. Minimum fall wolf population, Central Idaho Recovery Area (1995-2001)

6.4.2 Bald Eagle

Life History

The bald eagle (*Haliaectus leucocephalus*) is a large, powerful bird of prey. The sexes are alike with the entire head and tail colored white (Herrick 1933; Chura and Stewart 1967). Bald eagles are generalized predators and utilize a wide variety of prey items including fish, birds, mammals, and invertebrates (Hancock 1964). Fish are their most staple prey (Herrick 1934). Bald eagles are generally believed to mate for life (Bent 1937) and reach sexual maturity at 5 years of age (Johnsgard 1990). According to GAP 2 data, the potential breeding habitat for the bald eagle comprises approximately 8,074 square kilometers in the Clearwater subbasin (Figure 83). The timing of breeding and egg deposition varies throughout the birds' range and according to climate and latitude (Herrick 1934). Nest site preference includes areas with an open clear flight path to water, and may be built on the tallest tree in the stand (coniferous or deciduous) with an open view of the surrounding area, or on cliffs (Johnsgard 1990).

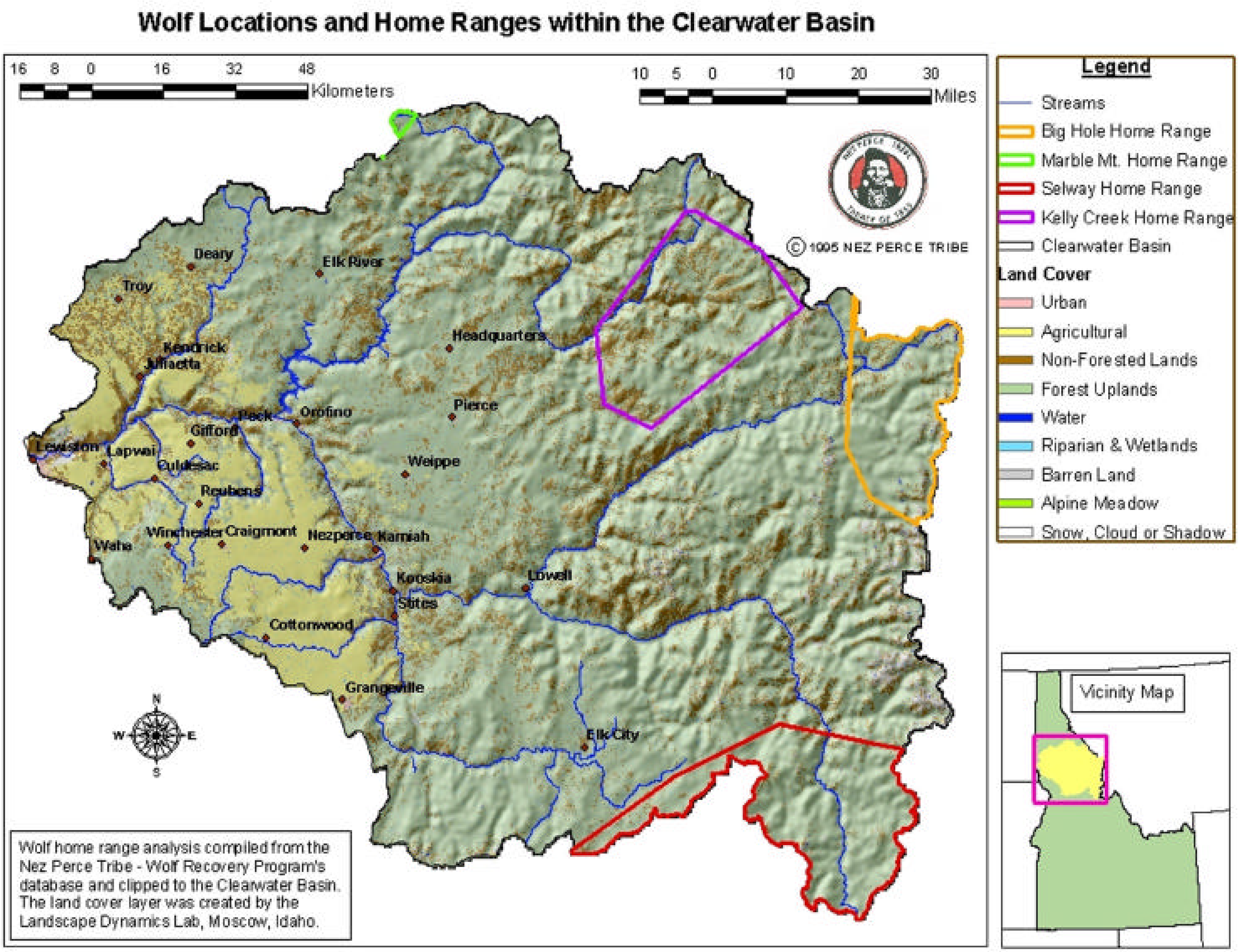

Figure 82. Home ranges for the established gray wolf packs within the Clearwater subbasin

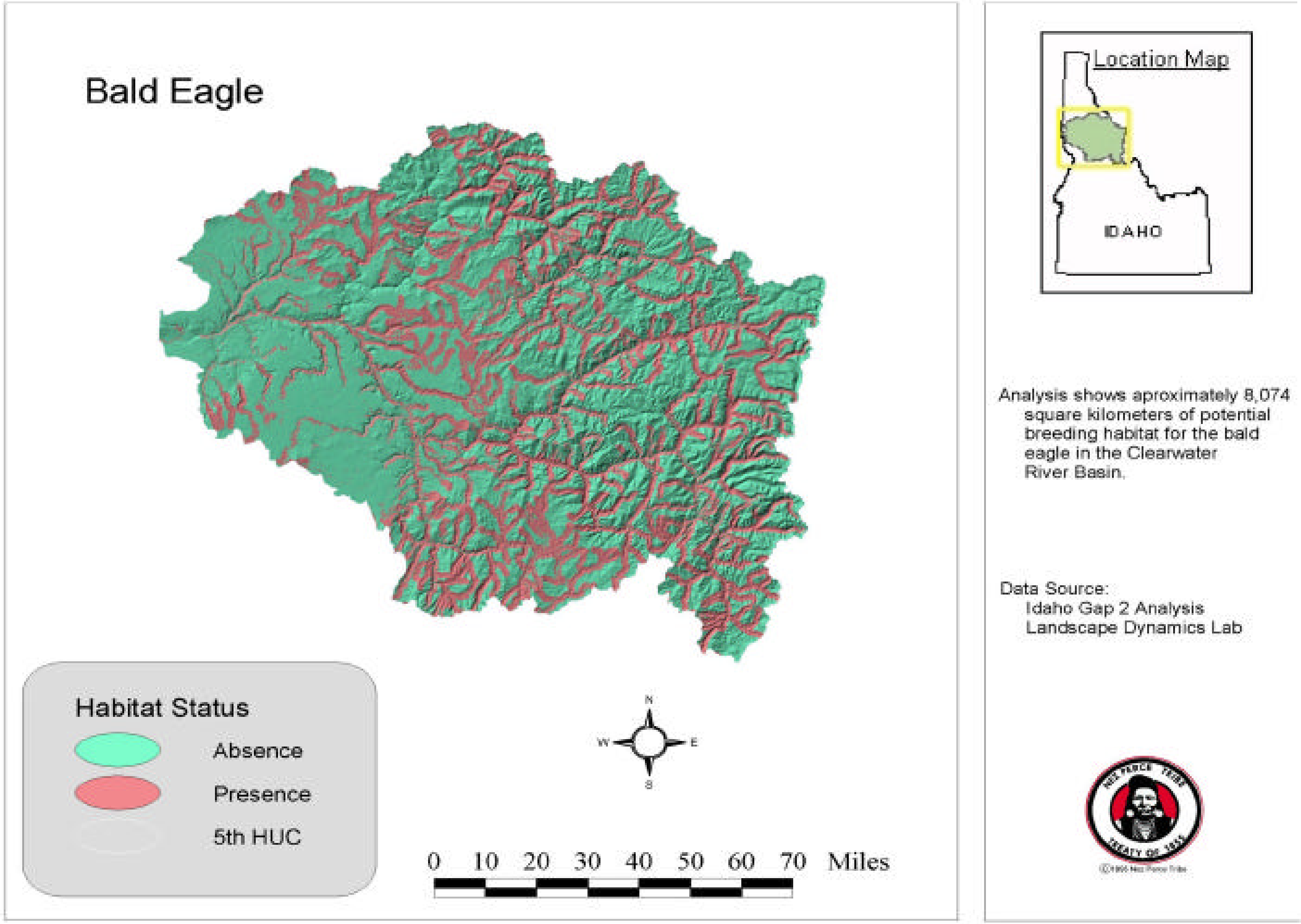

Figure 83. Potential breeding habitat for bald eagles within the Clearwater subbasin

Threats

Threats to the bald eagle include habitat loss due to human activities, human disturbance during the nesting season, pesticides which cause the reduction in hatchling success, and shooting eagles for sport or alleged depredation (Sprunt and Ligas 1966; Snow 1973).

Limiting Factors

The breeding habits of the bald eagle require an adequate supply of moderate to large-sized fish, nearby nesting sites, and a reasonable amount of freedom from disturbance during the nesting period.

Historic/Current Distribution

The range of the bald eagle extends from central Alaska and Canada to northern Mexico. When Europeans first arrived on the North American continent, bald eagles were prolific and widespread. The first major decline in population began in the mid- to late 1800s, which coincided with declines in waterfowl, shorebirds, and other major prey species. Direct eagle killing was also prevalent and coupled with the loss of nesting habitat reduced the number of bald eagles up to the 1940s (USFWS 1995). Shortly after WWII, the use of dichloro-diphenyl-trichloroethane (DDT) and other organochlorine compounds to control mosquitoes became widespread (USFWS 1995). DDT accumulated in bald eagles as they continuously ingested contaminated prey, and caused the loss of calcium, which is necessary for the formation of eggshells (USFWS 1995). The Bald Eagle Protection Act was passed in 1940 which prohibited the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export or import, of any bald eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. This increased awareness of the bald eagle's decline resulted in the partial recovery of the species in most areas of the country except Alaska.

By 1972 bald eagles south of the 40th parallel were listed as endangered and DDT was banned in the United States (USFWS 1986). In 1978, the Service listed the bald eagle throughout the lower 48 states as endangered except in Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was designated as threatened (USFWS 1995). A recovery program was initiated in the mid 1970s, and in 1994 the Service published the proposed rule to reclassify the bald eagle from endangered to threatened in most of the lower 48 states (USFWS 1995). By 1999 the Service proposed to delist the bald eagle from the threatened and endangered list (USFWS 2000a).

The Clearwater subbasin is part of Bald Eagle Recovery Zone 15, which encompasses all of central Idaho. The recovery goal for Zone 15 is to provide secure habitat for at least six bald eagle nesting territories, with long-term occupation of at least four. Bald eagles nested in the Cold Springs area near Dworshak reservoir in 1999 and 2000 but no offspring were produced. The nest site went unoccupied during 2001 and 2002, although numerous mature bald eagles were sighted. It is thought that eagles may still be nesting in the area but no nests have been located (R. Davis, USACE, personal communication, June 2002). Winter counts of bald eagles were conducted for the Clearwater subbasin between 1980 and 2000 (Figure 84) by the Idaho Fish and Game, Nez Perce National Forest, and the USGS Forest and Rangeland Ecosystem Science Center. These counts show an upward trend in the number of sightings.

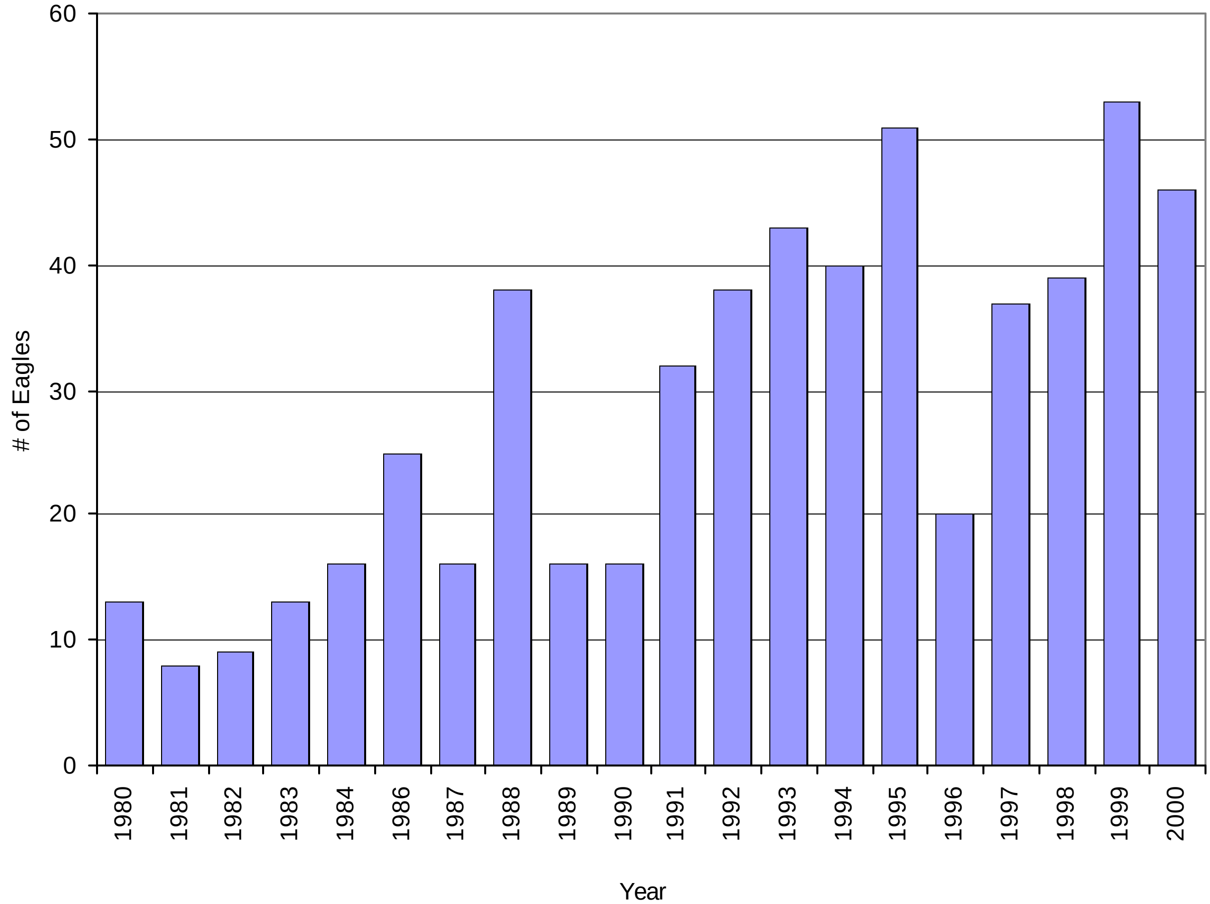

Figure 84. Number of bald eagles counted by year within the Clearwater subbasin

6.4.3 Lynx

Life History

Long legs and exceptionally large and densely furred feet make lynx (*Lynx canadensis*) well adapted to traveling in snow (Nowak 1991). They are suited to living in cold climates with deep snow and rely heavily on the snowshoe hare as a primary food source. Ten year Lynx population cycles that closely follow snowshoe hare population cycles have been well documented in the northern boreal forests of Canada. In the southern boreal forests, like those of the Clearwater subbasin, these population cycles are thought to be less defined or nonexistent (Ruggiero et al. 1999). This difference is thought to be at least partially due to a heavier reliance on alternative prey in the southern regions; grouse, ptarmigan, mice, red squirrels, and occasionally young ungulates, serve as alternatives to snowshoe hare for foraging lynx (Ruggiero et al. 1999).

In Idaho, lynx are often found above 4,000 feet in Englemann spruce, subalpine fir, and lodgepole pine forests. They require a mosaic habitat of early successional forests that contain high numbers of prey, and late successional forests that contain cover, especially windfalls, for kittens and denning. In addition, denning sites need to be within close proximity to hunting areas and have minimal human disturbance (Koehler and Aubry 1994).

Lynx select den sites in or near mature habitats dominated by large quantities of wind-felled trees. Dens are usually located within logs, stumps, or root balls of downed trees within mature or old growth forests. According to GAP 2 data, the potential breeding habitat for lynx comprises of approximately 15,958 square kilometers in the Clearwater subbasin (Figure 85).

Dense, young coniferous forests support the greatest year-round snowshoe hare populations and therefore provide the greatest hunting opportunities for lynx (Interagency Lynx Committee 1999). Young forests tend to have the highest availability of small diameter stems and branches, which provide showshoe hares with the greatest nutritional content. Snowshoe hare use was found to increase with the number of seedlings and samplings on the site (Scott and Yahne, 1989). Estimates of summer snowshoe hare densities in Montana indicate highest densities of 1.9 hares/ha in closed young forests (Ruggiero et al. 1999). Koehler (1991) found a mean of 15.8 hares/ha in Washington lodgepole pine forests < 25 years compared to 5.9 hares/ha found in lodgepole pine stands >80 years. Probably as a result of reduced cover and associated protection from predators, snowshoe hares have been shown to avoid very recently disturbed areas (Ruggiero et al. 1999). The role of brushy areas in canopy gaps of mature forests in supporting lynx prey species has not been adequately studied, but limited investigation indicates that these areas may be important in supporting both snowshoe hares and red squirrels, an important alternative prey species.

Threats

Snowshoe hare densities decline in response to reduced cover and thus extensive clearcutting and thining may be detrimental to lynx (Ruggiero et al. 1999). Roads and open areas have been demonstrated to inhibit lynx movement. Fragmentation of habitat and degradation of corridors for travel between denning and foraging habitats through, logging, agriculture, and road construction may negatively impact lynx populations (Ruggiero et al. 1999). Fire suppression and resultant ecological succession may reduce prey availability and lynx populations (Engle and Harris 2001, Ruggiero et al. 1999). Increased winter recreation may be causing displacement or mortality of lynx. Extensive snowmobile trails give coyotes and bobcats access to deep snow areas that were previously utilized by lynx (Engle and Harris 2001). Trappers have said that lynx are curious and tolerant of humans and although trapping of lynx is now illegal they are occasionally caught in traps meant for other species (Ruggiero et al. 1999).

Limiting Factors

Old growth forests are required for denning and dense early seral forests provide prime foraging areas (Nez Perce National Forest 1998). Density of coyotes appears to influence lynx habitat use more than the availability of snowshoe hare populations, because coyotes will compete for resources and have occasionally been known to kill young lynx (Ruggiero et al. 1999). Travel corridors are an important habitat feature because lynx will tend to avoid open areas larger than 300 feet wide (Koehler and Brittell 1990; Melquist and Davis 1997).

Historic/Current Distribution

Lynx harvest records in Idaho are available from 1934 to 1981, but they are considered unreliable due to the inclusion of “pale bobcats” as lynx. Overall, lynx numbers in the subbasin are reduced from historical levels. Populations never recovered from both regulated and unregulated exploitation in the 1970’s and 1980’s (Engle and Harris 2001).

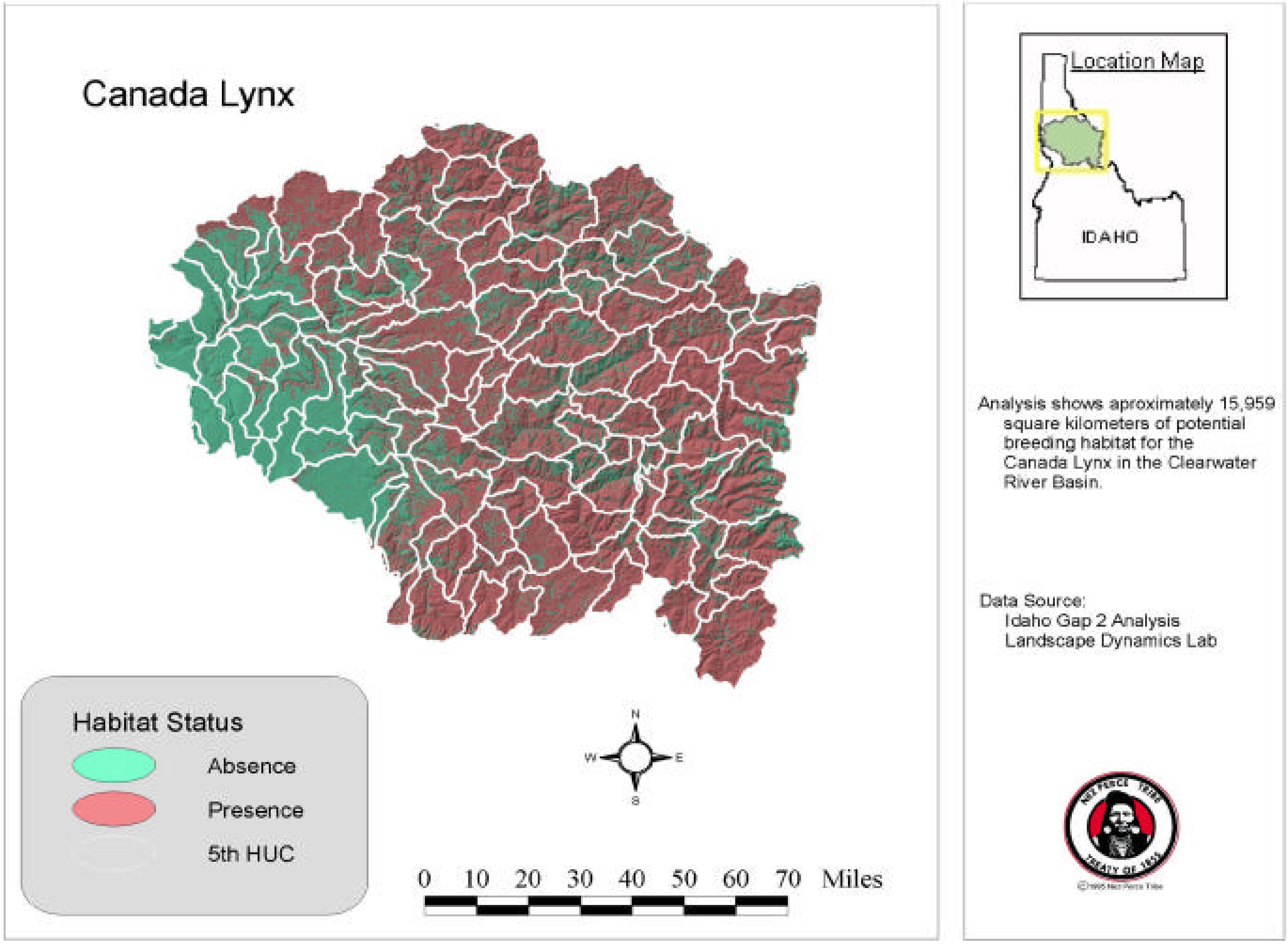

Figure 85. Potential breeding habitat for the lynx within the Clearwater subbasin

The lynx was unprotected in Idaho until 1977 when it was classified as a furbearer and hunting was limited to a shorter season. In 1996 the hunting season for lynx in Idaho was closed (Ruggiero et al. 1999). Lynx are rare in the Clearwater subbasin, but have been sporadically recorded. Little information on lynx populations exists, but there have been 39 reported occurrences to the CDC in the subbasin (Nez Perce National Forest 1998). One animal was trapped at Earthquake basin in 1991 and another was seen at Lightning Creek (Ruggiero et al. 1999). There was a single personal observation of a lynx recorded in 2001 (Dixon 2001).

6.4.4 Grizzly Bear

Life History

Grizzly bears (*Ursus arctos horribilis*) are omnivores that eat a wide variety of plant and animal matter. During the spring, grizzly bears will feed on grasses, forbs, roots, insects, carrion, berries and young ungulate calves. During the hyperphagic period in the fall, their main diet consists of high calorie foods such as fish, roots, pine nuts, and berries. Whitebark pine seeds, when present, can account for 40% of a grizzly bear's diet in the fall, and is directly related to post-hibernation survival, number of twins, and pre-hibernation health (Keane and Arno 2000). Primary foraging berry species include huckleberry, serviceberry, elderberry, buffaloberry, and mountain ash (USFWS 2000c). Biscuitroot is extremely important as a fall food source because it is almost 30% starch and easily digestible (Mattson 1997).

An adult male grizzly will weigh up to 600 pounds and females weigh 250 to 350 pounds before hibernation. After hibernation they will have lost 40 to 60 percent of their body weight. Grizzlies hibernate from October to April, with the cubs being born in January and nursing through the rest of the hibernation period. Optimal grizzly bear cover is composed of wooded areas interspersed with grasslands and meadows. Although timber is an important habitat component, grizzlies prefer more open shrub fields, wet meadows, ridges, and open grassy timbered sites (Snyder 1991). Home range for grizzly bears averages 100 square miles for a sow with cubs, 200 to 300 square miles for a male. GAP data depicting potential breeding area for the Clearwater subbasin is currently unavailable.

Threats

Human caused mortality is the major factor limiting the recovery of grizzly bears. Human caused deaths stem from human-bear wilderness encounters, poorly stored food, livestock-bear encounters, increased human occupation of grizzly habitat, illegal poaching, and mistaken identification by black bear hunters (Wisdom et al. 2000). Livestock grazing in the early 1900s increased due to the lush vegetation that followed the fires of 1910, 1919, and 1934. Most herbaceous grizzly foods are also livestock forage plants, and domestic livestock graze wet meadow areas much more efficiently and have greater impacts than grizzlies. The increased numbers of livestock also increased the chances of grizzlies being shot for preying upon livestock or encountering stockmen (Davis et al. 1986).

Anadromous fish and whitebark pine are important foods in the autumn and both have been significantly reduced from their historic abundance. Chinook salmon are particularly important, and current runs no longer provide a readily abundant food source (USFWS 2000c). Whitebark pine communities have been lost due to disease, insects, and succession, with distribution reduced 60-80% from historic levels (Keane and Arno 2000). Fire suppression has reduced the number of preferred grizzly forage species that are fire dependents. Roads have a negative impact on grizzly bears and increase the chance of human conflicts. Bears will avoid roads and underutilize otherwise high quality habitat. Grizzlies have a fairly low resiliency to human disturbance and populations take a long time to recover from losses.

Limiting Factors

Essential habitat components for the grizzly bear include space, isolation, sanitation, food, denning, vegetation types, and safety (USFWS 2000c). Lack of travel corridors limits habitat utilization by grizzly bears, isolates small populations, and reduces the likelihood of recolonization once a population has been extirpated (Wisdom et al. 2000). Grizzlies have a low reproductive rate and late maturation age which makes them susceptible to overharvesting (Snyder 1991).

Historic/Current Distribution

When Lewis and Clark came through the Bitterroot Mountains in the early 1800s grizzly bears were abundant. At least seven grizzlies were killed while they traveled along the Clearwater River, and three were taken near Kamiah, ID (USFWS 2000c). Grizzlies were thought to be common in the Clearwater drainage and the Selway-Bitterroot Mountains up to the turn of the century. During the early 1900s hunters and trappers killed 25 to 40 grizzlies annually in the Bitterroot Mountains. There were 9 accounts of grizzly sightings in the Selway and North Fork Clearwater drainages between 1937 and 1978 (Dixon 2001). Hunting, trapping, predator control programs, and the decline of anadromous fish runs led to the virtual extirpation of the species in the Bitterroots by the 1950s (USFWS 2000c). Grizzlies probably remained in the Lochsa drainage until 1946. The current extent of grizzly bear habitat is fairly similar to historic times, but it is largely unpopulated due to extirpation and a lack of connective travel corridors for recolonization.

6.5 Recently Extirpated or Diminished Species

Some populations of wildlife have been reduced in number or geographic extent since the arrival of Euramericans 200 years ago. Land uses, extensive hunting, and interactions with domestic livestock have all contributed to declines of some native species. Those species outlined in the following selections have been selected to represent some of the resource changes observed since 1800. This is not comprehensive list, but rather serves to illustrate some significant changes documented. Some species are considered economically important (bighorn sheep, mountain goat) while others represent lost habitat components (sharp-tailed grouse, mountain quail), or intolerance to human presence and disturbance (sandhill crane).

6.5.1 Bighorn Sheep

Life History

Bighorn sheep (*Ovis canadensis canadensis*) are an ecologically fragile species adapted to limited and increasingly fragmented habitats (Valdez and Krausman 1999). Gregarious and extremely loyal to their home range, bighorns typically inhabit river canyons, talus slopes, cliffs, open meadows, and clearcut or burned forests. The use of each habitat type varies seasonally and with requirements such as breeding, lambing, and thermal cover (Valdez and Krausman 1999). According to GAP 2 data, the potential breeding habitat for bighorn sheep comprises of approximately 1,794 square kilometers in the Clearwater subbasin (Figure 86).

Elevational migrations are common, and bighorns will follow the wave of new vegetation upward in the spring. Preferred climate is relatively warm and arid with cold, dry winters. Low annual snowfall is important for lamb survival. Bighorn sheep require 4-5% of their body weight in water each day, but may be able to get sufficient water from succulent plants in the spring and snow in the winter to not be limited by standing water sources (Valdez and Krausman 1999). Bighorns mainly eat grasses and forbs, though they will switch to shrubs depending on availability. Valdez and Krausman (1999) describe their diet as "cosmopolitan." Bighorn sheep tend to avoid tall or overhanging vegetation that blocks their view of predators.

Threats

Decimating factors for the bighorn include overgrazing by cattle and sheep, disease, uncontrolled hunting, competition with deer and elk, off-road vehicle use, introduced exotic species, and usurped water resources. Habitat loss and fragmentation stem from dams, canals, fence and road construction, logging, urban expansion, and mining (Valdez and Krausman 1999).

Limiting Factors

Bighorns are particularly susceptible to death during their first year of life. Early spring mortality is usually due to predation, disease, poor maternal nutrition, or human disturbance. Late summer mortality is usually due to starvation. Mountain lions commonly prey upon adult bighorns and coyotes are the major predator of bighorn lambs. Proximity to escape cover is important, and bighorns will usually remain within 800m of escape cover in all seasons. Habitats with poor escape cover have higher rates of lamb mortality (Valdez and Krausman 1999). Rugged mountain terrain with southern exposure and minimal snow pack is considered an important habitat feature. Critical snow depth is 12 to 18 inches for lambs, and bighorns in general tend to avoid snow deeper than 12 inches.

Salt and mineral licks are an important factor for Rocky Mountain bighorn sheep because their habitats are generally found on granitic soils that have a low mineral content. Major declines in some bighorn populations have been attributed to mineral deficiencies (Valdez and Krausman 1999).

Disease is an infrequent but major limiting factor. Die offs of greater than 50% are common and seem to result from a combination of stress and viral or bacterial infection (Valdez and Krausman 1999). Domestic sheep, goats, and exotic relatives of bighorn sheep are responsible for several recent catastrophic die offs. They also compete for range resources and cause genetic pollution of bighorn sheep by hybridizing (Smith et al. 1991). Inbreeding is a limiting factor that can be significant for the small isolated herds with a low rate of dispersal (Valdez and Krausman 1999). If a herd is to survive it needs to have a minimum of 125 members to remain genetically sound. This number can be reduced if there are migration corridors between herds to allow rams access to multiple populations (Smith et al. 1991). Natural barriers to bighorn migration can be swift water, dense vegetation, nontraversable cliffs, or sparsely vegetated valleys or plateaus. Humanmade barriers that inhibit travel include canals, fences, highways, and urban areas (Smith et al.1991).

Historic/Current Distribution

Humans and mountain sheep have coexisted in North America since human arrival, and bighorns were an important historical resource for Native Americans. Horns and bones were used to make tools and ornaments, hides were used for clothing, and the meat was an important protein source (Valdez and Krausman 1999). Reports by early explorers, trappers and settlers suggest that at one time bighorn sheep were one of the most abundant large animals in Idaho. Lewis and Clark noted that the local Indians told them that bighorns were present in large numbers in the Clearwater Mountains (Buechner 1960).

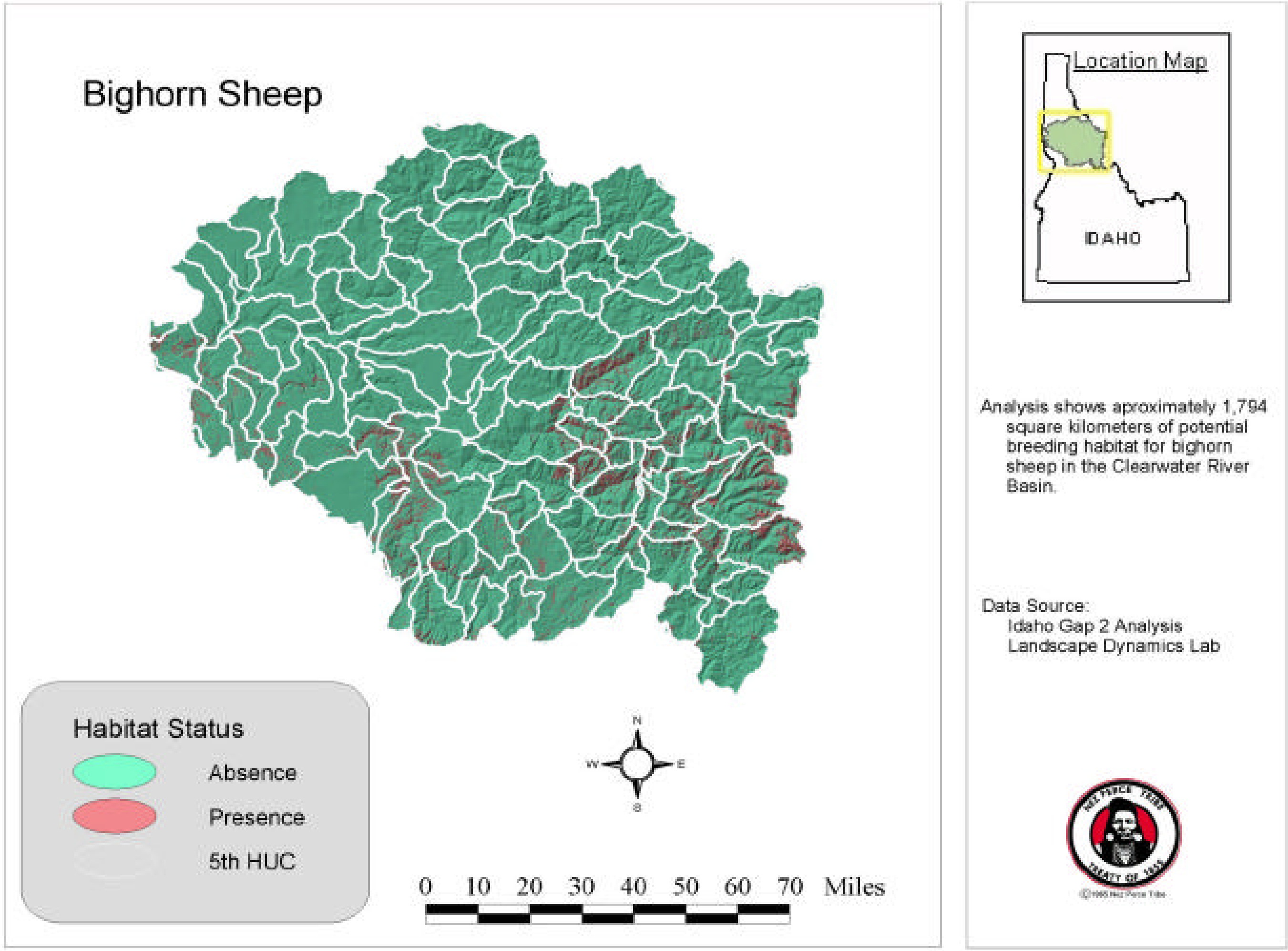

Figure 86. Potential breeding habitat for the bighorn sheep within the Clearwater subbasin

Rocky Mountain is the only race of bighorn sheep found in the Clearwater subbasin, and is greatly reduced in numbers and distribution from its historic range. Major declines in population occurred in the late 1800s and early 1900s. Overgrazing by cattle and sheep, disease, and uncontrolled hunting greatly reduced and often extirpated populations. Bighorns have increased since the 1900s due to a series of reintroductions, but much of their previous range is still unoccupied (Wisdom et al. 2000). Transplanting is necessary to stimulate new populations in unoccupied habitats because bighorn are extremely loyal to their territories and will not readily move into new ranges (Parker 1985).

Much of the bighorns' historic range is no longer suitable habitat because urbanization, cultivation, and fire suppression have permanently changed it. Native shrub and grasslands that were used as winter range have been converted to agriculture, and many of the important source habitats such as whitebark pine forests have gone through a successional transition to Engleman spruce-subalpine fir forests (Wisdom et al. 2000). These closed canopy forests offer a decrease in available forage and poor visibility for predator detection and are not preferred habitat. Some cliff areas and corridors between winter and summer ranges are currently inaccessible because bighorns will not cross through dense stands of closed timber (Wisdom et al. 2000).

6.5.2 Mountain Goat

Life History

Mountain goats (*Oreamnos americanus*) are indigenous to only three of the contiguous 48 states: Idaho, Montana, and Washington. They are usually found above timberline at elevations between 5,000 to 9,000 feet. Mountain goats did not experience the extensive population losses that most ungulate species did in the early 1900s because of their remote and relatively inaccessible habitats. In the last few decades though, many of Idaho's mountain goat populations have decreased. Some of this reduction was due to habitat fragmentation, but the main cause has been overharvest by hunters (Kuck 1985). Prior to 1960 only two years occurred in which annual goat harvests exceeded 100 animals, but in the late 1960s harvests reached a peak of 161 animals in two separate years. In 1985 tighter regulations were implemented and only 50 permits were issued (Kuck 1985).

Important habitat features include talus slopes, cliffs, and seasonal wetlands. Mountain goats show no preference for particular cover types as long as they occur on or near steep talus slopes or cliffs. According to GAP 2 data, the potential breeding habitat for the mountain goat comprises of approximately 7,104 square kilometers in the Clearwater subbasin (Figure 87). Grasses and sedges comprise most of the diet, along with lichens, mosses, ferns and shrubs (Wisdom et al. 2000). Goats ensure high winter survival rates by remaining in small groups to reduce competition for limited winter foods. Mountain lions, wolves, bobcats and grizzly bears prey upon mature mountain goats, and very young kids are preyed upon by golden eagles (Wisdom et al. 2000).

Threats

Human disturbance can disrupt mountain goats and cause displacement from source habitats. Low flying aircraft, road blasting and sonic booms cause defensive behavior, avoidance, and signs of stress. A mountain goat herd repeatedly exposed to human disturbance showed a decrease in reproduction and kid survival (Wisdom et al. 2000). Habitat fragmentation, hunting pressure, mining, and timber harvest may all have significant effects on mountain goat herds. Roads increase mortality by collision deaths and both legal and illegal hunting. Adult mountain goats are highly susceptible to hunting mortality and herds are slow to recover (Wisdom et al. 2000). Small herd size reduces competition for limited resources but increases the possible deleterious effects of inbreeding. Recent fire suppression practices have decreased the number of high mountain meadows and grasslands. In addition, lack of fire has allowed open migration corridors between critical habitat features to become dominated by coniferous forest that mountain goats will not travel through (Tesky 1993).

Limiting Factors

Mountain goats are specialized cliff dwellers. This reduces the amount of competition from other ungulate browsers, but restricts their distribution and numbers. Distance to cliffs is the most important factor determining goat distribution, and they make little use of forage more than 1,300 feet from cliffs (Tesky 1993). Salt licks are a very important habitat feature, and peak use of licks occurs in spring or early summer (Tesky 1993). The general limiting factor and cause of mortality in mountain goats, and especially young goats, is the lack of suitable forage during the winter when weather increases susceptibility to predation, parasites, disease, and accidents (Tesky 1993). Unlike other ungulates, mountain goat reproduction rates do not increase to offset losses by hunters, and the production of kids declines as the herd declines (Kuck 1985).

Historic/Current Distribution

The Region One U. S. Forest Service wildlife census of 1942 estimated the mountain goat populations of the Clearwater National Forest at 400 animals, and the Nez Perce National Forest at 110 animals (Rust 1946).

Based on Idaho Department of Fish and Game estimates, the number of mountain goats in the subbasin in 1985 was approximately 510 animals (Kuck 1985). Herds in both the Clearwater and Lochsa drainages have decreased noticeably since the 1950s, but other introduced herds have held the overall total at stable numbers. Native populations in Idaho have decreased due to a lack of new genetic stock, while introduced populations are stable or increasing (Wisdom et al. 2000).

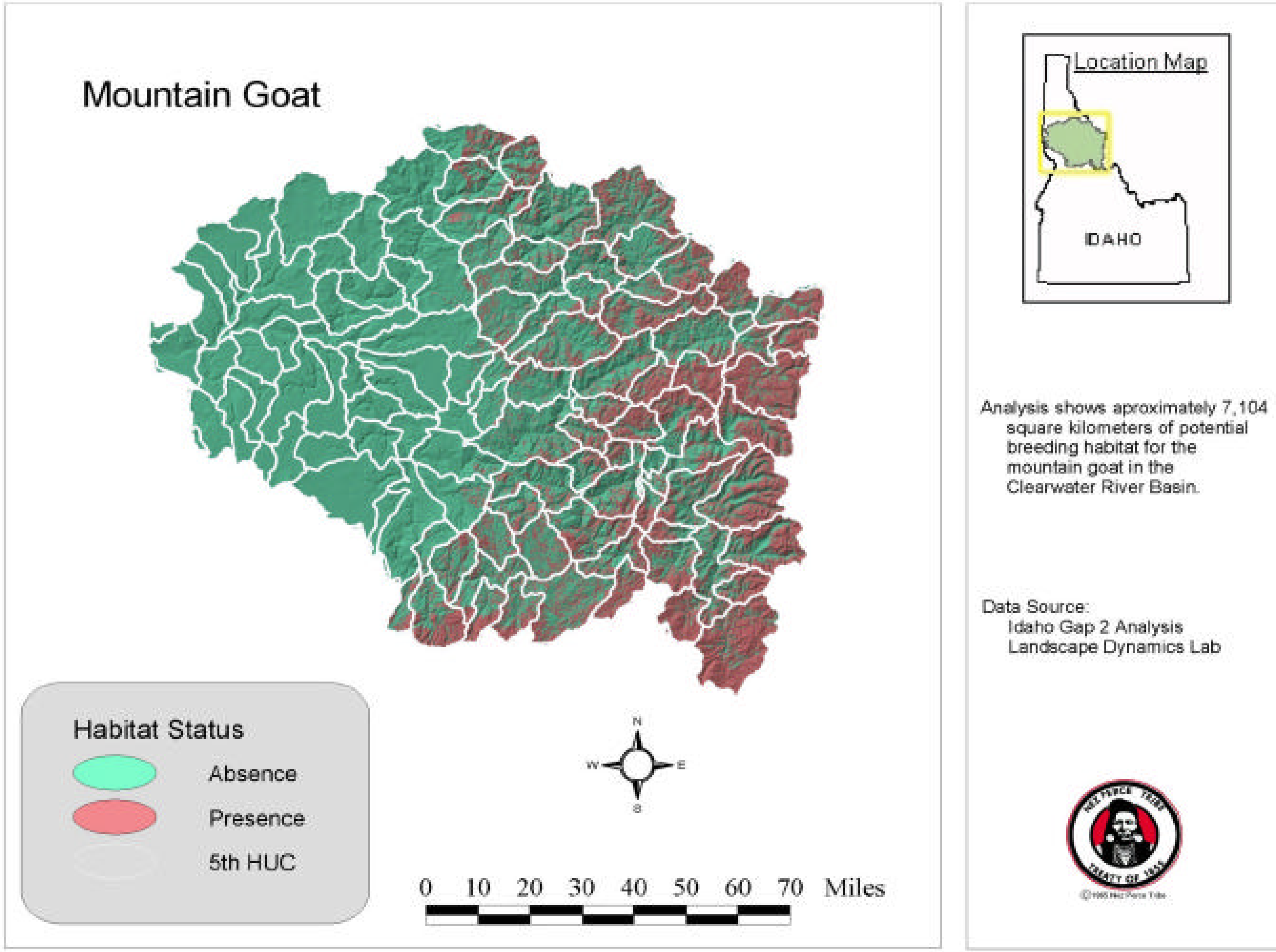

Figure 87. Potential breeding habitat for the mountain goat within the Clearwater subbasin

6.5.3 Bison

Life History

The American bison (*Bison bison*) is a gregarious bovine, and was historically widespread across North America. Early explorers told of three separate varieties: mountain bison, wood bison, and plains bison, but the distinction is thought to have been no more than a climatic or geographical variation (Garretson 1938). Classification still remains a matter of debate. The "mountain" buffalo was the variety of bison found in Idaho, Oregon, and Washington. These are characterized as being smaller, more active, more timid, and covered with a darker, silkier hair than the plains bison (Thomas 1991).

Most bison are migratory, and movements are both seasonal and altitudinal. Historically, bison would migrate southward as much as 200 miles to reach winter range. Bison thrive in open grasslands and meadows, and will use forested areas for shade and escape cover from insects (Tesky 1995). Grasses and sedges are preferred grazing forage where available, but if those species are absent bison will utilize browse (Tesky 1995).

Winterkill bison carcasses (where present) are an important food source for grizzly bears upon emergence from hibernation in the spring. GAP data depicting potential breeding area for the Clearwater subbasin is currently unavailable.

Threats

Anthrax outbreaks cause sporadic mortality in northern bison herds, and they are also susceptible to tuberculosis and brucellosis infections. The transmission of these diseases is aggravated by the gregarious nature of bison. In the past, when large herds roamed the prairies, wildfires killed hundreds of bison (Tesky 1995). The main predators of bison are gray wolf, grizzly bear, and coyote.

Limiting Factors

The basic requirements of bison are water, space, and approximately 30 lbs of forage every day, but additional influences are shelter from insects, spring weather conditions, and intensity of fall snowstorms (Tesky 1995). It is believed that severe winters, disease, and hunting pressure caused the bison's decline and disappearance.

Historic/Current Distribution

Historically, bison were widespread in North America from Alaska and western California across the United Sates and into northern New Mexico. Before European settlement, bison occurred in grasslands, semideserts, and boreal forests (Tesky 1995). Lewis and Clark traveled through Idaho in 1805 and made no reference to bison being in the Clearwater drainage. There are few reports of mountain buffalo in the northwest after the 1840s and 50s due to disease, hunting and sever weather (Thomas 1991). No evidence exists that the American bison ever occurred in the subbasin, and it is currently extirpated in the Clearwater subbasin.

6.5.4 Sharp-tailed Grouse

Life History

Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) occupy mesic grasslands and shrub-steppe habitats, and their home range is usually restricted to within .75 mi of dancing grounds (Wisdom et al. 2000). Columbian sharp-tailed grouse winter almost exclusively in mountain shrub and riparian cover types where water birch and black hawthorn are present for escape cover. Sharp-tails will form coveys in the winter, and then break into small groups or individuals in the summer. Summer foods consist of insects, grasses and forbs, while winter foods are mainly hawthorn, serviceberry, and chokecherry (Marks and Marks 1988).

Threats

Loss of habitat has occurred due to farming, grazing, brush control by fire and herbicides, and severe fragmentation. As populations declined, Columbian sharp-tailed grouse were reduced to small isolated populations with little genetic variation.

Limiting Factors

Nesting/brooding cover at least ten inches tall is considered a critical habitat requirement. GAP data depicting potential breeding area for the Clearwater subbasin is currently unavailable. Chicks depend heavily on insects as a food source during the first few weeks of life, and sufficient insect populations are necessary to ensure good chick recruitment. Stream drainages that contain berries and forbs year-round are important feeding sites in the late summer and during droughts (Hays et al. 1998).

Historic/Current Distribution

The historic range of Columbian sharp-tailed grouse extended from British Columbia down to northeastern California, and east to Colorado and Utah. All six of the subspecies of sharp-tailed grouse have drastically declined throughout North America, and the Columbian subspecies is the rarest. Sharp-tails were plentiful when early explorers came west, and Lewis and Clark were the first to describe the Columbian subspecies (Hays et al. 1998). Sharp-tailed grouse were extirpated from much of their historic range by the 1920s. Agricultural practices in the late 1800s initially benefited sharp-tails, but continued conversion of grasslands to croplands and increased human settlement contributed to population decline (Hays et al. 1998). Columbian sharp-tailed grouse were historically associated with the Camas Prairie, but they have since been extirpated in the Clearwater subbasin. They currently occupy less than 10% of their historic range (Engle and Harris 2001).

6.5.5 Mountain Quail

Life History

The mountain quail (*Oreortyx pictus*) is a secretive bird and most often found in areas of steep terrain with dense shrubs (Heekin and Reese 1995; Wisdom et al. 2000). Winter habitat of mountain quail typically consists of mixed brush or riparian shrubs, and chokecherry, serviceberry, and rose are important habitat components (Wisdom et al. 2000). Diet consists of bulbs, succulent greens, conifer seeds, fruits from various shrubs, and insects (Johnsgard 1973; Wisdom et al. 2000). During the breeding season mountain quail utilize riparian/shrub, conifer/shrub and mountain shrub communities (Heekin and Reese 1995). Nests are usually well concealed, often placed under pine branches, at the base of trees, beside boulders, or in dense shrubby or herbaceous vegetation (Johnsgard 1973). Male mountain quail take an active part in brood rearing and will perform distraction displays to protect the nesting female, or may form a brood patch and incubate eggs if the female is killed. There is little evidence that more than one brood is produced in a year, but pairs may attempt to nest a second or third time if they are initially unsuccessful. Occasionally mountain quail will hybridize with California quail (Johnsgard 1973). According to GAP 2 data, the potential breeding habitat for mountain quail comprises approximately 3,313 square kilometers in the Clearwater subbasin (Figure 88).

Threats

Water impoundments, grazing, residential development and intense agricultural activities can alter the extent, composition, and structure of mountain quail habitat (Wisdom et al. 2000). Fire suppression, logging activities, and the loss of riparian shrub habitat to water impoundment have reduced the amount of shrub dominated habitat favored by mountain quail (Wisdom et al. 2000). Human encroachment negatively affects nesting/brood- rearing pairs, and domestic dogs and cats are effective predators of quail (Wisdom et al. 2000). Competition with chukar can possibly displace mountain quail (Engle and Harris 2001).

Limiting Factors

In unusually dry years, little or no nesting occurs, and coveys will be comprised entirely of adults (Johnsgard 1973). Nests are primarily located within 200-300 yards of water since chicks require water soon after hatching (Johnsgard 1973; Wisdom et al. 2000).

Historic/Current Distribution

The initial mountain quail population of Idaho may have stemmed from an introduction effort in British Columbia during 1880 (Johnsgard 1973). Mountain quail populations have been declining in the intermountain west for the past several decades, and the Idaho population has experienced the same pattern of decline since the 1930s (Heekin and Reese 1995). Populations have undergone broad regional and local extinctions in Idaho as a result of anthropogenic changes to key aspects of their habitat (Engle and Harris 2001). Populations occur in Idaho along the Snake, Boise, Clearwater and Salmon Rivers, in spite of hydroelectric impoundments along the Columbia River tributaries that have flooded thousands of acres of low-elevation mountain quail winter habitat. Remaining habitat areas are fragmented and populations often exist in isolated islands (Wisdom et al. 2000).

The mountain quail is susceptible to local extirpation, and due to a lack of data its status within the subbasin is unknown. Heekin (University of Idaho, personal communication, January 30, 1996) notes that in the mid-part of the century, mountain quail occurred as far east as the interior of the Selway-Bitterroot Wilderness, and as late as the 1970s they were still present along the Selway River near Fenn Ranger Station. Within the Idaho Fish and Game Conservation Data Center there are 13 mountain quail sightings recorded in the Clearwater subbasin, the last record was entered in 1997. Between 1961 and 1998 there have been 18 observations of mountain quail near the North Fork Clearwater drainage (Dixon 2001).

6.5.6 Sandhill Crane

Life History

Six subspecies have been attributed to the sandhill crane (*Grus canadensis*) species. The greater sandhill crane, (*G. c. tabida*), is the largest of the subspecies and occurs in Idaho. The greater sandhill crane historically occupied the Clearwater subbasin but birds had been absent for many decades until 2002 when two pairs were confirmed on the Weippe Prairie.Despite the return of these birds, suitable nesting areas remain currently unoccupied in the Clearwater (Lewis 1977). GAP data depicting potential breeding area for the Clearwater subbasin is currently unavailable.

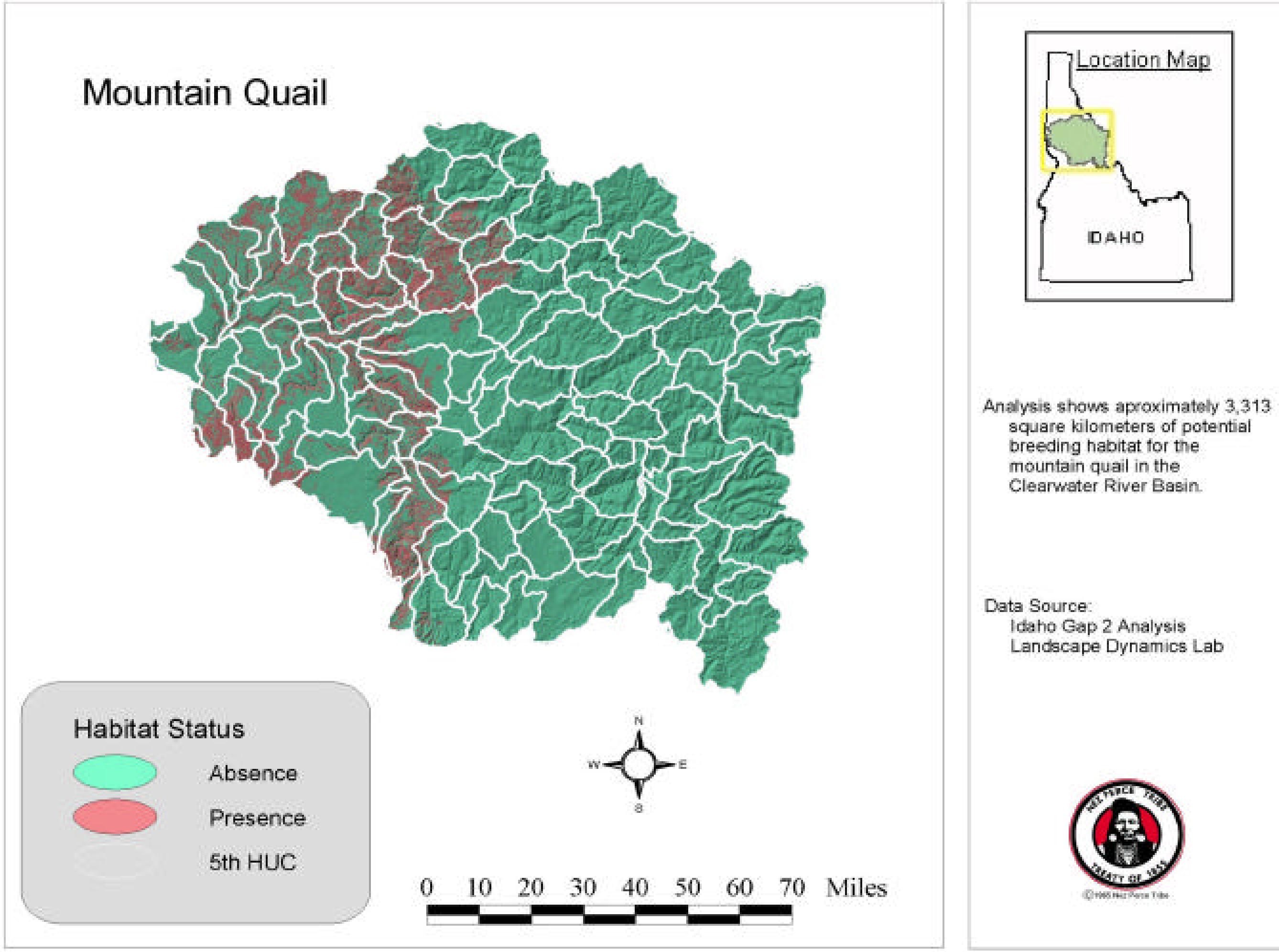

Figure 88. Potential breeding habitat for the mountain quail within the Clearwater subbasin

Sandhill cranes are omnivorous, feeding on a wide variety of plant materials (including waste grains) and small vertebrates and invertebrates, both on land and in shallow wetlands. Cranes tend to select remote and isolated wetlands for nesting, but in agricultural areas, they prefer nesting close to cultivated fields. The size of nesting territories varies widely within the breeding range, and breeding territories in Idaho average 17 ha. (Cranes 2001). The breeding grounds of the Rocky Mountain population of greater sandhill cranes are in west-central Montana, central and eastern Idaho, northeastern Utah, western Wyoming, and northwestern Colorado, while the main wintering grounds are in the middle Rio Grande valley of New Mexico (Cranes 2001). Habitats along migration routes tend to be open marshes and riparian wetlands near agricultural areas, while wintering habitats include riparian wetlands, wet meadows, and pastures.

Threats

The destruction and degradation of habitats, especially wintering grounds, breeding grounds, and migration stopovers, comprise the most important current threat to the greater sandhill crane (Cranes 2001). The habitats of the Rocky Mountain population are increasingly affected by residential and commercial development, changing agricultural practices, drainage of wetlands, water diversions, oil and gas exploration, development, and other land use changes (Cranes 2001). The population may now be declining due to the effects of regional drought, poor survival of chicks, and increased hunting pressure (Cranes 2001). Lead and mycotoxin poisoning, abnormal predation pressures, and collisions with fences, vehicles, and utility lines have been shown to negatively impact some populations of sandhill cranes (Cranes 2001).

Limiting Factors

Key habitat features are wet meadows for feeding, and roosting areas (Lewis 1977). Loss of suitable roosting habitat has caused high concentrations of migrating cranes, increasing the risks associated with disease (Cranes 2001). Isolation from human activity is important in nest site selection, and nest abandonment caused by human disturbance has been reported (Armbruster 1987).

Historic/Current Distribution

The sandhill crane was extirpated from the Clearwater subbasin since the mid 1900's but two pairs have been documented on the Weippe Prairie during 2002 and 2003. These birds have occupied the prairie during the spring and summer but nesting has not been documented (Rita Dixon, IDFG, Pers. Comm. 10-14-03).A small population currently exists in southeastern Idaho during the breeding season. The Rocky Mountain population of greater sandhill cranes had been more abundant prior to European settlement. Hunting, agricultural expansion, drainage of wetlands, and other habitat changes in the 18th and 19th centuries led to the extirpation of the greater sandhill crane from many parts of its breeding range, and the Rocky Mountain population reached an historic low of 150-200 breeding pairs in the 1940s (Cranes 2001). They have recovered dramatically, but may now be declining due to the effects of drought, poor chick survivorship, and hunting pressure. The western Rocky Mountain population is currently slightly declining, and has been estimated at 18,000-21,500 animals throughout its range (Cranes 2001).

6.6 Culturally or Economically Important Species

Many wildlife species can be considered important economically or culturally. Human use of such species adds to our cultural, economic, and spiritual well being. A complete discussion of all such species within the Clearwater subbasin is outside the scope of this document. The

Clearwater Terrestrial Subcommittee of the Clearwater Policy Advisory Committee decided to include elk to represent the culturally and economically important species within the subbasin. Elk have always been, and continue to be, important to the human inhabitants of the subbasin.

6.6.1 Elk

Life History

Elk (*Cervus elaphus*) are a significant wildlife component in the subbasin, both for recreational and economic reasons. Elk are found throughout the Clearwater subbasin although fewer animals are located in the southwestern quarter due to heavy agricultural land uses. They are an important game species for both subsistence and trophy hunting opportunities.

Elk habitat consists of summer and winter range. Generally, winter range is located at lower elevations than summer range and has less snow cover. Approximately 42.5% of the Clearwater subbasin has been classified as winter range (Rocky Mountain Elk Foundation 1999). Most of this winter range lies in the bottoms of major river drainages at lower elevations (Figure 89). During winter, cow elk seem to prefer shrub habitats compared to bull elk, which use more open timber types (Unsworth et al. 1998). Older bulls also tend to use higher elevation benches or ridgetop sites with heavier snowfall compared to habitat used by younger bulls and cows (Unsworth et al. 1998).

High quality forage is an important component of elk winter range. The kinds of plant material eaten by elk include grasses, forbs, and the tips of twigs from some woody vegetation (Csuti et al. 1997). Availability of different forage components varies throughout the subbasin. Areas located farther up the drainages consist largely of open or closed forests and shrub fields while lower down in the drainage wintering areas have fewer shrubs available and more grass species. On the Craig Mountain Wildlife Area within Snake River drainage Johnson (1986) found that winter diets of elk was comprised largely of bunchgrasses (88.8%) followed by forbs (9.6%) and shrubs (1.4%). Similar patterns of forage utilization may be expected within the Lower Clearwater, South Fork Clearwater, and Lower North Fork Assessment Units, which have a high proportion of their winter range in canyon grassland and open conifer forest communities.

Within the Lochsa, Selway, and Upper North Fork Assessment Units, shrub fields and conifer forests provide a higher proportion of winter forage than grassland sites. Species such as redstem ceonothus, serviceberry (*Amelanchior alnifolia*), maple, bitter cherry, and syringa provide much of the winter forage available to elk (Leege 1979).

The majority of the Clearwater subbasin is considered summer range for elk (Rocky Mountain Elk Foundation 1999). Summer range overlaps with wintering areas, but animals tend to move to higher elevations as the snow melts and additional forage becomes available. Approximately 8% of the Clearwater is considered unsuitable as elk summer range, largely due to conflicts with agricultural land uses and the proximity of human population centers. All of the unsuitable area lies within the Lower Clearwater Assessment Unit (Figure 90).

Important habitat components on spring, summer, and fall range include foraging sites, cover, calving areas, and security areas. Summer habitat use is influenced by disturbance factors such as roads. Unsworth et al. (1998) found that elk in roaded areas had increased use of closed-canopy cover types compared to elk in non-roaded areas, which had increased use of open canopy forest types. Older bulls in particular tend to prefer timbered cover types (Unsworth et al. 1998). This research suggests that security areas free from disturbance may be an important factor in habitat use of elk in the Clearwater subbasin.

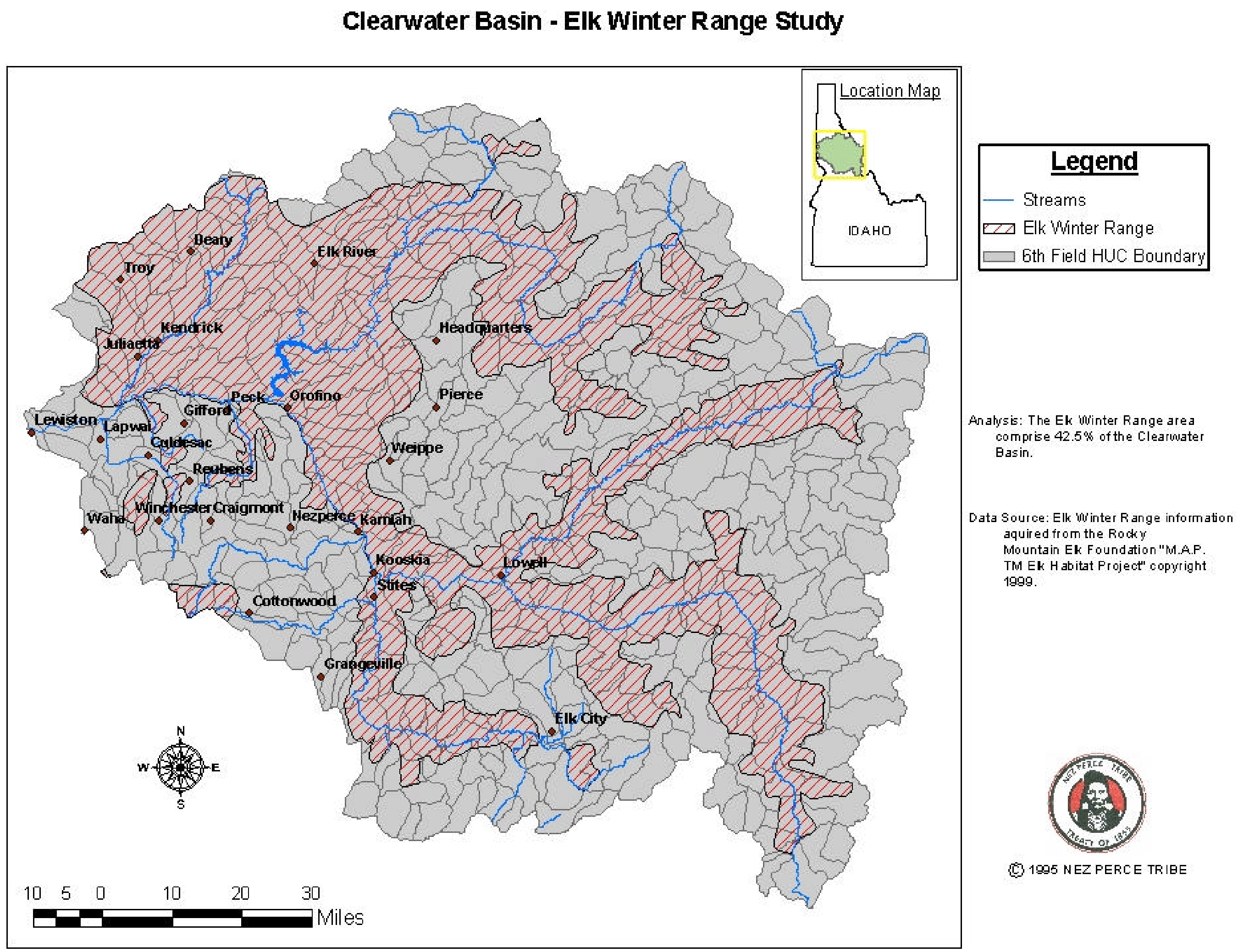

Figure 89. Elk winter range within the Clearwater subbasin (RMEF 1999)

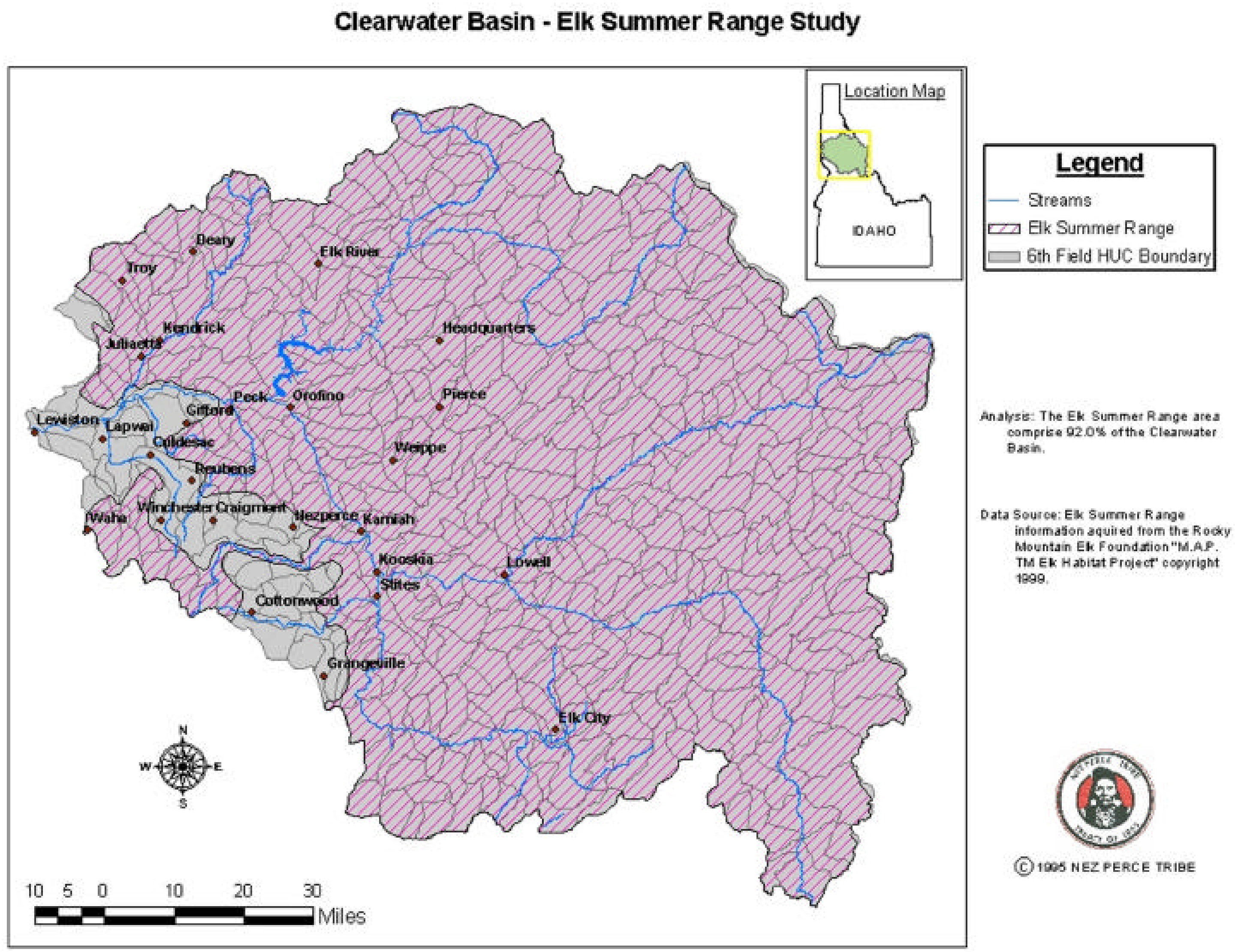

Figure 90. Elk summer range within the Clearwater subbasin

Threats

Early seral communities or shrub fields provide high quality forage on both summer and winter range. The large-scale fires that occurred early in this century to the benefit of elk habitat have been followed by nearly 50 years of fire suppression and forest succession. This has resulted in widespread habitat change as early seral stands have been replaced by closed canopy, more densely forested habitats (see Figure 46), smaller forest patches are replaced by larger less diverse homogeneous stands, and winter range shrub fields become senescent and less palatable (Leege 1969, 1979). Thick, decadent shrub fields also provide excellent cover for ambush predators such as black bear and cougar (S. Nadeau, Idaho Department of Fish and Game, personal communication, October 2001). Predation on elk calves has contributed to low cow/calf ratios within the Lochsa AU and other areas of the Clearwater subbasin. The amount of early seral vegetation in the North Fork Clearwater has declined from a historic average of 35-45 percent to approximately 14 percent (Clearwater National Forest Files 1999, cited in Servheen and Bomar 2000).

The availability and quality of low elevation winter range is a concern within the Clearwater subbasin. Many of the low elevation sites are inhabited by people, contain major highways, or have been significantly altered due to cheatgrass and noxious weeds. Noxious weeds have already infested a minimum 4.38% of elk winter range within the subbasin (Figure 91). Spotted knapweed and yellow starthistle are of particular concern because of their aggressive habits and ability to readily colonize new areas by dispersing along road corridors. Palatability of these species is poor and they displace native species that elk prefer. Cheatgrass is also an issue on winter range because it an unreliable food source (Roberts 1991). During drought periods it produces significantly less forage than native bunchgrasses so elk that are already stressed by poor summer forage due to drought then reach wintering areas with less available forage. In good years, cheatgrass can, however, provide palatable forage for big game species.

Livestock can negatively impact elk by competing for forage, altering habitat use patterns, and creating soil disturbance, which increases noxious weed invasions. The timing, duration, and intensity of livestock grazing can all influence the magnitude and direction (positive or negative) of change to plant populations and elk habitat values (Mackie 1978). The presence of livestock can also directly influence elk movement and habitat use because elk tend to avoid livestock if possible (Mackie 1978). Interspecific interaction can also occur between livestock, elk and deer species inhabiting sympatric range. Currently, approximately 35.9% of the subbasin is used for commercial livestock grazing (Figure 92).

Human habitation and land use is a limiting factor for elk within the Clearwater subbasin, particularly within the Lower Clearwater AU. Most of the human population resides within the Lower Clearwater (Figure 93). A combination of housing and road density with land use patterns result in poor habitat quality for elk. In addition, conflicts between agricultural production and elk depredation has resulted in historic removal (harvest) of elk within management units 8 and 8A (S. Nadeau, Idaho Department of Fish and Game, personal communication, October 2001). Concentrations of people also limit elk habitat values as a result of disturbance, land conversion, increased noxious weeds, and mortality from vehicle collisions, and domestic dogs.

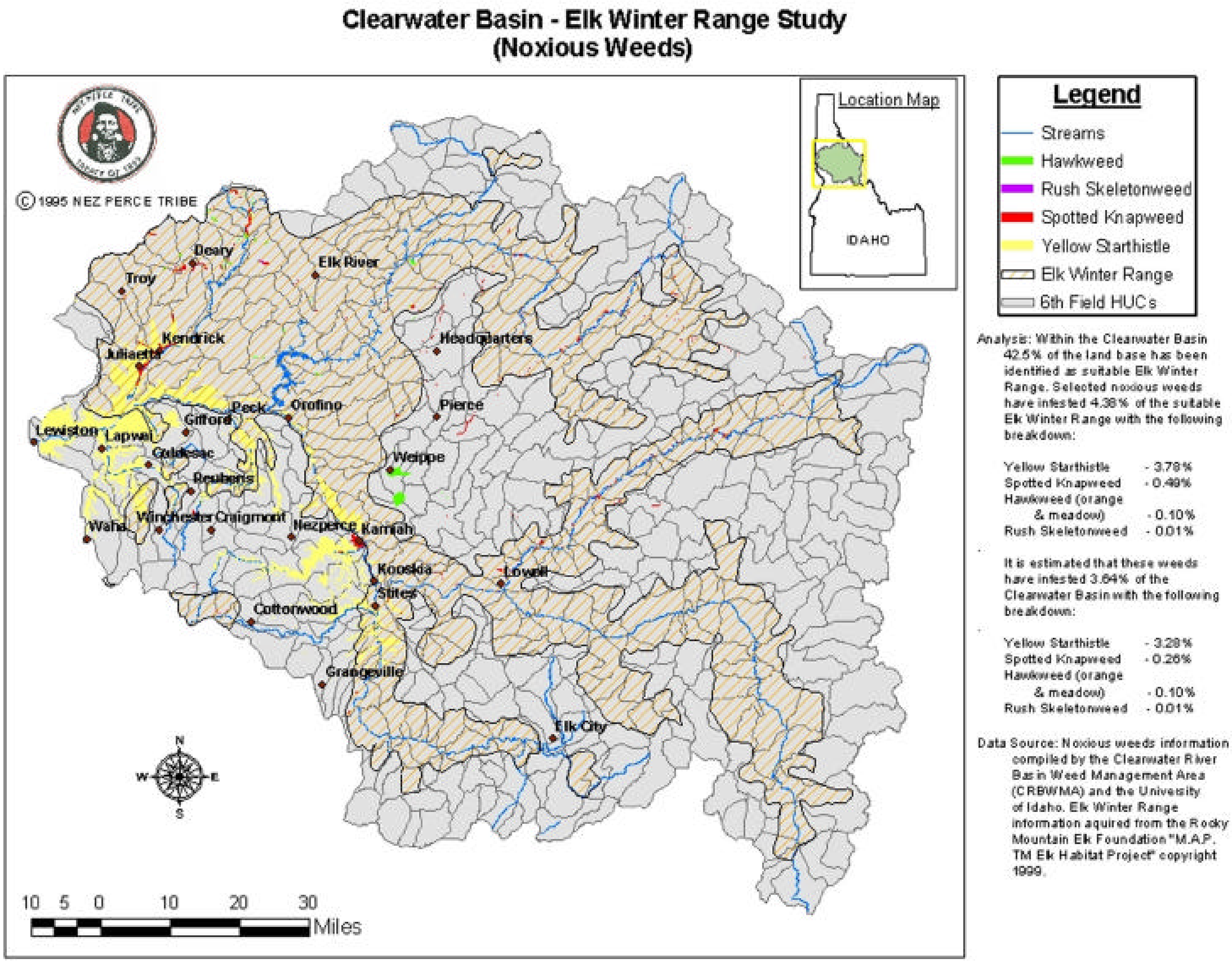

Figure 91. Relationship of selected noxious weed species to elk winter range within the Clearwater subbasin

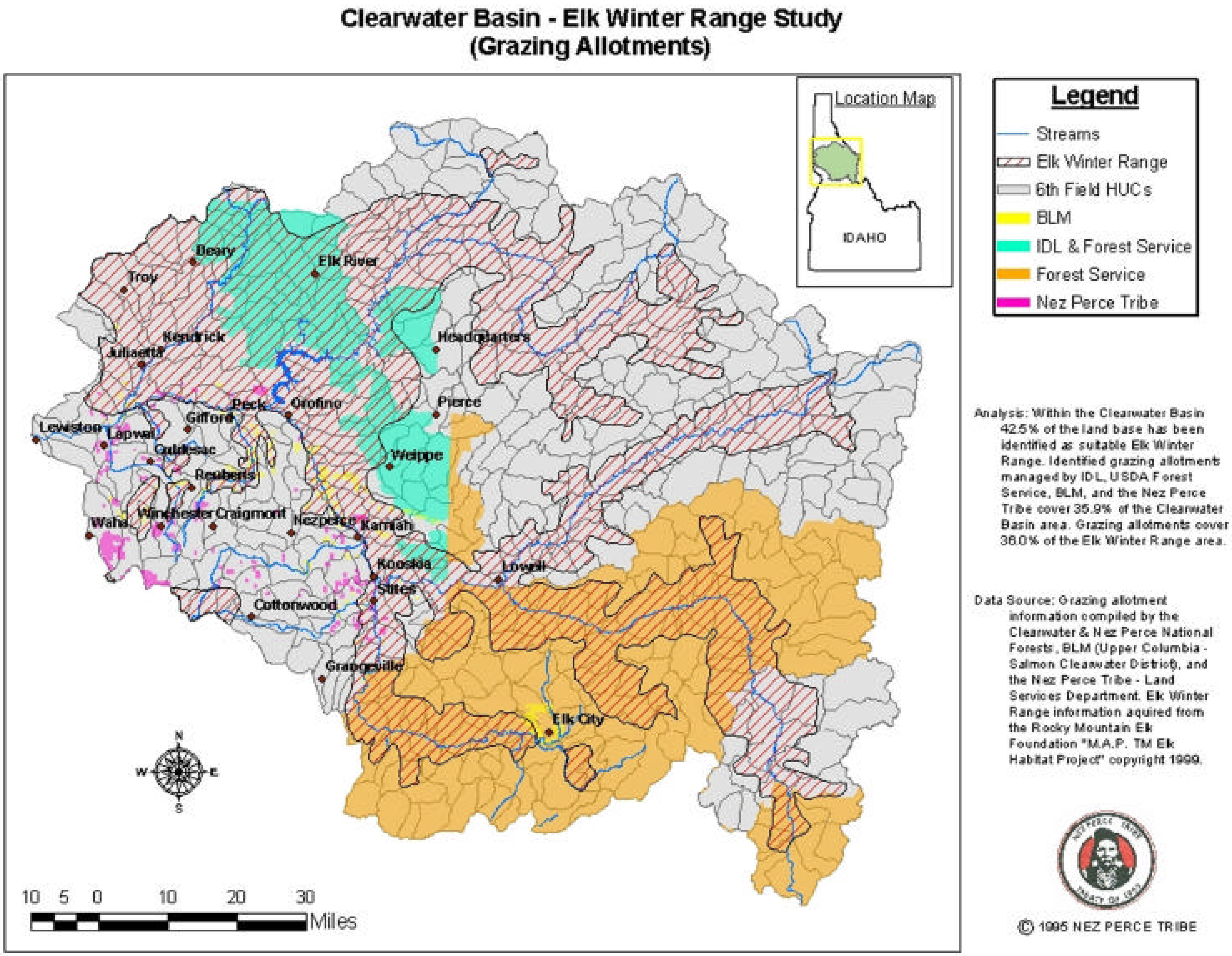

Figure 92. Spatial relationship of active livestock allotments and elk winter range within the Clearwater subbasin

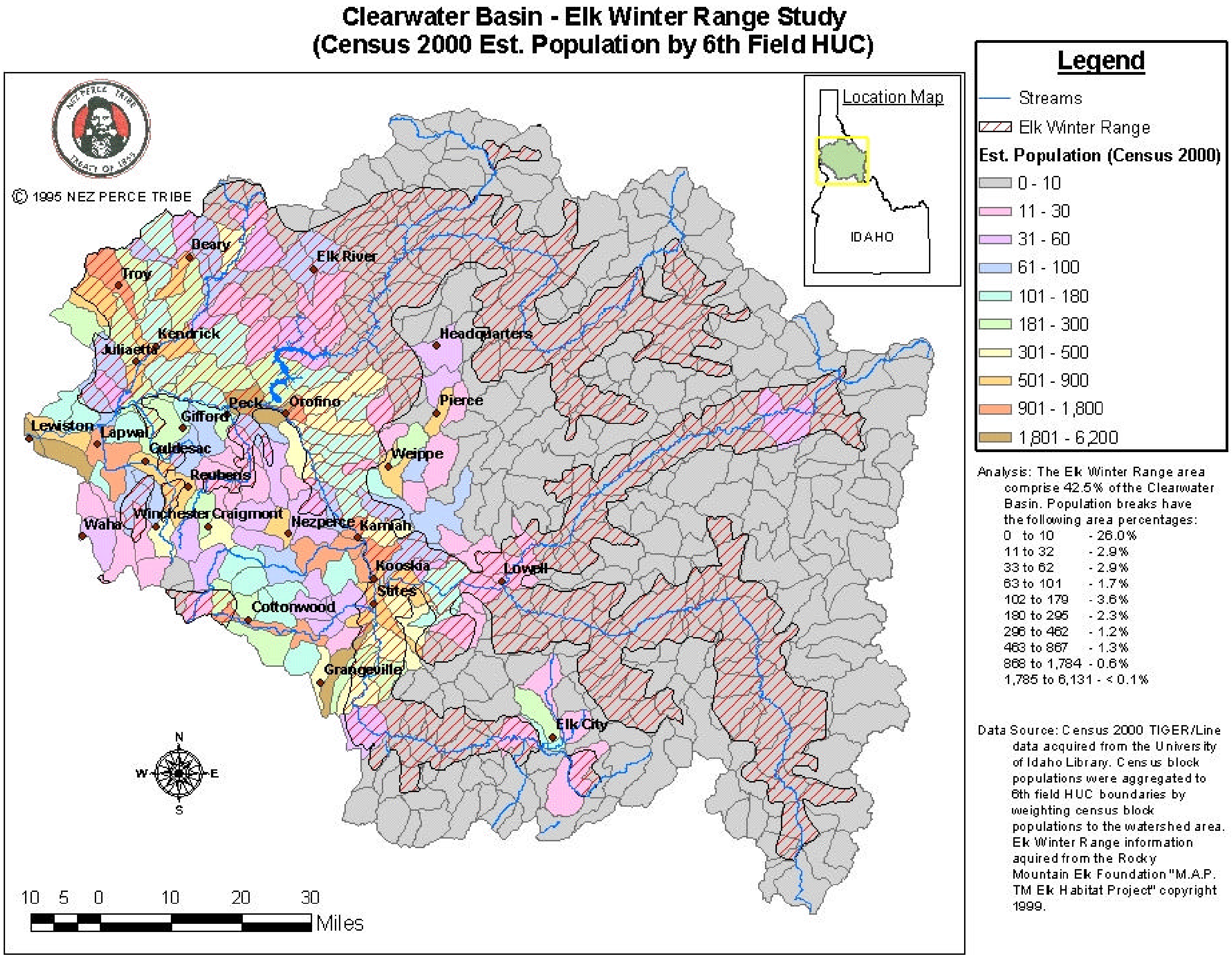

Figure 93. Spatial relationship of human population density to elk winter range within the Clearwater subbasin

Land management activities also contribute to limiting factors for elk in the Clearwater subbasin. Habitat fragmentation due to road construction, mining, and development has contributed to lowered habitat values in some areas of the subbasin. High road densities within the Lower North Fork, South Fork, and Lolo-Middle Fork AUs are of particular concern (See Figure 35). The following discussion explains the negative impacts of open roads on elk within the Clearwater subbasin.

Roads and Habitat Use

Due to vehicular traffic, habitat adjacent to forest roads is avoided by elk (Hieb 1976; Perry and Overly 1977; Lyon 1979; Rost and Bailey 1979). Even though habitat near roads is not denied to elk, it is not fully used (Lyon 1983). The width of the area avoided by elk has been reported as 0.25-1.8 miles, depending on the amount and kind of traffic, quality of the road, and density of cover adjacent to the road (Thomas and Toweill 1982). Roads themselves are not to blame since closed roads are often used as travel corridors for elk (Marcum 1979) as well as a variety of other species. The amount of traffic is the limiting factor in determining how much elk use will occur (Leege 1984) in habitat adjacent to roads.

Heavily used forest roads have a much greater effect on elk use of habitat than do primitive roads (Marcum 1979; Perry and Overly 1977; Leege 1984). However, there is some indication that elk respond less to constant non-stopping vehicle traffic than to slow vehicles which periodically stop (Ward 1976; Leege 1984) and disturb wildlife. Disturbance from traffic during the critical wintering period can impact winter survival rates. Perhaps more significant is the avoidance of wintering habitat adjacent to open roads.

Roads and Hunting Pressure

Hunted elk avoid open roads and select habitats as far as possible from the nearest open road (Irwin and Peek 1979; Unsworth et al. 1998). Despite the fact that elk densities adjacent to open roads are reduced, the harvest rate on elk remaining is much higher because of high hunter densities (Daneke 1980). Those elk that remain in areas with open roads are three times more likely to be killed (Hurley and Sargent 1991). In one study, nearly twice as many elk were killed within a quarter mile of open roads as any subsequent quarter mile interval (Daneke 1980). Road density and pattern, including off-road travel, are important in determining the security an area provides to elk during the hunting season (Basile and Lonner 1979).

Bull elk vulnerability has been documented to be at its highest in areas with open roads, reduced in areas with closed roads, and lowest in roadless areas (Leptich and Zager 1991; Unsworth and Kuck 1991). In the Coeur d'Alene River drainage, it was found that access-associated mortality rates had a marked effect on the age structure of bull elk populations. In roaded areas, essentially no bulls lived beyond 5.5 years of age (Leptich and Zager 1991).

Roads and Disturbance

Roads and associated disturbances have been presumed to be the primary agent driving elk distribution across seasons and landscapes (Leege 1984; Lyon 1979). Study results have indicated that expanding road systems and/or increasing traffic volumes, negatively affect elk distribution (Rost and Bailey 1979). A reduction in elk movement due to decreased vehicular traffic and human harassment may benefit the survivability of elk and the recruitment of calves. Reduced movements suggest that elk expend less energy (Cole et al. 1997) and the potential benefits of reduced energy expenditure include increased fat reserves, increased survival rate and increased productivity (Cole et al. 1997). Elk herds within the region have shown signs of decline. The potential to increase habitat use by closing roads is one way to help improve area elk herds.

When roads are built, elk security is lost and access management cannot completely mitigate that loss (Leptich and Zager 1991). Security areas are areas elk retreat to for safety when disturbance on their usual range is increased (Leege 1984). Such would occur during hunting season or any other human intrusion. The value of a secure area depends on the distance from open roads and the amount of cover available. Secure areas must be at least 250 continuous acres that are more than 2 miles from open roads (Leege 1984). Road closures either permanent or temporary will effectively increase security for hunted elk; but a more productive consideration involves prevention of habitat fragmentation (Lyon and Canfield 1991).

Road Densities

Road density varies within the Clearwater subbasin with the highest densities reached within commercial timber harvest areas within the Lower North Fork, Upper North Fork, and Lolo/Middle Fork AUs (refer to Figure 36). Isolated areas of high road density also occur near Grangeville, Elk City and along the Lochsa near Powell. Nearly all winter range areas have some level of open road density (Figure 94).

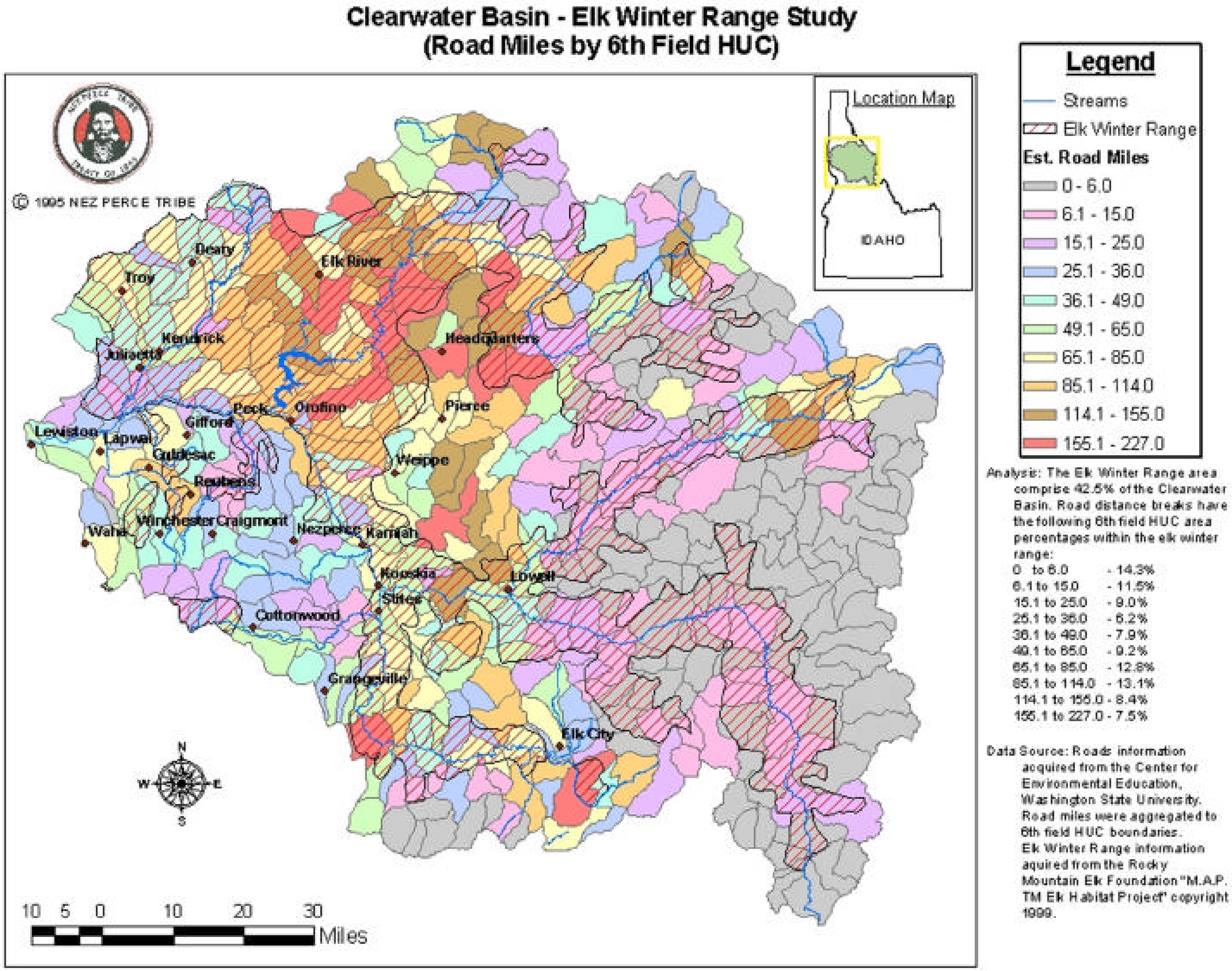

Figure 94. Relationship of localized road miles to elk winter range within the Clearwater subbasin

Limiting Factors
Poor nutritional quality of forage is a threat to the Clearwater elk herd. Changes in nutritional quality has resulted from fire suppression, succession, livestock grazing, noxious weed invasions, and land conversions. Loss of early seral plant communities due to fire suppression is of particular concern. Shrub fields are becoming decadent and too tall for effective foraging. A lack of selenium may also threaten elk nutrition within the Lochsa AU (S. Nadeau, Idaho Department of Fish and Game, personal communication, October 2001). The encroachment of noxious weeds onto low elevation winter range is also contributing to poor forage quality within the subbasin. Many noxious weeds are unpalatable while others provide unreliable or seasonally restricted food supplies. Forage removal by domestic livestock can also impact the availability and quality of forage for elk on both summer and winter range.

Poor recruitment threatens the long-term survival of elk within the Clearwater subbasin. Cow:calf ratios have consistently declined over the last decade (Idaho Department of Fish and Game, unpublished data). The direct cause of these declines is unclear but is likely due to poor condition of cows, low calf weights, and/or high predation rates.

Predation by black bears (*Ursus americanus*), cougars (*Puma concolor*), coyotes (*Canis latrans*), wolves, and humans can all threaten elk populations. Black bear, coyotes, and cougar tend to predate young animals while wolves prey on young, old, and/or injured animals. Habitat conditions can contribute to high predation rates. Dense shrub stands can provide good cover for black bear and other predators, while habitat fragmentation can contribute to high hunter success because security areas are limited.

Humans illegally harvest all types of elk, but regulated harvest is largely limited to adult males. Poaching is a significant problem within the subbasin with estimates of illegal take ranging as high as 50% that of legal harvest (S. Nadeau, Idaho Department of Fish and Game, personal communication, October 2001). Losses from wounding and escapement during fall hunting season are also a concern. Predation rates by humans increase near roads (Daneke 1980).

Severe winter weather has the potential to limit elk numbers. Cold temperatures and heavy snowfall can decrease winter survival rates and increase vulnerability to predation. Poor quality forage, human disturbance and/or habitat fragmentation can acerbate such conditions. Significant die-off events have occurred within the Clearwater subbasin in 1948-49 and 1996-97.

The Clearwater elk herd does not appear to be threatened by major disease occurrences. The herd is free of brucellosis and no evidence of chronic wasting disease has been found (S. Nadeau, Idaho Department of Fish and Game, personal communication, October 2001).

Historic/Current Distribution
The elk populations in the subbasin have change dramatically over time (Space 1964). Archaeological evidence from digs in the Clearwater subbasin suggests that elk have inhabited this area for more than 10,000 years (Clearwater National Forest 1999). In the late 1800s and early 1900s, elk abundance and distribution in the Clearwater was slim and scattered. The already scattered and sometimes sparse populations were impacted in the 1860s when thousands of gold miners took advantage of the unlimited hunting in some areas (Clearwater National Forest 1999).

Several extensive wildfires between 1910 and 1934 removed expanses of overstory and opened up a large forage area. Portions of the area were declared a wildlife reserve, allowing the elk to respond to this increase in forage. The subbasin's elk population grew to over 36,000 elk (U.S. Department of Agriculture 2000). By 1935, elk were becoming so plentiful, that the Clearwater Forest grazing report stated that elk were depleting their winter range. Although there is no documentation, forest personnel suspect that the elk population reached its peak in 1948. The severe winter of 1948-1949 greatly reduced the population size and since then hunting pressure has kept the population below the suspected 1948 peak (Space 1964).

From 1954 to1957 the Idaho State Fish and Game Department conducted a Game and Range study of the Clearwater that indicated a significant increase in the population (Space 1964). In 1976 hunting restrictions were enacted that only permitted bull hunting (U.S. Department of Agriculture 2000b). This allowed for an increase in population that continued for about 15 years (U.S. Department of Agriculture 2000b), until the subbasin's elk population declined in the 1990s (U.S. Department of Agriculture 2000b). In 1997, a significant drop occurred in the elk populations within certain parts of the subbasin when deep snow covered elk winter range (U.S. Department of Agriculture 2000).

Recent data (Figure 95) shows the Clearwater elk populations are in decline within some management units (Idaho Department of Fish and Game, unpublished data). Elk numbers within Lolo management units 10 and 12 show a particularly significant decline from approximately 15,270 animals in 1989 to approximately 7,745 animals in 1997-98. Elk numbers within the Selway units 16A and 17 also show a slight downward trend. Elk numbers within the Dworshak unit 10A and Elk City units 15 and 16 appear to be relatively stable over the last 12 years (Figure 95). Calf:cow ratios have consistently declined in all units over the last 10-15 years. The greatest declines have been observed in management units 10, 10A, and 12 (Dworshak and Lolo). Reasons for these declines are unclear but may be related to changes in forage quality, predation, declining security cover, human disturbance, and/or hunting pressures.

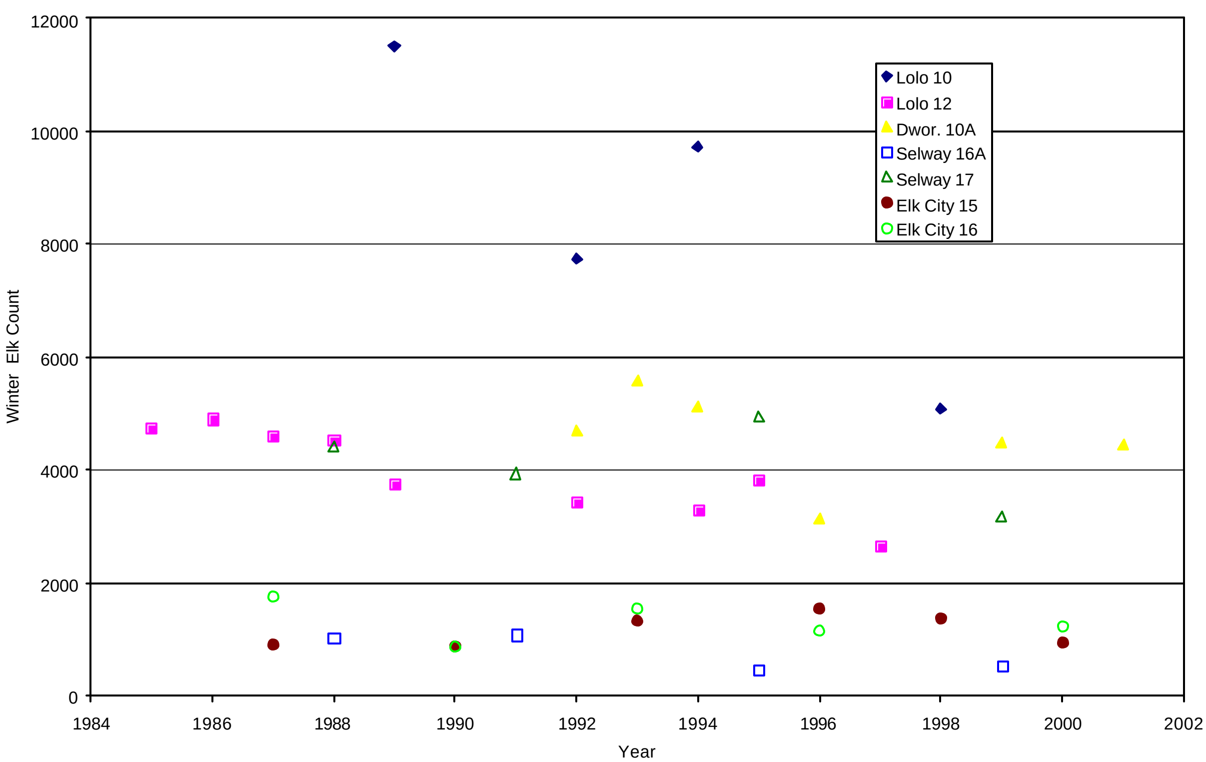

Figure 95. Winter elk counts displayed by IDFG management units for 1984-2001

6.7 Terrestrial Species Limiting Factors

6.7.1 Habitat loss, destruction, or modification

Habitat loss, destruction, or modification is the single most pervasive limiting factor for terrestrial species throughout the Clearwater subbasin, and affects nearly every focal species within the drainage. Key factors that contribute to the alteration of habitats include grazing, agriculture, mining, urban sprawl, fire suppression, logging, forest fragmentation, human construction projects, erosion, and noxious weeds.

Grazing impacts can be detrimental to riparian areas, grasslands, and fragile communities such as wet meadows. Cattle spend 20-30% more time in riparian areas than elsewhere on their range because of the abundant forage, availability of water, and protection from the elements, magnifying their impacts on these habitats (Knutson and Naef 1997). Livestock grazing can cause soil compaction, alter stream and habitat structure, distort bird and small mammal species composition, reduce big game forage, distribute noxious weeds, transmit diseases to wildlife, modify forest tree species composition, and reduce the abundance of fine fuels that once carried low-intensity fires through forests quickly. The historic grazing pressures imposed by native ungulates were light, and the herds moved through an area without causing excessive compaction or habitat alteration. Terrestrial species most susceptible to grazing impacts include Clearwater phlox, Jessica's aster, Palouse goldenweed, spacious monkeyflower, broadfruit mariposa lily, Spalding's catchfly, Macfarlane's four o'clock, water howellia, Ute ladies' tresses, huckleberry, camas, lomatium, western toad, bighorn sheep, northern goshawk, mountain quail, elk, and sharp-tailed grouse.

Agricultural practices have greatly changed the historic grasslands and prairies of the Clearwater subbasin. The vast ranges of fescue and *Agropyron* bunchgrasses that once dominated the lowland areas of the subbasin have been almost completely converted to agricultural use. Removal of native perennial grass cover has left the soil vulnerable to erosion by wind and water, altered hydrologic regimes, and aided grassland colonization by annual grasses and noxious weeds (Quigley and Arbelbide 1997; Black et al. 1997). The massive loss of prairie grasslands, has contributed to the decline of many species such as Ute ladies' tresses, Spalding's catchfly, broadfruit mariposa lily, Palouse goldenweed, Jessica's aster, camas, lomatium, lynx, elk and mountain quail, and led to the extirpation of the sharp-tailed grouse and sandhill crane from the subbasin (Deeble 2000).

The continuing growth of human populations and cities, characterized as "urban sprawl," has steadily encroached upon wildlife habitats. Increasing development results in habitat fragmentation, higher road densities, and loss of wildlife security. Low elevation big game winter range is particularly vulnerable to urban encroachment. Long-term capability of the habitat to support big game and other wildlife species is permanently reduced. Humans living in previously wild areas also result in significant predation on native fauna by pets, particularly free-ranging cats. Cats can kill large numbers of small animals, impacting both the populations of these species and their predators (Knutson and Naef 1997). Free-ranging dogs chase deer and elk and can cause stress and habitat avoidance in other wildlife species. A large percentage of the terrestrial focal species within the Clearwater subbasin are hindered by habitat fragmentation due to growing human populations. The impacts of urban sprawl are far reaching and affect such species as Spalding's catchfly, water howellia, Ute ladies' tresses, Clearwater phlox, Jessica's aster, Palouse goldenweed, camas, lomatium, fisher, wolverine, white-headed woodpecker, Townsend's big-eared bat, fringed myotis, gray wolf, elk, mountain goat, grizzly bear, bighorn sheep, sharp-tailed grouse, mountain quail, and sandhill crane.

As human populations continue to grow, so do public works such as roads, dams, water canals, fences, and power lines. These projects reduce the availability of wildlife habitat in the subbasin and result in fragmentation between habitat patches. Canals formed of steep, sloping, concrete walls form a barrier between isolated wildlife populations, habitat patches, migration corridors, and changing seasonal wildlife resources. Fences cause mortality in young ungulates that cannot cross high-strung barbed wire, and either get tangled in the strands, or get separated from the herd. Many bird species have difficulty avoiding and navigating around power lines, especially at night or when pursuing prey.

More than 65 species of terrestrial vertebrates in the interior Columbia River Basin are negatively affected by road-associated factors (Wisdom et al. 2000). Increasing road densities can reduce big game habitat effectiveness, increase vulnerability to harvest, facilitate firewood cutting and commercial harvest of large trees and snags, aid in the spread of noxious weeds, and encourage the spread of species into otherwise unsuitable habitat. For instance, coyotes have been shown to negatively affect lynx populations through competition for prey where roads allow coyotes access to areas where they would otherwise be excluded by snow depths. Populations of reptiles that use roads for thermal regulation, wide-ranging forest carnivores, and migrating amphibians are particularly vulnerable to road mortality.

Roads are commonly constructed parallel to stream and river courses for scenic reasons and ease of construction. This results in the removal of riparian vegetation and alters the development of meanders, side channels, and attached wetlands that provide important habitat for aquatic wildlife. Reductions in the size, quality, and connectivity of riparian habitats in the Clearwater subbasin have reduced their ability to support wildlife populations and to protect aquatic habitats. Of past and existing dams in the Clearwater subbasin, Dworshak Dam has had by far the greatest impact to wildlife resources. The single greatest impact of the Dworshak project is the loss of approximately 15,000 acres of deer and elk winter range due to water inundation (U.S. Army Corps of Engineers 1975). The flooded habitat once had high potential for supporting animals during adverse winter weather conditions (Norberg and Trout 1958). Species in the subbasin that have been impacted by human construction and public works include Macfarlane's four o'clock, salmon-flower desert-parsley, water howellia, wolverine, flammulated owl, white-headed woodpecker, black-backed woodpecker, harlequin duck, Townsend's big-eared bat, fringed myotis, western toad, Coeur d'Alene salamander, gray wolf, lynx, elk, mountain goat, grizzly bear, bighorn sheep, and mountain quail.

Fire management strategies of the past few decades have significantly changed the successional processes within the Clearwater subbasin. In the continued absence of fire, shade-tolerant fir species have become dominant as the canopy becomes dense enough that shade-intolerant ponderosa pine seedlings cannot compete, causing a shift from early and late successional forests to a prevalence of mid-seral forests (Johnson et al. 1994). The amount of early-seral habitat in the subbasin was probably widespread after the occurrence of huge fires in 1910 and 1919, but has been steadily declining since. The resulting reductions in early-seral forage have lowered the suitability of the subbasin to support many grazing and browsing wildlife species, and reductions in early successional stage dependent prey have reduced the suitability of the subbasin to certain dependent predators (Wisdom et al. 2000). Ongoing fire suppression has raised the tree density and fuel loads above historic levels, and increased the likelihood that when fire does occur, it will be an intense, stand replacing fire. In addition, these higher stand densities have increased the forests' susceptibility to insects and disease (Quigley and Arbelbide 1997).

This decline in multi-stage forests has probably reduced the suitability of the subbasin for ponderosa pine dependents and many other species, including huckleberry, flammulated owl, fisher, wolverine, gray wolf, lynx, white-headed woodpecker, black-backed woodpecker, northern goshawk, grizzly bear, bighorn sheep, mountain goat, mountain quail, and elk.

Timber harvest in the Clearwater subbasin has been primarily responsible for the reduction in mature forest types, multi-layered forest structure, and old growth ponderosa pine forests (Quigley and Arbelbide 1997). Local hydrologic features such as seeps and springs are important habitat features for many plant and wildlife species, and these features are modified or eradicated by extensive logging. Large, old trees, snags, logs, and downed wood are structural elements, common in mature forests, with significant importance to wildlife. The prevalence of these elements has been reduced in the region through the removal of older trees that might soon die and create snags, salvage harvest, fire wood collection, and the reduction of insect-infested trees that serve as food sources for insectivorous species (Wisdom et al. 2000). Clearcut logging leaves large, open tracts of exposed ground that many wildlife species will avoid, thereby causing habitat fragmentation and underutilization of resources.

Logging practices outside of the subbasin affect focal wildlife species that migrate seasonally to other locations. Loss of winter habitat in Mexico, via massive harvest without reforestation, may be the single-most important factor in long-term survival of the flammulated owl (McCallum 1994). Many species are sensitive to human disturbance and will abandon nests or territories due to logging activity, and siltation of streams caused by logging degrades wildlife habitat. The mountain moonwort, crenulate moonwort, water howellia, flammulated owl, fisher, wolverine, gray wolf, lynx, white-headed woodpecker, black-backed woodpecker, fringed myotis, northern goshawk, grizzly bear, bighorn sheep, and mountain goat have all been impacted or reduced by timber harvest practices within the subbasin.

Mining and ore extraction has been an historically significant industry within the Clearwater subbasin. The mining history of the subbasin included periods of intense placer, dredge, and hydraulic mining, in addition to draglines, drag shovels, and hand operations (Paradis et al. 1999, Staley 1940). Impacts of these operations often directly affect streams by way of siltation and stream channel diversion, and reduce the habitat quality for wildlife. In the 1860s thousands of gold miners took advantage of the unlimited hunting resources of the Clearwater drainage, and hunting pressures and disturbances had significant impacts on local species. Old mine shafts within the subbasin are critical habitat features for many bats, and resuming mining activities causes permanent abandonment of the roost and possible loss of the colony. Even though the number of prospectors has decreased, large mining operations continue to degrade habitats. Species negatively impacted by mining include Macfarlane's four o'clock, bighorn sheep, mountain goat, harlequin duck, Coeur d'Alene salamander, Townsend's big-eared bat, and fringed myotis.

Erosion and structural breakdown of fragile soils has led to the degradation of many wildlife habitats by allowing the establishment of nonnative and noxious weedy species throughout the Clearwater subbasin. The introduction of nonnative plant and animal species has reduced the drainage's ability to support native species. Erosion often occurs from livestock directly accessing streams, livestock pastures lacking protective wood and perennial grass cover, loss of vegetation along stream channels, or land disturbance events such as timber harvest, mining, fire, road construction, and agricultural tilling. Many noxious weeds are aggressive annual species that colonize new disturbances quickly and outcompete the perennial native species for available resources. Noxious weed invasions onto rangelands have drastically reduced forage production, forage quality, plant and animal species diversity, and habitat suitability. Nonnative wildlife often hybridizes with local native species, creating offspring that are less fit for survival and introducing genetic diseases. Species susceptible to erosion and invasive nonnative species impacts include Jessica's aster, Palouse goldenweed, spacious monkeyflower, Spalding's catchfly, broadfruit mariposa lily, water howellia, Ute ladies' tresses, Macfarlane's four o'clock, western toad, bighorn sheep, mountain goat, northern goshawk, mountain quail, elk, sandhill crane, and sharp-tailed grouse.

6.7.2 Human disturbance, presence, and activities

Human disturbance, presence, and activities often have significant repercussions for the focal species within the Clearwater subbasin. Scientific collection, recreation, vandalism, and various forms of hunting all have far reaching effects that reduce or restrict the populations of plant and wildlife species.

Many scientists collect rare and unique species of flora and fauna within the Clearwater subbasin, and occasionally species are overharvested or do not rebound from such disturbance. Species that have been negatively impacted by scientific collection include Clearwater phlox, Jessica's aster, Spalding's catchfly, Macfarlane's four o'clock, Townsend's big-eared bat, peregrine falcon, western toad, and Coeur d'Alene salamander.

Recreational disturbances within wildlife habitats have increased as the human population has continued to grow throughout the Clearwater subbasin. Activities such as hiking, mountain biking, angling, boating, bird watching, edible plant collection, cave exploration, rock climbing, and operating off-road vehicles such as snowmobiles, ATV's, and motorcycles, can cause the unintentional eradication of plant and wildlife communities. Some species are extremely sensitive to human disturbance, and even a low frequency of encounters can cause whole communities to abandon critical habitat features. Terrestrial focal species within the subbasin that are particularly intolerant of human contact are Palouse goldenweed, wolverine, harlequin duck, Townsend's big-eared bat, fringed myotis, northern goshawk, peregrine falcon. ESA listed, and culturally important or extirpated species sensitive to human disturbance include Spalding's catchfly, water howellia, Ute ladies' tresses, gray wolf, lynx, grizzly bear, bald eagle, bighorn sheep, mountain goat, mountain quail, elk, and sandhill crane.

Vandalism and destructive acts aimed at wildlife are often the product of superstition, negative folklore, and fear. The two species particularly susceptible to vandalism within the subbasin are Townsend's big-eared bat and the fringed myotis.

Hunting and trapping, for subsistence or sport, have been practiced in the subbasin throughout history. Indigenous peoples have put some form of hunting pressure on the subbasin's wildlife for thousands of years, but as wildlife habitat quality declines and the human populations continue to rise, the impacts to wildlife communities are increasing. In the 1860s large numbers of gold miners flooded into the subbasin and the unregulated hunting, for sport and subsistence, had serious impacts to wildlife. Many species were greatly reduced by this period of overharvest. In the 1900s, ranchers and public agents promoted eradication programs that destroyed many predatory wildlife species to protect the public from disease or attacks, and support livestock interests. Currently, hunting seasons limit excessive harvesting of intensively hunted species, but poaching, misidentification, and unforeseen population fluctuations continue to alter viability and composition of some wildlife communities. Some species within the subbasin are particularly vulnerable to trapping and hunting due to curiosity, trapability, inability to rebound from losses, high poaching rates, and a lack of refugia to avoid hunters. These sensitive species are fisher, wolverine, peregrine falcon, Townsend's big-eared bat, fringed myotis, gray wolf, bald eagle, lynx, grizzly bear, bighorn sheep, mountain goat, bison, elk, and sandhill crane.

Wisdom et al. (2000) found roads to be detrimental to >70% of the 91 species of wildlife reviewed. The development and use of roads affect ecosystems and the wildlife dependent on them in numerous ways. Roads eliminate habitat through their development; they fragment habitat, compact soils, disturb and destroy organic layers, and cause higher rates of erosion or mass wasting. Car and truck traffic associated with roads becomes a vector for the spread of noxious weeds, injures and kill animals through collisions, minimizes or limits the use of adjacent habitat by ungulates, results in an increased harvest rate on the remaining animals, and creates a loss of security for ungulates that cannot be completely mitigated through access management. Numerous studies have documented the impacts roads can have on the behavior, movement, and mortality of animals (Trombulak and Frissell 2000; Ercelawn 1999; Hieb 1976; Perry and Overly 1977; Lyon 1979; Rost and Bailey 1979; Witmer and deCalesta 1985).

6.7.3 Intensive application of herbicides, pesticides, and chemicals

Intensive application of herbicides, pesticides, and chemicals often has deleterious effects on nonintended species of plants and wildlife. Species within the Clearwater subbasin can be directly affected by these chemicals through pesticide/herbicide drift from aerial spraying, contamination of water sources, and habitat loss. An indirect affect to wildlife is the reduction of prey bases that many wildlife species feed on. Cumulative effects are spread throughout a system when predators accumulate toxic doses of a poison through the consumption of contaminated prey. Terrestrial focal species subject to losses by herbicide or pesticide application include Palouse goldenweed, harlequin duck, peregrine falcon, Townsend's big-eared bat, fringed myotis, and Coeur d'Alene salamander. Threatened and Endangered plant and animal species whose declines may be partially attributable to herbicide and pesticide application include Spalding's catchfly, Macfarlane's four o'clock, Ute ladies' tresses and bald eagle.

6.7.4 Disease and parasite

Infestation by disease or parasites is a common limiting factor of many plant and wildlife species within the Clearwater subbasin. While some species may have low-intensity infestations that reduce viability without killing the host, other species have cyclic, reoccurring infestations that can cause massive die-offs and eliminate whole communities. Species that are vectors for a disease but are not affected themselves, may still be negatively impacted if the disease is perceived to be a danger to humans. Species within the Clearwater subbasin that have a history of disease and/ or parasite outbreaks include Clearwater phlox, Jessica's aster, salmon-flowered desert-parsley, Spalding's catchfly, Macfarlane's four o'clock, Townsend's big-eared bat, peregrine falcon, western toad, gray wolf, bighorn sheep, mountain goat, and bison.

6.7.5 Critical habitat or specialized needs/aversions

Critical habitat or specialized needs/aversions can be unique characteristics critical to a life phase, or factors that cause a species to avoid otherwise suitable habitat. Home range requirements, extreme range loyalty, avoidance of landscape features, reproduction habitat features, and feeding habitat characteristics all define critical habitat for a particular species, and may limit that species' abundance if absent. Some terrestrial focal species within the subbasin can be characterized as "generalists" and can survive in a wide variety of habitat types, but many have specialized criteria or sensitivities that limit their suitable habitat types. These specialized terrestrial focal species include Clearwater phlox, spacious monkeyflower, salmon-flowered desert-parsley, mountain moonwort, crenulate moonwort, fisher, wolverine, flammulated owl, white-headed woodpecker, black-backed woodpecker, harlequin duck, Townsend's big-eared bat, fringed myotis, peregrine falcon, and Coeur d'Alene salamander. Lynx, grizzly bear and water howellia are threatened and endangered species with specialized requirements. Specialized culturally important or extirpated species include huckleberry, camas, bighorn sheep, mountain goat, sharp-tailed grouse, mountain quail and sandhill crane.

6.7.6 Limited or specialized reproductive capabilities

Limited or specialized reproductive capabilities can greatly reduce a community's ability to rebound from loss, adapt to habitat changes, or recolonize disjunct habitats. Some species have intrinsically low birth and maturation rates that hinder their ability to respond quickly to changing environments and resources. Other species have such high neonatal or juvenile mortality rates that their populations grow very little over time, and are highly susceptible to extirpation if mature breeding adults are lost. Climate, weather, human disturbance, maternal nutritional level, nest usurpation, excessive predation on young, availability of prey or forage, stress, habitat quality, and cyclic patterns of population change all affect reproductive success and recruitment. There are several terrestrial focal species within the Clearwater subbasin that exhibit limited reproductive capability: broadfruit mariposa lily, fisher, flammulated owl, black-backed woodpecker, harlequin duck, Townsend's big-eared bat, goshawk, peregrine falcon, and western toad. Limited reproductive capacity may have also been a factor in reductions in populations of water howellia, lynx, grizzly bear, bald eagle, bighorn sheep, mountain goat, mountain quail and sandhill crane.

6.7.7 Interspecies competition and selective predation

Competition among native species can often severely limit the viability of a plant or wildlife community. Some species continuously compete for the same resources, such as sunlight, pollinators, prey, territory, and quality habitat features, or are targeted by specialized predators. This intense struggle results in stress, increased energy output to guard territories, loss of fitness, and higher risk of predation to young. Excessive loss of fitness can limit a population and reduce community health. Terrestrial focal species subject to high levels of interspecies competition or predation are fisher, wolverine, black-backed woodpecker, western toad, and peregrine falcon. Macfarlane's four o'clock, huckleberry, lynx, bighorn sheep, mountain quail, sandhill crane, and elk are Threatened, Endangered, recently extirpated, dimininished or culturally important species susceptible to high levels of interspecies competition or predation.

6.7.8 Herbivory susceptibility

Herbivory susceptibility is a limiting factor for species that focus all of their reproductive energy into the production of a single fruiting body. Large seed heads are highly palatable and likely to be consumed by herbivores and browsers, but the widespread distribution of the individual plants helps to distribute herbivory impacts. If a susceptible community is intensively grazed due to poor livestock rotation or severe weather limiting herbivore dispersal, it may eliminate reproduction and recruitment for an entire year. The broadfruit mariposa lily is the only species within the Clearwater subbasin known to be limited by herbivory of fruiting bodies.

6.7.9 Obligate relationships

Obligate relationships are formed by the resources available and the needs of different species. Many species are dependent upon the health of another plant or wildlife community to provide a resource or critical habitat feature that cannot be otherwise utilized, and the management of each must reflect these relationships. Keystone species have complex obligate relationships, and are therefore critical to ecosystem health. The anadromous salmonids are an example of keystone species within the subbasin. Reductions in the anadromous salmon runs within the Clearwater subbasin have limited the system's ability to support many of the wildlife populations that current habitat could otherwise maintain. Wildlife derive nutrition from salmon through direct consumption in the form of predation, parasitism, or scavenging of spawning fish, carcasses, eggs, or fry. Carcass decomposition, and the particulate and dissolved organic matter released by spawning fish, deliver nutrients to plants, which in turn, also provide sustenance to wildlife (Cederholm et al. 2001). Wildlife species have been identified that have a strong consistent relationship with salmon, and three of these, the harlequin duck, grizzly bear, and bald eagle, occur presently or historically in the Clearwater subbasin (Cederholm et al. 2001).

Examples of simple obligate relationships are pollination, providing carcasses for scavengers, specialized prey base, excavating snags for secondary nesting species, or forming symbiotic fungal dependencies. In addition, some species form an obligate relationship among its collective communities, (termed a metapopulation), which is a regional grouping of interdependent populations affected by recurrent extinctions and linked by recolonization (Shelly and Gamon 1996). Many small communities of the same species need to be maintained to supply a recolonization source in the event of localized extirpation or destruction of an individual population. This is particularly important for species tied to disturbance or volatile habitats. Terrestrial focal species limited by their obligate relationships are mountain moonwort, crenulate moonwort, wolverine, flammulated owl, and harlequin duck. Endangered and Threatened species thought to be limited by their obligate relationships include Macfarlane's four o'clock, water howellia, lynx, grizzly bear, and bald eagle.

6.7.10 Natural disaster

Natural disaster events can be an opportunity for some plants and wildlife in the subbasin to gain an advantage over other less resilient species. Many plants and wildlife have become so specialized that they are dependent upon occasional flood, fire, drought, cold, or general mass disturbance periods to create reproduction, feeding, nesting, or rearing opportunities. Flooding induces seed establishment of important riparian species, and fire creates snags and dead wood, and causes some conifer cones to dispense seeds. Many seeds need specific wet-dry or hot-cold cycles to induce germination. Plants and wildlife within the subbasin that have become dependent, and therefore limited, by their tie to natural disasters are water howellia, huckleberry, white-headed woodpecker, black-backed woodpecker, and lynx.

6.7.11 Sensitivities to climate and environmental changes

Sensitivities to climate and environmental changes such as increased pollution, declining water quality, prolonged drought, poor seasonal forage production, and extreme seasonal temperatures, can limit dispersal, survival of offspring, reproductive success, overwinter health, and general fitness of many species. Some terrestrial focal species within the subbasin are very intolerant of habitat fluctuations and are easily extirpated if extreme changes occur. The terrestrial focal species most sensitive to climate extremes or have experienced large die-offs due to environmental shifts are Clearwater phlox, harlequin duck, Townsend's big-eared bat, western toad, and Coeur d'Alene salamander. Other species sensitive to environmental shifts include water howellia, huckleberry, bighorn sheep, mountain goat, bison, mountain quail, sandhill crane, and elk.

6.7.12 Small endemic populations

Small endemic populations are subject to extirpation by inbreeding depression, genetic drift, isolation from the larger population, lack of travel corridors between regional populations or resources, loss of genetic variability, and a poor survival rate for transplanted individuals. Isolated and endemic populations can be created by various factors such as forest fragmentation, construction of barriers such as roads, water impoundments, or fences, large die-offs that fragment a species' distribution, diminishing resources, habitat destruction, loss of critical habitat features, extreme separation of suitable habitats, limited mobility or dispersal ability, or extreme loyalty to home range. Many terrestrial focal species within the Clearwater subbasin are currently declining or have been extirpated due to small, isolated populations and deleterious genetic effects. These species are Clearwater phlox, Jessica's aster, Palouse goldenweed, broadfruit mariposa lily, crenulate moonwort, fisher, wolverine, harlequin duck, Townsend's big-eared bat, and Coeur d'Alene salamander. Spalding's catchfly, Macfarlane's four o'clock, Ute ladies' tresses, water howellia, lynx, grizzly bear, bighorn sheep, mountain goat, sharp-tailed grouse, and mountain quail are Threatened, Endangered, Extirpated or Diminished species that have been impacted by the effects of small or isolated populations.

6.7.13 Global or regional limitations

Global or regional limitations can reduce a species that inhabits the Clearwater subbasin seasonally but travels outside the drainage in other times of the year. Many migrant populations are declining due to global or national limiting factors such as habitat destruction, climate changes, or pollution that are effecting the worldwide distribution of a species. Terrestrial focal and Threatened species species at risk from global limiting factors are flammulated owl, harlequin duck, lynx, and bald eagle.

6.7.14 Other reasons

Unknown reasons for declining plant and wildlife communities are still being studied for many species. Some historic community locations are on private property and unavailable for current surveys, or some species may be responding negatively to unknown environmental variables in addition to well documented factors. Species that are declining for unknown reasons are spacious monkeyflower, salmon-flowered desert-parsley, western toad, harlequin duck, lynx, mountain quail, and elk. A summary of focal plant species (Table 38) and wildlife species (Table 39) affected by each limiting factor are listed below.

Table 38. Limiting factors of focal,Threatened and Endangered, and culturally or economically important plant species within the Clearwater subbasin

LIMITING FACTORS	Phlox	Aster	Goldenweed	Monkeyflower	Dst Parsley	Lily	Mt. Mnwort	Cr. Mnwort	Catchfly	4 O'Clock	Howellia	Ute L's tress	Huckleberry	Camas	Lomatium
Habitat loss/ destruction/ modification															
Grazing		x	x	x		x			x	x	x	x	x	x	x
Agriculture		x	x			x			x			x		x	x
Urban sprawl	x	x	x						x		x	x		x	x
Human construction projects	x				x					x	x				
Fire suppression													x		
Logging/forest fragmentation							x	x			x				
Mining										x					
Erosion/ noxious weeds		x	x	x		x			x	x	x	x			x
Human disturbance															
Scientific collection	x	x							x	x	x				
Recreation			x						x		x	x			
Vandalism															
Hunting/Trapping/Poaching															
Herbicides/ Pesticides			x						x	x		x			x
Disease/ parasites	x	x			x				x	x					
Critical habitat or specialized needs/aversions	x			x	x		x	x			x		x	x	
Limited/ specialized reproductive capabilities						x					x				
Native species competition/selective predation										x			x		
Herbivory susceptibility						x									
Obligate relationships							x			x	x				
Subject to/ dependent on natural disasters											x		x		
Climatic/ environmental conditions	x			x			x	x			x		x	x	
Small endemic populations subject to extirpation	x	x	x			x		x	x	x	x	x			
Global or regional limitations	x									x					
Unknown/questionable cause of decline				x	x										

Table Name	Common Name	Scientific Name	Table Name	Common Name	Scientific Name
Phlox	Clearwater phlox	*Phlox idahonis*	Catchfly	Spalding's catchfly	*Silene spaldingii*
Aster	Jessica's aster	*Aster jessicae*	4 O'Clock	MacFarlane's four o'clock	*Mirabilis macfarlanei*
Goldenweed	Palouse goldenweed	*Haplopappus liatriformis*	Howellia	Water howellia	*Howellia aquatilis*
Monkeyflower	Spacious monkeyflower	*Mimulus ampliatus*	Ute L's tress	Ute ladies' tressess	*Spiranthes diluvialis*
Dst Parsley	Salmon-flowered desert-parsley	*Lomatium salmoniflorum*	Huckleberry	Big huckleberry	*Vaccinium membranaceum*
Lily	Broadfruit mariposa lily	*Calochortus nitidus*	Camas	Camas	*Camassia quamash*
Mt. Mnwort	Mountain moonwort	*Botrychium montanum*	Lomatium	Lomatium	*Lomatium spp.*

Table 39. Limiting factors of focal, Threatened and Endangered, recently extirpated or diminished, and culturally or economically important wildlife species within the Clearwater subbasin

LIMITING FACTORS	Fisher	Wolverine	F. Owl	W-H wdpker	B-B wdpker	Duck	Big-ear bat	Myotis	Goshawk	Peregrine	Toad	Salamander	Wolf	Bald eagle	Lynx	Grizzly	Bighorn	Mt. Goat	Bison	Grouse	Mt. Quail
Habitat loss/ destruction/ modification																					
Grazing									x		x						x			x	x
Agriculture															x					x	x
Urban sprawl	x	x		x			x	x					x			x	x	x		x	x
Human construction projects	x		x	x	x	x	x	x			x	x	x		x	x	x	x			x
Fire suppression	x	x	x	x	x				x				x		x	x	x	x			x
Logging/ forest fragmentation	x	x	x	x	x			x	x				x		x	x	x	x			
Mining						x	x	x				x					x	x			
Erosion/ noxious weeds									x		x						x	x		x	x
Human disturbance																					
Scientific collection							x			x	x	x									
Recreation		x				x	x	x	x	x			x	x	x	x	x	x			x
Vandalism							x	x													
Hunting/ Trapping/ Poaching	x	x					x	x		x			x	x	x	x	x	x	x		
Herbicides/ Pesticides						x	x	x		x		x		x						x	
Disease/ parasites							x			x	x		x				x	x	x		
Critical habitat or specialized needs / aversions	x	x	x	x	x	x	x	x		x		x			x	x	x	x		x	x
Limited/ specialized reproductive capabilities	x		x		x	x	x		x	x	x			x	x	x	x	x			x
Native species competition / selective predation	x	x			x					x	x				x		x				x
Herbivory susceptibility		x	x			x								x	x	x					
Obligate relationships																					
Subject to/ dependent on natural disasters				x	x										x						
Climatic/ environmental conditions						x	x				x	x					x	x	x		x
Small endemic populations subject to extirpation	x	x				x	x					x			x	x	x	x		x	x
Global or regional limitations			x			x									x						
Unknown / questionable cause of decline						x					x				x						x

Wildlife Species

Table Name	Common Name	Scientific Name
Fisher	Fisher	*Martes pennanti*
Wolverine	Wolverine	*Gulo gulo*
F. Owl	Flammulated owl	*Otus flammeolus*
W-H wdpker	White-headed woodpecker	*Picoides albolarvatus*
B-B wdpker	Black-backed woodpeckers	*Picoides arcticus*
Duck	Harlequin duck	*Histrionicus histrionicus*
Big-ear bat	Townsend's big-eared bat	*Corynorhinus townsendii*
Myotis	Fringed myotis	*Myotis thysanodes*
Goshawk	Northern goshawk	*Accipiter gentilis*
Peregrine	Peregrine falcon	*Falco peregrinus anatum*
Toad	Western or Boreal toad	*Bufo boreas*
Salamander	Coeur d'Alene salamander	*Plethodon vandykei idahoensis*
Wolf	Gray wolf	*Canis lupus*
Bald eagle	Bald eagle	*Haliaectus leucocephalus*
Lynx	Lynx	*Lynx canadensis*
Grizzly	Grizzly bear	*Ursus arctos horribilis*
Bighorn	Bighorn sheep	*Ovis canadensis canadensis*
Mt. Goat	Mountain goat	*Oreamnos americanus*
Bison	American bison	*Bison bison*
Grouse	Columbian sharp-tailed grouse	*Tympanuchus phasianellus colu*
Mt. Quail	Mountain quail	*Oreortyx pictus*
SH Crane	Greater sandhill crane	*Grus canadensis tabida*
Elk	Elk	*Cervus elaphus*

7 Aquatic Resources

7.1 Fish Habitat Areas and Quality

7.1.1 Anadromous Species

Due to the significant loss of mainstem habitat, function, and direct and indirect mortalities associated with the Federal Columbia River hydropower system (FCRPS), tributary habitat has become more critical to the survival and recovery of listed anadromous species throughout the Columbia Basin. Due to direct and indirect effects of the FCRPS, NOAA Fisheries has directed in its ESA 2000 BIOP that tributary habitat improvements are required as part of off-site mitigation activities of the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, and the Bonneville Power Administration for continued operation. The potential for habitat-based off-site mitigation within the Clearwater subbasin is affected by the Dworshak Dam blockage of the North Fork Clearwater River system, and by expanses of pristine habitats in wilderness and other protected areas.

In the Clearwater subbasin, steelhead trout and fall chinook salmon are listed as threatened under the Endangered Species Act (ESA) and have had critical habitats designated by NOAA Fisheries. Spring chinook salmon within the Clearwater subbasin have been excluded from the ESA listing for Snake River spring/summer chinook and therefore have no designated critical habitat areas. While subpopulations of spring chinook salmon are distributed throughout the subbasin, they are not listed under the ESA because the current natural runs are primarily the result of the past reintroduction programs (NPT and IDFG 1990; Columbia River Inter-Tribal Fish Commission 2000). Critical habitat as defined by NOAA Fisheries includes all waterways, substrate and adjacent riparian zones below longstanding, naturally impassable barriers. Riparian zones are defined as those areas within a horizontal distance of 300 feet from the normal line of high water of a stream channel or from the shoreline of a standing body of water. Indian lands are excluded from designated critical habitats.

For steelhead trout, critical habitat within the Clearwater subbasin includes all accessible river reaches, and excludes areas above Dworshak Dam and any longstanding, naturally impassable barriers in existence for at least several hundred years. Current documentation of naturally impassable barriers is lacking. Attempts have been made to document natural barriers (Murphy and Metsker 1962), but incomplete records and subsequent modification or elimination of many barriers has precluded documentation of those that currently exist.

Designated critical habitat within the Clearwater subbasin for fall chinook salmon includes the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek, the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam, and all other river reaches presently or historically accessible to fall chinook salmon in the Lower Clearwater and Lower North Fork Clearwater (below Dworshak Dam) AUs.

Habitat quality for spring chinook salmon and steelhead trout was estimated in a relatively comprehensive manner throughout the subbasin during development of the Northwest Power Planning Council Presence/Absence Database. Habitat quality ratings were compiled by stream reach and are qualitative and species specific. Habitat quality for each species was rated as excellent, good, fair or poor. For the purposes of this assessment, NPPC stream reach ratings of habitat quality were subsequently summarized within each applicable 6th field HUC by assigning numerical values to each rating, and calculating the weighted average for each HUC using segment length as the weighting variable.

Very little habitat within the Clearwater subbasin has been defined as excellent for spring chinook salmon. Excellent habitat is typically limited to the highest elevation headwater streams within the Lochsa and Upper Selway AUs (Figure 96). However, if not blocked by Dworshak Dam, the Upper and Lower North Fork AUs would provide substantial amounts of excellent spring chinook habitat (Mallett 1974). The USFWS (1962) found that headwater streams in the North Fork Clearwater subbasin, prior to blockage by Dworshak Dam, provided excellent spawning and rearing habitat for anadromous fish, including spring chinook salmon. Good and fair spring chinook salmon habitat is widely intermixed and found throughout the majority of the usable mainstem and tributary reaches of the Lochsa, South Fork, and Upper and Lower Selway AUs. Poor habitat conditions for spring chinook are typically associated with lower mainstem reaches of major tributaries (Lolo Creek, Lochsa, Selway and South Fork Clearwater Rivers) and the mainstem Clearwater River.

Prior to blockage by Dworshak Dam, habitat in the North Fork Clearwater provided excellent steelhead spawning and rearing habitat that supported 60% of the spawning activity in the Clearwater subbasin (USFWS 1962). Of the remaining habitat in the subbasin, excellent steelhead trout habitat characterizes the vast majority of the available habitat in the Upper Selway AU, and the majority of tributary habitats within the Lower Selway and Lochsa AUs (Figure 97). The mainstem Lochsa River and mainstem Selway River above the wilderness boundary provide ‘good’ steelhead trout habitat, as do most of the tributary systems within the South Fork AU. Within the South Fork AU, ‘excellent’ steelhead trout habitat is associated with drainages originating within the Gospel Hump Wilderness Area: Johns Creek, Tenmile Creek, and the uppermost reaches of Crooked River. The Lower Clearwater and Lolo/Middle Fork AUs are most typically characterized by fair to poor steelhead habitat throughout. Notable exceptions are Big Canyon Creek and portions of Lolo Creek which are characterized as “good” steelhead trout habitat.

7.1.2 Resident Species

Bull trout have more specific habitat requirements than other salmonids. Strong bull trout populations are associated with a high degree of channel complexity, including woody debris and substrate with clear interstitial spaces. The amount of habitat complexity or cover required to maintain strong bull trout population(s) cannot however, be quantified (Batt 1996).

Temperature is a critical habitat element for bull trout, which may experience considerable stress in temperatures over 15°C (1992 cited in Clearwater subbasin Bull Trout Technical Advisory Team 1998a; Batt 1996). Optimum temperatures for incubation and rearing have been cited between 2 and 4°C and 7 and 8°C, respectively (Rieman and McIntyre 1993). Other habitat parameters of particular importance to bull trout populations include channel stability, substrate composition, cover, and migratory corridors (Rieman and McIntyre 1993).

Ten bull trout key watersheds within the Clearwater subbasin were defined in the State of Idaho Bull Trout Conservation Plan (Batt 1996) based in part on the following habitat characteristics: key watersheds must provide all critical bull trout habitat elements and are selected from the best available habitat with the best opportunity to be restored to high quality. Key watersheds defined for bull trout within the Clearwater subbasin are summarized in Table 54 and Figure 106.

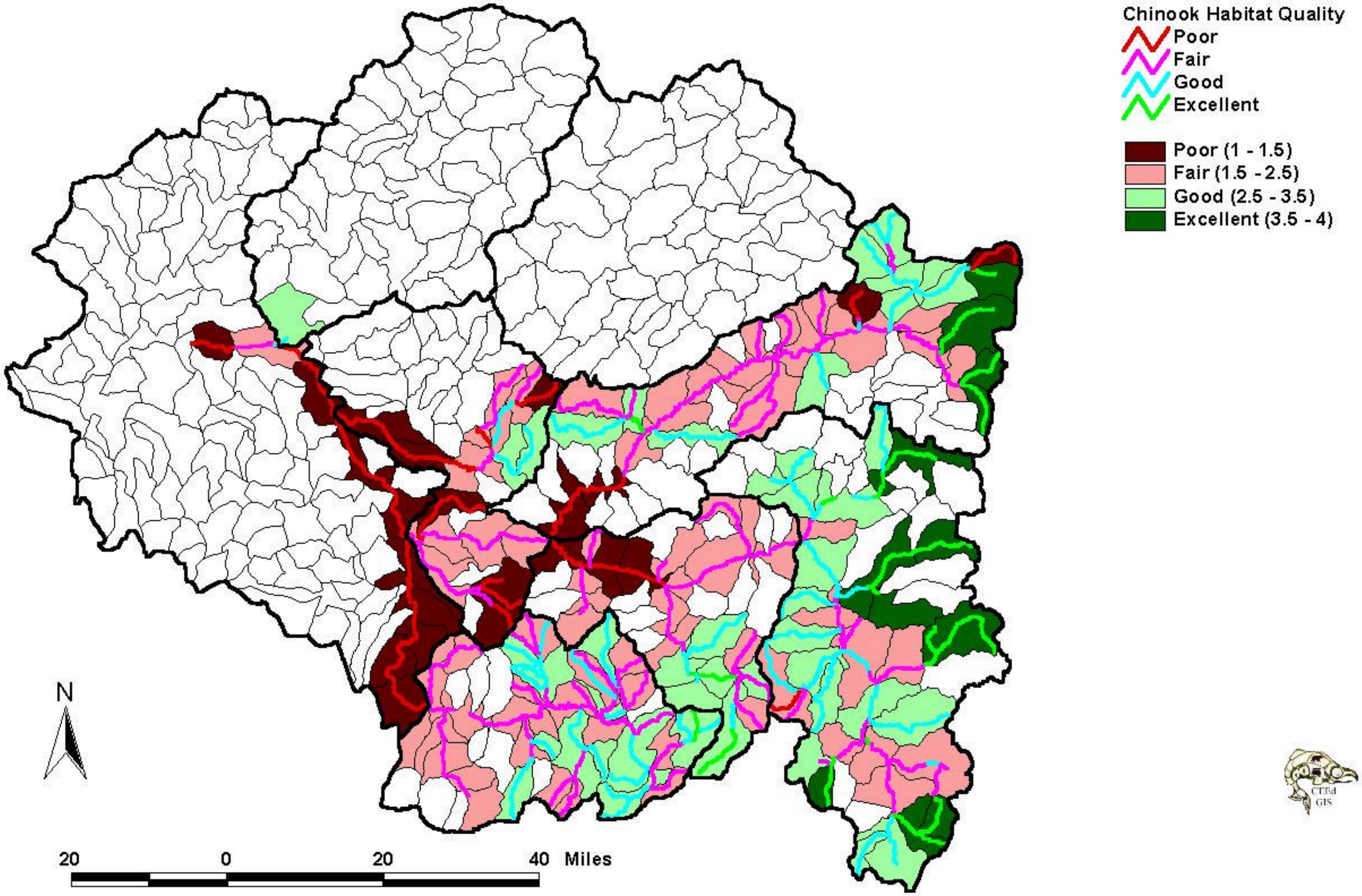

Figure 96. Habitat quality for spring chinook salmon as defined by NPPC's presence absence database (stream reaches) summarized by subwatershed

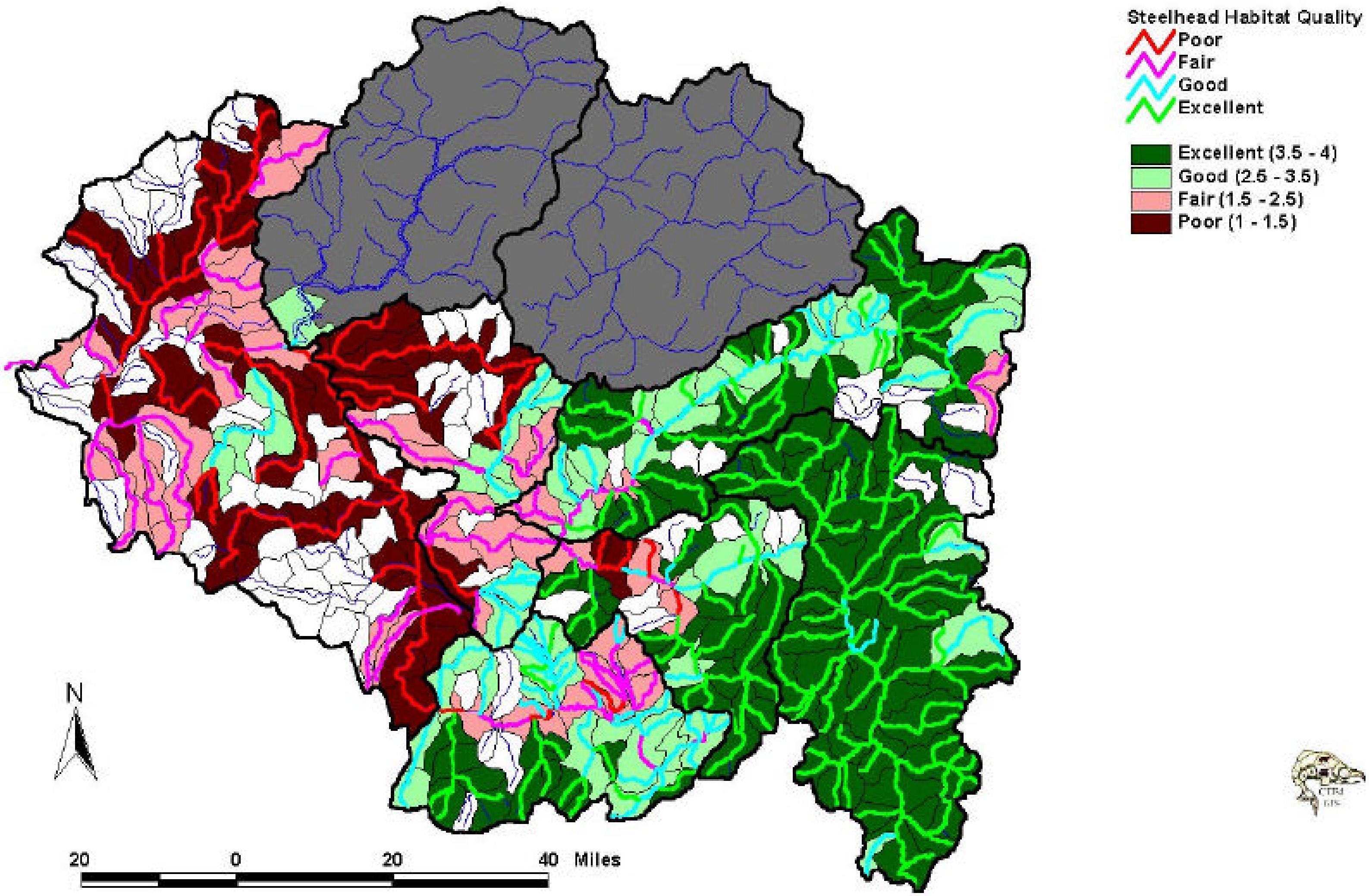

Figure 97. Habitat quality for steelhead trout as defined by NPPC's presence absence database (stream reaches) summarized by subwatershed

Specific habitat areas of critical importance to westslope cutthroat trout have not been defined within the Clearwater subbasin. Based on the current distribution and status of westslope cutthroat trout (Figure 105), it is presumed that the majority of the subbasin provides adequate habitat for maintenance of relatively strong population(s) of westslope cutthroat trout.

The construction of Dworshak Dam and Reservoir eliminated about 717,000 square yards of spawning habitat within the pool area that was suitable for resident trout and anadromous fish (USFWS 1962). This habitat loss is likely to have affected both bull trout and westslope cutthroat trout populations.

7.2 Aquatic Productivity

At the subbasin scale, understanding spatial patterns in potential production can be critical to restoration planning and evaluation efforts. Such an understanding can facilitate prioritization of restoration efforts and also provide a benchmark against which success of restoration efforts can be gauged.

Productivity is defined as the rate of production and illustrates how much of something (e.g. benthic biomass or numbers of smolts) can be produced over a given amount of time. Production is defined as the total output, illustrating how much is actually produced. In fisheries, spatial variations in production and productivity are commonly indexed (using differences in fish counts) rather than directly measured, leading to estimates of *relative* production or productivity between areas.

Fish production is driven by a variety of factors including local productivity, habitat quantity, and habitat quality. It is possible for an area of high productivity to realize relatively low production if habitat quantity or quality are limited. In contrast, an area of low productivity may realize relatively high production if high quality habitat is plentiful. Productivity is therefore an integral component of production although the reverse is not necessarily true. Increases in production can however, result in increased productivity in some areas, particularly in areas where anadromous fish spawn, die and decay, resulting in increased nutrient levels, which in turn, increase local productivity.

In the case of fish populations, production is often assessed through long term juvenile density data or spawner counts. Although a high degree of variability exists in natural populations, it can be assumed that over long periods, areas that produce more fish on average are more productive. Juvenile densities are influenced by a variety of factors including the number of spawners available to produce juveniles, and local habitat quality and quantity. Spawner counts are influenced by past production of juveniles, relatively long term (full life-cycle) survival rates, and in the case of anadromous species, temporal variation in migration and ocean conditions.

Datasets considered for use in examining potential fish production throughout the Clearwater subbasin are limited in both scope and utility. Relatively long term and consistently recorded data is available through redd surveys (adults) and the IDFG Parr Monitoring Database (juveniles). Both databases suffer from the following drawbacks which make them unsuitable for use in estimating relative production potential throughout the subbasin

- Both databases monitor and provide information only for those areas accessible to anadromous species.
- The majority of the data is from a post-dam time period. It can be reasonably argued that adult returns have been heavily influenced by out-of-subbasin issues (migration and ocean conditions) and that smolt production is reflective of adult recruitment (not local production potential).

Based on these drawbacks, both redd survey data and the Parr Monitoring Database were thought to be inappropriate for use in defining relative production potential throughout the Clearwater subbasin. Since information regarding spatial differences in production potential throughout the subbasin are thought to be critical to successful recovery planning, an experimental approach was developed to examine the use of benthic macroinvertebrate biomass as an indicator of relative production potential. Advantages of using macroinvertebrate biomass include

- Data collection can be completed in a relatively timely manner across broad geographic areas
- Measured as biomass, benthic macroinvertebrate production is highly dependent on local productivity (In contrast, commonly monitored macroinvertebrate community metrics such as diversity, richness, etc. are primarily driven by habitat condition)
- Spatial variation in benthic biomass production may be assumed to be potentially indicative of patterns in fish production at qualitative scales (H/M/L); areas producing high benthic biomass may be assumed to have the inherent capacity to produce more fish than areas producing less benthic biomass.

A study was conducted as part of this subbasin assessment process to evaluate the utility of using benthic biomass to assess spatial variation in potential production throughout the Clearwater subbasin. Fifth code HUCs were chosen to be consistent with similar work conducted by other agencies and are thought to be an appropriate scale at which to assess spatial variability in productivity for anadromous fish-bearing waters (Feist et al. Unpublished data).

The hypotheses tested by this study include the following:

1) differences in benthic biomass between 5th code HUCs can be identified using a relatively small number of samples within each HUC
2) at the 5th code HUC scale, qualitative differences in benthic biomass can be accurately described using landscape level features thought to influence production potential

Assumptions drawn for the purposes of conducting this study include

1) benthic macroinvertebrate production provides a useful index of local production potential
2) spatial variation in production potential will be directly reflected in benthic biomass, highly productive areas will consistently produce more benthic biomass than areas with lower production potential
3) while spatial variation in habitat quality would be expected to result in substantial differences in community composition, it does not significantly alter relative differences in benthic biomass between sampling locations

A total of thirteen 5th code HUCs in the Lochsa (6) and South Fork AUs were sampled for benthic biomass during July and August, 2000 (Table 40). Eight locations were sampled within each HUC (exceptions are 5 sites in John's Creek and 7 in Warm Springs Creek). Sampling locations were subjectively chosen and intended to provide a representative cross section of available habitat types within each HUC. Three benthic samples collected from each sampling site using a Surber sampler ($0.093m^2$) were combined into one composite sample (0.28 m^2) for biomass analysis. Biomass was determined by subtracting the ash free dry weight (AFDW) of the sample from the dry weight of the sample (refer to EPA 1973). Dry weight was obtained by drying samples at 105°C for 24 hrs. and then subtracting the weight of the crucible. AFDW was obtained by placing dried samples in a muffle furnace at 500°C for one hour, cooling, and then returning sample to a constant weight at 105°C and finally subtracting the weight of the crucible. The difference between dry and burned weight was used to define organic weight (biomass) for each composite sample.

Table 40. Relative production potential of each 5th code HUC in which benthic macroinvertebrate biomass data was collected

HUC Name [1]	5th Code HUC #	Assessment Unit	Mean Biomass ($mg/0.28m^2$)	Production Potential
American River	1706030506	South Fork	183.01	High
Meadow Creek	1706030502	South Fork	149.60	High
Red River	1706030507	South Fork	130.38	High
Crooked River	1706030508	South Fork	82.10	Moderate
Johns Creek	1706030510	South Fork	72.38	Moderate
Brushy Fk.	1706030307	Lochsa	70.46	Moderate
Newsome Creek	1706030505	South Fork	67.67	Moderate
Tenmile Creek	1706030509	South Fork	63.90	Moderate
Fish-Hungery Ck.	1706030302	Lochsa	51.73	Low
Bear (Papoose) Ck.	1706030304	Lochsa	45.34	Low
Walton Ck.	1706030308	Lochsa	42.06	Low
Warm Spring Ck.	1706030311	Lochsa	37.27	Low
Pete King Creek	1706030301	Lochsa	36.99	Low

1 Names assigned for identification purposes; indicates one (not all) named stream within each HUC.

Average biomass estimates for each 5th code HUC ranged from approximately 37 mg/site to 183 mg/site (Table 40). Analysis of variance indicated that significant differences in mean biomass existed between sampled HUCs ($p < 0.0001$). Hierarchical cluster analysis was subsequently used to define relative production classes for each sampled HUC, resulting in definition of three production classes: High (biomass >100mg), Moderate (biomass 60-85 mg), and Low (biomass <55mg; Figure 98). Identified breaks between classes correspond closely with those identified in a separate study by Burkantis (1998; High > 200 mg, Medium high 100-199mg, medium 50-99mg, and low < 50mg).

HUCs within the South Fork AU typically had higher benthic biomass than those in the Lochsa AU. All seven HUCs sampled within the South Fork AU were classified as having either "High" or "Moderate" productivity whereas 5 of 6 HUCs sampled within the Lochsa AU were classified as having "Low" productivity (Table 40).

Stepwise discriminant analysis was applied to develop a discriminant function which could be used to assign 5th code HUCs to the most likely relative production class. The discriminant function is essentially a predictive equation used to assign items (HUCs) to qualitative classes (H/M/L production potential) using quantitative data. Twenty-nine variables were assessed for their utility in discriminating relative production class. Variables assessed were generally landscape scale characteristics and included topography (4), elevation (5), geology (3), ownership (3), channel characteristics (4), watershed area (1), fish carrying capacity (2), canopy cover (4), and land disturbance (3). With the exception of fish carrying capacity (available only for anadromous production areas), variables were chosen based on consistent availability across the entire subbasin.

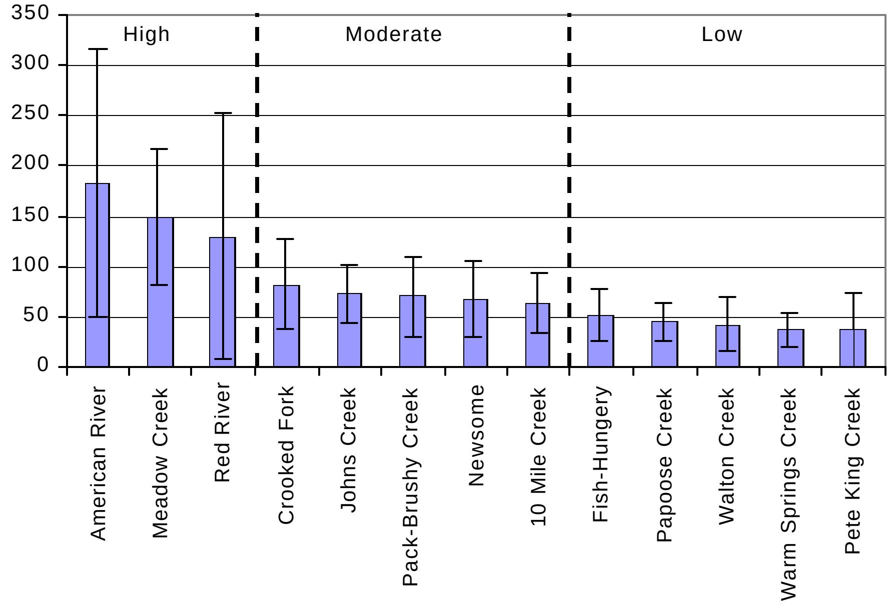

Figure 98. Mean biomass (mg/0.28m^2) $\pm$ one standard deviation sampled from each 5th code HUC. Sample size is 8 for all HUCs except Johns Creek (5) and Warm Springs Creek (7)

Results of the stepwise discriminant analysis indicated that benthic production of each 5th code HUC could best be predicted using two variables related to local topography (mean and standard deviation of land slope). The percent of channel length with gradient >20% was also selected during the stepwise process, but was removed from the model for statistical concerns (sample size vs. model complexity) and because it is largely a derivative of the other two variables.

Due to the small sample size, the ability of the discriminant function developed to accurately predict relative production classes was evaluated using cross-validation techniques. In summary, the method removes one sample from the set and calculates a discriminant function based on the remaining 12 samples. Factors used in this process are limited to those previously defined using the entire dataset (mean and standard deviation of land slope). The hold-out sample is then classified using the discriminant function developed from the other twelve samples. This process is repeated until each individual sample has been used as a hold-out and classified as having High, Moderate, or Low production potential.

Cross-validation suggests that the discriminant function developed during this process results in a relatively low degree of misclassification (Table 41). The overall error rate (misclassification) was 15.4%, and error rates for individual classification levels did not exceed 20%. All areas defined as having High production potential were properly classified using this technique. When misclassification did occur, the result tended to be overestimation of production potential (Low misclassified as Moderate, or Moderate misclassified as High).

Table 41. Classification matrix for potential production classes based on cross-validation techniques

		Into Potential Production Class				Error Rate
		High	Moderate	Low	Total	(%)
From Potential Production Class	High	3	0	0	3	0
	Moderate	1	4	0	5	20
	Low	0	1	4	5	20
	Total	4	5	4	13	15.4

Having determined that production potential of sampled HUCs could be predicted with a relatively high degree of accuracy, the discriminant function was then used to estimate the relative production potential of all 5th code HUCs within the Clearwater subbasin (Figure 99). It is crucial to note that landscape characteristics in the sampled HUCs did not constitute a representative sample of the range of conditions that exist throughout the Clearwater subbasin (Table 42). The level of confidence with which the developed discriminant function can be used to estimate production potential in dissimilar areas is unclear (e.g. developed in areas dominated by granitic and meta-sedimentary geology, the predictive function may or may not be applicable to areas dominated by volcanic geology).

Figure 99 also reflects the relative degree of confidence associated with the predicted production potential of each 5th code HUC. The degree of confidence was assigned subjectively based on how well landscape level characteristics in each HUC were represented by those from which actual sampling was conducted. A high degree of confidence was assigned if landscape attributes in the predicted HUC were reflective of those in sampled HUCs. A moderate degree of confidence typically signifies that one major landscape scale characteristic (listed in Table 42) differs from that of the sampled HUCs. A low degree of confidence was assigned to areas where multiple characteristics differ substantially from that of the sampled HUCs.

The confidence with which the model predicts production potential throughout the Clearwater subbasin is generally lowest in the Lower Clearwater and Lolo/Middle Fork AUs where landscape features differ dramatically from those in sampled areas. Modeling confidence is generally moderate to high throughout the Upper and Lower North Fork, Lochsa, Upper and Lower Selway, and South Fork AUs where landscape characteristics are most similar to sampled areas.

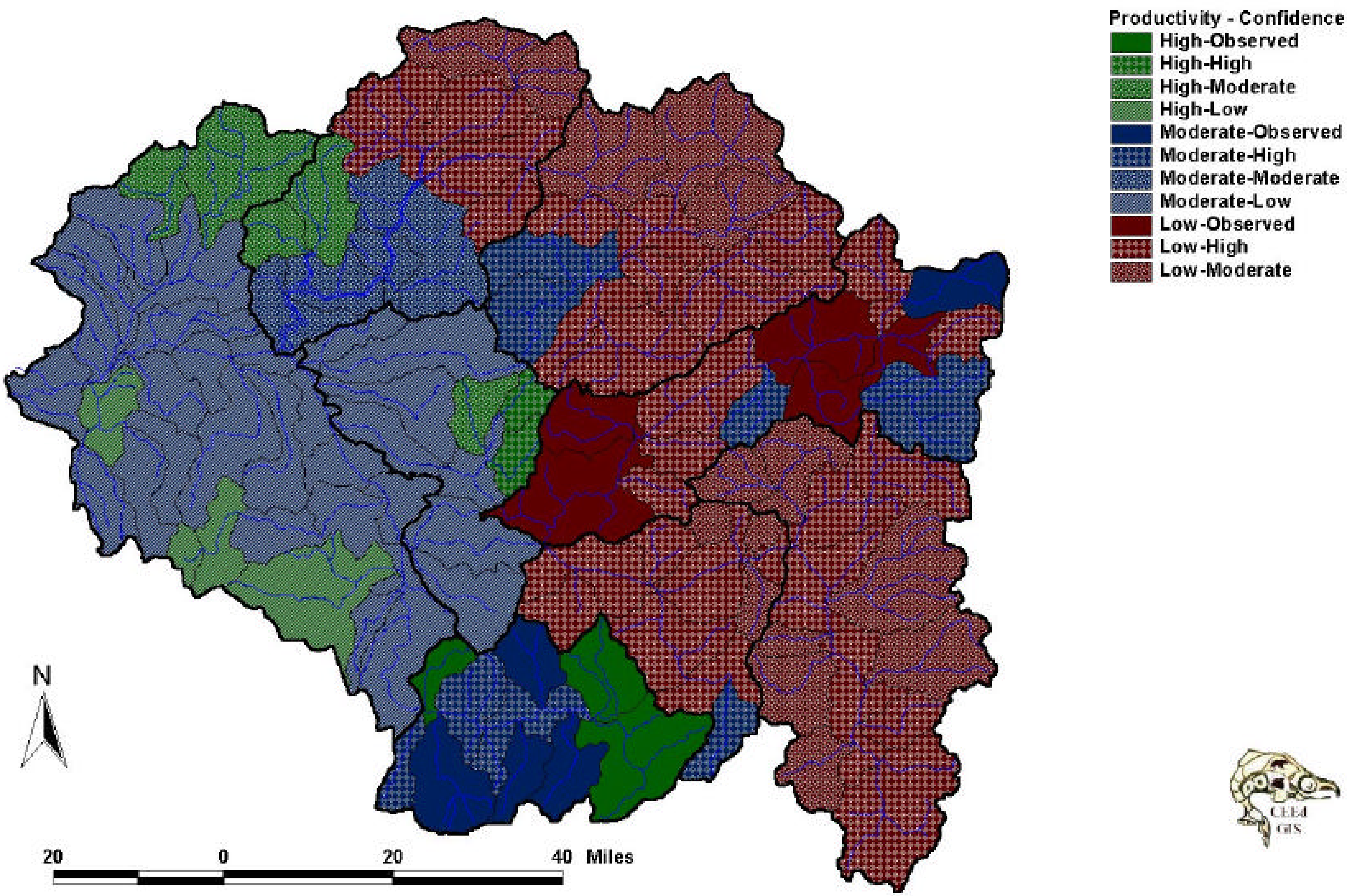

Figure 99. Predicted production potential and related degree of confidence for each 5th code HUC within the Clearwater subbasin

Table 42. Landscape scale characteristics of the Clearwater subbasin which may be useful to predict production potential. Characteristics representative of HUCs sampled during 2000 are presented in bold print.

Dominant Canopy Cover Class	Dominant Geology	Topography (Landforms)	Elevation Classes (m)	Dominant Ownership	Dominant Channel Gradient
< 15%	Quaternary	Foothills	500-750	Federal	Depositional (<4%)
15-39% [1]	Granitic	Plateau	750-1,000	State	**Transport (4-20%)**
40-69%	Volcanic	Breaks	**1,000-1,250**	Private Timber Co.	Source (>20%) [1]
>69%	**Meta-sedimentary**	Mountains	**1,250-1,500**	Other Private	
	Sedimentary [1]	Glaciated Mountains	**1,500-1,750**	Tribal [1]	
		Intermontane Basin	**1,750-2,000**		

1 Characteristic is not the dominant category in any 5th code HUC.

It is notable that results of this experimental model are consistent with the limited anecdotal information available about historic productivity of fish throughout the subbasin. The upper half of the South Fork Clearwater maintained a historically strong population of steelhead (Nez Perce National Forest 1998; Paradis et al. 1999b); the most substantial production of spring chinook salmon in the Lower Clearwater AU probably occurred in the Lolo and Potlatch Creek drainages (Clearwater National Forest 1997). Each of these drainages includes areas predicted to have high productivity during our modeling effort. Streams underlain by granitic geology (see Figure 6) are not typically expected to be highly productive for fish; these areas were most commonly predicted to have low productivity based on the experimental model results.

The overall theme represented by the factors selected during stepwise discriminant analysis can be summarized as topography. Experimental relaxation of the constraints used to develop the discriminant function suggested that two themes will dominate if sampling is expanded, topography and geology. However, due to the small sample size and limited distribution of samples used in this process, the actual utility of geology in predicting aquatic production potential at the landscape scale within the Clearwater subbasin remains unclear.

As subbasin planning proceeds, the need for additional, more comprehensive information regarding spatial variations in production potential should be considered. The primary intent of this analysis was to investigate the potential for using benthic macroinvertebrate biomass to differentiate spatial variations in production potential throughout the Clearwater subbasin. A small sample size (thirteen 5th code HUCs) certainly impacted the results of this analysis although results do suggest that both original hypotheses can be addressed using this approach. If additional information is required for subbasin planning process to proceed, an expanded systematic sampling approach should be developed to better represent the range of landscape conditions found throughout the subbasin. An expanded approach should lead to increased confidence associated with predictions of production potential, thereby enhancing the subbasin planning process.

8 Fishery Resources

8.1 Fish Status

Currently more than 30 species of fish inhabit the Clearwater subbasin, including 19 native species, two of which have been reintroduced (Table 43). Salmonids and cyprinids are most numerous, representing 10 and 6 species, respectively. Exotic species within the subbasin are generally introduced sport or forage species, and include primarily centrarchids, ictalurids, and salmonids.

Five fish species have been chosen as aquatic focal species in this assessment: chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss* subspecies), westslope cutthroat trout (*Oncorhynchus clarki lewisi*), bull trout (*Salvelinus confluentus*) and brook trout (*Salvelinus fontinalis*). Aquatic focal species may serve as indicators of larger communities, and are listed by federal and/or state agencies as species of concern or, in the case of brook trout, have the potential to negatively impact other selected species. In addition, aquatic focal species had adequate data available for species status, distribution, and habitat use to aid future decision making.

Information is also provided for additional species of interest for which only limited data exists, redband trout (*Oncorhynchus mykiss* subspecies), Pacific lamprey (*Lampetra tridentata*) and coho salmon (*Oncorhynchus kisutch*). Although species status is discussed, data limitations for these species prohibits substantial consideration of limiting factors and distribution or condition of existing habitat areas.

The resident fishery in Dworshak Reservoir is also considered a substantial fishery resource in the Clearwater subbasin. The Dworshak Reservoir fishery involves multiple species, and is addressed as a single fishery rather than as a large number of individual species.

Distribution and status information was compiled for the five aquatic focal species using 23 data sources. Sources included regional, state, and localized databases, recent agency publications and assessments, and personal interviews with regional biologists. For the purpose of starting with consistent and subbasin-wide distribution and status information for each species, GIS layers were obtained from the most recent (2000) updates to the ICBEMP database. The ICBEMP layers were then modified using data from the other 22 sources. In making revisions to the ICBEMP data layers, a list of rules was applied to ensure consistent consideration of sources (based on data age, etc.) and resolution of conflicting data sources (i.e. presence vs. absence).

8.1.1 Chinook Salmon

Two chinook salmon ESUs are recognized by the National Marine Fisheries Service under the Endangered Species Act, spring/summer and fall chinook salmon. For the purpose of this document, three life history forms of chinook salmon will be discussed; spring, fall, and early-fall chinook salmon. Early-fall chinook salmon are distinguished by the NPT (Hesse and Cramer 2000) as “fish that spawn principally in October, and would have a life history similar to that of summer chinook salmon in the mid-Columbia (October spawning and subyearling smolts), but not to the Snake River summer chinook salmon (late August-early September spawning and yearling smolts).” Early fall chinook are not recognized or described by other management agencies. The historical summary of life-history/run timing of summer chinook salmon in the Clearwater River subbasin is described in Richards (1967) and NPT and IDFG (1990).

Table 43. Fish species inhabiting the Clearwater subbasin

Species – Common Name	Scientific Name	Origin
Bridgelip Sucker	*Catostomus columbianus*	Native
Bull Trout	*Salvelinus confluentus*	Native
Chiselmouth	*Acrocheilus alutaceus*	Native
Largescale sucker	*Catostomus machrocheilus*	Native
Longnose Dace	*Rhinichthys cataractae*	Native
Mottled Sculpin	*Cottus bairdi*	Native
Mountain Whitefish	*Prosopium williamsoni*	Native
Northern pikeminnow	*Ptychocheilus oregonensis*	Native
Pacific Lamprey	*Lampetra tridentata*	Native
Paiute sculpin	*Cottus beldingi*	Native
Peamouth	*Mylocheilus caurinus*	Native
Redside shiner	*Richardsonius balteatus*	Native
Sandroller	*Percopsis transmontana*	Native
Shorthead sculpin	*Cottus confusus*	Native
Speckled Dace	*Rhinichthys osculus*	Native
Steelhead/Rainbow/Redband Trout	*Oncorhynchus mykiss*	Native/Exotic [1]
Torrent sculpin	*Cottus rhotheus*	Native
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi*	Native
Chinook Salmon (Fall)	*Oncorhynchus tshawytscha*	Native/Reintroduced
Chinook Salmon (Spring)	*Oncorhynchus tshawytscha*	Reintroduced
Coho Salmon	*Oncorhynchus kisutch*	Reintroduced
Arctic Grayling	*Thymallus arcticus*	Exotic
Black Bullhead	*Ictalurus melas*	Exotic
Black crappie	*Pomoxis nigromaculatus*	Exotic
Bluegill	*Lepomis macrochirus*	Exotic
Brook Trout	*Salvelinus fontinalis*	Exotic
Brown bullhead	*Ictalurus nebulosus*	Exotic
Carp	*Cyprinus carpio*	Exotic
Channel catfish	*Ictalurus natalis*	Exotic
Golden Trout	*Salmo aguabonita*	Exotic
Kokanee	*Oncorhynchus nerka*	Exotic
Largemouth bass	*Micropterus salmoides*	Exotic
Pumpkinseed	*Lepomis gibbosus*	Exotic
Smallmouth bass	*Micropterus dolomieu*	Exotic
Tiger Muskie	*Esox lucius x masquinongy*	Exotic
Yellow Perch	*Perca flavescens*	Exotic

1 Includes exotic resident rainbow trout

Indigenous chinook salmon in the Clearwater River subbasin were eliminated by Lewiston Dam (Schoen et al. 1999; USFWS 1999c; Murphy and Metsker 1962). However, naturalized populations of spring chinook salmon have been reestablished in some portions of the subbasin as a result of reintroduction efforts (Schoen et al. 1999; Larson and Mobrand 1992). Reintroduction efforts for fall chinook salmon were considered unsuccessful (Hoss 1970), and the existing fall chinook runs in the lower Clearwater subbasin may likely represent a combination of recent hatchery supplementation efforts and recolonization by Snake River stock(s). Fall chinook salmon upstream of Lower Granite Dam (including the Clearwater River) are considered part of a single genetically similar aggregate and represent one evolutionarily significant unit (Waples et al. 1991).

Historical status

Sources suggest that spring, summer (Simpson and Wallace 1982), and fall (Clearwater National Forest 1997; NPT and IDFG 1990; CBFWA 1991) chinook were likely present within the mainstem Clearwater River prior to 1900. The USFWS (1999) claim it is reasonable to assume that fall chinook spawning occurred within the lower Clearwater River prior to dam construction on the Snake River.

Historical numbers of chinook salmon entering the Clearwater River subbasin are assumed to be substantial, but no documentation on actual numbers is available (NPT and IDFG 1990). Chapman (1981) modeled “pristine production” of chinook salmon (race not clearly defined, presumably spring and fall) from the Clearwater subbasin, estimating that 1.8 million smolts were produced resulting in 94,169 adults returning to the mouth of the Columbia River annually. Of those fish, 63,617 originated from tributaries and 30,552 were from the mainstem[3]. The majority of historical chinook salmon (again, race not clearly defined, presumably spring and fall) production was thought to occur in major tributary systems of the Clearwater River (North, South, and Middle Forks), with less than 10% of total production in the mainstem reach (Clearwater National Forest 1997). Within the mainstem portion of the Clearwater River, the most substantial production of spring chinook salmon probably occurred in the Lolo and Potlatch Creek drainages (Clearwater National Forest 1997; Clearwater subbasin Bull Trout Technical Advisory Team 1998b).

Spring Chinook Salmon

Spring chinook salmon within the Clearwater subbasin are excluded from the ESU encompassing other spring/summer stocks throughout the Snake River basin, but represent an important effort aimed at restoring an indigenous fish population to an area from which they had been extirpated. Efforts to reestablish spring chinook salmon in the subbasin were extensive and have previously been summarized by NPT and IDFG (1990), Cramer and Neeley (1992), and Cramer (1995), and Bowles and Leitzinger (1991). Currently, hatchery spring chinook are released for harvest mitigation and to supplement natural production (NPT and IDFG 1990; IDFG 2001c)

Reintroduction of spring chinook salmon following removal of the Lewiston Dam has resulted in naturally reproducing runs in Lolo Creek and mainstem/tributary reaches of the Lochsa, Selway, and South Fork Clearwater Rivers (Larson and Mobrand 1992). Founding

[3] Calculation error(s) were made in estimating production from South Fork tributaries in the original publication (D. Chapman, Chapman Consultants, personal communication, August 2, 2001). Appropriate corrections have been made, and numbers presented here are therefore derived from, but do not directly reflect those presented in the published report

hatchery stocks used for spring chinook salmon reintroductions were primarily obtained from the Rapid River Hatchery (Kiefer et al. 1992; NPT and IDFG 1990). Initially however, spring chinook stocks imported for restoration came from Carson, Big White, Little White or other spring chinook captured at Bonneville Dam (NPT and IDFG 1990). Genetic analyses confirm that existing natural spring chinook salmon in the Clearwater River subbasin are derived from reintroduced Snake River stocks (Matthews and Waples 1991).

Spring chinook salmon enter the Columbia River and begin spawning migrations during April and May, reaching the Clearwater subbasin from April through July (NPT and IDFG 1990). Spring chinook salmon indigenous to the Snake River basin tend to spawn earlier and higher in elevation than summer (early-fall) and fall races (Chapman et al. 1991). Spawning of spring stocks typically occurs in tributaries and headwater streams in August and September. Eggs hatch in December with emergence completed by April (NPT and IDFG 1990; USFWS 1999c). Spring chinook salmon remain in freshwater for one year, migrating to the ocean in the spring of their second year, typically from March through June (USFWS 1999c; Walters et al. 2001). Nearly all adult spring and summer chinook that return to the Snake River basin result from fish that smolted as yearlings in April-May (Matthews and Waples 1991).

Although spring chinook salmon smolt as yearlings, in-basin migrations as fry or parr are not uncommon. Fry dispersal was well documented in the Selway River during studies of chinook salmon reintroductions (Cramer 1995). A second downstream migration of spring chinook salmon in the upper portion of the rearing areas again occurs in the fall as juveniles seek suitable winter habitat (Hesse et al. 1995; Walters et al. 2001).

Little is known about the distribution of Snake River spring chinook salmon in the ocean, because few are ever caught in ocean fisheries. Analyses of Coded-Wire Tag (CWT) recoveries from Snake River spring chinook salmon during the intensive ocean fisheries of the 1980s indicated that harvest rate of these fish in the ocean was less than 1% (Berkson 1991).

Distribution of spring chinook salmon to the North Fork Clearwater River is blocked by Dworshak Dam, and with the exception of the mainstem migration corridor, they are absent from the Lower Clearwater AU (Figure 100). The current distribution of spring chinook salmon within the Clearwater subbasin includes the Lolo Creek drainage and all major drainages above the confluence of the Middle and South Forks of the Clearwater River. Relatively contiguous distributions of spring/summer chinook salmon exist in the Lolo/Middle Fork, South Fork, and Upper and Lower Selway AUs. Spring/summer chinook salmon are absent from many tributaries in the Lochsa River drainage, but found in Pete King and Fish Creeks, and most tributaries above (and including) Warm Springs Creek.

Spring chinook salmon are classified as “present – depressed” in all areas of the Clearwater subbasin where status information is available (Figure 100). Aerial surveys of spring chinook salmon redds in the Clearwater subbasin have been conducted since 1966. Data has been collected from established reaches on an annual basis in both natural production areas as well as areas where production is regularly influenced by hatchery releases of chinook salmon. Table 44 illustrates trends in chinook salmon redds counted by aerial surveys (summarized by AU) since 1966. Additional redd count information is also presented for spring chinook salmon in Nez Perce Tribal Hatchery Monitoring and Evaluation streams and for Idaho Supplementation Studies streams (Table 45).

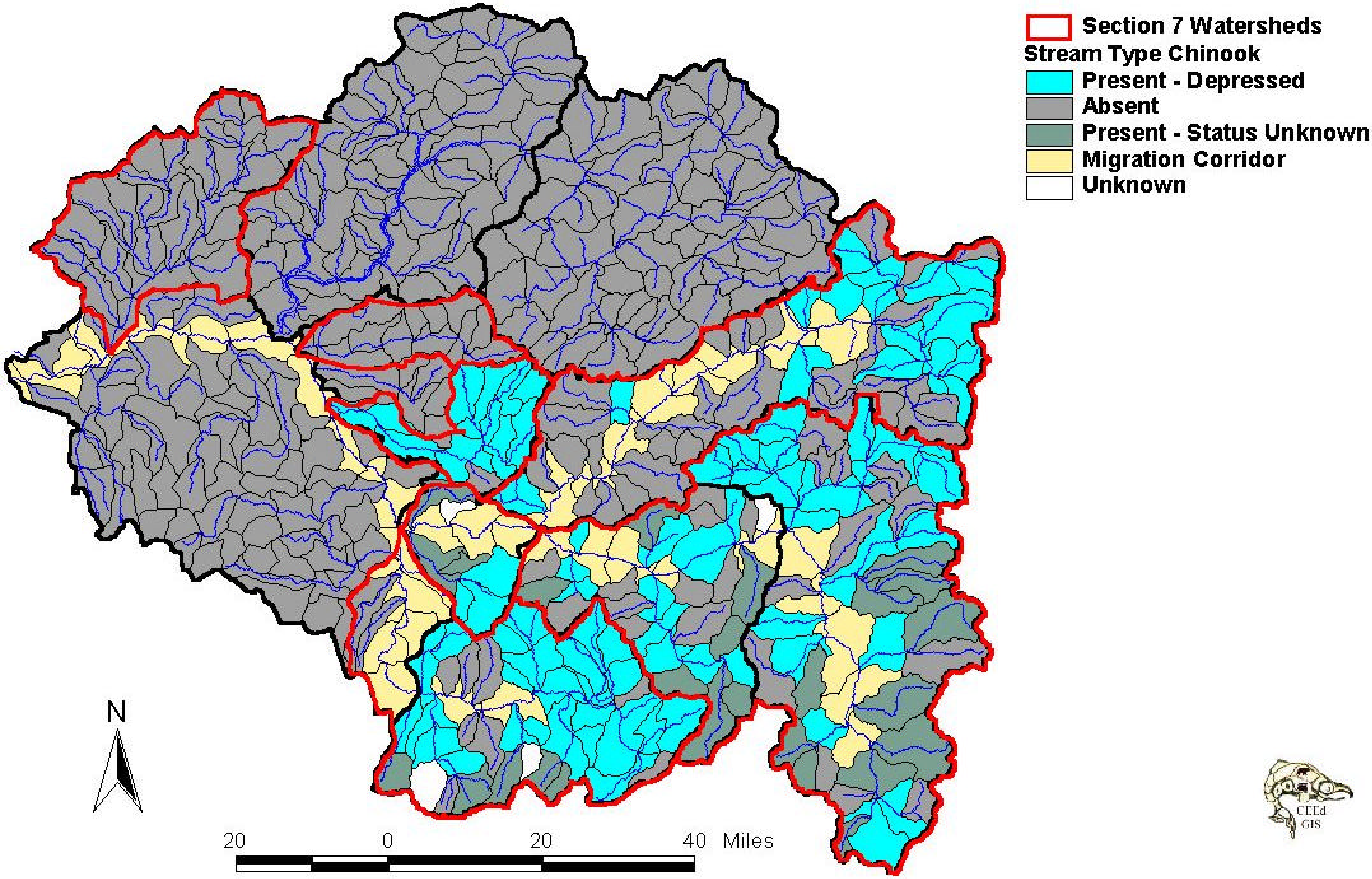

Figure 100. Known distribution and relative status of spring chinook salmon in the Clearwater subbasin. Red lines delineate consultation watersheds defined under Section 7 of the ESA

Table 44. Clearwater River subbasin spring chinook salmon traditional trend aerial redd counts, 1966-2000

Year	South Fork Clearwater [1]	Lochsa River [2]	Selway River [3]		Clearwater subbasin Index Areas Combined
1966	---	---	44		44
1967	---	0	29		29
1968	---	15	27		42
1969	---	112	84		196
1970	---	34	98		132
1971	---	1	77		78
1972	---	63	232		295
1973	---	60	347		407
1974	17	28	97		142
1975	59	35	31		125
1976	33	62	94		189
1977	88	66	141		295
1978	77	62	161		300
1979	27	18	30		75
1980	46	26	55		127
1981	75	52	65		192
1982	112	51	54		217
1983	113	13	44		170
1984	87	37	49		173
1985	130	61	15		206
1986	109	41	56		206
1987	143	36	63		242
1988	110	51	62		223
1989	53	17	22		92
1990	78	20	35		133
1991	6	15	23		44
1992	98	41	29		168
1993	209	77	61		347
1994	17	11	19		47
1995	6	10	9		25
1996	44	37	11		92
1997	242	75	18[4]		335
1998	64	21	34		119
1999	5	1	12		18
2000	154	35	84[5]		273

1 South Fork Clearwater counts in Red, American, Crooked Rivers and Newsome Creek; Newsome Ck had 280 excess adult outplants during 1997 and 362adults, 125 jacks excess adult outplants during 2000.
2 Lochsa River counts in Brushy Fork and Crooked Fork Cks; 100 excess adult outplants White Sands Ck in 2000.
3 Selway River counts in Bear, Moose, White Cap, Running creeks and mainstem between Bear Creek and Thompson Flat
4 Excess Rapid River stock adult chinook (514) outplanted in Selway River Magruder Corridor, 1997. Count taken before outplant.
5 Excess Dworshakstock adult chinook (872) outplanted in Selway River Magruder Corridor, 2000.

Table 45. Summary of spring chinook salmon redds counted and redds per kilometer for Idaho Supplementation Studies (ISS) and Nez Perce Tribal Hatchery (NPTH) streams 1991-2000

AU Stream Name	Year	Stream Length Sampled (km)	Redds Counted	Number of Redds per kilometer	Program
Lolo/Middle Fork AU					
Clear Cr	2000	20.2	30	1.5	ISS
	1999	16.1	0	0	ISS
	1998	18.5	2	0.11	ISS
	1997	18.5	17	0.92	ISS
	1996	16.1	3	0.19	ISS
	1995	16.1	0	0.00	ISS
	1994	16.1	1	0.06	ISS
	1993	16.1	7	0.43	ISS
	1992	16.1	1	0.06	ISS
Eldorado Cr[1]	2000	3.5	0	0.00	NPTH
	1999	3.5	0	0.00	NPTH
	1998	3.5	0	0.00	NPTH
	1997	3.5	0	0.00	NPTH
	1996	3.5	0	0.00	NPTH
	1995	3.5	0	0.00	NPTH
	1994	3.5	0	0.00	NPTH
	1993	3.5	2	0.57	NPTH
	1992	3.5	0	0.00	NPTH
Eldorado Cr[3]	2000		1		NPTH
	1999	2.0	0	0.00	NPTH
	1998	13.3	0	0.00	NPTH
	1997	1.3	0	0.00	NPTH
Lolo Cr[1]	2000	18.3	98[g]	5.36	NPTH
	1999	18.3	9	0.49	NPTH
	1998	18.3	26	1.42	NPTH
	1997	18.3	110[b]	6.01	NPTH
	1996	16.7	21	1.26	NPTH
	1995	16.7	6	0.36	NPTH
	1994	16.7	7	0.42	NPTH
	1993	16.7	23	1.38	NPTH
	1992	16.7	19	1.14	NPTH
Lolo Cr[3]	2000		10		NPTH
	1999	41.5	1	0.02	NPTH
	1998	3.2	0	0.00	NPTH
	1997	23.5	29	1.23	NPTH
	1996	41.5	0	0.00	NPTH
Musselshell Cr[3]	2000		0	0.00	NPTH
	1999	8.8	0	0.00	NPTH
	1998	8.8	0	0.00	NPTH
	1997	8.8	1	0.11	NPTH
	1996	8.8	1	0.11	NPTH

Table 45 (Continued)

AU Stream Name	Year	Stream Length Sampled (km)	Redds Counted	Number of Redds per kilometer	Program
Lolo/Middle Fork AU (continued)					
Yoosa Cr[1]	2000	4.4	2	0.45	NPTH
	1999	4.4	0	0.00	NPTH
	1998	4.4	5	1.14	NPTH
	1997	4.4	0	0.00	NPTH
	1996	4.4	0	0.00	NPTH
	1995	4.4	0	0.00	NPTH
	1994	4.4	0	0.00	NPTH
	1993	4.4	1	0.23	NPTH
	1992	4.4	0	0.00	NPTH
Lochsa AU					
Bear (Papoose) Cr	1996	3	7	2.33	ISS
	1995	3	1	0.33	ISS
	1994	3	0	0.00	ISS
	1993	3	15	5.00	ISS
	1992	3	10	3.33	ISS
Big Flat Cr	2000	4.8	0	0	ISS
	1999	NC	NC	NC	ISS
	1998	NC	NC	NC	ISS
	1997	4.8	7	1.46	ISS
	1996	1.5	0	0.00	ISS
	1995	5.8	0	0.00	ISS
	1994	NC	NC	NC	ISS
	1993	6	3	0.50	ISS
	1992	8	8	1.00	ISS
Brushy Fork Cr	2000	12.6	16	1.27	ISS
	1999	12.6	3	0.24	ISS
	1998	12.6	19	1.51	ISS
	1997	20.7	75	3.62	ISS
	1996	21.5	5	0.23	ISS
	1995	14	5	0.36	ISS
	1994	21.5	0	0	ISS
	1993	18.1	25	1.38	ISS
	1992	14	7	0.50	ISS
Colt Killed Cr	2000	50.2	2	0.04	ISS
	1999	40.6	0	0	ISS
	1998	40.6	0	0.03	ISS
	1997	35.7	22	0.6	ISS
	1996	6.8	0	0.00	ISS
	1995	2.6	0	0.00	ISS
	1994	NC	NC	NC	ISS
	1993	7	2	0.29	ISS
	1992	11.5	3	0.26	ISS

Table 45 (Continued)

AU Stream Name	Year	Stream Length Sampled (km)	Redds Counted	Number of Redds per kilometer	Program
Lochsa AU (continued)					
Crooked Fork Cr	2000	18	100	5.56	ISS
	1999	18	8	0.44	ISS
	1998	19	17	0.94	ISS
	1997	19	118	6.2	ISS
	1996	21.5	76	3.53	ISS
	1995	19	4	0.21	ISS
	1994	21.5	0	0	ISS
	1993	28	10	0.36	ISS
	1992	29.5	11	0.37	ISS
Fishing (Squaw) Cr	1996	6	1	0.17	ISS
	1995	6	0	0.00	ISS
	1994	6	0	0.00	ISS
	1993	6	0	0.00	ISS
	1992	6	1	0.17	ISS
Pete King Cr	2000	8.0	2	0.3	ISS
	1999	8.0	0	0	ISS
	1998	8.0	0	0	ISS
	1997	8.0	4	0.13	ISS
	1996	8.0	0	0.00	ISS
	1995	8.0	0	0.00	ISS
	1994	8.0	0	0.00	ISS
	1993	8.0	0	0.00	ISS
	1992	8.0	0	0.00	ISS
Lower Selway AU					
Meadow Cr[2]	2000	68.0	18[h]	0.26	NPTH
	1999	68.0	3	0.04	NPTH
	1998	68.0	5	0.07	NPTH
	1997	68.0	146[c]	2.15	NPTH
	1996	68.0	0	0.00	NPTH
	1995	68.0	0	0.00	NPTH
	1994	68.0	3	0.04	NPTH
Upper Selway AU					
White Cap Cr	2000	19.8	8	0.40	ISS
	1999	12.9	0	0	ISS
	1998	19.8	4	0.20	ISS
	1997	19.8	0	0	ISS
	1996	19.8	3	0.15	ISS
	1995	19.8	0	0	ISS
	1994	19.8	2	0.10	ISS
	1993	19.8	6	0.30	ISS
	1992	19.9	2	0.10	ISS

Table 45 (Continued)

AU Stream Name	Year	Stream Length Sampled (km)	Redds Counted	Number of Redds per kilometer	Program
South Fork AU					
American River	2000	34.6	129	3.72	ISS
	1999	34.6	1	0.03	ISS
	1998	34.6	112	3.23	ISS
	1997	34.6	311	8.99	ISS
	1996	34.6	9	0.26	ISS
	1995	34.6	0	0	ISS
	1994	34.6	9	0.26	ISS
	1993	34.6	209	6.04	ISS
	1992	33.3	5	0.15	ISS
Crooked River	2000	21.9	93	4.25	ISS
	1999	21.9	1	0.05	ISS
	1998	21.9	30	1.43	ISS
	1997	21.9	62	2.96	ISS
	1996	21.9	6	0.18	ISS
	1995	21.9	0	0	ISS
	1994	21.9	4	0.18	ISS
	1993	21.9	54	2.47	ISS
	1992	21.9	54	2.47	ISS
	1991	21.9	4	0.18	ISS
Newsome Cr	2000	15.1	46[i]	3.05	NPTH
	1999	15.1	0	0	NPTH
	1998	15.1	32	2.12	NPTH
	1997	15.1	67[d]	4.44	NPTH
	1996	15.1	4	0.26	ISS
	1995	15.1	0	0	ISS
	1994	15.1	0	0	ISS
	1993	15.1	55[e]	3.64	ISS
	1992	15.1	2	0.13	ISS
Red River	2000	40.1	235	5.86	ISS
	1999	39.6	14	0.35	ISS
	1998	44.2	93	2.10	ISS
	1997	44.2	344	7.78	ISS
	1996	34.1	41	1.20	ISS
	1995	43.0	17	0.40	ISS
	1994	43.0	23	0.53	ISS
	1993	38.5	69	1.79	ISS
	1992	43.0	44	1.02	ISS
	1991	23.6	6	0.25	ISS

1 includes index reaches surveyed by ground counts
2 includes index reaches surveyed by ground and aerial counts
3 includes expanded reaches surveyed by ground and/or aerial counts
b 474 adults were outplanted from Dworshak National Fish Hatchery
c 601 adults were outplanted from Rapid River Fish Hatchery
d 280 adults were outplanted from Rapid River Fish Hatchery
e 250 adults were outplanted from Rapid River Fish Hatchery
f 300 adults were outplanted from Rapid River Hatchery
g 531 adults were outplanted from Dworshak National Fish Hatchery
h 399 adults were outplanted from Clearwater Hatchery and Dworshak National Fish Hatchery
i 500 adults were outplanted from Clearwater and Rapid River hatcheries

Spring chinook salmon carrying capacity was estimated for each subwatershed in which spawning and rearing is known to occur (Figure 101). Estimates are based on data downloaded from the Streamnet website (Pacific States Marine Fisheries Commission 2001) which was originally produced using the smolt density model developed in 1989 as part of the Northwest Power Planning Council Presence/Absence database. Detailed overview of methods used to estimate smolt carrying capacity are presented in NPPC (1989). In short, the smolt density model estimates potential smolt capacity accounting for both the amount of available habitat and the relative quality of that habitat within a given stream reach.

Based on NPPC data, spring chinook carrying capacity estimates for individual subwatersheds are variable throughout all AUs with little discernable pattern with regard to high or low production areas. Estimates ranged from 205 to 147,015 smolts per subwatershed (Figure 101). The highest estimates by AU were associated with the Upper Selway (approximately 1.2 million) and Lochsa AUs (approximately 900,000; Table 46). The lowest spring chinook smolt carrying capacity estimates at the AU scale are associated with the Lower Clearwater and Lower North Fork AUs where available habitat is most limited (Table 46). Only two miles of the North Fork Clearwater River are accessible below Dworshak dam, and use of the lower Clearwater AU by chinook is limited to mainstem reaches. Based on NPPC data, the estimated carrying capacity for spring chinook salmon in the entire Clearwater subbasin is 3,491,240 smolts.

Chapman (1981) used a different approach to estimate production (not carrying capacity) of chinook salmon smolts from the Clearwater subbasin under pristine conditions. Chapman (1981) estimated potential smolt production based solely on the amount of available habitat and, since he was considering pristine production, included potential production from areas no longer utilized by chinook salmon (including the North Fork Clearwater and Potlatch River drainages). Chinook salmon smolt production from the Clearwater subbasin was estimated by Chapman (1981) to be 1,817,625[3]. Chapman's data suggests that tributary systems in the Lower Clearwater and Upper and Lower North Fork AUs were historically substantial producers of chinook salmon, accounting for roughly 65 percent of chinook salmon smolt production from the Clearwater subbasin tributaries (excluding mainstem production).

Table 46. Estimated spawning/rearing area, total carrying capacity (smolt) and average percent of carrying capacity (parr) realized between 1985 and 1997 for spring chinook salmon within each Clearwater subbasin AU

Assessment Unit	Usable Area [1] (stream miles)	Estimated Capacity (# smolts)	Avg. percent realized [2] (85-97) (IDFG 1999a)
Lower Clearwater	78.7	62,296	0
Lower North Fork	2.0	7,628	Unknown
Upper North Fork	Not Accessible	--	--
Lolo/Middle Fork	154.5	311,794	14
Lochsa	278.9	919,444	6
Lower Selway	146.1	408,892	3
Upper Selway	301.8	1,217,129	1
South Fork	291.8	564,057	23
Subbasin Total	1,253.6	3,491,240	14

1 Excludes reaches used only for migration purposes.

2 Derived from Parr Monitoring Database and presented for comparative purposes. No direct link has been established between parr and smolt production.

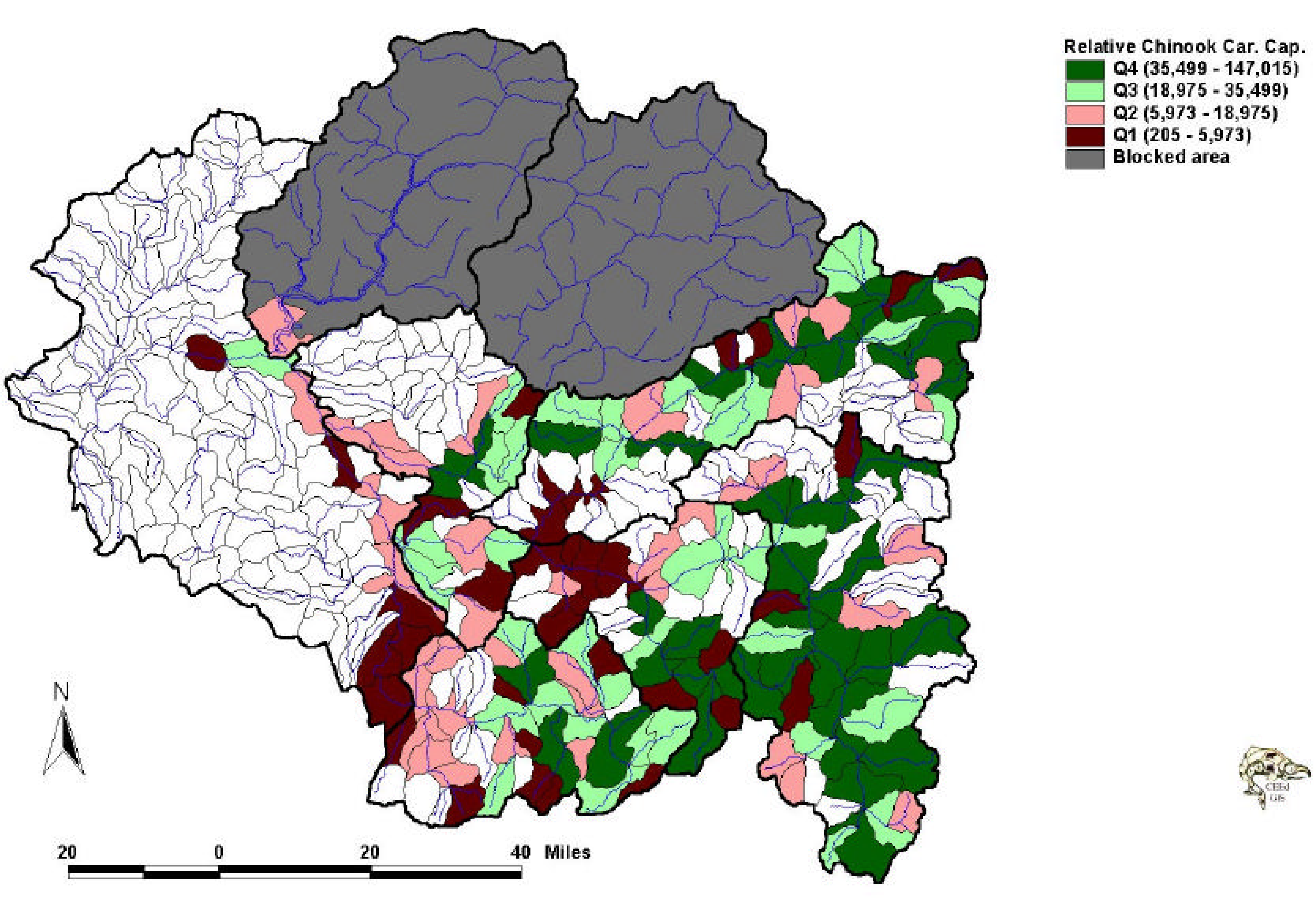

Figure 101. Estimated carrying capacity of spring chinook smolts based on usable area and habitat quality within each subwatershed. Estimates are grouped into quartiles (Q1-Q4), with an equal number of subwatersheds in each

Direct comparison of Chapman's (1981) production estimates with the NPPC carrying capacity estimates (i.e. comparison of historic vs. current condition) is not appropriate. The two databases were developed to represent different spatial and temporal areas, the methods used vary substantially, as does the general intent of each (production vs. carrying capacity).

Fall Chinook Salmon

Natural recolonized and reintroduced fall chinook salmon within the Clearwater subbasin are part of the Snake River evolutionarily significant unit (ESU) as defined by the ESA. As such, fall chinook salmon within the Clearwater subbasin represent an important metapopulation within the Snake River ESU. Maintenance and function of fall chinook salmon metapopulation dynamics within the Clearwater subbasin itself will play an important role in recovery of the Snake River ESU.

Fall chinook salmon reintroduction efforts in the Clearwater subbasin began in 1960. A total of 6,733,000 fall chinook were reintroduced by the IDFG into the upper Clearwater subbasin from 1960-1967, mainly through eyed-egg plants in artificial spawning channels along the Selway River near the Fenn Ranger Station (Richards 1968). Counts of fall chinook at the Lewiston Dam increased from three in 1962 to a high of 122 in 1966, and back down to 90 in 1969. Due to insignificant returns of fall chinook, the original reintroduction program was terminated in 1968 (Hoss 1970).

Fall chinook salmon begin spawning migrations during August or September and reach the Clearwater subbasin from September through December. Spawning of fall chinook salmon in the Clearwater River subbasin occurs principally in the mainstem below the confluence with the North Fork Clearwater River (Arnsberg and Connor 1992; Garcia et al. 1999). However, spawning adults have been observed throughout the mainstem Clearwater River, and in the lower portions of the mainstem South Fork Clearwater River (Figure 102). Emergence of fall chinook salmon typically occurs in early April and May in the Clearwater River (Arnsberg and Statler 1995). Fall chinook salmon outmigration typically occurs from the Clearwater subbasin from June through August (USFWS 1999c).

Aerial fall chinook redd surveys of the mainstem Clearwater have occurred annually since 1988 (Arnsberg and Connor 1992; Arnsberg and Statler 1995). Over the course of the study, both the timing and number of redds constructed has changed. Redd observations, which initially were most frequent during the month of November, have become increasingly more common during October, and have been even noted as early as October 5 (Garcia et al. 1999). Similarly, the number of redds observed have recently increased from a range of 4-36 during 1988-1995, to 78 in 1998 and 184 in 1999 (Table 47). Fall chinook redds decreased slightly in the subbasin to 172 in 2000, with eight redds observed in the mainstem above the North Fork Clearwater confluence and one redd found in the South Fork Clearwater River. This was the highest number of redds observed in the Clearwater River subbasin above the North Fork than in all previous years combined since 1988. Hatchery fish released in the Clearwater River first returned as adults in 1999, with 43% of carcasses in 1999, and 60% of carcasses in 2000 determined to be hatchery fish (Bill Arnsberg, Nez Perce Tribal Fisheries, personal communication). Nearly all carcasses collected in 2000 were found in a spent state, therefore, it appears that supplementation fish are contributing to natural reproduction (Bill Arnsberg, Nez Perce Tribal Fisheries, personal communication, April 20, 2001).

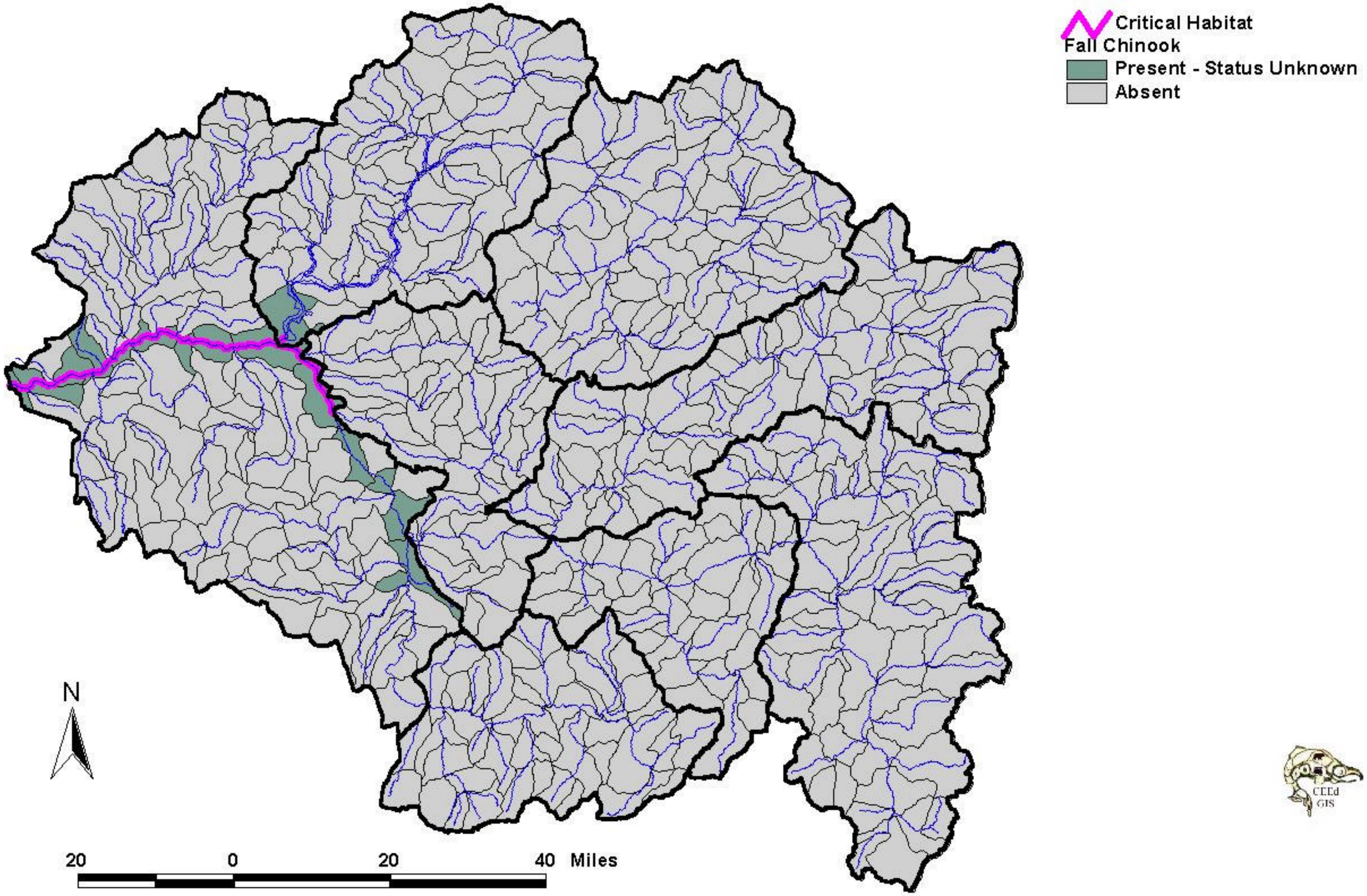

Figure 102. Known distribution of spawning habitat utilized by fall chinook salmon in the Clearwater subbasin. Heavy pink line indicates designated critical habitat for fall chinook salmon

Table 47. Number of fall chinook salmon redds observed by aerial surveys in the Clearwater River Subbasin, 1988-2000

Year	Clearwater (Rm 0-41)	Clearwater (Rm 41-74)	N.F. Clearwater	S.F. Clearwater
1988	21	--	--	--
1989	10	--	--	--
1990	4	--	--	--
1991	4	--	--	--
1992	25	1	0	0
1993	36	0	0	0
1994	30	0	7	0
1995	20 [1]	0	0	0
1996	66	0	2	1
1997	58	0	14	0
1998	78	0	0	0
1999	179	2	1	2
2000	163	8	0	1

1 A flood event during peak spawning prevented an accurate redd count in the Clearwater subbasin for 1995.

No status designations were found regarding fall chinook salmon in the Clearwater subbasin. However, between 1988 and 1997 fall chinook redds counted in the Clearwater River accounted for 25% of all fall chinook redds observed above Lower Granite Dam (Garcia 1998, cited in USFWS 1999c). The proportion of fall chinook redds above Lower Granite Dam observed in the Clearwater River has increased since 1993 (USFWS 1999c).

Arnsberg and Connor (1992) used the Instream Flow Incremental Methodology (IFIM) to quantify the amount of fall chinook spawning habitat available in the lower Clearwater River. Based on habitat suitability criteria alone, 95,000 redds was given as an estimated capacity. This was thought to be a liberal estimate, since IFIM tends to overestimate spawning habitat in large rivers (Shrivell 1990) and other hydraulic and biological factors that may influence spawning selection were not measured (Arnsberg and Connor 1992). However, spawning habitat is not a limiting factor for fall chinook recovery in the lower Clearwater based on the vast amount of suitable habitat measured and the number of redds documented within and around these measured sites since redd counts began in 1988 (Bill Arnsberg, Nez Perce Tribal Fisheries, personal communication, April 20, 2001).

As a consequence of cold winter water temperatures, the early life history timing of fall chinook salmon in the Clearwater River occurs on the latest schedule of all present-day Snake River stocks. Many young Clearwater River fall chinook salmon do not reach smolt size or migrate seaward during the first year of life because growth is out of synchronization with environmental cues such as photoperiod (Connor et al. 2001). In some years, releasing cool water from Dworshak Reservoir for summer flow augmentation could cause juvenile fall chinook salmon to hold over an extra year in freshwater by markedly reducing water temperatures and disrupting water temperature cues that prompt outmigration (Connor et al. 2001).

Early-Fall Chinook Salmon

The Nez Perce Tribe uses the term 'early-fall chinook salmon' to refer to fish that spawn principally in October, and would have a life history similar to that of "summer" chinook salmon in the mid-Columbia (October spawning and subyearling smolts), but not to the Snake River summer chinook salmon (late August-early September spawning and yearling smolts). Temperature data indicate that late September and early-October would be the most favorable spawning times in much of the Clearwater River subbasin, whereas spawning before or after that time might lead to high egg mortality from thermal stress in many years (Arnsberg and Statler 1995; Cramer 1995). Hatchery records in the Grande Ronde subbasin in the early 1900s indicate that spawning of chinook salmon extended from early September all of the way through October (Van Dusen 1903 and 1905). Evermann (1896) presented data on catches and spawning of chinook salmon in the Snake River indicating that peak spawning occurred during mid-October in 1894.

No known populations of early-fall chinook salmon remain in the Snake River basin that spawn through October, but temperature data indicate that late September and early October would be the favorable spawning times in the lower Selway, Lochsa, South Fork Clearwater, and mainstem Clearwater (above the North Fork confluence) rivers (Arnsberg and Statler 1995). Because of Dworshak Reservoir on the North Fork of the Clearwater River, temperature of the mainstem Clearwater River below the North Fork is 2-5^{0}C cooler during July-September and 1-2^{0}C warmer during November through March than the mainstem above the North Fork (Arnsberg and Connor 1992), and is therefore the only section of river in the Clearwater River subbasin suited to November spawning chinook salmon (Cramer 1995). Cramer (1995) presented evidence that spawning of chinook salmon, in order to coincide with thermal optimums for egg survival, must occur sufficiently early in the fall for eggs to develop to eyeing before water temperatures drop below 4-5^{0}C, but sufficiently late in the year that water temperatures have dropped below the upper tolerance limits of freshly spawned eggs (approximately 14^{0}C). These temperature conditions would be met by spawning that occurs between late September through mid-October for most streams of the subbasin at elevations below 770 m (2,500 ft). Although the October spawning segment of the run has been nearly eliminated, the genetic potential to reproduce it may still be contained in the genome, and could be re-expressed through natural selection or selective breeding with Snake River stock.

The juvenile life history of chinook salmon that spawned in October was not documented, and can only be deduced. Cramer (1995) concluded that the race of October-spawning chinook salmon would likely have smolted as subyearlings, because high stream temperatures at the elevation they were adapted to would have promoted rapid growth in the spring, but stressful rearing conditions during the summer. October spawning chinook salmon in the mid-Columbia smolt primarily as subyearlings. Most likely, early-spawning fall chinook salmon to be developed in the Clearwater River from the Lyons Ferry stock will be predominantly subyearling migrants. Additionally, their migration patterns in the ocean and vulnerability to ocean fisheries are also likely to parallel those of Lyons Ferry fall chinook salmon.

Since the historical presence of early fall chinook salmon in the Clearwater subbasin is inferred, no status designations or carrying capacity estimates have been made. However, on-going research by the Nez Perce Tribe could be used to estimate carrying capacity. It is anticipated that when the research is concluded, fisheries managers will be able to more accurately define the potential for the self-propogation of the stock and the potential for a sustainable fish harvest.

Two satellite facilities of the Nez Perce Tribal Hatchery on the lower South Fork Clearwater River and the lower Selway River (near Fenn Ranger Station) will initiate the restoration of early-fall chinook salmon to the Clearwater subbasin. The stock will be developed by selecting early spawners from Snake River fall chinook broodstock at Lyons Ferry Hatchery and capture of fish spawning in the Clearwater River (Ed Larson, NPT, personal communication, May 11, 2001).

8.1.2 Steelhead Trout

Summer run steelhead trout in the Clearwater subbasin are listed as threatened under the ESA. Both A-run and B-run steelhead trout exist in the Clearwater subbasin and are included in the Snake River ESU of steelhead trout (Busby et al. 1996). A-run steelhead occupy the lower Clearwater, including the Middle Fork Clearwater and Lower South Fork Clearwater rivers and tributaries (Kiefer et al. 1992). B-run steelhead occupy the Lochsa, Selway, and upper South Fork Clearwater rivers, and were extirpated by Dworshak Dam on the North Fork Clearwater River (Kiefer et al. 1992). B-run steelhead have been documented from only two subbasins in the Columbia River system, the Clearwater and Salmon (NPT and IDFG 1990). A-run steelhead trout from the Clearwater subbasin have typically spent one year in saltwater environments; B-run steelhead trout spend 1-3 years in saltwater environments before returning to spawn, with over 90 percent having spent two years (W. Miller, USFWS, personal communication, March 5, 2001). Due to differing lengths of ocean residence, differentiation of the two forms of Clearwater steelhead trout can be based on size, with B-run fish averaging 75-100 mm larger than A-run fish (CBFWA 1991). In addition, B-run steelhead enter the Columbia River later in the year than A run and benefit from the extra ocean time to rear, resulting in a 2 ocean A-run fish being smaller than a 2 ocean B-run fish (W. Miller, USFWS, personal communication, April 20, 2001).

Historical Status

Mallett (1974) estimated that 55% of all Columbia River steelhead trout historically originated from the Snake River basin, of which Clearwater steelhead made up a substantial component. Over 43,000 steelhead were counted at Lewiston Dam near the mouth of the Clearwater River during the 1962-63 run year (Miller 1987) and historic runs may have ranged as high as 40,000 - 60,000 steelhead annually (W. Miller, USFWS, personal communication, March 5, 2001). Wild steelhead trout historically occupied all major drainages and a majority of the tributaries within the Clearwater subbasin. However, no documentation of historic distributions specific to the Lochsa or Selway River systems could be located.

The upper half of the South Fork Clearwater watershed maintained a historically strong population of steelhead trout (Nez Perce National Forest 1998). Spawning habitat in the South Fork Clearwater occurred primarily in the lower canyon portions of mainstem tributaries such as Newsome Creek, American River, Red River, Crooked River, and low gradient reaches along the mainstem South Fork Clearwater River (Nez Perce National Forest 1998; Paradis et al. 1999b). Historic spawning distributions of steelhead trout also likely included Tenmile, Johns, Meadow, and Mill creeks (Jody Brostrom, IDFG, personal communication March 30, 2001). Low order streams and accessible headwater portions of high order streams provided early rearing habitat (Nez Perce National Forest 1998).

The South Fork Clearwater River may have historically maintained a genetically unique stock of steelhead trout within the Clearwater subbasin, but hatchery supplementation has since clouded the lines of genetic distinction between stocks throughout the subbasin (Nez Perce National Forest 1998). Robin Waples (In a letter to Sharon Kiefer, IDFG, August 25, 1998) found that steelhead trout in Johns and Tenmile creeks are genetically most similar to fish originating from the Selway River system, suggesting that some genetic difference may have existed historically within the South Fork Clearwater drainage. A statewide genetic analysis is currently being conducted using DNA markers, and may provide more information on past and current genetic distinctions between steelhead trout stocks in the Clearwater subbasin (Byrne 2001).

The North Fork Clearwater provided substantial amounts of spawning and rearing habitat for steelhead trout prior to the construction of Dworshak Dam in 1969, which blocked 26% of Clearwater subbasin habitat from anadromous fish (NPT and IDFG 1990). An estimated 50 to 60 percent of the steelhead entering the Clearwater River spawned in the North Fork Clearwater River and its tributaries (Miller 1987). Similar to the South Fork, the mouths of the larger North Fork tributaries were likely the primary spawning areas, while the accessible headwater sections of the tributaries provided habitat for rearing and resident rainbow/redband trout populations (Clearwater National Forest 1999). In addition to spawning and rearing, mainstem habitat was used for migration and overwintering.

Historical spawning and rearing habitat in the Selway River occurred throughout the subbasin. Lower portions of mainstem tributaries hosted overwintering habitat for juveniles, while the upper portions provided rearing habitat.

Current Status

Steelhead trout ascend the Columbia River between May and October, and generally arrive at the mouth of the Clearwater River in the fall (September-November). Adult steelhead trout remain in the large pools of the mainstem Clearwater or Snake Rivers or in Lower Granite Reservoir through the winter. This timing is different than before the Snake River dams were built, when the majority of the fish arrived to Lewiston dam in March-May (Whitt 1954). Spawning of B-run steelhead trout in the Clearwater subbasin occurs from mid-March through early June, with emergence during June and July. A-run steelhead spawn from February through early May, with emergence from mid-April through May (NPT and IDFG 1990). The majority of juveniles rear for two years in freshwater with subsequent outmigration from March through May.

With the exception of the genetically distinct North Fork origin B-run steelhead, the only remaining steelhead trout runs in the Clearwater subbasin with limited or no hatchery influence occur in the Lochsa and Selway River systems (B-run) and lower Clearwater River tributaries (A-run; Busby et al. 1996; IDFG 2001c). Steelhead trout in other portions of the subbasin have been heavily influenced by hatchery stocking, with the majority originating from Dworshak National Fish Hatchery (NPT and IDFG 1990). Steelhead trout production at Dworshak National Fish Hatchery is made up entirely of B-run steelhead trout originating from North Fork Clearwater stock.

Steelhead trout are widely distributed throughout the Clearwater subbasin, using at least a portion of all accessible watersheds (5^{th} code HUCs; Figure 103). Excluding areas blocked by Dworshak Dam, subwatersheds (6^{th} code HUCs) currently not being used by steelhead trout are typically singular, scattered, and associated with low order tributaries.

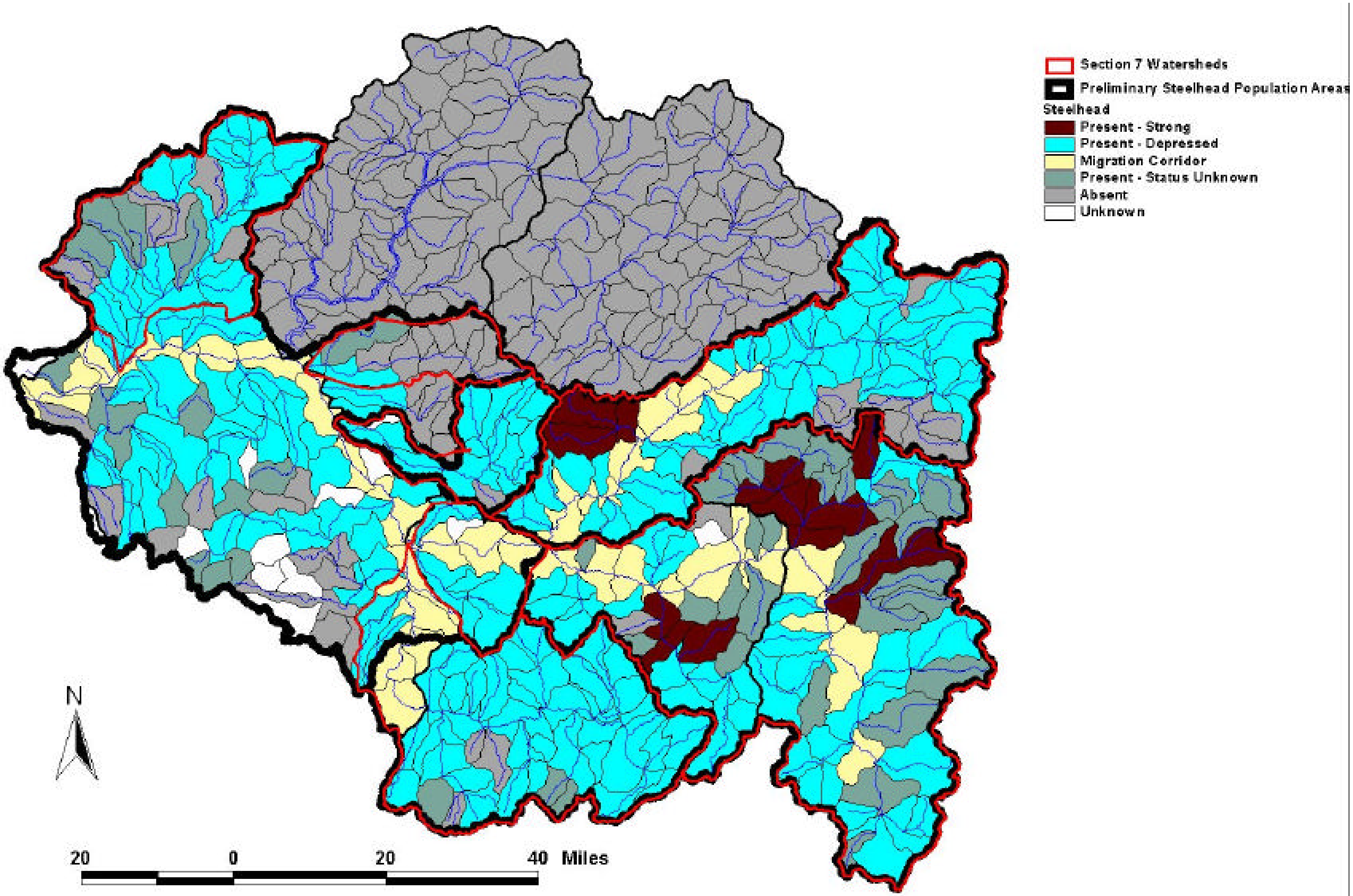

Figure 103. Known distribution and relative status of steelhead in the Clearwater subbasin. Heavy black lines represent preliminary steelhead population areas defined by NOAA Fisheries. Red lines delineate consultation watersheds defined under ESA Section 7

Clusters of 6^{th} code HUCs are not currently used by steelhead trout in Orofino and Jim Ford Creeks (Lolo/Middle Fork AU) where a passage barrier exist in the lower mainstem of each creek (Johnson 1985; Clearwater Soil and Water Conservation District 1993), and the headwaters of the White Sands Creek drainage (Lochsa AU). The relatively contiguous distribution of steelhead trout throughout the subbasin suggests a potentially high degree of connectivity exists.

Status and distribution of A-run steelhead in lower Clearwater River tributary streams was described by Kucera et al. (1983), Fuller et al. (1984), and Johnson (1985). No adult steelhead abundance estimates are available for tributaries in the lower Clearwater AU, although an experimental weir was operated on weekdays in Big Canyon Creek in 1995 (USFWS and NPT 1997). Quantification over time of B-run adult steelhead escapement to individual tributaries or spawning aggregates is limited to four locations in the Clearwater River subbasin where adult weirs are operated: Clear Creek (Middle Fork Clearwater River), Fish Creek (Lochsa River), Red River and Crooked River (South Fork Clearwater). Some additional information is available from the hatchery facility at Powell (Lochsa River). Adult steelhead abundance information in the Selway River system is comprised of angler survey data collected during the 1950s, catch in the Selway Falls fish ladder during the mid 1990s, and steelhead caught and radio-tagged below Selway Falls in 1998. Unfavorable environmental/stream conditions during the spawning season preclude conducting accurate spawning ground surveys for steelhead in the Clearwater subbasin although attempts have been made and limited data does exist (Table 48).

Wild A-run steelhead trout within the Clearwater subbasin occurs only in the lower mainstem tributaries (Rich et al. 1992), South Fork Clearwater tributaries up to Butcher Creek, and Maggie Creek in the Middle Fork Clearwater (NPT and IDFG 1990). The Potlatch River and East Fork Potlatch River are considered important streams for production of wild A-run steelhead trout because of their accessibility in relation to the mainstem Clearwater (A. Espinosa, Espinosa Consulting, personal communication 1999). Wild A-run steelhead trout also occur in Big Canyon, Cottonwood, Lapwai, Mission, Bedrock, and Jacks Creeks (Clearwater National Forest 1997; USFWS and NPT 1995; Kucera and Johnson 1986), with Big Canyon and Cottonwood creeks as the primary aggregates based on available habitat and observed juvenile densities (USFWS and NPT 1997). No hatchery outplanting of A-run steelhead trout has occurred within the Clearwater subbasin, and interbreeding of A-run and hatchery produced B-run steelhead trout is thought to be minimal due to differences in spawn timing (USFWS and NPT 1997). Habitat problems in A-run streams include high soil erosion rates, high bedload movement rates, altered channel morphology and riparian areas, variable streamflows with severely limited late summer flows, and high summer temperatures in lower tributary reaches (Kucera and Johnson 1986; NPT and IDFG 1990).

Steelhead trout status is present–depressed throughout the majority of their range in the Clearwater subbasin (Figure 103). Designations of present–strong for steelhead trout are only noted in Fish and Hungery Creeks (Lochsa AU), the lower portions of Meadow Creek (Lower Selway AU), and portions of Moose and Bear Creeks (Upper Selway AU)(Figure 103). The Lochsa and Selway River systems have been identified as refugia areas for steelhead trout (Thompson 1999) based on location, accessibility, habitat quality, and number of roadless tributaries.

Recent trend information related to steelhead populations in the Clearwater subbasin consists primarily of weir counts. Table 49 presents available information on adult steelhead collections at various weir sites within the subbasin.

Table 48. Aerial steelhead redd counts in Clearwater subbasin streams, 1990-2000

AU Stream	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
South Fork AU											
Crooked R.	219	50	20	4	3	4	0	0	0	NC[1]	NC
Red River	2	NC	NC	5	6	6	2	0	1	NC	NC
Lochsa AU											
Lochsa R	5	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Colt Killed Cr	12	7	20	NC	12	3	3	7	3	NC	NC
Storm Cr	11	0	3	NC	3	8	1	0	1	NC	NC
Crooked Fk Cr	33	7	10	NC	8	11	1	6	2	NC	NC
Fish Cr	9	0	3	NC	5	5	NC	NC	NC	NC	NC
Hungery Cr	2	0	NC	NC	NC	NC	NC	NC	NC	NC	NC
Selway AU											
Mainstem	NC	NC	NC	NC	NC	1	NC	NC	0	NC	NC
Bear Cr	15	2	4	NC	6	8	2	2	2	NC	NC
EF Moose Cr	NC	NC	NC	NC	3	6	6	5	5	NC	NC
Running Cr	0	0	NC	NC	NC	NC	NC	NC	NC	NC	NC
Whitecap Cr	4	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

[1/]NC – No counts

Table 49. Adult steelhead returning to weirs, Clearwater subbasin, 1990-2000

	Fish Creek		Crooked River		Red River		Powell		Clear Creek	
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
1990	ND	ND	17	32	ND	ND	50	1	5	11
1991	ND	ND	5	44	ND	ND	ND	ND	ND	25
1992	105	0	19	34	ND	ND	32	1	13	45
1993	267	0	17	32	ND	ND	0	0	24	200
1994	70	0	5	1	ND	ND	0	0	43	303
1995	32[a]	0	15	2	ND	ND	1	0	48	421
1996	32 [a]	0	2	1	ND	ND	0	0	24	385
1997	21 [a]	0	5	0	0	0	2	0	61	450
1998	75	0	2	0	0	0	ND	ND	18	235
1999	72 [a]	0	3	7	0	0	ND	ND	53	722
2000	26	0	6	10	0	0	ND	ND	17	320

(a) Weir was breached by high flows and debris, so counts don't represent total escapement

According to the IDFG's parr monitoring database, steelhead trout parr densities in the Clearwater subbasin averaged approximately 27% of the estimated carrying capacity between 1985 and 1997 (IDFG 1999a; Table 50). Monitoring surveys included in the database indicate the highest relative densities of steelhead trout in the Lower Selway, Lower Clearwater, and Lochsa AUs where the average percentages of carrying capacity were 46, 38, and 38%, respectively. Lesser percentages of estimated carrying capacity are being realized in the Upper Selway (12%), Lolo/Middle Fork (23%), and South Fork (25%) AUs.

Carrying Capacity

The carrying capacity for steelhead trout was estimated for each subwatershed in which spawning and rearing is known to occur (Table 50). Estimates are based on data downloaded from the Streamnet website (Pacific States Marine Fisheries Commission 2001) which was originally produced using the smolt density model developed in 1989 as part of the Northwest Power Planning Council Presence/Absence database (NPPC 1989).

Estimates of carrying capacity for steelhead smolts ranged from 31 to 54,708, with the highest subwatershed estimates associated with the Lochsa (approximately 482,000) and Upper Selway AUs (approximately 488,000). The lowest steelhead smolt carrying capacity estimates at the AU scale are associated with the Lolo/Middle Fork and Lower Clearwater AUs and the Lower North Fork AU where available habitat is limited by the presence of Dworshak Dam (Table 50).

Table 50. Estimated spawning/rearing area, total carrying capacity (smolt) and average percent of carrying capacity (parr) realized between 1985 and 1997 for steelhead trout within each Clearwater subbasin AU

Assessment Unit	Usable Area [1] (stream miles)	Estimated Capacity (# smolts)	Avg. percent realized [2] (85-97) (Idaho Dept Fish and Game 1999a)
Lower Clearwater (A-run)	525.5	184,746	38
Lower North Fork	2.0	4,709	Unknown
Upper North Fork	Not Accessible	--	--
Lolo/Middle Fork	263.7	135,419	23
Lochsa	437.3	482,182	37
Lower Selway	241.8	238,978	46
Upper Selway	563.7	487,849	12
South Fork	389.2	201,358	25
Subbasin Total	2,423.2	1,735,259	27

1 Excludes reaches used only for migration purposes

2 Derived from Parr Monitoring Database and presented for comparative purposes. No direct link has been established between parr and smolt production.

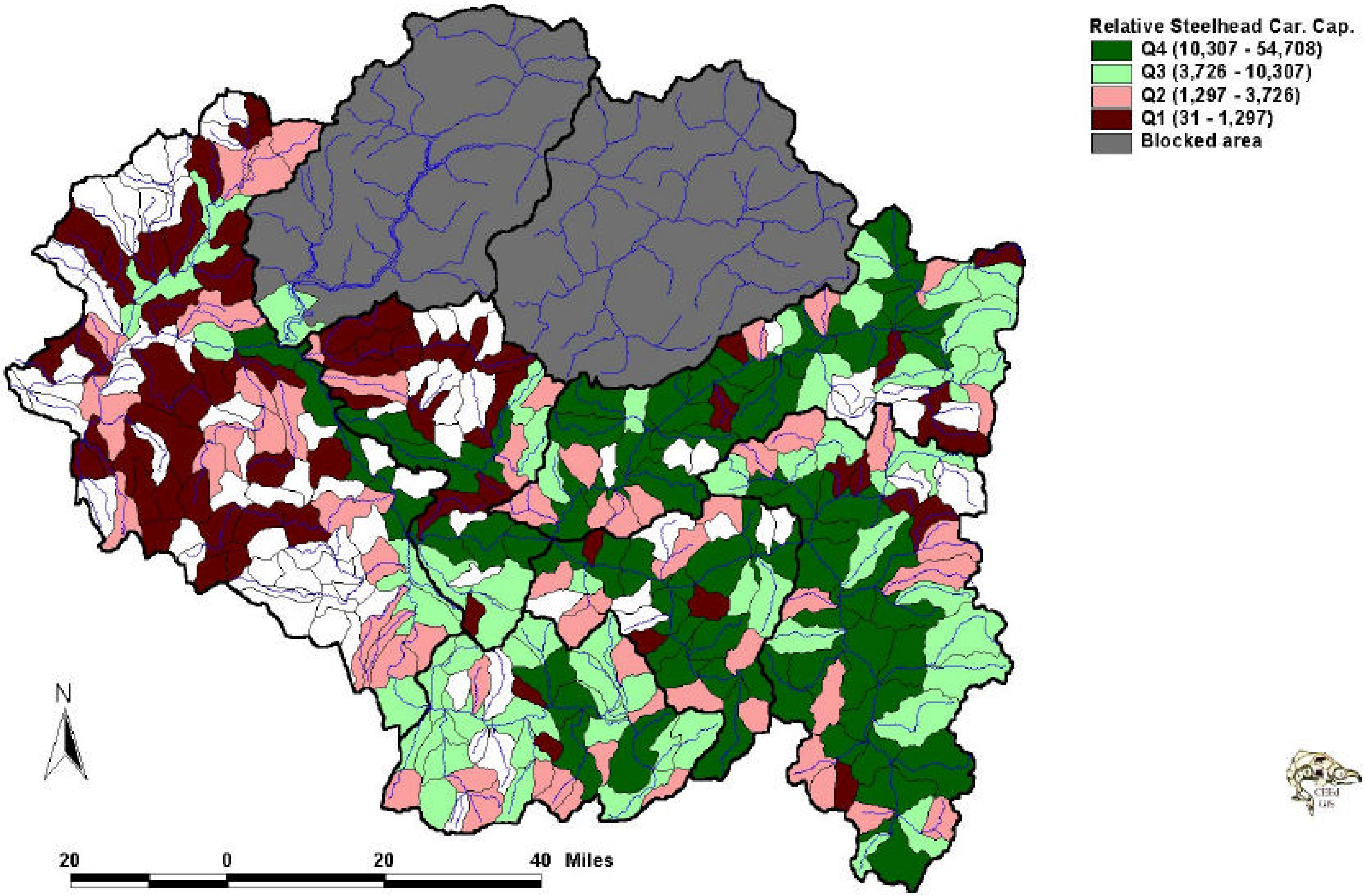

Figure 104. Estimated carrying capacity of steelhead trout smolts based on usable area and habitat quality within each subwatershed. Estimates are grouped into quartiles (Q1-Q4), with an equal number of subwatersheds in each

8.1.3 Coho Salmon

Coho salmon are believed to have historically migrated to and spawned in the Clearwater subbasin (Fulton 1970 cited in NPT and IDFG 1990). The NPT Office of Legal Counsel documented the historical presence of 'cuhlii or kallay' (coho) in their language and records this species as having been present throughout several streams in the Clearwater subbasin (Ed Larson, NPT, personal communication, May 11, 2001). However, coho runs throughout the Snake River basin were officially declared extinct in 1986. In the Clearwater subbasin, poor passage facilities at the Lewiston Dam (constructed in 1927) are generally accepted as having caused extirpation of coho salmon runs (NPT and IDFG 1990). Efforts were made by the Idaho Department of Fish and Game to reintroduce coho salmon to the Clearwater subbasin between 1962 and 1968, but were curtailed due to lack of success.

The Nez Perce Tribe currently has a reintroduction program underway for coho salmon in the Clearwater subbasin. Three primary factors may constrain success of coho production in the Clearwater during reintroduction: stock selection, habitat availability, and out-of-subbasin mortality related to dams and fisheries (NPT and IDFG 1990).

Coho salmon spawn in October over gravel/cobble-sized substrate with a fairly swift current. Fry emergence generally occurs between March-April, after which time they will reside in freshwater for one to two years. In fresh water, the diet of juvenile coho consists of aquatic insects and zooplankton (Simpson and Wallace 1982).

Historical Status

Coho salmon were likely present within the larger mainstem Clearwater tributaries, and depending on the amount of flow, accessed habitat in some of the smaller tributaries for spawning and rearing (Clearwater National Forest 1997). Specifically, the Potlatch River, Fish Creek and Lolo Creek likely provided habitat for spawning and rearing of historic coho populations (Clearwater National Forest 1997; A. Espinosa, Espinosa Consulting, personal communication 1999). Reviews of historical documents and interviews of residents by Johnston (1993, cited in Clearwater National Forest 1997) support the fact that the Potlatch River contained historical runs of chinook, steelhead and coho during the late 1800s and early 1900s. Run presence was likely a function of migration corridor connectivity, habitat suitability and water temperatures.

The lower South Fork Clearwater River was considered as supporting runs of coho salmon, however this documentation is largely anecdotal (Paradis et al. 1999b). The Idaho Department of Fish and Game has records of eyewitness accounts of historic coho runs in the Clearwater River (Richards 1967). The Nez Perce Tribe, through testimony of elders and review of historic literature, have identified several streams that historically supported populations of coho salmon in the Clearwater River subbasin (P. Kucera, NPT, personal communication, March 8, 2001).

The only recorded counts of coho salmon entering the Clearwater River were made at Lewiston Dam following reintroduction efforts by the Idaho Department of Fish and Game. Lewiston Dam counts, which were sporadic at best, ranged from 325 fish in 1968 to as low as 9 adults in 1972 (Table 51). As shown in Table 51, Clearwater coho comprised a relatively small proportion of Snake River coho that passed Ice Harbor dam between 1965-1972.

Clearwater subbasin coho supplementation projects were initiated in 1962 by IDFG under the auspices of the Columbia River Fisheries Department Program (NPT and IDFG 1990). Over 11 million eggs were planted into two controlled-flow hatching channels on the Red River and Crooked River within the South Fork subbasin (NPT and IDFG 1990). Fry releases occurred within mainstem channels and South Fork tributaries, although subsequent adult escapement rates were poor. The project was discontinued in 1968 because of the poor return rates, however, coho were still being counted over the dam up until its removal in 1972-73 (NPT and IDFG 1990).

Table 51. Number of coho salmon counted over the Lewiston Dam and over Ice Harbor Dam from 1965-1972 (Simpson and Wallace 1982)

Run Year	Adult Coho Salmon Counted	
	Lewiston Dam	Ice Harbor Dam
1965	21	320
1966	115	878
1967	43	3,770
1968	325	6,227
1969	31	5,316
1970	40	3,682
1971	61	3,029
1972	10	2,522

Current Status

Reintroduction of coho salmon in the Clearwater River subbasin was initiated in 1995 by the Nez Perce Tribe. Broodstock from Willard and Eagle Creek National Fish Hatcheries in Oregon has been used to stock eyed eggs, fry, parr, and smolts into tributaries of the lower mainstem Clearwater and South Fork Clearwater rivers. Stocking locations and life stages have varied across years, with the Potlatch River, Lapwai Creek, Mission Creek, Quartz Creek, Cottonwood Creek, Big Canyon Creek, Orofino Creek, Lolo Creek, Meadow Creek (Selway), and Meadow Creek (South Fork Clearwater) being supplemented at least once. Primary efforts have been focused in Lapwai Creek, Potlatch River, Eldorado Creek, and Meadow Creek (Selway River) with parr and smolt outplants (Table 52).

Post-release survival and life history traits are being monitored. Representative groups of parr and smolt releases have been coded-wire tagged and PIT tagged. Subsequent tag detection and recovery is being used to establish baseline emigration survival and smolt-to-adult return rate survival estimates.

Adult escapement abundance is being monitored at Lower Granite Dam, Lapwai Creek, Potlatch River, Clear Creek, Meadow Creek (Selway), and Dworshak National Fish Hatchery ladder. Adult escapement counts at Lower Granite Dam since 1997 have range from 12 to 1,089 (Table 53). Tributary specific returns have fluctuated across years with streams receiving smolt outplants generally having the highest return number. The Dworshak National Fish Hatchery may capture up to 190 adults even though fish are not released there (rearing does occur at the hatchery). Aerial and ground spawning ground surveys for coho salmon have been conducted with only a limited number of redds being observed in Lapwai Creek, Potlatch River, and Meadow Creek (Selway). Age of adult at return is predominately 2-ocean with a small percentage of jacks (1-ocean). The Nez Perce Tribe is currently in the process of developing a localized coho salmon brood stock from adult returns to the Clearwater River subbasin to support reintroduction efforts. To date no tribal or sport harvest season has occurred, however incidental capture during steelhead season is likely.

Table 52 Stocking summary of parr and smolt coho salmon releases since 1995 into Clearwater River tributaries

Location	1995	1998	1999	2000
Lapwai Creek	--	244,640 smolt	290,176 smolt	267,102 smolt
Potlatch River	142,456 parr	231,076 smolt 175,000 parr	276,682 smolt 175,000 parr	267,166 smolt
Orofino Creek	49,849 parr	--	--	--
Eldorado Creek	94,777 parr	125,000 parr	125,000 parr	124,470 parr
Clear Creek	--	218,501 smolt	245,168 smolt	280,750 smolt
Meadow Creek (South Fork Clearwater)	--	--	--	148,578 parr
Meadow Creek (Selway)	335,145 parr	150,000 parr	150,000 parr	149,300 parr

Table 53 Coho salmon adult escapement counts at Lower Granite Dam and tributary specific weir sites from 1997 to 2000.

	1997		1998		1999		2000	
	Adults	Jacks	Adults	Jacks	Adults	Jacks	Adults	Jacks
Lower Granite Counts	94	10	10	2	271	29	1033	56
Total Weir Counts			--	--	189	6	487	98

8.1.4 Pacific Lamprey

Pacific lamprey are considered an endangered species by the state of Idaho (IDFG 2001c). Throughout their range in the Columbia River Basin, Pacific lampreys have declined to only a remnant of their pre-1940s populations. Lower Snake dam counts numbered over 30,000 in the late 1960s, but have declined to less than 500 fish in recent years. Currently, an estimated 3% of the lamprey that pass Bonneville Dam are counted at Lower Granite Dam (Close 2000). Based on adult lamprey observations at Lower Granite Dam the current status in the Clearwater subbasin is thought to be extremely depressed (CBFWA 1999).

Pacific lamprey in Idaho are threatened by dams on the Snake and Columbia Rivers, stream alteration, and ammocoete harvest by bait fishermen according to a status review by the Idaho Chapter of the American Fisheries Society (cited in Paradis et al. 1999b). Because they spend extended periods in freshwater, Pacific lamprey are especially vulnerable to degraded stream conditions, including sedimentation due to land disturbance, and water quality limitations that impact diatom (food) production in nursery streams (Paradis et al. 1999b).

General life history and habitat descriptions can be found in several sources which are summarized in Close (2000). Migration of adult lampreys into fresh water typically occurs from May through September, with spawning the following March or April. Hatching occurs 2-3 weeks following fertilization. Following hatching, ammocoetes burrow into mud where they remain for 5 or more years before transforming to adults. As juveniles, Pacific lamprey feed primarily on diatoms and desmids. Following transformation, lampreys migrate to the ocean and become parasitic, attaching themselves to fish and consuming blood and body fluids from their prey (Simpson and Wallace 1982).

Historical Status

One of the earliest documented occurrences of Pacific lamprey in Idaho was in the Snake River near Lower Salmon Falls, and downstream near Lewiston (Gilbert and Evermann 1895). Culturally important to native tribes (Columbia River Inter-Tribal Fish Commission 1996), they were also popular for use of their oily flesh and as sturgeon bait (Gilbert and Evermann 1895). Ecologically, they are an important food for white sturgeon, and the carcasses of spawned adults provide nutrients to tributaries that also rear salmon and steelhead (Kan 1975).

It is thought that Pacific lamprey formerly migrated to all streams accessible to salmon and steelhead (Simpson and Wallace 1982), suggesting that they were present in all major drainages in the Clearwater subbasin. Sightings of, and parasitism by, Pacific lamprey in Dworshak Reservoir declined rapidly after impoundment (Simpson and Wallace 1982), suggesting that they may not have residualized in the North Fork Clearwater AUs. Lamprey were collected in Dworshak Reservoir as late as 1989 (16 years after impoundment), but have not been seen after this date (Melo Maiolie, IDFG, personal communication, April 20, 2001).

Current Status

Pacific lamprey populations in the western half of the Clearwater subbasin may be limited to the mainstem Clearwater River and larger accessible tributaries, including the Potlatch and Lolo Creek drainages (U.S. Bureau of Land Management 2000). Lapwai, Big Canyon, Orofino, Lolo and Lawyer Creek may also be used by Pacific lamprey (U.S. Bureau of Land Management 2000). According to Schoen et al. (1999), Pacific lamprey utilize the Lochsa River drainage although no information on their distribution within the system is provided. Hammond (1979) studied larval lamprey biology on the Potlatch River, and presented limited information on juvenile lamprey in Lolo Creek and the Clearwater River. Ammocoetes have been caught in recent years in smolt traps on Lolo Creek (NPT), Red River (IDFG 1998a), the Clearwater River (IDFG, Unpublished Data) and the Selway River near O'Hara Creek (IDFG, Unpublished Data). They are thought to occur in the American River system as well (Paradis et al. 1999b). A life history study currently being conducted in the South Fork Clearwater documented lamprey rearing in Red River and the mainstem South Fork (Cochnauer and Claire 2001). A recent biological assessment of the Lower Selway River (Thompson 1999) did not document the presence of Pacific lamprey in that area, although they have been observed at rkm 70 (RM 43) in recent years (Tim Cochnauer, IDFG, personal communication, March 30, 2001).

Potential factors affecting declines include problems with habitat and the migratory corridor (Close et al. 1995). Ammocoete abundance may be affected by water temperature and other physical characteristics during early development (Young et al. 1990 cited in Stone et al. 2001). Availability and accessibility of suitable spawning habitat may limit the amount of reproduction that occurs within a basin. Factors influencing survival of early life history stages may be critical to determining recruitment to the population (Houde 1987).

Within the Clearwater subbasin, limiting factors include habitat disturbance. Low flows, poor riparian conditions and resultant high water temperatures reduce the quality and quantity of adult spawning and juvenile rearing areas (Close 2000).

Out of the subbasin, the major limiting factors for ammocoetes and macrothalmia are passage and bypass mortalities at facilities on mainstem Snake and Columbia dams as well as migration delays through the reservoirs (Hammond 1979). For adults, the primary limiting factor is higher water velocities in the adult fish ladders and migration system. Adults have extreme difficulty negotiating the fish ladder weir orifices (T. Bjornn cited in Close 2000).

The Columbia Basin Lamprey Technical Workgroup (Close 2000), Close et al. (1995) and the Idaho Department of Fish and Game (1996 and 2001b) state that basic distribution, life history and population status are urgently needed to fully understand this species and to begin intensive management before extinction occurs and supplementation programs are implemented. Understanding the cause of decline through various data gathering and research efforts will be critical to implementing effective restoration actions for Pacific lamprey in the Columbia River Basin (Close et al. 1995).

8.1.5 Redband (Rainbow) Trout

Redband trout are thought to represent the resident form of steelhead trout in areas where they coexist (or coexisted historically), although the subspecies also exists in areas outside the historic range of steelhead trout (Behnke 1992). Redband trout are considered a species of special concern by the American Fisheries Society and the state of Idaho, and are classified as a sensitive species by the U.S. Forest Service and Bureau of Land Management (Quigley and Arbelbide 1997).

Although redband trout likely existed historically throughout the Clearwater subbasin (Quigley and Arbelbide 1997), little is known about the current distribution or status of redband trout populations in the subbasin. One reason for the lack of information is the inability to differentiate juvenile steelhead and resident redband trout phenotypically, and coexistence of the two subspecies throughout most of the Clearwater subbasin complicates efforts to gather information on redband trout population(s).

Hybridization of redband trout and stocked rainbow trout is common (Quigley and Arbelbide 1997), and often leads to questions over the genetic integrity of existing redband trout population(s). In the North Fork Clearwater drainage, where steelhead trout have been excluded by Dworshak dam, potential hybridization with stocked rainbow trout leaves the current distribution of redband trout in question. Methodology using DNA markers exists to differentiate redband trout from the common coastal rainbow stocks that have been used for hatchery stocking. For example, initial results from a study conducted by Mays (2001) in the Salmon River, suggests few genetic introgression legacy effects from past stocking of exotic trout in redband waters. There remains a need to identify the genetic integrity of redband populations in the Clearwater subbasin in areas naturally or artificially blocked, heavily or sparsely stocked, and where they are sympatric with or isolated from steelhead.

8.1.6 Westslope Cutthroat Trout

Westslope cutthroat trout are currently listed as federal and state (Idaho) species of concern and sensitive species by the USFS and BLM. The subspecies has been proposed for listing under the ESA in some portions of its range. The historic range of westslope cutthroat trout has been reduced substantially (Rieman and Apperson 1989), and the existence of relatively strong population(s) throughout north-central Idaho may provide an important component to regional recovery efforts.

Westslope cutthroat trout exhibit resident, fluvial, and adfluvial life histories within the Clearwater subbasin (Thompson 1999; Weigel 1997). Westslope cutthroat mature at approximately five years of age, with fish in some areas spawning at three or four years (Simpson and Wallace 1982). Spawning typically occurs in April and May, with emergence during June and July. Migratory behaviors in cutthroat trout are seasonal in nature and associated with finding suitable spawning or wintering habitat (Bjornn and Mallett 1964). Westslope cutthroat trout are highly dependent upon substrate conditions for overwintering survival, particularly in headwater streams. Overwintering occurs in large deep pools or within crevices and interstitial spaces in the substrate in streams without adequate pools (Paradis et al. 1999a; Meehan and Bjornn 1991).

Three primary factors have been identified which have contributed to the decline of westslope cutthroat populations: species introductions, angling mortality, and habitat disruption (Quigley and Arbelbide 1997). Hybridization with exotic trout is considered the greatest threat to the conservation of native westslope cutthroat trout in northern Idaho and Montana (Allendorf and Leary 1988, cited in Weigel 1997). Both westslope and yellowstone cutthroat have been stocked in most of the AUs in the past although, since the late 1970s, only westslope cutthroat have been stocked, and then only in mountain lakes (Jody Brostrom, IDFG, personal communication, April 22, 2001).

Evolution of cutthroat trout has occurred with a variety of salmonid species, and habitat segregation is common when cutthroat trout coexist with other salmonids (Thompson 1999; Pratt 1984; Hansen 1977). Hybridization with rainbow trout is common in some areas where the species coexist, while in other areas coexistence occurs with minimal hybridization (Behnke 1992). Behnke (1992) stated that areas exist within the Clearwater subbasin where essentially pure native westslope populations are relatively common. More recent investigations by Weigel (1997) suggest that introgression between westslope cutthroat trout and introduced rainbow trout in the North Fork Clearwater River may be widespread and substantial in some areas. Weigel (1997) also located genetically pure westslope cutthroat trout stocks within the higher elevations of the study area. Weigel and Statler (2001) indicated that genetic introgression with rainbow trout was detected in about 2/3 of the sites sampled in the North Fork Clearwater subbasin (1/3 low introgression, 1/3 moderate introgression). Current methodology precludes the ability to distinguish between hatchery influenced and natural introgression of rainbow trout into cutthroat trout populations. However, Liknes and Graham (1988) indicated that westslope cutthroat trout and steelhead/rainbow trout in the Clearwater drainages evolved sympatrically without significant hybridization. The mechanisms that limit the potential for hybridization between those two species include aggressive spawning behavior and spatial separation between spawning sites (Liknes and Graham 1988). No baseline genetic data exists on natural introgression of rainbow trout into populations of the North Fork Clearwater River (Jody Brostrom, IDFG, personal communication, March 30, 2001). It is also unknown what effect Dworshak Dam and the removal of the anadromous component had on the degree of natural introgression in the North Fork Clearwater drainage. A need exists to document natural or hatchery influenced introgression in cutthroat trout populations in the Clearwater subbasin so that remaining populations can be protected and managed.

Westslope cutthroat trout are highly susceptible to angling pressure and angling mortality has contributed to declines in the status of westslope cutthroat throughout their range (Behnke 1992). However, many populations have been shown to respond to restrictive angling regulations (Nez Perce National Forest 1998) with increased survival, abundance, and size (Bjornn and Johnson 1978, cited in Behnke 1992).

Effects of habitat disruption on westslope cutthroat trout populations are similar to those on other salmonid species. Extensive land use activities have led to population declines by increasing stream temperatures, decreasing the quality and quantity of suitable gravel and cover, and fragmenting existing populations. A strong association with roadless and wilderness areas suggests a substantial vulnerability to habitat alterations (Quigley and Arbelbide 1997).

Historic Status
Westslope cutthroat trout were historically the dominant salmonid in streams of northern and central Idaho (Behnke and Wallace 1986, cited in Nez Perce National Forest 1998), although documentation of status and distribution is limited. In the Lower Clearwater and Lolo/Middle Fork AUs, westslope cutthroat trout were likely abundant throughout the headwaters of mainstem tributaries, with limited use of the mainstem Clearwater River (Clearwater National Forest 1997). The upper reaches of both the Potlatch River and Lolo Creek historically maintained healthy populations of westslope cutthroat trout according to the Clearwater National Forest (1997), although Duff (1996) suggests that the Potlatch River did not historically support the subspecies. The majority of the South Fork AU was identified as a historic stronghold for westslope cutthroat (Nez Perce National Forest 1998). Past distribution and status of the subspecies within the Upper and Lower Selway AUs is thought to have been similar to current conditions, although large fluvial forms may have been more abundant historically (Thompson 1999). In the Upper and Lower North Fork AUs, westslope cutthroat trout populations are thought to have been historically strong (Liknes and Graham 1988). No information was found on the historic status of westslope cutthroat trout populations in the Lochsa River drainage, although they were thought to exist throughout (Duff 1996).

Current Status
Strong populations of westslope cutthroat trout currently exist in only about 11% of their historical Idaho range (Rieman and Apperson 1989). Westslope cutthroat trout are widespread in all portions of the Clearwater subbasin except the Lower Clearwater AU and are considered present–strong throughout the majority of their current range (Figure 105).

Available status information indicates that westslope cutthroat trout populations throughout the Upper North Fork, Lochsa, Upper and Lower Selway AUs are typically present-strong with the exception of a few tributaries or tributary systems. Data collected by IDFG suggest that the population of westslope cutthroat trout within the Selway River subbasin has experienced slight declines in the abundance of large fluvial individuals over the past two decades, but is still considered stable (Thompson 1999). Smolt traps operated in the Lochsa AU (Fish Creek and Crooked Fork Creek) regularly catch juvenile westslope cutthroat (IDFG 1998a; Byrne 2001). Westslope cutthroat tagged at the Fish Creek trap have been recaptured in later years, suggesting that the Lochsa is an important rearing area and the Fish Creek population is not entirely resident (Byrne 2001).

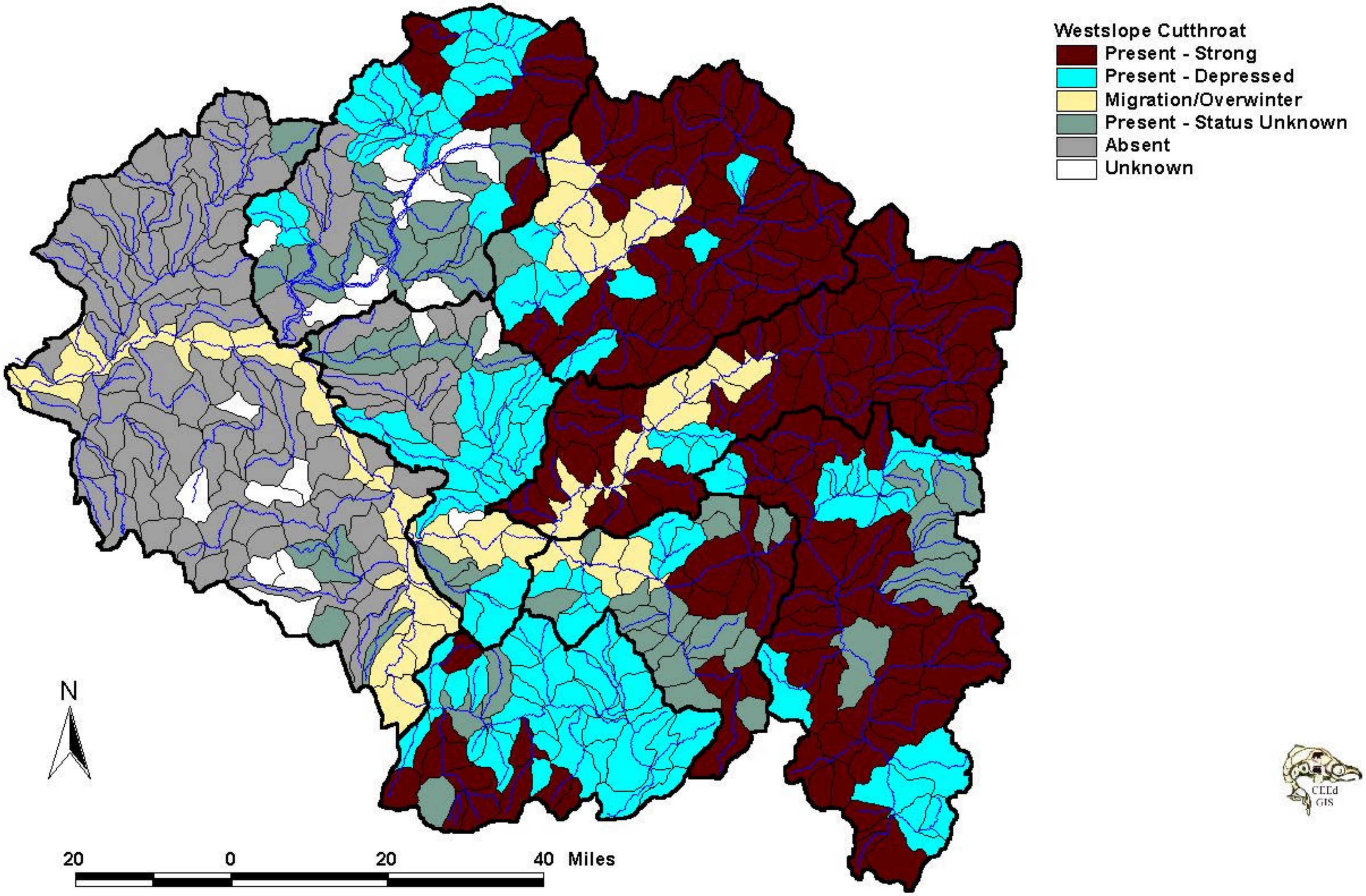

Figure 105. Known distribution and relative status of westslope cutthroat trout in the Clearwater subbasin

Westslope cutthroat trout are considered absent from the vast majority of tributaries in the Lower Clearwater AU, although rare sightings have occurred in some streams. Based on the frequency and distribution of sightings in the Lower Clearwater AU, westslope cutthroat trout that have been documented in most drainages are likely strays or dispersing juveniles from other areas within the subbasin. Only 15 were sampled during Gas Bubble Trauma monitoring between 1995-1999 (Cochnauer 1999).

In the Lolo/Middle Fork AU, westslope cutthroat trout are absent from Jim Ford Creek, but present in all other major drainage systems. Westslope cutthroat trout are defined as present–depressed in all areas of the Lolo/ Middle Fork AU where status information is available.

In the Lower North Fork AU, westslope cutthroat trout are absent from the Elk Creek drainage but present in all other major drainages. Little status information is available in areas other than the Little North Fork Clearwater, where status designations are relatively evenly divided between present–depressed and present–strong.

Although widely distributed, westslope cutthroat trout are present–depressed through the majority of their range in the South Fork AU. Designations of present–strong within the South Fork AU are limited to Johns and Tenmile Creeks and the headwater reaches of Mill and Meadow Creeks and Crooked River. The Nez Perce National Forest (1998) describes the distribution of cutthroat trout within the South Fork drainage as similar to historical, with remaining stronghold areas closely associated with roadless/wilderness areas.

The Idaho Department of Fish and Game has taken steps to protect wild trout, including cutthroat, in the past 30 years. Most streams that contain westslope cutthroat trout have a restrictive sport fishing regulation, and the season is opened after the fish are believed to have spawned. Only sterile rainbow trout are used for most stocking to prevent hybridization with wild trout.

8.1.7 Bull Trout

The current distribution of bull trout within the Columbia River Basin occupies about 44% of their estimated historic range, with the core remaining distribution in the central Idaho mountains, including the Clearwater River subbasin (Nez Perce National Forest 1998). Bull trout were listed under the ESA as threatened in Idaho in June 1998 (63 FR 31647). Concern over declines in bull trout abundance and distribution led to the development of a statewide conservation plan by the state of Idaho in 1996 (Batt 1996). Major goals of this plan include identification and maintenance of critical bull trout habitats, implementation of recovery strategies aimed at both abundance and habitat, and establishment of key watersheds to achieve stable or increasing populations and maximize potential for recovery. Under this plan, 10 watersheds in the Clearwater River subbasin were identified as key watersheds for bull trout conservation (Table 54). Bull trout were closed to sport fishing harvest in 1994. The extent and impact of tribal harvest on bull trout populations is not known.

Bull trout exhibit adfluvial, fluvial, and resident life history patterns within the Clearwater subbasin. Fluvial and resident bull trout populations have been commonly cited throughout the current range of bull trout in the Clearwater subbasin (Paradis et al. 1999b; Thompson 1999). The only suspected adfluvial bull trout population within the Clearwater subbasin is associated with Fish Lake in the Upper North Fork AU (Clearwater Subbasin Bull Trout Technical Advisory Team 1998c). Although bull trout in fish lake are assumed to be adfluvial in origin, no radiotagged bull trout were documented entering the lake, but one spawned in the outlet, Lake Creek (Schriever and Schiff 2001). Fifty bull trout PIT-tagged in

Fish Lake did not move out of the lake during summer and fall months suggesting that the Fish Lake population may be resident. Size of fish captured in the lake support this contention, as does the fact that mature females were also captured. Further research is ongoing to define the status of the Fish Lake bull trout population.

Bull trout have more specific habitat requirements than other salmonids (Batt 1996). Strong bull trout populations are associated with a high degree of channel complexity, including woody debris and substrate with clear interstitial spaces (Batt 1996). Perhaps one of the most critical habitat requirements of bull trout is water temperature. Bull trout may experience considerable stress when temperatures exceed 15°C (59°F; Pratt 1992, cited in Clearwater subbasin Bull Trout Technical Advisory Team 1998c; Batt 1996). Optimum temperatures for incubation and rearing have been cited between 2 and 4°C (35.6 - 39.2°F) and 7 and 8°C (44.6 – 46.4°F), respectively (Rieman and McIntyre 1993). Other habitat parameters of particular importance to bull trout populations include channel stability, substrate composition, cover, and maintenance of migratory corridors (Rieman and McIntyre 1993).

Table 54. List of key watersheds within the Clearwater subbasin identified in the state of Idaho's Bull Trout Conservation Plan (Batt 1996)

Key Watershed	Description
North Fork Clearwater	The North Fork of the Clearwater River from Dworshak Reservoir upstream to Kelly Creek
Little North Fork Clearwater	The Little North Fork of the Clearwater River upstream of Dworshak Reservoir
Weitas Creek	Entire Weitas Creek Drainage, tributary to the North Fork of the Clearwater River
Kelly Forks	The entire North Fork of the Clearwater River drainage from the mouth of Kelly Creek upstream
South Fork of the Clearwater	The entire South Fork of the Clearwater drainage upstream from the Meadow Creek drainage
Lochsa River	The entire Lochsa River drainage
Meadow Creek	Selway River upstream from mouth of Lochsa River encompassing entire Meadow and Gedney Creek drainages
Selway River, Middle	The Selway River encompassing the Mink Creek, Marten Creek, Three Links Creek, Petibone Creek, Bear Creek and Bad Luck Creek drainage
Moose Creek	The entire Moose Creek drainage, tributary to the Selway River
Selway River, Upper	The Selway River encompassing the White Cap Creek, Indian Creek, Clearwater Creek, Swet Creek, Deep Creek, and Selway River headwaters

Historical Status

The entire Clearwater subbasin lies within the native range of bull trout (Meehan and Bjornn 1991). However, historic abundance and trend data are scarce because bull trout were considered a nuisance species (Clearwater subbasin Bull Trout Technical Advisory Team 1998a, 1998b, 1998c, 1998d), and few records of their status were maintained.

The Nez Perce National Forest (1998) states that historic distribution of fishes in the South Fork Clearwater were probably similar to current distributions, although the status of existing stocks (including bull trout) has declined significantly. This report also indicates that migratory (fluvial) bull trout were likely found throughout the South Fork Clearwater subbasin, with concentrations in mainstem tributaries. Historic abundance and distribution information for bull trout in other areas of the Clearwater subbasin is rare or nonexistent (Clearwater subbasin Bull Trout Technical Advisory Team 1998a, 1998b, 1998c, and 1998d), and existing records do not allow for interpretation of historical distribution or abundance at the subbasin scale. In addition, the connectivity of bull trout populations between assessment units is not known.

Current Status

Bull trout are distributed throughout most of the large river and associated tributary systems within the Clearwater subbasin (Figure 106). Relatively contiguous distributions of bull trout exist in the South Fork, Selway, and Upper North Fork AUs. Although bull trout are widely distributed in the Lochsa River AU, they are absent from many tributary systems in the lower half of the Lochsa drainage. Bull trout are sparsely distributed in the Lolo/Middle Fork AU, using the mainstem reaches of Lolo Creek and upper reaches of Clear Creek for spawning/rearing, and the Middle Fork Clearwater River for migration.

The Lower North Fork AU contains bull trout in portions of the North Fork Clearwater and Little North Fork Clearwater Rivers upstream of Dworshak Reservoir. Bull trout also occupy Dworshak Reservoir, and spawner size in some tributaries of the North Fork Clearwater River suggest that some bull trout spend extensive amounts of time feeding in the reservoir (A. Espinosa, Espinosa Consulting, personal communication, 1999). Current research documents bull trout catches in Dworshak Reservoir, and through use of radio-tags, has documented their migration into headwater tributaries of the North Fork Clearwater River to spawn (Schriever and Schiff 2001) and return to the reservoir for overwintering.

With the exception of the mainstem Clearwater River, bull trout are essentially absent from the Lower Clearwater AU (Figure 106). Occasional documentation of bull trout has occurred in Lower Clearwater tributaries, but such sightings are regarded as random occurrences associated with juvenile dispersal. Bull trout may regularly use the mainstem Clearwater River. Recent sampling events directed at monitoring gas bubble trauma in the mainstem Clearwater River have regularly collected adult bull trout (Cochnauer 1999) and the trap at the base of Dworshak Dam catches subadult and adult bull trout every year in the spring. Dworshak Dam has likely fragmented the Clearwater subbasin bull trout population, and it is not known whether fish in the lower Clearwater have come from Dworshak Reservoir (Schriever and Schiff 2001).

Interpretation of bull trout status throughout the Clearwater subbasin is complicated by a lack of available information in many areas. Where status information is available, bull trout are most commonly designated as “present–depressed” (Figure 106). Designations of “present–strong” are assigned to 18 subwatersheds in the subbasin. Of seven AUs utilized by bull trout for purposes other than migration, five contain at least one subwatershed where bull trout are designated as present-strong. These include the Lower North Fork, Lochsa, Upper and Lower Selway, and South Fork AUs. Of 10 key watersheds defined for bull trout by the state of Idaho within the Clearwater subbasin, six contain areas where bull trout status is defined as present–strong in at least one subwatershed.

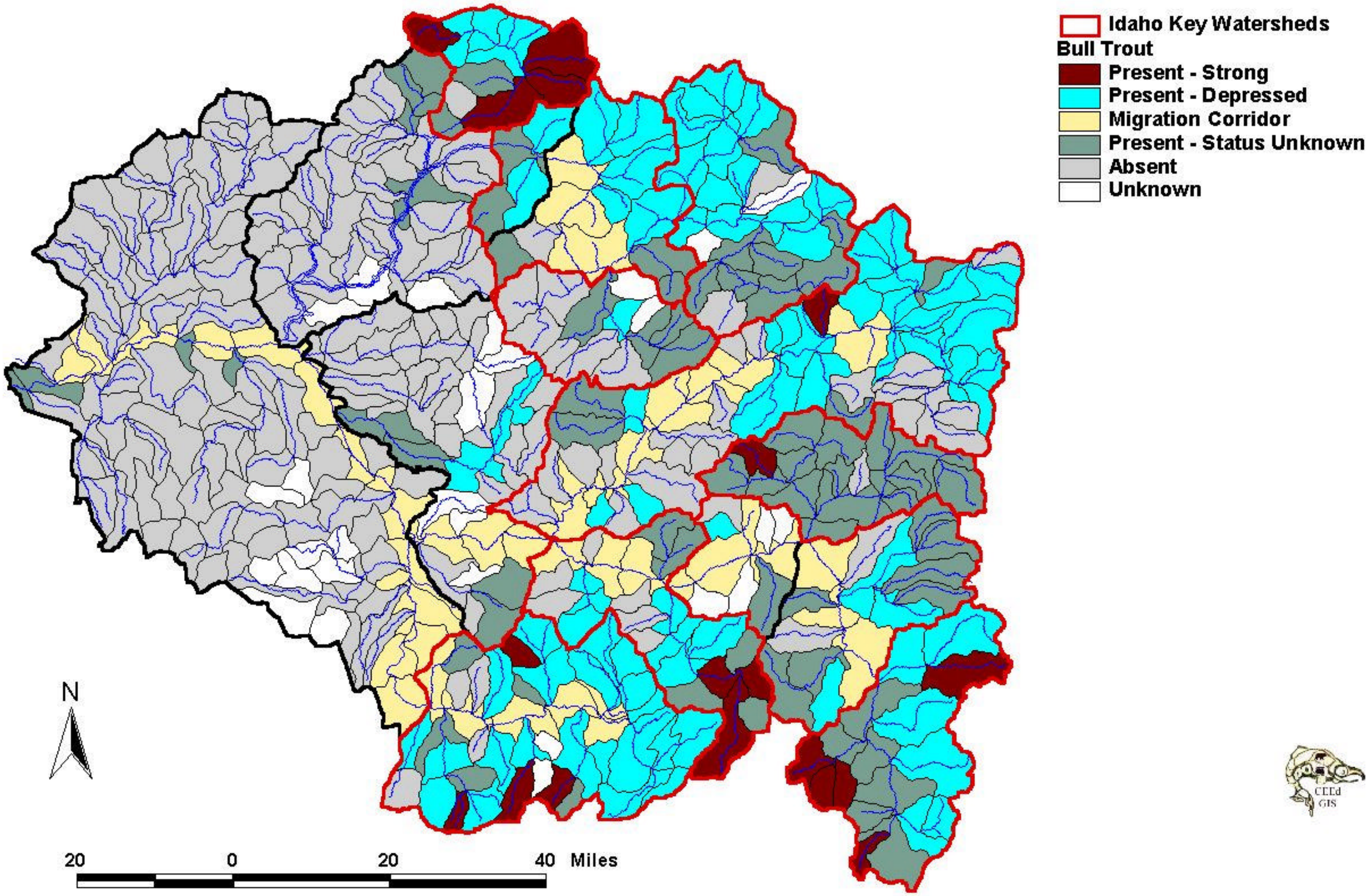

Figure 106. Known distribution and relative status of bull trout in the Clearwater subbasin. Red lines delineate key watersheds defined in the Idaho Bull Trout Conservation Plan

The Nez Perce National Forest (Paradis et al. 1999b) states that connectivity between the Lochsa and Selway subbasins is high, and that regular exchange of bull trout between these areas is likely. Bull trout are also thought to use the Middle Fork Clearwater River (Paradis et al. 1999a).

Based on available status information, contiguous areas with defined (or apparent potential for) strong bull trout subpopulations exist in the Little North Fork Clearwater drainage (Lower North Fork AU), the upper reaches of Meadow Creek in the Lower Selway AU, and portions of the Upper Selway AU. Strong subpopulations of bull trout in the South Fork AU are scattered and limited to headwater portions of Johns, Newsome, and Tenmile Creeks and Crooked and Red Rivers.

The South Fork AU has the most comprehensive data known about bull trout in the Clearwater subbasin. A multi-year study documented juvenile distribution in most major tributaries and headwater streams within the AU (IDFG 2001d). The anadromous weir operated at Crooked River has captured subadult and adult bull trout since the early 1990s. From 1993-1999 an average of 16 were caught (range 0-32 fish; IDFG 2001d). Fish captured at this weir in 1998 and implanted with radiotags show that bull trout migrate over 25 miles from the middle reach of the mainstem South Fork Clearwater River to spawn in Crooked River. In addition, juvenile bull trout captured in smolt traps have been implanted with PIT-tags, and recapture data shows movement within and between tributaries in the South Fork AU (IDFG 2001d).

The Selway River supports a significant metapopulation of fluvial bull trout that are widely distributed through the subbasin in variable densities (Thompson 1999). The subbasin also supports widely distributed resident populations in some upper tributary reaches (Thompson 1999). The Selway population is thought to contain “thousands of individuals” and be fluctuating around an equilibrium, but not growing (Thompson 1999).

The only subpopulation of bull trout defined as present–strong in the Lochsa AU is in Fishing (a.k.a. Squaw) Creek. Fishing Creek contains both resident and fluvial stocks of bull trout, with some of the most significant known bull trout habitat within the Lochsa drainage. An estimated 81 adults returned to spawn in Fishing Creek in 1997 and 1998 (Schoen et al. 1999). Based on the quantity of suitable habitat in Fishing Creek, this population size is considered low to moderate (Schoen et al. 1999).

8.1.8 Brook Trout

Brook trout are indigenous to eastern North America and have been introduced throughout the western states. Brook trout have been introduced in areas throughout the Clearwater River subbasin (Nez Perce National Forest 1998; Thompson 1999) beginning as early as 1936. Recent records indicate that the state of Idaho has not stocked brook trout in the Clearwater subbasin since 1984. Figure 107 shows the documented current distribution and relative status of brook trout population(s) within the Clearwater subbasin.

Introductions and subsequent spread of brook trout within the Clearwater subbasin may threaten bull trout populations in areas of coexistence. Hybridization of bull trout and brook trout is a common problem where populations overlap, and hybrids are often sterile (Clearwater subbasin Bull Trout Technical Advisory Team 1998d). Brook trout will outcompete bull trout in degraded streams (Clearwater subbasin Bull Trout Technical Advisory Team 1998a), although the opposite may be true in very cold streams (less than 10°C; Adams and Bjornn 1994, cited in Clearwater subbasin Bull Trout Technical Advisory Team 1998a). Currently methods are being tested in the Clearwater subbasin to remove brook trout from mountain lakes and adjacent tributaries where they are threats to bull trout (Murphy et al.2001).

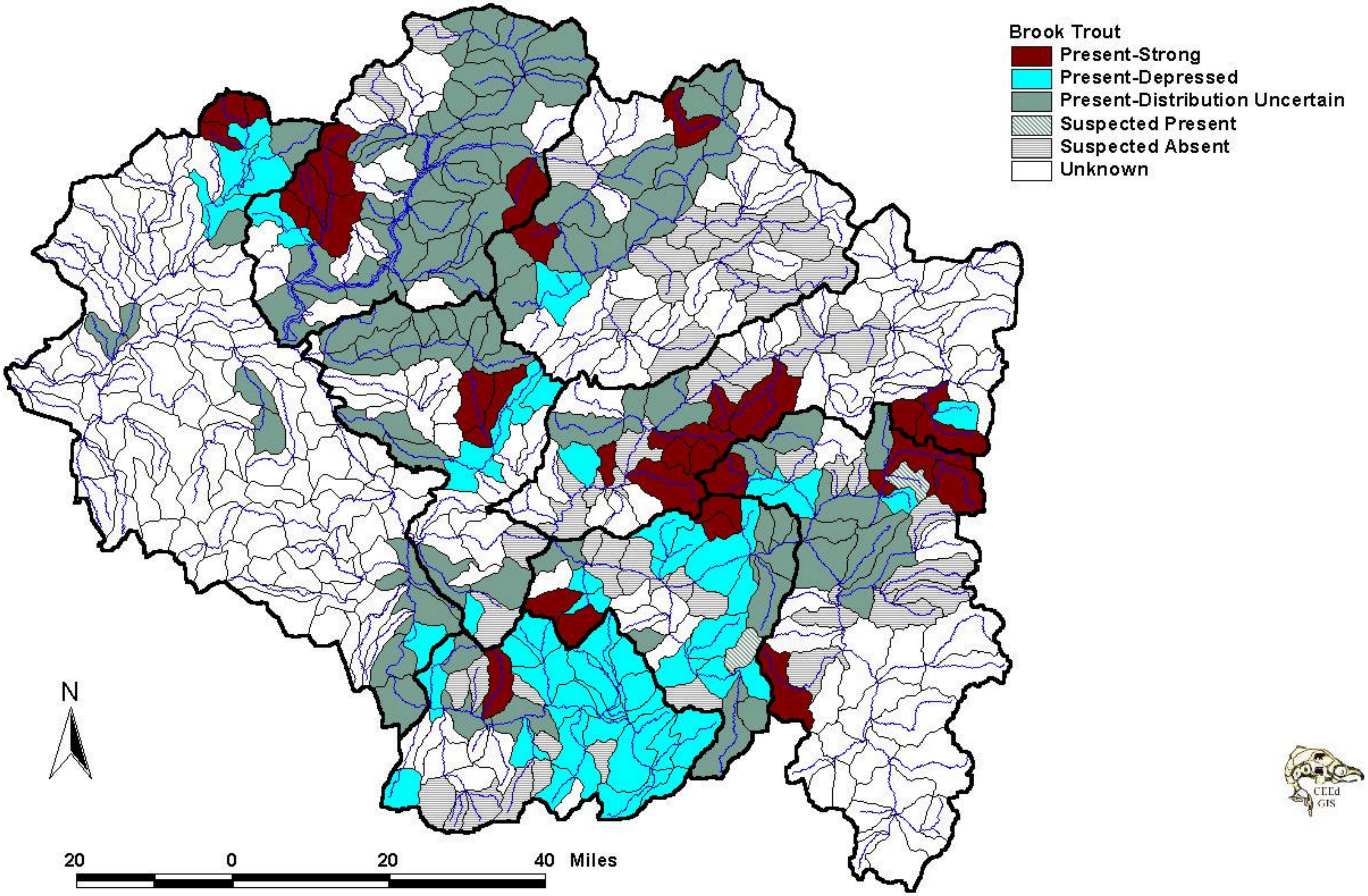

Figure 107. Known distribution and relative status of brook trout in the Clearwater subbasin

A statewide bonus harvest limit for brook trout exists (currently 25 brook trout) in addition to the general limit. In the Clearwater subbasin this applies to all waters except Elk Creek. There are no cutthroat or bull trout in Elk Creek, and the brook trout attain a large size and are highly sought after by anglers.

Brook trout may also displace westslope cutthroat trout from some native habitat (Behnke 1992). Griffith (1988, cited in Behnke 1992) stated that brook trout are more likely to displace cutthroat trout from lower gradient stream reaches, whereas cutthroat trout are likely to outcompete brook trout in areas of higher gradient.

Brook trout typically mature by age two or three, and rarely exceed six years of age (Simpson and Wallace 1982). Spawning usually occurs during late September and October, and the young emerge during April and May. Brook trout most often construct redds in gravel, but if groundwater upwelling is sufficient, they may spawn on sand or silty bottoms (Meehan and Bjornn 1991).

8.1.9 Dworshak Reservoir Resident Fishery

The Idaho Department of Fish and Game, U.S. Army Corp of Engineers, U.S. Fish and Wildlife Service and Nez Perce Tribe work together to provide and manage a fisheries program for Dworshak Reservoir (Idaho Department of Water Resources 2000). The program recognizes the importance of optimizing the kokanee fishery, enhancing the smallmouth bass fishery, stocking rainbow trout, and managing native species such as bull trout and westslope cutthroat trout (Idaho Department of Water Resources 2000).

Dworshak Dam blocked upstream fish passage to all but the lower 1.9 miles of the North Fork Clearwater River drainage. Dworshak hatchery was constructed to mitigate the resultant loss of steelhead production areas. In addition, the USACE has the legal responsibility to mitigate the effects of lost fishing opportunity resulting from construction of Dworshak Dam and Reservoir on the North Fork Clearwater River. Mitigation was originally defined as 100,000 pounds of hatchery reared fish annually, a goal which has only been reached three times since 1972. Annual stocking rates in Dworshak Reservoir have averaged 38,500 pounds over the past 25 years, and less than 15,000 pounds in the past 10 years (Idaho Department of Water Resources 2000).

Originally the Dworshak Reservoir fishery was comprised primarily of rainbow trout stocked as part of a federal fisheries mitigation requirement. From 1972 through 1980, rainbow trout dominated the fishery in Dworshak Reservoir, with angler use averaging about 88,000 hours annually (Idaho Department of Water Resources 2000). Smallmouth bass and kokanee were subsequently introduced to the reservoir, and by the 1980s, kokanee had replaced rainbow trout as the dominant fishery (Idaho Department of Water Resources 2000).

Kokanee are a landlocked form of sockeye salmon, which are not native to the Clearwater subbasin. Kokanee were first stocked into Dworshak Reservoir in 1972 (Horton 1980). Four sources of fish were initially used, but the early spawning strain from Anderson Ranch Reservoir, Idaho now populates the reservoir (Winans et al. 1996). These fish spawn during September in tributary streams as far as 140 km above the reservoir. They reach maturity primarily at age 2, although age 1 and age 3 spawners were occasionally found. Adults range in size from 200 to 400 mm in total length depending on density in the reservoir, but generally average 300 mm during spawning (Maiolie and Elam 1995).

Kokanee provide a highly desirable and popular sport fishery in Dworshak Reservoir. They are unique in their ability to build to high population numbers in this drawdown reservoir environment. Winter water releases from Dworshak Dam result in entrainment of kokanee, and a high degree of annual fluctuation in population levels of kokanee (Idaho Department of Water Resources 2000). Summer water releases result in substantially less kokanee entrainment because fish are more active and tend not to be congregated near the dam (Idaho Department of Water Resources 2000). In years when their numbers are good, kokanee have provided fisheries with harvests of over 200,000 fish per year (Mauser et al. 1989). Kokanee abundance within the reservoir, however, fluctuates widely (as much as 50 fold) due to entrainment losses into the dam (Figure 108). Kokanee spawner counts also fluctuate widely with the change in reservoir populations and entrainment loss (Table 55).

Entrainment losses limit the kokanee population in Dworshak Reservoir. Currently, strobe lights are being tested near Dworshak Dam as a method to reduce kokanee entrainment, and results are promising. Strobe light testing at off-site locations was successful and statistically significant reductions in densities of kokanee were found near the lights (Maiolie et al. 1999a; Maiolie et al. 1999b).

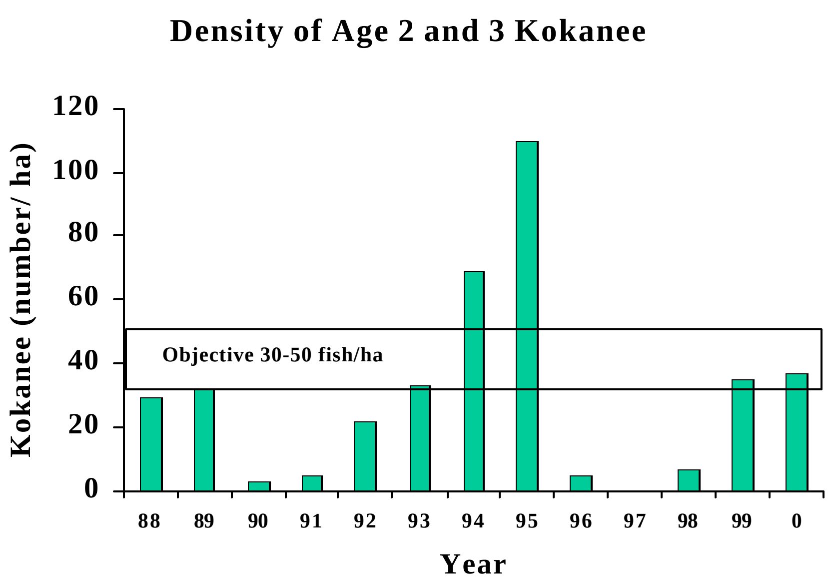

Figure 108. Abundance of age 2 and age 3 kokanee in Dworshak Reservoir, Idaho, from 1988 to 2000. Note the wide fluctuations in the population both above and below the objective to optimize the fishery

Table 55. Number of spawning kokanee observed in Dworshak Reservoir tributaries, 1981-2000

Year	Number of Spawning Kokanee
1981	8,070
1982	10,576
1983	2,451
1984	12,200
1985	20,000
1986	NC
1987	6,348
1988	21,820
1989	19,985
1990	15,456
1991	5,995
1992	13,192
1993	39,221
1994	31,424
1995	36,480
1996	2,569
1997	144
1998	678
1999	11,320
2000	4465

Success and consistency of the smallmouth bass fishery is also defined largely by the operational effects of Dworshak Dam and a general lack of productivity in the reservoir (Idaho Department of Water Resources 2000). Water level fluctuations in the reservoir also have eliminated successful spawning of redside shiners, substantially reducing forage availability for smallmouth bass (Idaho Department of Water Resources 2000). Smallmouth bass in Dworshak Reservoir have the slowest growth rate of any regional population, due primarily to a lack of forage, and the smallmouth bass fishery currently produces only limited harvest opportunity (Idaho Department of Water Resources 2000).

Rainbow trout stocking in Dworshak Reservoir has had mixed results, and in years of low kokanee abundance rainbow trout comprise the majority of consumptive fishing opportunities (Idaho Department of Water Resources 2000). Hatchery reared rainbow trout also dominate the creel of shoreline anglers in the reservoir (Idaho Department of Water Resources 2000). Beginning in 2000, all hatchery rainbow stocked in the reservoir are sterile to minimize risk of hybridization with native cutthroat trout and redband trout (Jody Brostrom, IDFG, personal communication, May 7, 2001).

8.2 Artificial Production

A general overview of artificial production facilities located within the boundaries of the Clearwater subbasin is presented in Table 56. More detailed information on artificial production facilities follows.

8.2.1 Idaho Department of Fish and Game

The Idaho Department of Fish and Game operates the Clearwater Fish Hatchery, located at the mouth of the North Fork Clearwater River. Clearwater Fish Hatchery was authorized and constructed under the Lower Snake River Compensation Program (LSRCP), and is the newest LSRCP hatchery program in the Snake River basin (The overall Snake River basin LSRCP program is described in USFWS 2001b). The hatchery was completed and became operational in 1990. The implementation of the Clearwater Fish Hatchery program was guided by the following management objectives: 1) restore and maintain natural spawning populations, 2) re-establish historic recreational and tribal fisheries, 3) establish total adult returns that meet LSRCP goals, 4) operate the hatchery programs so that genetic and life history characteristics of hatchery fish mimic wild fish, and 5) minimize impacts on resident stocks of game fish. The IDFG strongly emphasizes maintaining selective fisheries with the steelhead and chinook salmon programs. Clearwater Fish Hatchery also produces steelhead and chinook salmon juveniles for release as part of the Idaho Supplementation Studies (chinook salmon) and Steelhead Supplementation Studies projects occurring in the subbasin. The Clearwater Fish Hatchery salmon and steelhead artificial production programs conform to statewide fisheries policies and management goals identified in the 2001-2006 Fisheries Management Plan (IDFG 2001c).

Clearwater Fish Hatchery serves only incubation and early rearing functions for steelhead and chinook salmon. All juvenile production is released off site. Dworshak National Fish Hatchery supplies fertilized B-run steelhead eggs for the Clearwater Fish Hatchery steelhead program. Adult spring chinook salmon trapping and spawning, and juvenile fish final rearing and release are conducted at the hatchery's three satellite facilities. The Powell satellite, located on the Lochsa River was completed in 1989. Red River (completed in 1986) and Crooked River (completed in 1990) satellites are located in the South Fork Clearwater subbasin. Juvenile fish pond capacities at the satellite facilities are 334,000 at Powell, 334,000 at Red River, and 700,000 at Crooked River. The chinook salmon total juvenile release target of 1.3695 million fish was intended to return about 12,000 adult spring chinook salmon back to the LSRCP project area (above Lower Granite Dam). The steelhead total juvenile release target of 2.8 million smolts (8 fish per pound) was intended to return about 14,000 adult steelhead to the LSRCP project area above Lower Granite Dam.

An extensive monitoring and evaluation program documents hatchery practices and evaluates the success of hatchery programs at meeting LSRCP mitigation objectives, IDFG management objectives, and monitors and evaluates the success of supplementation programs. The IDFG-LSRCP hatchery monitoring and evaluation program identifies hatchery rearing and release strategies that will allow the LSRCP program to meet its mitigation requirements and improve the survival of hatchery fish while avoiding negative impacts to natural (including listed) populations. In some cases, particularly in light of ESA requirements and Idaho Supplementation Study (ISS) plans, hatcheries may be used to enhance naturally reproducing populations.

Table 56. Description of production programs utilized within the Clearwater subbasin

Stock	Intent	Initial Broodstock	Operating Broodstock	Adult Collection/Holding	Central Facility (Incubation/rearing)	Acclimation and release sites	Status	Funding Source
Chinook - S	Harvest/Mitigation	Little White/ Leavenworth/ Rapid River	Dworshak	Dworshak	Dworshak NFH/ Kooskia NFH	Dworshak N.F. Clearwater	Ongoing	LSRCP
Chinook - S	Supplementation (ISS)	Rapid R., Crooked R., Red R., Powell., Kooskia	Rapid R., Crooked R., Red R., Powell., Kooskia	Red R, Crooked R., Powell, Kooskia	Clearwater Hatchery, Kooskia NFH	Upper Red and Crooked rivers, Clear Cr., Pete King Cr, Fishing (Squaw) Cr., Bear (Papoose) Cr., Colt Killed Cr., Big Flat Cr	Ongoing	LSRCP
Chinook - S	Supplementation	Rapid River	Rapid River Dworshak	Yoosa, Newsome, Mill Cks	Nez Perce Tribal Hatchery (under construction)	Yoosa, Newsome, Mill Creeks – Ponds; Meadow, Boulder, Warm Springs- direct	Step 3 (5/3/99)	NPPC
Chinook - S	Harvest/Mitigation	Carson/ Rapid River	Kooskia	Kooskia/Dworshak	Dworshak, Kooskia NFH	Kooskia at Clear Creek	Ongoing	USFWS
Chinook - F	Supplementation	Snake R. @ Hells Canyon Dam	Lyons Ferry	Lyons Ferry	Lyons Ferry; FCAP Project	Big Canyon, Clearwater R.	Ongoing	BPA/LSRCP
Chinook - F	Supplementation	Lyons Ferry	Local	N. Lapwai, Lukes Gulch	Sweetwater Springs and NPTH	Cedar Flats/Selway R, mainstem Clearwater R. N. Lapwai, Lukes Gulch/ S.F. Clearwater R.	Step 3 (5/3/99)	NPPC
Steelhead	Harvest/ Mitigation	Dworshak – North Fk. Clearwater B-run	Dworshak	Dworshak	Dworshak NFH	mainstem-direct, SF and MF	Ongoing	USACE
Steelhead	Harvest/ Mitigation	Dworshak – North Fk. Clearwater B-run	Dworshak	Dworshak	Clearwater Hatchery	SF and MF Clearwater,	Ongoing	LSRCP
Steelhead	Supplementation	Dworshak – North Fk. Clearwater B-run	Dworshak	Dworshak	Clearwater Hatchery and Dworshak and Hagerman NFHs	Lolo, Mill, Newsome, Meadow Crks, American, Red and Crooked R./Dworshak direct	Ongoing - 2002	LSRCP/USACE
Coho	Reintroduction	Eagle Creek, Bonneville,	Creating Broodstock w/ Adult Returns	Kooskia,Dworshak, Potlatch R., Lapwai, Crk.	Dworshak,Clear-water, Sweetwater, NPTH	Sweetwater Springs, Kooskia, Potlatch R., Meadow/Lolo/Lapwai Creeks	Ongoing	NPPC

To properly evaluate the compensation effort, adult returns to facilities, spawning areas, and fisheries that result from hatchery releases are documented. IDFG's LSRCP program requires the cooperative efforts of the Hatchery Evaluation Study, the Harvest Monitoring Project, and the Coded Wire Tag Laboratory program. The Hatchery Evaluation Study evaluates and provides oversight of certain hatchery operational practices, e.g., brood stock selection, size and number of fish reared, disease history, and time of release. Hatchery practices are assessed in relation to their effects on adult returns and recommendations made for improvement of hatchery operations. Continuous coordination between the Hatchery Evaluation Study and IDFG's BPA-funded supplementation research project is required because these programs overlap in several areas, including juvenile outplanting, brood stock collection, and spawning (mating) strategies. LSRCP hatchery production will play a substantial role in IDFG's supplementation research. The Harvest Monitoring Project provides comprehensive harvest information for evaluating the success of the LSRCP in meeting adult return goals. The number of hatchery and wild/natural fish in overall returns to the project area in Idaho are estimated, and data on the timing and distribution of hatchery and wild stocks are collected and analyzed to develop LSRCP harvest management plans. Harvest data provided by the Harvest Monitoring Project are coupled with hatchery return data to provide an estimate of returns from LSRCP releases. Coded-wire tags continue to be used extensively to evaluate fisheries contribution of representative groups of LSRCP production releases. However, most of these fish serve experimental purposes as well, e.g., for evaluation of hatchery controlled variables such as size, time, and location of release, rearing densities, and so on.

More detailed information on the Clearwater Fish Hatchery steelhead and chinook salmon programs is contained in Appendix G, Draft Hatchery and Genetic Management Plan (HGMP) – Clearwater Fish Hatchery. A complete HGMP for the program will be submitted to NOAA Fisheries.

8.2.2 Nez Perce Tribe Department of Fishery Resource Management

Nez Perce Tribe Resident Fish Substitution Program

The goal of this program is to substitute resident fisheries in confined ponds as partial mitigation for loss of anadromous fisheries resulting from construction of Dworshak Dam. This program does not operate a hatchery, nor does it propagate species or populations in a hatchery. Hatchery products are used in the execution of the project, however, and within that context a Hatchery and Genetic Management Plan (HGMP) is provided for the program (See Subbasin Inventory, Section 3.5).

Nez Perce Tribal Hatchery

The Nez Perce Tribal Hatchery mitigates for the loss of naturally-reproducing salmon in the Clearwater River subbasin. The overall goal is to produce and release fish that will survive to adulthood, spawn in the Clearwater River subbasin and produce viable offspring that will support future natural production and genetic integrity. Several underlying purposes of fisheries management will be maintained through this program:

- protect, mitigate, and enhance Columbia River subbasin anadromous fish resources
- develop, reintroduce, and increase natural spawning populations of salmon within the Clearwater River subbasin

- Provide long-term harvest opportunities for Tribal and non-Tribal anglers within Nez Perce treaty lands within four generations (20 years) following project completion
- Sustain long-term fitness and genetic integrity of targeted fish populations
- Keep ecological and genetic impacts to nontarget populations within acceptable limits
- Promote Nez Perce Tribal management of Nez Perce Tribal hatchery facilities and production areas within Nez Perce treaty lands (Bonneville Power Administration et al. 1997).

Previous reports that describe the NPTH program include

- Nez Perce Tribal Hatchery Master Plan and Appendices (Larson and Mobrand 1992)
- Genetic Risk Assessment of the Nez Perce Tribal Hatchery Master Plan (Cramer and Neeley 1992)
- Selway Genetic Resource Assessment (Cramer 1995)
- Supplement to the Nez Perce Tribal Hatchery Master Plan (Johnson et al. 1995).
- Monitoring and Evaluation Plan for the Nez Perce Tribal Hatchery (Steward 1996).
- Nez Perce Tribal Hatchery Program Final Environmental Impact Statement (Bonneville Power Administration et al. 1997)
- Hatchery Genetic Management Plan (Kincaid 1998)
- Nez Perce Tribal Hatchery Benefit Risk Analysis (Columbia River Inter-Tribal Fish Commission 1999)
- Nez Perce Tribal Hatchery Monitoring and Evaluation Action Plan (Hesse and Cramer 2000).

In the Nez Perce Tribal Hatchery Master Plan, Larson and Mobrand (1992) propose the restoration of spring, summer and fall chinook as the principle management strategy. The Nez Perce Tribe Office of Legal Counsel has released documents which are part of the Snake River Basin Adjudication instream flow claims in which Tribal members and others substantiate the fishery resources used historically and presently by the Nez Perce Tribe (Marshall 1998; Greiser 1998; Slickpoo 1989; Carter 1998; Whitman 1998; Oatman 1998; Axtell 1998; Crow 1998). These documents, along with Reiser (1998), substantiate the presence of anadromous and resident species that historically occurred in the Clearwater subbasin prior to dams, irrigation, and other commercial practices that lead to their demise. Based on these documents, species which would constitute an all species, stock and population approach to recovery and restoration for the Clearwater River subbasin would include

- Spring Chinook Salmon
- Summer Chinook Salmon
- Fall Chinook Salmon, to include an "early"-type
- A-type (run) Steelhead Salmon
- B-type (run) Steelhead Salmon
- Coho Salmon
- Sturgeon
- Pacific Lamprey
- Resident species including bull trout, westslope cutthroat trout, suckers, etc.

While projects and plans for the immediate recovery of all these species will not be included in this document, they should be noted as a restoration need for future planning as the ecosystem is recovered.

Fall Chinook Acclimation Project, Big Canyon Acclimation Site
Initial design and funding occurred under a 1995 Congressional grant organized by Senator Hatfield wherein the U.S. Oregon process provided oversight and direction to the U.S. Army Corps of Engineers to construct facilities. This program designed and constructed three acclimation facilities above Lower Granite Dam to aid in restoring natural spawning Snake River fall chinook. The Nez Perce Tribe operates and maintains three satellite facilities developed since 1996, 2 on the Snake River and 1 at Big Canyon Creek/Clearwater River confluence. Each satellite acclimates and releases smolts reared at Lyons Ferry Hatchery. Up to 150,000 yearling smolts are acclimated and released each year. Up to 1.8 million subyearling have also been acclimated and released by dividing them between the 3 satellite facilities. All fish are marked for identification as emigrants, and as adult returns they are allowed to ascend above Lower Granite Dam to spawn naturally. Present adult response indicates a major increase in redd counts and smolt emigration counts. The goals and objectives of this program are identical to those shown under the Nez Perce Tribal Hatchery project.

Nez Perce Clearwater Coho Restoration Project
This project started because State and Federal agencies in U.S. v. Oregon PAC (Production Advisory Committee) identified surplus coho eggs not being used for production. A portion of the project is linked to the NMFS Mitchell Act Program calling for restoration of coho stocks for the Tribes upriver of Bonneville Dam. Initial funding was created from BIA 638 budget at the Nez Perce Tribe. Mitchell Act funding occurred in 1999 and 2000. BPA as authorized by NPPC, has provided planning funds in 1998 to present. Additional BIA funds have maintained supplies and transport costs for the past 3 years. Joint in-kind support by USFWS, IDFG and NPT has provided personnel and allowed on-the-job training for NPTH staff during construction. In 1994, PAC, which had 10-14 million surplus eggs; received a request from the Nez Perce Tribe for 800,000 eyed-eggs to be imported annually. This project has expanded to provide annually up to 450,000 coho parr produced at Clearwater Hatchery and 280,000 coho smolts reared at Dworshak with acclimation and release at Kooskia Hatchery. In addition, 570,000 Mitchell Act/USFWS smolts are imported and directly released each year at Lapwai Creek and Potlatch River, approximately half per stream. A multiphased approach is proposed to enhance the recovery of this species in a Master Plan being rewritten at this time. Adult returns from this program have occurred in 1997, 1998, 1999, and 2000. Broodstock from returning adults has been incorporated to replace the out-of-basin eggs take in 1999 and 2000 and has provided 3/8ths and 5/8ths of the eggs needed in 1999 and 2000, respectively. The 2001 adult returns are anticipated to meet all egg import needs and perhaps to partially replace the need to import smolt broodstock. Completion of the Clearwater Coho Master Plan is anticipated to occur in conjunction with the Provincial Review and Subbasin Assessment process being conducted by the NPPC. The goals and objectives of this program are identical to those shown under Nez Perce Tribal Hatchery project above.

8.2.3 U.S. Fish and Wildlife Service

Dworshak National Fish Hatchery - Summer Steelhead Program

Dworshak National Fish Hatchery (NFH) is located at the confluence of the North Fork and the mainstem of the Clearwater River near Ahsahka, Idaho. Construction of the hatchery was included in the authorization for Dworshak Dam and Reservoir (Public Law 87-847, October 23, 1962) to mitigate for losses of steelhead trout caused by the dam and reservoir. The hatchery was designed and constructed by the U.S. Army Corps of Engineers (USACE) and has been administered and operated by the U.S. Fish and Wildlife Service since the first phase of construction was completed in 1969. At that time, the hatchery had 25 ponds on a single reuse system and 59 other ponds on single-pass water. In 1972, a second phase of construction placed all ponds on three reuse systems with the option of operating on either reuse or single-pass. The hatchery began using only single-pass for the oldest system (25 ponds) in 1986. Present production is 2.3 million smolts at an average size of 200mm in length.

The North Fork Clearwater River summer steelhead trout stock maintained by Dworshak NFH is unique. As a result of the blocked habitat behind Dworshak Dam, currently no natural populations remain in the North Fork Clearwater River. Recent collections of rainbow trout in tributaries of the North Fork Clearwater River above the dam show genetic profiles very close to the genetic profile of steelhead trout returning to the hatchery. Genetic analysis indicates that Dworshak B-run steelhead trout more closely resemble the North Fork rainbow trout than any other rainbow trout or steelhead trout collected in Idaho. The stock has been included as part of the Snake River steelhead trout ESU identified by the NOAA Fisheries under the Endangered Species Act (ESA), but is not needed for recovery.

At maturity, males and females of this particular stock of "B" run steelhead trout average about 91 cm (36 inches) and 82 cm (33 inches) in length, respectively. Spawning stock is comprised of three age classes; I-, II-, and III-"salt" fish. This nomenclature refers to the number of complete years fish have spent in salt water. Fish are actually two years older than this system indicates, as they are reared for one year in the hatchery and spend another year migrating to and from the ocean.

Most "B" run steelhead trout enter the Columbia River in August through September, usually later than the smaller "A" run fish. The Clearwater "B" run steelhead trout may reach the Snake and Clearwater rivers in the fall, then overwinter until their final run into the hatchery. Some of the fish arrive at Dworshak NFH in the fall. The Dworshak NFH fish ladder and trap is operated during the fall to insure inclusion of sufficient early arriving steelhead (~500 adults) into the hatchery gene pool. The ladder is then reopened from February through April to capture broodstock from the mid- and late portions of the run.

The Dworshak NFH steelhead trout program has the potential to affect listed A-run steelhead trout and Snake River fall chinook salmon in several ways: 1) predation; 2) competition; 3) adverse behavioral interactions; 4) disease transmission; 5) alteration of the gene pool; (6) harvest and/or (7) facility operation and maintenance. Although some potential exists for the program to affect listed species, the USFWS has concluded that any affect would not be significant. In addition, the USFWS continues to evaluate and improve the production program to produce the healthiest and most physiologically fit smolts at release in order to minimize residualization and potential interactions with listed species.

Releases of steelhead trout smolts from Dworshak NFH began in 1970 with the first hatchery produced adults returning in 1972. The 1999-2000 return marked the 28th year that artificially spawned North Fork Clearwater River steelhead trout have returned to Dworshak NFH. The adult return goal for Dworshak NFH is 20,000 adults to the Clearwater River. Since the male to female ratio is about 1:1 and spawning protocol calls for 1:1 spawning, the goal for broodstock collection is about 400 adults. Table 57 summarizes the Dworshak NFH steelhead trout returns to the Clearwater River from 1972-2000. Table 58 summarizes smolts released, adults returned by age, and the smolt-to-adult rate of return from 1980-1998.

Dworshak National Fish Hatchery - Rainbow Trout Program

To mitigate for the lost resident sports fishery in the North Fork Clearwater River, the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service agreed that 100,000 pounds of rainbow trout would be reared at Dworshak NFH for stocking in Dworshak Reservoir annually. During the early years rainbow were produced at Dworshak NFH and stocked directly into the reservoir. Numbers and pounds of fish stocked has varied over the years, but 100,000 pounds per year has never been stocked. The rainbow trout are from sources outside of Idaho and concerns exist about hatchery rainbow trout from Dworshak Reservoir ascending into the North Fork of the Clearwater River to hybridize with native cutthroat trout. This issue and concerns about the cost/benefit ratio of stocking rainbow trout into Dworshak Reservoir is under review by IDFG, NPT, USFWS, and USACE. Currently, some rainbow are raised at Hagerman NFH and released into reservoirs in southern Idaho. In replacement, the Idaho Department of Fish and Game releases a quantity of rainbow trout into Dworshak Reservoir from a disease free hatchery, and in recent years the trout have been sterile. In addition to rainbow, the USFWS has stocked other species such as small mouth bass and kokanee salmon into Dworshak. Kokanee are now the primary sport fish in the reservoir and are primarily self-sustaining. Table 55 provides a history of early stocking of resident fish in Dworshak Reservoir.

Kooskia National Fish Hatchery - Spring Chinook Program

Kooskia NFH was authorized by Congress (75 Statute 255) in August 1961 and was built by U.S. Fish and Wildlife Service (USFWS) to raise spring chinook salmon. The program called for releases of spring chinook salmon smolts into the Clearwater subbasin to mitigate for fish losses from federal water development projects in the Columbia River Basin. Kooskia NFH is located about 1.5 miles southeast of Kooskia, Idaho, near the confluence of Clear Creek and Middle Fork of the Clearwater River and is funded by the USFWS.

The Kooskia NFH Spring Chinook Salmon Program was started using a variety of stocks from the Lower Columbia River and Rapid River State Fish Hatchery. However, from 1973 through 1980, smolt releases had a very strong Carson stock influence. Egg transfers of Carson type stock from Dworshak NFH in 1985 and 1986 resulted in smolt releases in 1987 and 1988 of a mixed stock, referred to as Clearwater stock (Table 60). Since the Kooskia NFH program already had stock made up primarily of Carson derivatives, the resultant program (1989 and later) is still considered a Carson type stock, and is referred to as Kooskia stock. Length frequency data, ocean age class at return time information, and allele frequencies all support a distinction between Dworshak and Kooskia stocks.

The first smolt releases were made in 1971. The first adults began to arrive back at the hatchery in 1972. A summary of the program to date is provided in Table 61. The production goal has been modified over the years. Currently, Kooskia NFH has the capacity to rear about 600,000 to 650,000 spring chinook salmon from the egg stage through smolt size. Smolts are released directly into Clear Creek at a size of about 20 fish per pound or 140 mm (TL). To meet this objective, about 200 adult females are needed for spawning. Since the male to female ratio is about 1:1 and spawning protocol calls for 1:1 spawning, the goal for broodstock collection is about 400 adults.

Table 57. Number of steelhead returning to Dworshak NFH, estimates of hatchery fish harvested, and total hatchery returns to the Clearwater River, Idaho, 1972-2000 (1972-73 to 1983-84 data from Pettit 1985).

Return[1]	Number Back to Dworshak NFH	Estimated Clearwater Sport Harvest[2]	Estimated Clearwater Tribal Harvest[3]	Unharvested Clearwater Hatchery Fish[4]	Total Hatchery Fish Returning to Clearwater River
1972-73	9,938	2,068	-	0	12,006
1973-74	7,910	2,320	-	0	10,230
1974-75	1,698	N.S.[5]	290	0	1,988
1975-76	1,858	N.S.	430	0	2,288
1976-77	3,100	N.S.	410	0	3,510
1977-78	12,272	14,000	(1000)[6]	0	27,272
1978-79	4,939	4,610	(500)	0	10,049
1979-80	2,519	N.S.	1,250	300	4,069
1980-81	1,968	4,510	(1000)	500	7,978
1981-82	3,054	1,665	(1000)	0	5,719
1982-83	7,672	13,967[7]	(1,500)	0	23,139
1983-84	3,284	6,500	(500)	100	11,384
1984-85	14,018	19,410	(1,500)	2,700	37,628
1985-86	4,462	7,240	1,471	1,800	15,002
1986-87	5,286[8]	15,679	4,210	3,000	28,175
1987-88	3,764	8,766	1,478	2,000	16,008
1988-89	6,041	11,332	1,242	3,700	22,315
1989-90	10,630	27,952	1,710	3,650	43,943[9]
1990-91	7,876	12,973	1,211	2,250	24,147
1991-92	3,700	10,416	1,326	1,650	17,092
1992-93	7,900	19,351	1,184	3,368	31,803
1993-94	3,757	14,063	675	1,457	17,096
1994-95	1,394	5,953	730	1,307	9,384
1995-96	4,480	2,139	992	1,315	9,106
1996-97	2,980	4,926	513	779	9,198
1997-98	3,601	7,611	145	479	11,836
1998-99	5,419	8,773	1,007	1,137	16,335
1999-00	2,882	7,177	1,000	720	11,775

[1]Return year is from October through May.
[2]Unless otherwise noted, estimates of sport harvest in the Clearwater River taken from IDFG annual reports.
[3]Unless otherwise noted, estimates of tribal harvest in the Clearwater River were taken from Nez Perce Tribe Department of Fishery Resource Management annual reports.
[4]Based on return percentage back to hatchery to calculate returning II-salts from upstream releases.
[5]N.S., no sport fishing season.
[6]( ) guesstimate on tribal harvest by author.
[7]Pettit IDFG, Lewiston, Idaho (personal communication) included an additional 2,000 fish in harvest from Snake River for a total of 15,967.
[8]Ladder was closed for several days due to high number of returns; not a total hatchery return figure.
[9]We believe the sport estimate of 27,953 is about 8,000 too high and the total number of Dworshak steelhead to the Clearwater River was in the range of 32,000 to 35,000.

Table 58. Return vs. release numbers for summer steelhead at Dworshak NFH, release years 1980-1998

Release Year	Smolts Released	Returns				Rack Return %
		I-Salt	II-Salt	III-Salt	Total	
1980	2,666,085	400	6,613	652	7,665	0.2875
1981	1,930,047	124	1,538	1,219	2,881	0.1493
1982	2,108,319	1,094	12,679	403	14,176	0.6724
1983	1,259,110	120	3,359	239	3,718	0.2953
1984	1,208,319	700	8,318	119	9,137	0.7562
1985	1,035,573	431	3,487	317	4,235	0.4090
1986	1,239,541	168	5,296	215	5,679	0.4582
1987	1,206,580	428	9,896	314	10,638	0.8817
1988	1,432,125	487	7,339	250	8,076	0.5639
1989	1,073,900	218	3,132	162	3,512	0.3270
1990	1,466,664	313	7,349	153	7,815	0.6699
1991	1,192,503	389	3,543	76	4,008	0.3361
1992	1,224,101	61	1,270	71	1,331	0.1087
1993	1,217,990	48	4,005[1]	83	4,136	0.3396
1994	1,153,417	384	2,537	38	2,959	0.2565
1995	1,213,577	349	3,308	87	3,744	0.3085
1996	1,377,435	253	4,976	69	5,298	0.3846
1997	1,361,034	356	2,225			
1998	1,228,944	588				

1 Does not include twenty unmeasured fish.

Table 59. Dworshak Reservoir rainbow trout stocking history, 1972-2000

Year	Number	Weight(lbs.)	Size (#/lb.)	Stock	Hatchery
1972	1,043,506	99,917		Unknown	Dworshak
1973	2,554,170	134,808		Unknown	Dworshak
1974	1,070,260	19,075		Unknown	Dworshak
1975	917,856	114,301		Unknown	Dworshak
1976	763,286	64,133		Unknown/ WY	Dworshak/Hagerman
1977	1,162,670	34,217		Unknown	Dworshak
1978	25,936	13,412		Unknown	Dworshak
1979	1,313,524	92,541		Unknown	Dworshak
1980	1,616,245	36,052		Unknown	Dworshak
1981	861,429	87,049		Ennis/Ca	Dworshak
1982	153,956	34,940		Unknown	Dworshak
1983	574,255	58,503	9.8	Unknown	Dworshak
1984	67,561	27,285	2.5	Unknown	Dworshak
1985	120,000	40,000	3.0	Unknown	American Falls/Mackay
1986	156,773	14,388	10.9	Shasta	Hagerman
1987	93,856 80,400	3,755 1,340	25.0 132.0	Kamloops Unknown	Hagerman Grace
1988	294,906	28,120	10.5	Arlee & Shasta	Hagerman
1989	245,380	23,202	10.6	Arlee & Shasta	Hagerman
1990	222,026	14,350	15.5	Arlee & Shasta	Hagerman
1991	NONE				
1992	101,186	2,844	35.6	Arlee & Shasta	Kooskia
1993	195,760	9,732	20.1	Arlee & Shasta	Kooskia
1994	NONE				
1995	17,700	5,900	3.0	Kamloops	Nampa
1996	30,500	8,350	3.7	Kamloops	Nampa
1997	40,000	10,592	3.8	Hayspur	Clearwater
1998	28,640	8,183	3.5	Mixed	Hayspur
1999	150,155	49,150	3.1	Kamloops	Nampa
2000	132,630	44,665	3.0	T9 sterile	Hayspur

Table 60. Genetic background of Kooskia NFH spring chinook salmon smolts directly released from the hatchery, 1971-2000

Release Year	Genetic Background [1]
1971	86% RR,14% WR
1972	100% RR
1973	100% CA
1974	100% CA
1975	58% RR, 42% CA
1976	100% SS
1977	84% CA, 11% KK, 5% LW
1978	75% RR, 25% CA
1979	69% KK, 31% CA
1980	31% KK, 69% CA
1981	64% CA, 19% KK, 17% RR
1982	100% CA
1983	65% KK, 35% LE
1984	89% KK, 11% RR
1985	100% KK
1986	100% KK
1987	100% CL
1988	100% CL
1989 -2000	100% KK

1 RR = Rapid River, KK = Kooskia, LE = Leavenworth, SS = South Santiam, CL = Clearwater, LW = Little White Salmon, CA = Carson, WR = Wind River

Table 61. Hatchery rack returns and age composition of spring chinook salmon for Kooskia NFH, 1972-2000

Year	I-Salt	II-Salt	III-Salt	Unmeasured	Total Return
1972	5	0	0	0	5
1973	5	45	0	0	50
1974	16	35	2	0	53
1975	15	284	27	0	326
1976	409	286	106	0	801
1977	333	2,539	154	0	3,026
1978	23	1,676	336	0	2,035
1979	11	100	264	0	375
1980	9	55	3	0	67
1981	1	168	78	0	247
1982	3	116	139	0	258
1983	1	231	141	0	373
1984	55	80	206	0	341
1985	26	449	54	0	529
1986	21	159	103	0	283
1987	16	607	64	0	687
1988	39	363	193	0	595
1989	107	717	142	7	973
1990	11	921	209	0	1,141

Table 61 (cont.)

Year	I-Salt	II-Salt	III-Salt	Unmeasured	Total Return
1991	10	98	350	9	467
1992	14	239	38	21	312
1993	11	749	409	11	1,180
1994	1	96	135	0	232
1995[1]	21	7	12	0	40
1996	86	113	3	0	202
1997	7	1,523	127	0	1,657
1998	1	200	207	0	408
1999	72	28	57	0	157
2000	966	604	11	0	1,581

Production is primarily limited by the hatchery well water supply. Because of this constraint, temperature considerations, and other factors, Dworshak NFH holds and spawns spring chinook salmon adults trapped at Kooskia NFH. Kooskia NFH eggs and juveniles are also often held at Dworshak NFH. However, each stock is released at its own facility. In the past two years Kooskia NFH has been used for incubation and early rearing of Dworshak NFH chinook because of the cold well water supply. In 1995 Kooskia NFH was included in the Dworshak Fisheries Complex and fish production at the two hatcheries is closely coordinated.

The Kooskia spring chinook salmon program has the potential to affect listed A-run steelhead and Snake River fall chinook salmon in several ways: 1) competition; 2) adverse behavioral interactions; 3) disease transmission; and 4) facility operation and maintenance. As with the steelhead program at Dworshak NFH, the USFWS has concluded that any affect of the spring chinook salmon program at Kooskia NFH on listed species would not be significant. The USFWS continues to evaluate and improve spring chinook salmon production to minimize interactions with listed species.

8.2.4 Miscellaneous Anadromous Stocking

During years with surplus adult hatchery returns, outplanting of adult steelhead or spring chinook salmon is conducted in areas of agreement between subbasin salmon managers. Streams receiving outplants have past stocking histories, and wild steelhead areas are not stocked. Fish outplanted have originally returned to Dworshak and Kooskia National Fish Hatcheries, Clearwater Hatchery satellites or, in some cases, Rapid River Hatchery (chinook). These are not part of any program and only occur when there is a surplus. No monitoring and evaluation program is currently being conducted on these releases.

8.3 Fish Limiting Factors

Six types of information have been considered for review of limiting factors to fish populations in the Clearwater subbasin, each differing in relative scale and species considerations:

1. Regional documentation of nonspecies specific factors limiting production of resident and anadromous fish in the subbasin as a whole;
2. Past subbasin specific research documents and current professional judgement of species specific factors limiting populations in individual AUs within the subbasin;
3. Information compiled by the Northwest Power Planning Council as part of the subbasin planning process for review of reach specific limiting factors related to spring chinook and steelhead;
4. The 1998 §303(d) list compiled by IDEQ of reach specific factors limiting beneficial use(s), including cold water biota and/or salmonid spawning;
5. Potential connectivity/passage issues related to road culverts with potential to impact all species of fish throughout the subbasin.
6. Temperature modeling was conducted to examine broad-scale patterns in temperature variations in the Clearwater subbasin as they relate to potential fish distribution.

Hatchery influences to fish populations are not addressed here as limiting factors due to the debatable and often site specific nature of hatchery influences to existing fish stocks. Hatchery supplementation of wild fish stocks has the potential to adversely impact the genetic or biological integrity of existing stocks (Busby et al. 1996; Evans et al. 1997; USFWS and NPT 1995). However, the degree of impact often depends on numerous factors including stocking densities and distribution, and the status of existing wild/natural stocks. Interactions of hatchery and wild anadromous fish stocks in the Clearwater subbasin have been investigated and potentially negative impacts to wild stocks have been suggested (USFWS and NPT 1995 and 1997). However, such impacts have not been clearly defined in the Clearwater subbasin.

8.3.1 Subbasin Scale – Regional Sources

Primary factors limiting resident salmonid populations in the Clearwater subbasin relate to the impacts of land management activities on hydrology, sedimentation, habitat distribution and complexity, and water quality (CBFWA 1999). In addition, bull trout and other resident and anadromous fish may be limited by reductions in available forage, aquatic macroinvertebrate biomass and taxonomic richness, and reduced growth rates due to loss of anadromous fish production and the nutrients that carcasses provide (Cederholm et al. 2000; CBFWA 1999, Piorkowski 1995, Minakawa 1997, Wipfli et al. 1998). Another significant limiting factor to resident fish populations is the loss of 53 miles of resident salmonid spawning habitat inundated by Dworshak Reservoir (Dave Statler, NPT, personal communication, April 20, 2001).

At the subbasin scale, anadromous fish production in the Clearwater subbasin is limited by three primary factors: 1) adult escapement of salmon and steelhead is currently limited by out-of-subbasin factors (e.g. dams and ocean conditions) and is insufficient to fully seed available habitat; 2) habitat carrying capacity and fish survival have been reduced within the subbasin by land management activities which impact hydrology, sedimentation, habitat distribution and complexity, and water quality (CBFWA 1999); and 3) Dworshak Dam blocks access to habitat that once produced up to 60% of steelhead and provided excellent spawning and rearing habitat for spring chinook salmon, and is a limiting factor at the subbasin scale.

General agreement exists that hydropower development on the lower Snake River and Columbia River is the primary cause of decline and continued suppression of Snake River salmon and steelhead (IDFG 1998a; CBFWA 1991; NPPC 1992; NMFS 1995 and 1997; NRC 1995; Williams et al. 1998). However, less agreement exists about whether the hydropower system is the primary factor limiting recovery (Marmorek et al. 1998).

Impacts of hydropower development limit anadromous populations within the Clearwater subbasin by keeping yearly effective population size low, thereby increasing genetic and demographic risk of localized extinction. Small populations may develop intrinsic demographic problems such as unbalanced sex ratios, unstable age distributions, random failures in survival and fertility (Foose et al.1995) that can fatally disrupt persistence (Goodman 1987). Small population size also disposes a population to inbreeding depression (Soule 1980, Franklin 1980). Stochastic environmental events such as droughts, floods, ice flows, landslides, have the potential to negatively affect reproductive success and thus population persistence. A sufficiently robust population size is necessary to maintain an effective population size to buffer against risks of extinction, and for short term survival and continuing adaptation.

Adult escapement of anadromous species remains low even given significant hatchery production/reintroduction efforts. Low adult abundance in Idaho Supplementation Study streams has resulted in stocking at variable rates between years, depending on the availability of brood fish (Walters et al. 2001). Smolt-to-adult return rates (SAR), from smolts at the uppermost dam to adults returning to the Columbia River mouth, averaged 5.2% in the 1960s before hydrosystem completion and only 1.2% from 1977-1994 (Petrosky et al. 2001; Figure 109). This is below the 2%-6% needed for recovery (Marmorek et al. 1998).

In contrast to the decline in SAR, numbers of smolts per spawner from Snake River tributaries did not decrease during this period, averaging 62 smolts per spawner before FCRPS completion and 100 smolts per spawner afterward (Petrosky et al. 2001; Figure 109). In this summary both spawner escapement and smolt yield are measured at the uppermost mainstem dam (currently Lower Granite). Smolt increase per spawner was due to a reduction in density dependent mortality as spawner abundance declined. Accounting for density dependence, there was a modest decrease in smolts per spawner from Snake River tributaries over this period, but not of a magnitude to explain the decline in life-cycle survival (Petrosky et al. 2001).

The dams cause direct, indirect, or delayed mortality, mainly to emigrating juveniles (IDFG 1998a; Nemeth and Kiefer 1999). As a result, Snake River spring and summer chinook declined at a greater rate than downriver stocks, coincident with completion of the FCRPS (Schaller et al. 1999). Schaller et al. (1999) concluded that factors other than hydropower development have not played a significant role in the differential decline in performance between upriver and downriver stocks. The Snake River stocks above eight dams survived one-third as well as downriver stocks migrating through 3 dams (Schaller et al. 1999; Deriso *in press*) for this time period, after taking into account factors common to both groups. Additional declines in productivity of upriver stocks relative to downriver stocks indicate this portion of the mortality is related to factors unique to upriver stocks. Patterns of Pacific Decadal Oscillation and salmon production suggest that poor ocean conditions existed for Columbia River salmon after the late 1970s (Hare et al. 1999). However, natural fluctuations of ocean productivity affecting all Columbia River stocks, in combination with hydrosystem mortality, appear to have caused the severe declines in productivity and survival rates for the Snake River stocks. Temporal and spatial patterns of hatchery release numbers did not coincide with the differential changes in survival rates between upriver and downriver stocks (Schaller et al. 1999). Harvest rates were drastically reduced in the early 1970s in response to declines in upriver stream-type chinook abundance. Given that changes in smolts per spawner cannot explain the decreases in SAR or overall survival rates for Snake River stocks, it appears the altered migration corridor has had a strong influence on the mortality that causes these differences in stock performance.

The SAR and smolt per spawner observations (Figure 109) indicate that the overall survival decline is consistent primarily with hydrosystem impacts and poorer ocean (out-of-subbasin factors), rather than large-scale impacts within the subbasins between the 1960s and present (Schaller et al. 1999; Petrosky et al. 2001). Because the smolt per spawner data represent aggregate populations from a mix of habitat qualities throughout the Snake River basin after dam development, they do not imply that no room exists for survival improvement within the Salmon, Clearwater, Grande Ronde and Imnaha subbasins. However, because of limiting factors outside the subbasin, and critically reduced life-cycle survival for populations, even in pristine watersheds, it is unlikely that potential survival improvements within the Snake River subbasins alone can increase survival to a level that ensures recovery of anadromous fish populations.

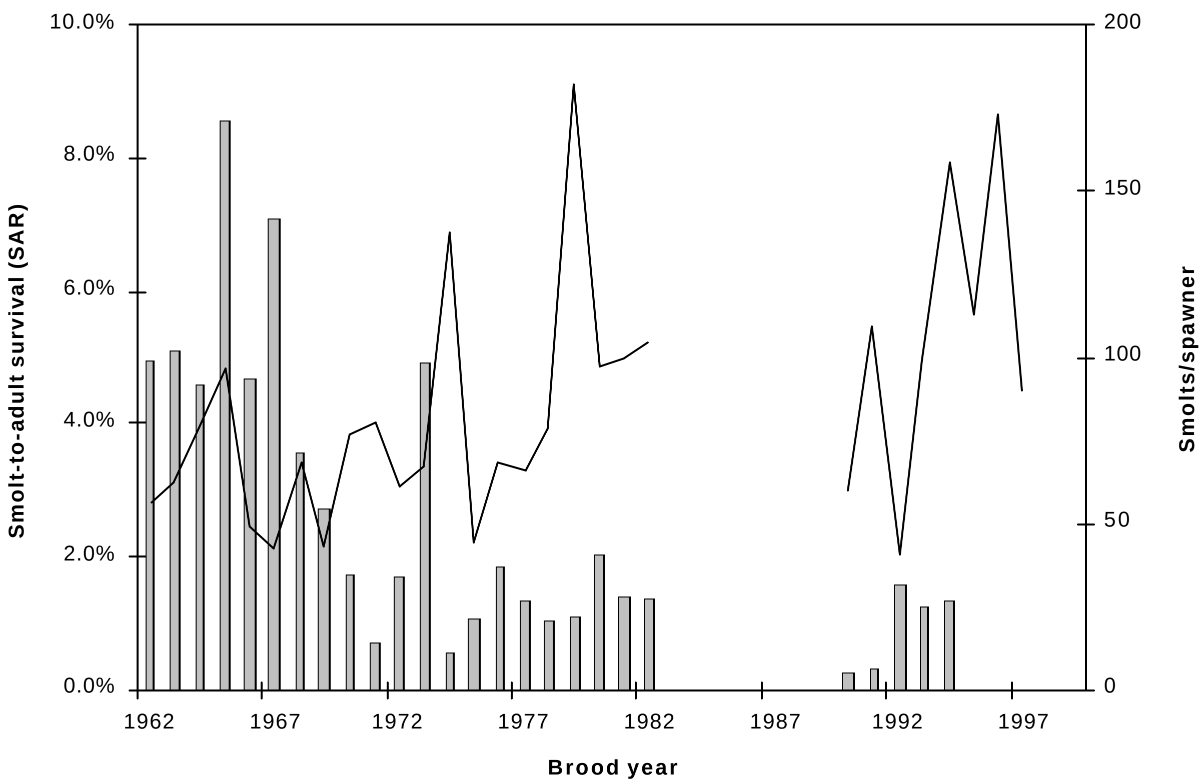

Figure 109. Smolt-to-adult survival rates (bars; SAR) and smolts/spawner (solid line) for wild Snake River spring and summer chinook. The SAR describes survival during mainstem downstream migration back to returning adults; smolts per spawner describes freshwater productivity in upstream freshwater spawning and rearing areas (From Petrosky et al. 2001)

8.3.2 Assessment Unit Scale – Local Sources

Numerous sources were reviewed for documentation of limiting factors at scales similar to the defined assessment units (Sources are listed in Appendix G). Note that factors limiting local fish production or survival may differ from those defined across broader scales, and that limiting factors in a given location may vary between species. The information presented in Table 62 attempts to address these issues by summarizing limiting factors over areas of intermediate size (assessment units) and for individual fish species. It does not address factors found to limit fish production or survival in individual streams or stream reaches.

Limiting factors have been assigned a value of 1-3, depending on the degree to which they are thought to limit specific species within each AU[4]. A value of 1 indicates a principal or most influential limiting factor, whereas a value of 3 indicates a less influential factor limiting population(s). A value of 2 represents factors of intermediate influence on populations. While factors have been individually "ranked" to aid in interpretation, all factors listed in Table 62 are considered limiting to local populations, and cumulative impacts of several factors ranked as 2 or 3 may outweigh the influence of an individual factor ranked as 1.

In order to rectify different reporting methods, limiting factor designations were standardized in some cases. This process particularly affects the categories of sediment, watershed disturbance, habitat degradation, and connectivity. Within the context of Table 62**,** the definitions of these categories are:

- Sediment = Natural and/or elevated sediment loading from undefined sources
- Watershed Disturbance = Upland disturbances such as mining, timber harvest and roading, including instream sediment resulting from defined upland sources (i.e., roads)
- Habitat Degradation = Riparian or instream habitat loss or disturbance
- Connectivity/Passage = All forms of population fragmentation including physical, chemical, or thermal barriers

Limited information is available in some areas and for some species (e.g. few limiting factors specific to westslope cutthroat trout have been defined at the landscape level within the subbasin). The approach is intended to provide a relative picture of limiting factors within, not necessarily between, each assessment unit. For example, documented temperature and sediment limitations in the Lower Selway AU are most likely related to natural regimes (Thompson 1999). In contrast, temperature limitations in the Lower Clearwater AU are likely due to a combination of natural and altered conditions, including low elevation, low degree of natural shading, agricultural impacts to runoff, water withdrawals, and Dworshak Dam operations.

Subwatersheds, streams or stream reaches throughout the subbasin may realize limitations due to factors not documented here. Proposals directed at addressing such factors should supply additional information as necessary to justify the project(s). Additional information may come from finer scale assessments or research, be based on results of recent or ongoing studies, or unpublished information sources.

[4] Values were assigned by technical advisory team members using their best professional judgment. Judgments were supplied by team members only for areas/species with which they were familiar; Two to four judgments were typically supplied for each AU/species combination. Where discrepancies existed amongst judgments, a 'majority rules' approach was used to assign the value, applying the most commonly suggested value. If judgements were similar but no value constituted a majority (e.g. four judgements supplied: 1, 1, 2, and 2), the lowest value suggested was assigned. In cases where judgements were dissimilar and none was in majority (e.g. 1, 1, 3, and 3), the technical advisory team discussed the matter until assigning a value by consensus.

Table 62. Limiting factors defined by species and AU during previous research or assessments. Factors are ranked from most (1) to least (3) substantial, although all are considered limiting

AU/Species	Temperature	Base Flow	Flow Variation	Sediment	Instream Cover	Watershed Disturbances[1]	Habitat Degradation[2]	Exotics/Introgression	Harvest[3]	Connectivity/ Passage[4]
Lower Clearwater										
Bull Trout	3	3	3						3	3
Westslope Cutthroat	3		3			3				
Steelhead	1	1	2	1		1	1	3		3
Chinook	2	1		2		1	2			3
Pacific Lamprey										
Lower North Fork										
Bull Trout	2			1		1	1	1	3	3
Westslope Cutthroat	2			1		2	2	2	2	3
Steelhead	--	--	--	--	--	--	--	--	--	--
Chinook	--	--	--	--	--	--	--	--	--	--
Pacific Lamprey										
Upper North Fork										
Bull Trout	2			2		2		1	3	
Westslope Cutthroat				2		2	2	2	2	
Steelhead	--	--	--	--	--	--	--	--	--	--
Chinook	--	--	--	--	--	--	--	--	--	--
Pacific Lamprey										
Lolo/Middle Fork										
Bull Trout	1			1	2	1	1		3	
Westslope Cutthroat	2		3	1	2	1	1		3	
Steelhead	2	3		1	2	1				
Chinook	3			1	2	1	2			
Pacific Lamprey	2			1		1	1			3
Lochsa										
Bull Trout	3			2	3	2	2	3	3	
Westslope Cutthroat	2			2	3	2	2	3	2	
Steelhead	3			3	3	2	2			2
Chinook	3			3	3	2	2			2
Pacific Lamprey										
Lower Selway										
Bull Trout	2						2	3	3	
Westslope Cutthroat	3			2				2	2	
Steelhead	3			2						
Chinook	3									
Pacific Lamprey										

Table 62 (Continued)

AU/Species	Temperature	Base Flow	Flow Variation	Sediment	Instream Cover	Watershed Disturbances[1]	Habitat Degradation[2]	Exotics/Introgression	Harvest[3]	Connectivity/ Passage[4]
Upper Selway										
Bull Trout							3	3	3	
Westslope Cutthroat				3				3	3	
Steelhead	3			3						3
Chinook										3
Pacific Lamprey										
South Fork										
Bull Trout	2			1	1	1	1	2	3	2
Westslope Cutthroat	1			1	1	1	1	2	2	2
Steelhead	1			1	1	1	1	2	3	
Chinook	1			1	1	1	1			
Pacific Lamprey	1			3		1	1			3
Dworshak Reservoir Resident Fishery										
Kokanee			1[5]							
Smallmouth Bass							1			
Redside Shiner							1			

1 Includes upland disturbances such as mining, timber harvest and roading.
2 Includes riparian, instream habitat loss and disturbance or reservoir drawdowns.
3 Sport harvest of bull trout is not permitted in the subbasin, although poaching and some tribal harvest of the species may occur.
4 Includes passage barriers or other forms of population fragmentation.
5 Entrainment as influenced by flow variations through Dworshak Dam.

Dworshak Dam

Anadromous Species

As mentioned previously, the construction of Dworshak Dam in 1972 has eliminated anadromous access to one of the most productive systems in the subbasin, and has modified the fishery downriver from the impoundment. Although differing views exist relative to the degree to which the structure should be considered an "active" limiting factor to anadromous production, its discussion is nonetheless merited.

Located two miles (3 km) above the mouth of the North Fork Clearwater River, the dam blocked passage to 26% of the subbasins anadromous spawning and rearing habitat (NPT and IDFG 1990). For steelhead, this loss was considerable, as it is estimated that the North Fork Clearwater once supported as much as 60% of the subbasins spawning habitat (an area that could potentially accommodate 109,000 steelhead trout redds) and a significant amount of rearing and overwintering habitat (USFWS 1962; Miller 1987). Spring chinook salmon were similarly affected by the impoundment, as tributary systems in the Lower Clearwater and Upper and Lower North Fork AUs were historically substantial producers of chinook salmon, accounting for roughly 65 percent of the total chinook salmon smolt production from the Clearwater subbasin tributaries (excluding mainstem production; Chapman 1981). The degree to which Clearwater lamprey populations have been affected following their exclusion from the North Fork system has not been assessed. Some lamprey that remained upstream from the impoundment may have residualized in the North Fork Clearwater AUs, as they were collected in Dworshak Reservoir as late as 1989 (16 years after impoundment). None, however, have been seen after this date (Melo Maiolie, IDFG, personal communication, April 20, 2001).

The operation of Dworshak currently represents a limiting factor to fall chinook populations occurring downriver from the dam. In 1992 Dworshak flow releases were modified to facilitate anadromous fish migration in the lower Snake River. The change meant that up to 25 kcfs of cool water were released during parts of July, a period of the year that is typified by warmer water temperatures. As a consequence of cold winter water temperatures, the early life history timing of fall chinook salmon in the Clearwater River occurs on the latest schedule of all present-day Snake River stocks. Many young Clearwater River fall chinook salmon do not reach smolt size or migrate seaward during the first year of life because growth is out of synchronization with environmental cues such as photoperiod (Connor et al. 2001). In some years, releasing cool water from Dworshak Reservoir for summer flow augmentation could cause juvenile fall chinook salmon to hold over an extra year in freshwater by markedly reducing water temperatures and disrupting water temperature cues that prompt outmigration (Connor et al. 2001).

Resident Species

The construction of Dworshak Dam was a limiting factor to several resident fish populations. The dam replaced part of the North Fork of the Clearwater River and numerous tributaries with a reservoir environment. IDFG estimated that 200 km of river and stream habitat was lost. Based on densities of fish in other areas, this habitat could have supported 264,000 mountain whitefish, 110,000 cutthroat trout, 6,700 bull trout, 256,000 redside shiners, 93,000 suckers, 44,000 longnose dace, 4,400 northern pikeminnow, 27,000 sculpins and an unknown number of redband trout. The Department estimated 14,800 m^2 (3.6 acres) of stream habitat was inundated by the reservoir in first to fourth order tributaries and, an additional 962 ha (3.7 mi^2) of habitat was inundated in North Fork Clearwater tributaries larger than fourth order (IDFG, unpublished data).

The dam also blocked resident fish from using habitat above and below the dam site. The splitting of habitat into discontinuous areas could increase the risk of extinction for fish above and below the dam.

The current operation of Dworshak Dam is a limiting factor to fish populations within Dworshak Reservoir. Drawdowns of the reservoir can be a much as 47 m (154 ft.) and reduce the surface area by 52%, thereby reducing habitat for fish populations. Drawdowns also prevent the establishment of productive littoral areas around the shorelines of the reservoir, which affects near-shore spawning and feeding species.

Kokanee are the best-adapted species for this fluctuating reservoir since they occupy the pelagic, offshore, areas and spawn in tributary streams. Their densities have exceeded 100 adult kokanee per hectare, and harvest of kokanee by anglers has exceeded 200,000 fish in some years. The population's biggest limiting factor has been entrainment into Dworshak Dam outflows. For example in the spring of 1996, Idaho Department of Fish and Game estimated that 1.3 million kokanee were entrained, potentially reducing the kokanee population in the reservoir by 95%. These losses impacted the kokanee sport fishery for the next three years. Fickeisen and Geist (1993) noted that the principle bottleneck to the population appeared to be the entrainment losses of fish through the dam.

Reservoir operations also limit smallmouth bass populations. Fluctuating water levels during incubation have resulted in desiccation of nests and limited beds of aquatic vegetation that provide habitat for production of food needed by age 1 to age 4 fish (Fickeisen and Geist 1993).

8.3.3 Stream Reach Scale – NPPC Data

Constraints to production of chinook salmon and steelhead trout in the Clearwater subbasin were delineated for individual stream reaches during the prior subbasin planning process (NPT and IDFG 1990). Fourteen individual constraints were defined for steelhead trout, and twelve for chinook salmon in the Clearwater subbasin, any of which may inhibit spawning, rearing or migration of these species.

One major weakness of this database is its failure to address constraints in areas not currently being used by anadromous species at the time the data was compiled. It does not address constraints in areas of substantial historical distribution (e.g., the Potlatch River for chinook salmon), and did not delineate potential constraints in areas that might be accessible to either species in the future. Addressing these issues would require considerable time to replicate the methods and analyses used in developing the original database, and has therefore not been attempted.

Strength(s) of the database include that constraints to chinook salmon and steelhead trout have not likely changed much in the past 10 years, except in very localized areas with significant restoration efforts. The database should therefore still provide a good understanding of current constraints to anadromous production in the Clearwater subbasin.

As defined in the NPPC database, spring chinook salmon production in the Clearwater subbasin is predominantly constrained by steep gradient (520 stream miles) and sedimentation (411 stream miles; Table 63). Steep gradient is the primary constraint (in terms of stream miles impacted) to chinook production in the Upper Selway AU, and also important in the Lochsa, Lower Selway, and South Fork AUs. The Lochsa AU is also notably impacted by habitat constraints including lack of high quality pools and poor instream cover. Sedimentation is the principle constraint in the Lolo/Middle Fork and South Fork AUs. Constraints to spring chinook salmon production for individual stream reaches throughout the Clearwater subbasin are presented in Appendix H (Figure 123, Figure 124, Figure 125, Figure 126).

Table 63. Summary of stream miles where spring chinook use is constrained by various factors in the Clearwater subbasin (defined by NPPC and downloaded from Streamnet.org). Numbers in parenthesis represent the estimated total stream miles with habitat suitable for spawning, rearing, and/or migration by spring chinook

	Assessment Unit								
Constraint	Lower Clearwater	Lower North Fork	Upper North Fork	Lolo/Middle Fork	Lochsa	Lower Selway	Upper Selway	South Fork	Total
	(111.8)	(2.0)	(0.0)	(154.5)	(278.9)	(146.1)	(301.8)	(291.8)	(1,286.7)
Large Stream Size	78.3	2.0	---	7.1	68.8	40.0	13.0	15.8	225.0
Steep Gradient	0.0	0.0	---	59.2	107.5	74.8	176.9	101.5	520.1
Temperature	93.6	0.0	---	76.6	28.8	19.1	0.0	13.1	231.3
Sedimentation	39.5	0.0	---	146.9	22.6	3.5	15.1	183.7	411.3
Gravel Quantity	0.0	0.0	---	0.0	71.9	0.0	0.0	0.0	71.9
Blocked Passage	0.0	0.0	---	0.0	28.7	21.4	85.4	4.7	140.2
Impeded Passage	0.0	0.0	---	0.0	47.2	0.0	0.0	0.0	47.2
Poor Instream Cover	0.0	0.0	---	11.3	77.3	0.0	0.0	64.4	153.0
Lack of High Quality Pools	0.0	0.0	---	0.0	117.4	0.0	0.0	0.0	117.4
Bank Degradation	0.0	0.0	---	0.0	0.0	0.0	0.0	6.2	6.2
Channelization	0.0	0.0	---	0.0	0.0	0.0	0.0	14.6	14.6
Dewatering	0.0	0.0	---	11.3	0.0	0.0	0.0	0.0	11.3

The four principle factors constraining steelhead trout production in the Clearwater subbasin are sedimentation (965 stream miles), temperature (520 stream miles), dewatering (374 stream miles), and blocked or impeded passage (451 stream miles; Table 64). These four factors, with the addition of the mainstem Clearwater River's large stream size, also represent the principle constraints to steelhead trout in the Lower Clearwater AU. Important constraints to steelhead trout production vary considerably between other AUs. Sedimentation is an important constraint to steelhead trout production in the Lolo/Middle Fork and South Fork AUs, although temperature is also an important concern in the Lolo/Middle Fork AU. Instream habitat forming processes appear to present constraints to steelhead trout in the Lochsa AU, resulting in concern over lack of high quality pools, limited gravel quantity, and poor instream cover. In the Selway River AUs, steelhead trout population(s) are constrained predominantly by large stream size (Lower Selway AU) and blocked passage (Upper Selway AU). Constraints to steelhead trout production for individual stream reaches throughout the Clearwater subbasin are presented in Appendix H (Figure 127, Figure 128, Figure 129, Figure 130, Figure 131).

8.3.4 Stream Reach Scale - §303(d)

The majority of streams within the Clearwater subbasin have designated beneficial uses defined by IDEQ which include salmonid spawning and/or cold water biota. The IDEQ maintains the §303(d) list for stream reaches with impaired beneficial uses. These stream reaches and the associated pollutants have been summarized in the water quality section (4.9) of this report, and individual stream reaches listed under §303(d) for impairment are mapped in Appendix B.

8.3.5 Passage/Connectivity - Road Culverts

The degree to which connectivity limits fish migration and production within the Clearwater subbasin is thought to be underrepresented by existing data and reports. No data source exists which accurately documents known or potential barriers to fish migration within the Clearwater subbasin in a useable and widespread format. Particularly lacking are records of culvert conditions in relation to fish passage, which is thought to be a substantial issue throughout the Clearwater subbasin. Although data is regularly collected on culvert conditions during a variety of field surveys, the data often are not available in the detail and format necessary to map the locations of surveyed culverts.

In the absence of available information regarding culvert locations and condition, we constructed an index of culvert abundance by overlaying the road (1:24,000) and stream (1:100,000) coverages. Points of intersections were defined, and likely represent a reasonable estimate of the relative (not actual) distribution and density of culverts throughout the Clearwater subbasin (Figure 110).

Table 64. Summary of stream miles where steelhead trout use is constrained by various factors in the Clearwater subbasin (defined by NPPC and downloaded from Streamnet.org). Numbers in parenthesis represent the estimated total stream miles with habitat suitable for spawning, rearing, and/or migration by steelhead trout

	Assessment Unit								
Constraint	Lower Clearwater	Lower North Fork	Upper North Fork	Lolo/Middle Fork	Lochsa	Lower Selway	Upper Selway	South Fork	Total
	(525.5)	(2.0)	(0.0)	(263.7)	(437.3)	(241.8)	(563.7)	(389.2)	(2,423.2)
Large Stream Size	78.3	2.0	---	7.1	68.8	40.0	11.5	15.8	223.4
Steep Gradient	0.0	0.0	---	26.8	62.0	10.2	15.2	45.2	159.8
Temperature	342.2	0.0	---	116.8	28.8	19.1	0.0	13.1	520.0
Sedimentation	434.5	0.0	---	201.7	73.7	9.1	8.5	237.6	965.0
Gravel Quantity	0.0	0.0	---	0.0	145.1	0.0	0.0	0.0	145.1
Blocked Passage	94.2	0.0	---	66.1	52.6	27.0	84.7	4.7	329.3
Impeded Passage	51.2	0.0	---	0.0	57.7	0.0	13.3	0.0	122.2
Poor Instream Cover	38.8	0.0	---	11.3	83.4	0.0	0.0	70.9	204.4
Lack of High Quality Pools	16.3	0.0	---	40.1	185.5	0.0	0.0	0.0	241.9
Bank Degradation	19.8	0.0	---	0.0	0.0	0.0	0.0	2.0	21.7
Channelization	52.4	0.0	---	3.2	0.0	0.0	0.0	14.6	70.1
Dewatering	301.2	0.0	---	73.1	0.0	0.0	0.0	0.0	374.3
Poor Diversions	24.4	0.0	---	0.0	0.0	0.0	0.0	0.0	24.4
Chemicals	18.6	0.0	---	0.0	0.0	0.0	0.0	0.0	18.6

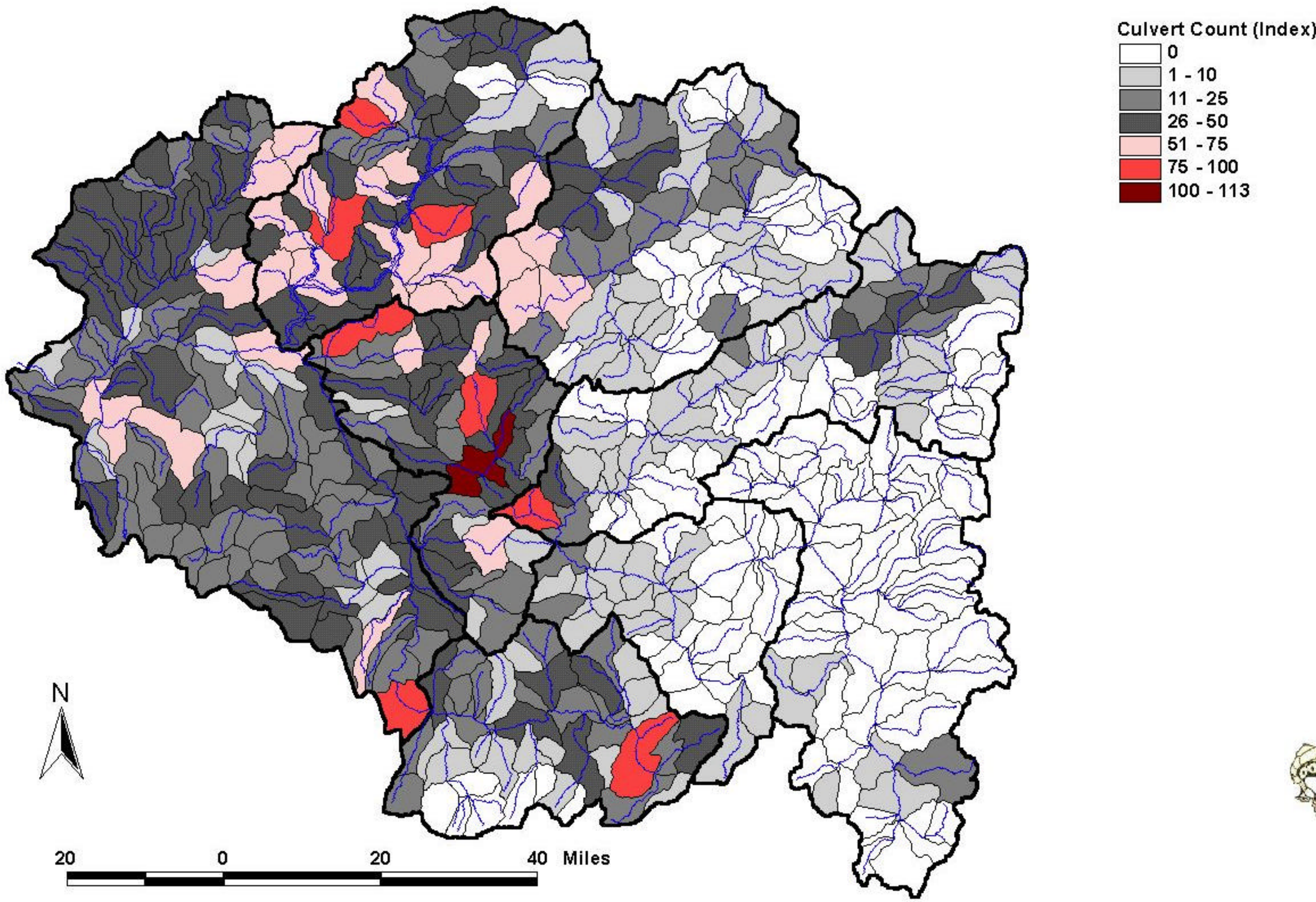

Figure 110. Estimated number of culvert locations (stream-road crossings) by 6th field HUC throughout the Clearwater subbasin

The Idaho Department of Lands has estimated that over 50% of existing culverts may pose either a partial or complete barrier to fish migration (J. Dupont, IDL, personal communication, February 6, 2001). Based on this information, it is reasonable to assume that the greatest potential for fish passage issues related to culverts is coincidental with areas of greatest culvert density. However, information presented in Figure 110 should be used only as a guide for planning culvert surveys or data collection. Additional information will be needed to define the impacts of culverts to fish populations. Such information will include fish distributions and seasonal habitat use, culvert design and construction, and availability and quality of fish habitat upstream.

Fish passage barriers have beneficial impacts in some areas as well. Although passage barriers are most typically considered to have negative impacts, they may be important mechanisms in limiting the spread of exotic species and subsequent introgression with native species of concern including bull trout and westslope cutthroat trout.

8.3.6 Temperature Limitations (modeled)

Suitable water temperature is an important habitat component for most fish species, and temperature is commonly cited as a limiting factor to fish distribution or production (See Table 62 and Appendix H). The Idaho Department of Lands (2000) developed a model to predict the seven-day rolling average of maximum daily stream temperature, otherwise called the mean weekly maximum temperature (MWMT). The relative simplicity made this particular model practical for use in this assessment, and results are likely adequate for examining broad-scale patterns in temperature variations in the Clearwater subbasin as they relate to potential fish distribution.

Based in part on work by Sugden et al. (1998), predicted MWMTs were related to Idaho's stream temperature standards for numerous fish species (Table 65). Guidelines relating fish use to MWMT are based on species presence and use patterns (i.e. fall vs. spring spawners) and expected to result in conditions meeting applicable Idaho standards for each species throughout the year. For example, spring/summer chinook are most likely to spawn during the periods of highest water temperatures, and therefore require the lowest MWMT to ensure adequate conditions during spawning and incubation. Although bull trout typically require colder water than spring/summer chinook for spawning, they spawn later in the fall during periods of declining temperatures, allowing for a slightly higher MWMT.

Idaho DEQ has compiled an issue paper concerning the application of uniform temperature criteria in diverse environments (Essig 1998) suggesting that uniform standards applied to individual species may not be the most appropriate manner in which to evaluate temperature limitations. However, for the purposes of this assessment, comparison of species distributions to uniform standards has been conducted to ensure consistency and uniform interpretability across broad scales.

The IDL temperature model has demonstrated limited accuracy when applied to areas in north Idaho (r^2=0.58; Idaho Department of Lands 2000), and reliance on available GIS coverages to estimate the data necessary to model MWMT across the subbasin has likely added additional sources of error to the results. For these reasons, results presented here should not be used for site specific planning purposes or to make implications about localized water quality.

The model predicts the MWMT, using three variables (stream shade, elevation, and drought index) as

MWMT (°C) = 29.09861 – (elevation in feet*0.00262)-(canopy cover*0.08492)-(DI*0.29433)

For the purposes of this assessment, normal climatic conditions (DI=0) were assumed. Stream shade was estimated using four canopy cover classes delineated by the Idaho GAP project (<15%, 15-39%, 40-69%, and ≥70%). We assumed that the actual canopy cover for each cell was equal to the midpoint of the range depicted by the Idaho GAP data layer (7.5, 27, 55, and 85%, respectively, for each of four classes). The GAP canopy coverage was obtained as a GIS grid coverage with 30m cell resolution, matching the degree of resolution of the available DEM elevation data. Modeling was conducted for cells overlain by a 1:100,000 scale stream coverage. The decision to use the 1:100,000 scale stream layer was based on prior work indicating that finer scale stream layers include substantial numbers of intermittent streams that would be dry during periods of highest stream temperatures and which, therefore needed to be excluded from predictions of MWMT.

Results of stream temperature modeling are presented in Figure 111 and summarized by 6th field HUC in Figure 112. Both maps also illustrate expected species presence based on the predicted MWMT (see Table 65). In general, expected species distributions are similar to those currently observed (See Section 8), illustrating the role of temperature in determining habitat suitability throughout the Clearwater subbasin. However, exceptions to this trend do exist for some species.

Based on predicted temperature conditions, westslope cutthroat trout in the Clearwater subbasin appear to currently occupy virtually all suitable habitat areas. Some use of potentially marginal temperature conditions (15-18°C MWMT) by westslope cutthroat trout are evident in the Lolo/Middle Fork AU, a situation not typically seen in other areas of the subbasin with similar temperature regimes.

Existing distributions of bull trout are generally similar to areas of predicted suitable temperatures, with the primary exception(s) occurring in the Lochsa AU. Based on predicted temperature conditions, suitable habitat for bull trout exists throughout the vast majority of the Lochsa AU (Figure 112). Bull trout however, are presumed absent from a substantial portion of the tributary habitat in the central and lower portions of the Lochsa drainage (See Figure 106). Similar instances bull trout absence from predicted potential habitat can be seen in the Upper and Lower Selway, South Fork, and Upper and Lower North Fork AUs, although less frequently than in the Lochsa AU. It is unclear if these discrepancies result from modeling errors, patchy population structure, or the influence of other habitat conditions influencing bull trout populations in some areas.

Based on predicted temperatures, both westslope cutthroat trout and bull trout appear to utilize some areas of marginal habitat within the Lolo/Middle Fork AU. For both species, suitable temperature conditions are predicted in headwater areas, and their use of marginal habitats may arise from downstream dispersal of individuals from these areas (Figure 111 and Figure 112).

Table 65. Mean weekly maximum temperatures anticipated to result in applicable temperature standards being met for various species or types of fish

Species Present	Suitable MWMT
Spring/Summer Chinook	≤ 12°C (53°F)
Bull Trout	≤ 13°C (55.4°F)
Other Salmonids	≤ 15°C (59°F)
No Salmonids	≤ 21°C (69.8°F)

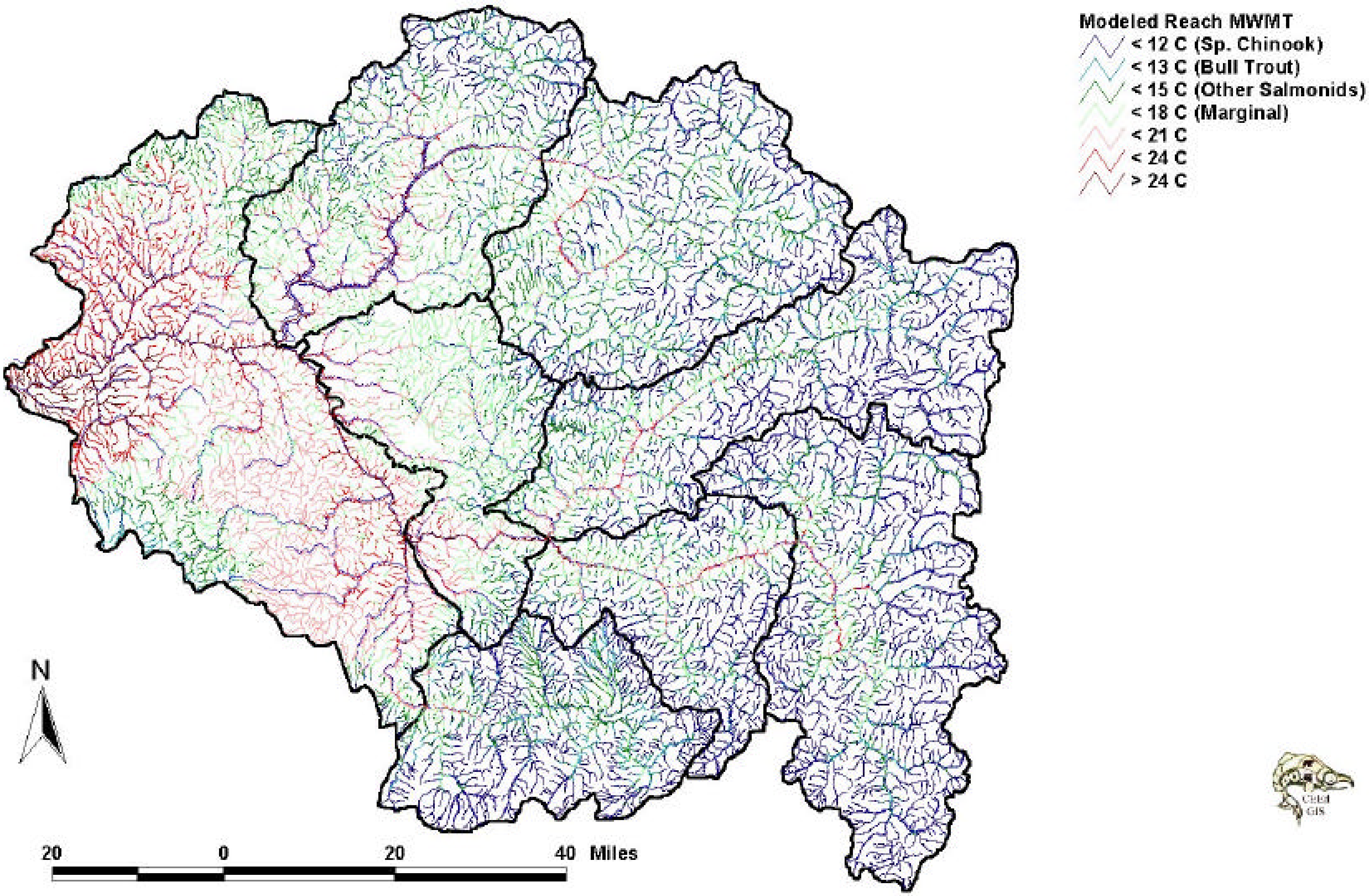

Figure 111. Modeled maximum weekly maximum temperatures (MWMT) for streams throughout the Clearwater subbasin

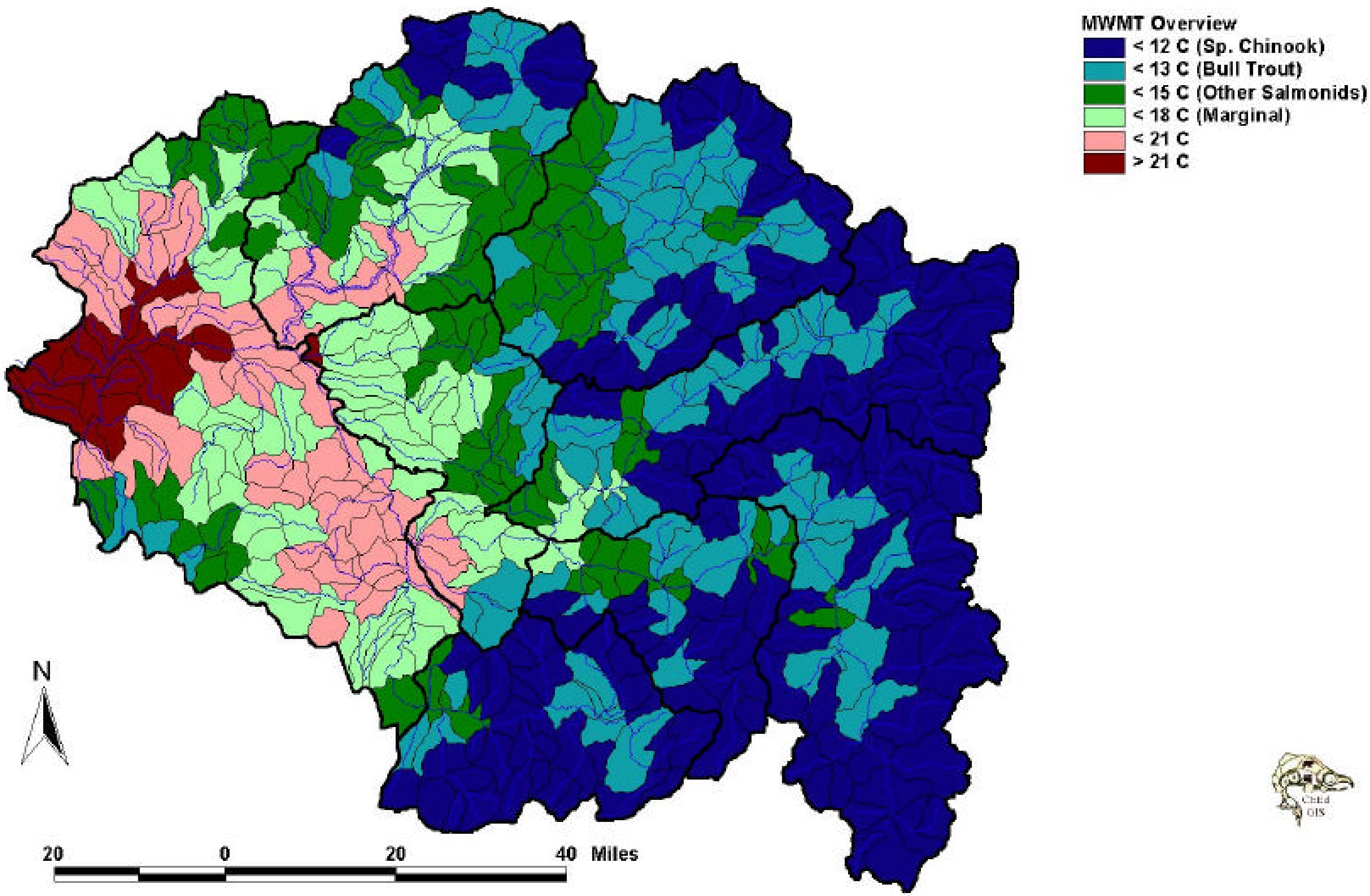

Figure 112. General overview of anticipated MWMT and associated salmonid species distribution

The relationship between spring chinook salmon distribution and predicted temperature conditions follows a similar pattern to that presented for bull trout. With the exception of substantial amounts of tributary habitats within the Lochsa AU, spring chinook salmon appear to currently utilize nearly all suitable areas within the Clearwater subbasin (See section 8.1.1 and Figure 96). Modeling suggests that although marginal temperature conditions exist in the headwaters of the Lolo Creek drainage, temperatures there are generally unsuitable for chinook salmon (Figure 112). Spring chinook salmon are, however, widespread throughout the Lolo Creek drainage (See section 8.1.1). The reason for the discrepancy between expected and realized distribution of spring chinook salmon throughout the Lolo Creek drainage is unclear, but may result from inaccuracies in the modeled temperatures, inaccuracy in the predicted species relationships to MWMT (see Table 65), or the heavy hatchery influence in the drainage.

Historic accounts suggest that spring chinook salmon utilized the Potlatch River system, although they are not currently known to do so (See sections 7.1 and 8.1.1). Predicted temperature conditions suggest highly unfavorable habitat conditions currently exist for spring chinook salmon within the Potlatch drainage (See Figure 111 and Figure 112). If historical accounts are accurate, temperature regimes in the Potlatch River system have been altered substantially from historic times. Impacts to temperature regimes in the Potlatch River system are likely cumulative in nature, and related largely to the predominantly private ownership and consumptive land uses (forestry and agriculture) throughout the watershed.

Based on information presented in Table 65, suitable temperatures for steelhead trout are found throughout much of the Clearwater subbasin, with the primary exception in the Lower Clearwater AU (Figure 111 and Figure 112). Temperature conditions in some areas of the Lolo/Middle Fork AU may be marginal for steelhead (15-18°C [59-64°F] MWMT), although use does occur in these areas. Predicted suitable temperatures for steelhead trout ($\leq$15°C MWMT; Table 65) reasonably represent the current range of B-run steelhead trout throughout the Clearwater subbasin, with A-run steelhead trout generally distributed throughout areas of substantially higher temperatures in the Lower Clearwater AU. Many tributaries of the Lower Clearwater AU, where A-run steelhead predominantly exist, are expected to experience MWMTs exceeding 21°C (69.8°F) in normal years, and temperatures would be expected to be higher in dry years. Temperature limitation of steelhead populations throughout the Lower Clearwater tributaries is widely acknowledged (See Table 62 and Appendix H; NPT and IDFG 1990; Kucera and Johnson 1986; Johnson 1985; Fuller et al. 1984; Kucera et al. 1983) and presents a potentially substantial concern to the recovery of A-run steelhead within the subbasin.

9 Resource Synthesis and Definition of Potential Management Units

In order to synthesize information in this Assessment, a total of 22 Potential Management Units (PMUs) have been defined throughout the Clearwater subbasin (Figure 113). The term "Potential" is being used here to clarify that these management units are open to interpretation, and may be altered to some degree during the subbasin planning effort. PMUs are groups of HUCs (either contiguous or noncontiguous) intended to characterize areas which have similar themes regarding species distributions, disturbance regimes, and other characteristics that will influence future subbasin scale restoration or recovery planning. The delineation of PMUs is not intended for direct use in small scale project planning. While the delineated PMUs characterize themes across relatively broad geographic areas, actual project planning will require site specific information.

Definition of PMUs was done in a largely subjective manner. Statistical cluster analysis was not used largely due to uncertainty over its ability to delineate meaningful management units. For the purposes of planning at the subbasin scale, and given limitations in data availability and accuracy based on the broad scale nature of this assessment, subjective PMU delineations are believed to be as valid and more practical than statistical delineations.

In delineating PMUs, 38 variables were considered for their individual and combined influence to potential future management scenarios (Table 66). Due to the large amount of information being synthesized, raw data were often categorized (e.g. ranging from Very Low to Very High) in order to make comparison and interpretation feasible. The following discussion and comparison of individual PMUs relies heavily on these categorical descriptors. All information presented or summarized in this section has been presented in greater detail earlier in this assessment with information on sources, scales, compilation methods, and potential weaknesses pertaining to each dataset. Where applicable, values used to delineate categories for individual variables are included in Table 66.

PMUs were not delineated in a species-specific manner due to a lack of comprehensive distribution and status information for some species, the heavy reliance on landscape level characteristics used to define them, and the potential for altered species distributions in the future (through reintroductions or habitat improvement). Where applicable, notes on the distribution and status of aquatic and terrestrial focal species are provided within the discussion of each PMU.

Although PMUs may have considerable overlap in their overall characteristics, they can typically be differentiated from one another based on either one, or a combination of "distinguishing" characteristics. In order to emphasize major differences in planning concerns, PMUs are presented and discussed individually within three distinct areas of the subbasin: those dominated by private ownership (excluding corporate ownership), mixed ownership (including corporate ownership), or federal ownership. Within the Clearwater subbasin, land use and management strategies differ substantially between these ownership areas, and will likely impact future planning strategies within and between them. Identifiers have been assigned to each PMU which include a prefix and a number. Prefix codes are used to identify the primary ownership area within each PMU. These include PR (private), MX (mixed), or FD (Federal). Number codes are assigned sequentially within each ownership area as a means to differentiate PMUs.

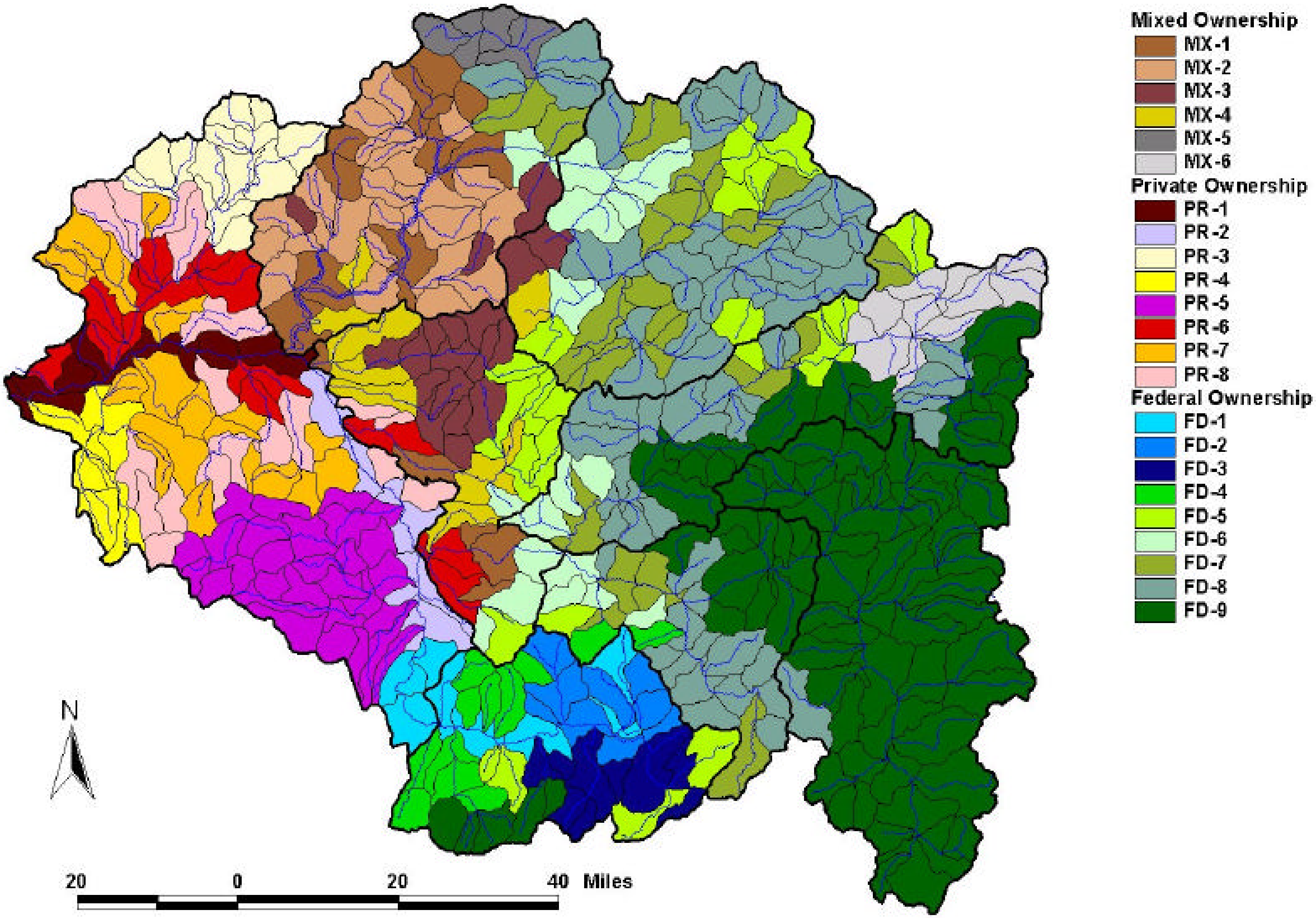

Figure 113. Potential Management Units (PMUs) delineated throughout the Clearwater subbasin.

Table 66. Attributes used to delineate PMUs throughout the Clearwater subbasin, including descriptions of categories used to summarize data

Attributes	Description and comments	# of Variables
Species Attributes		
Distribution and Status	Presence/absence, and relative status if known	1
Life History Types	A run steelhead, B run steelhead, spring chinook, fall chinook, fluvial/resident bull trout, fluvial/resident cutthroat trout	8
Hatchery Influence	Relates to same species influence	1
Exotic Species	Brook trout distribution and status	1
Landscape Level Attributes		
Accessibility	Differentiates areas known to be blocked to anadromous species	1
Existing Protection	Differentiate areas with high degree of protected status (>90% or >75%)	2
Land Use (Dominant and Subdominant)	Forested or Agriculture/Range. Dominant and Subdominant (>25%) classes were considered	2
Ownership (Dominant and Subdominant)	Dominant classes: Federal, State, Private Corporation, Other Private Subdom. (>25%) classes: Federal,State,Private Corp.,Other Private,Tribal	2
Habitat		
Habitat Quality	From NPPC database	1
Limiting Factors	From Table 45 and NPPC database	2
Water Quality	Relative amount and distribution of 303(d) listed stream segments	1
Temperature Modeling	As potential limiting factor to species distributions (not related to water quality)	1
Hydrology/Water Use	Runoff Pattern (Lipscomb 1998) and Water Use	2
Disturbances		
Vulnerability	Percent of HUC within PSSZ	1
Grazing Potential	Percent of HUC defined as grazable: >50 High ; 20-50 Moderate; <20 Low	1
Road Density	Used USFS designations and added class delineating “Very High” density: Very High >5 mi./sq. mi.; High >3 mi./sq. mi.; Moderate=1-3 mi./sq. mi.; Low <1 mi./sq. mi.	1
Road Density in PSSZ	Designations based on USFS streamside road density designations with added class delineating “Very High” density: Very High>4 mi./sq. mi.; High=2-4 mi./sq. mi.; Moderate=1-2 mi./sq. mi.; Low<1 mi./sq. mi.	1
Mine Hazard (mines)	Sum of “Ecological hazard ratings” delineated by ICBEMP: Very High>100; High=50-99; Moderate=25-49; Low=10-24; Very Low<10	1
Mine Hazard (claims)	Estimated number of claims: Very High >500; High=200-500; Moderate=100-200; Low=50-100; Very Low <50	1
Sediment Regime	Major source(s) - Mass wasting, surface erosion, or both	1
Landslide Hazard	Used % of land area defined as Moderate-High Hazard: Very High>20; High=10-20; Moderate=5-10; Low=2-5; Very Low <2	1
Surface Erosion Hazard	Based on relative ratings developed by ICBEMP. Values assigned as quantiles with 20% of HUCs in each category: Very High, High, Moderate, Low, Very Low	1
Hazard Combinations	Road Density/Landslide Hazard; PSSZ Road Density/Landslide Hazard; Grazing Potential/Surface Erosion Hazard; Landslide/Surface Erosion Hazard	4

In the following textual descriptions of each PMU, information is presented regarding attributes that will influence future planning strategies. In most cases, no discussion is presented for factors not believed to impact aquatic resources within a PMU unless the notable absence of that activity (e.g. grazing) is thought to have a potential influence on planning strategies. Textual descriptions are intended to represent the overall character of the PMU, and do not necessarily directly reflect the characteristics of every HUC within it (e.g. road densities throughout a PMU are characterized as High, although densities in one or more HUCs may individually be characterized as Moderate or Very High).

Characteristics are typically discussed in a singular fashion within each PMU, with little attempt to discuss interrelationships between them, or direct impacts of characteristics on aquatic resources. The ability to discuss interrelationships between variables is minimal at this scale due to the often site specific nature of such relationships (e.g. the relationship of road density and landslide hazard is dependent on road age and construction techniques, placement on slope, localized climate, etc.). In a similar sense, it is not possible to discuss actual impacts of landscape level characteristics to aquatic and terrestrial resources since impacts also tend to be site specific.

In broad scale planning, higher degrees of disturbance (e.g. higher road densities) are likely to have more substantial impacts on resources, and combined disturbances (e.g. high road density and high landslide hazard) are likely to have cumulative impacts. However, interpretation the cumulative impacts within each PMU to impact aquatic and terrestrial resources remains speculative, and therefore is not discussed here.

9.1 PMUs Predominated by Private Ownership

A total of eight PMUs have been delineated which are predominated by private ownership and unique (or very nearly so) to the Lower Clearwater AU (Figure 114). To signify the predominance of private ownership, PMUs within these areas are designated by the prefix “PR”. Of the eight PMUs defined, two are used to delineate portions of the mainstem river corridor used by all aquatic focal species. The remaining six PMUs delineate tributary watershed areas which are utilized primarily by A-run steelhead trout.

Primary characteristics used to differentiate PMUs within the Lower Clearwater AU include aquatic species presence, dominant ownership and land cover, and natural and induced disturbance regimes. Table 67 summarizes differences in primary characteristics between the eight PMUs in this area. Textual descriptions are provided below, and include discussion of additional details regarding conditions within each PMU as they relate to aquatic species and habitat.

These PMUs are displayed separately (Figure 114) to emphasize the substantial differences in management concerns in areas dominated by private ownership and agricultural land uses relative to other areas of the subbasin. PMUs within this area were defined with the following distinctions in mind, and, unless noted, these characteristics apply to all PMUs defined in this area

1. The mainstems of the Clearwater and South Fork Clearwater rivers function as migration and overwintering habitat for all aquatic focal species considered in this assessment and contain the entire known spawning and rearing distribution of fall chinook salmon within the Clearwater subbasin
2. Tributaries to the mainstem Clearwater and South Fork Clearwater Rivers support only one aquatic focal species: A-run steelhead trout. Populations are considered “depressed” throughout the Lower Clearwater AU, and are not directly influenced by hatchery production
3. Citations or occurrences of aquatic focal species (other than steelhead trout) in tributaries are sporadic and likely indicative of migrating individuals rather than populations
4. With limited exception, ownership is predominantly private, and land cover is predominantly nonforested and highly influenced by agricultural and rangeland uses
5. The entire Clearwater subbasin is within the Nez Perce Tribe Ceded Territory, and the majority of the Nez Perce Indian Reservation and related Tribal land holdings exist within PMUs defined within the Lower Clearwater AU.
6. Sediment regimes are dominated by surface erosion processes throughout much of the Lower Clearwater AU, although landslides/mass wasting processes may be important in limited areas.

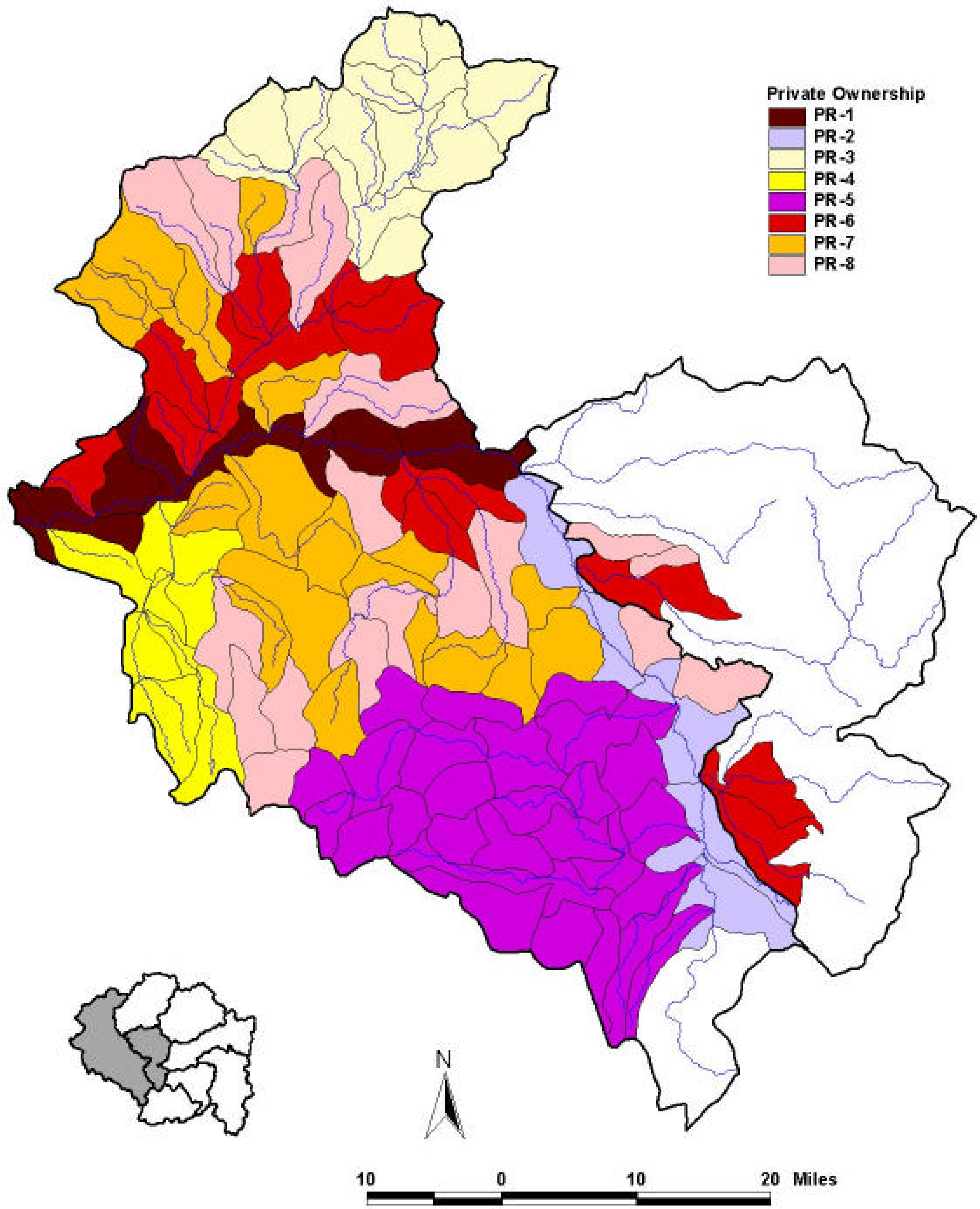

Figure 114. Potential Management Units (PMUs) delineated within areas of predominantly private ownership in the Clearwater subbasin

Table 67. Comparison of primary characteristics used to differentiate PMUs delineated throughout areas dominated by private ownership within the Clearwater subbasin. Characteristics in bold print are primary defining characteristics of each PMU

						Potential Disturbance			
PMU	Species Present	Dominant Owner	Water Use	Peak Runoff	Land Cover Dominant/Sub-Dom.	Road Density	Landslide Hazard	Surface Eros. Hazard	Primary Sediment source
PR-1	**All**	Private	Moderate	May	Ag./Forest	Mod.- High	**Mod.-High**	High	Mass/Surface
PR-2	**All**	Private	Moderate	May	Forest/Ag.	Mod.- High	**Very High**	**Very High**	Mass/Surface
PR-3	A-run SH	**Mixed**	Low	May	**Forest/None**	**High**	V Low-High	High-V High	**Mass/Surface**
PR-4	A-run SH	Private	**V High**	April	Ag./Forest	Moderate	Low	Very High	Surface Erosion
PR-5	A-run SH	Private	Low-Mod.	**March**	Ag./None	Moderate	Very Low	High-V High	Surface Erosion
PR-6	A-run SH	Private	Low-Mod.	April	Ag./Forest	Moderate	**Mod.-High**	**Very High**	**Mass/Surface**
PR-7	A-run SH	Private	Low	April	**Ag./None**	Moderate	V Low-Low	High-V High	Surface Erosion
PR-8	A-run SH	Private	Low	April	**Ag./Forest**	Moderate	V Low-Low	High-V High	Surface Erosion

9.1.1 PMU PR-1

Primary Distinguishing Characteristic(s)

Eight HUCs make up this PMU, which is distinguishable as the mainstem Clearwater River below its confluence with the North Fork Clearwater River (Figure 114). Reaches within this PMU are highly influenced by Dworshak Dam operations and used by fall chinook salmon for spawning and rearing, and other aquatic focal species primarily for migration and overwintering.

General Description

This PMU constitutes one of only two utilized by fall chinook salmon for spawning and rearing, and is utilized by all other target species principally for overwintering and migration purposes. This PMU may also constitute an important rearing area for juvenile A-run steelhead which are forced to migrate from natal tributary streams during periods of low flow and high temperature, a situation which has been suggested (Kucera et al. 1983; Fuller et al. 1984; and Johnson 1985) but not substantiated.

Habitat quality for fall chinook salmon has not been rated in this reach, but is thought to be relatively high. Fall chinook habitat quality is primarily impacted and limited by operations at Dworshak Dam which alter flow and temperature regimes throughout the spawning and rearing period. Habitat quality for other anadromous species is limited primarily by large stream size which inhibits spawning and early rearing. All aquatic focal species are thought to use this PMU for migration and overwintering purposes, and limited use by resident species may occur throughout the year. Water quality concerns in this PMU listed under §303(d) include only total dissolved gas resulting from the operation of Dworshak Dam.

The terrestrial focal species Jessica's aster, and the culturally important Lomatium have been documented by the Idaho CDC to occur in this PMU. Jessica's aster is a perennial representative of prairie grasslands. All of the locations of Jessica's aster in this PMU are on private property. Threats to this species in this PMU consist of grazing, destruction of habitat, and competition with introduced species. Lomatium is a perennial found in open areas with little herbaceous cover in canyon grasslands. Many locations of lomatium are on private land in this PMU. Lomatium is threatened by roadside disturbance, gravel pit/quarry work and weevil attacks. This PMU may contain high quality ponderosa pine, prairie grassland remenants and wetland habitats in need of inventory, protection and/or restoration.

Ownership is predominantly private throughout this PMU, with limited Federal, State, and Tribal holdings. Protected status of lands within this PMU is minimal, equating to less than 1 percent of any HUC. Land cover is dominated by agriculture and range lands, with interspersed forested areas generally comprising less than 25% of any HUC.

Relatively high surface erosion and landslide hazards combine to create substantial sediment production concerns throughout this PMU. Modeled landslide hazards range from Moderate to High and surface erosion hazard is considered Very High. Mining impacts, based on ecological hazards and numbers of mining claims, are minimal and probably have little influence on sediment production.

Overall road densities are Moderate, with the exception of populated areas where road densities range from High (Orofino) to Very High (Lewiston) due to municipal road networks. Following a similar trend, road densities within the PSSZ are Moderate throughout most of the PMU, and High in the populated areas. Although a combination of relatively high inherent landslide potentials and road densities occurs in this PMU, the overall likelyhood of road related landslides is thought to be low due to the prevalence of well maintained rural and urban (not forest) roads.

Very High surface erosion hazards coupled with predominantly agricultural land use, and Moderate to High grazing potential make surface erosion a potential concern within this PMU. However, the relative impact of localized versus upstream sediment sources to instream fine sediment levels in this PMU is unclear.

9.1.2 PMU PR-2

Primary Distinguishing Characteristic(s)

Five HUCs make up this PMU, which is distinguishable as the mainstem portions of the Clearwater and South Fork Clearwater rivers between Butcher Creek and the North Fork Clearwater River (Figure 114). Reaches within this PMU are used by fall chinook salmon for spawning and rearing, and are not subject to the influence of Dworshak Dam operations.

General Description

This PMU is similar to PR-1: it is utilized by fall chinook salmon for spawning and rearing, albeit to a much lesser extent, and by all other aquatic focal species primarily for overwintering and migration purposes. As is the case with PR-1, this PMU may also constitute an important rearing area for juvenile A-run steelhead, which are potentially forced to migrate from natal tributary streams during periods of low flow and high temperature.

Protected status of lands along the Clearwater River reaches within this PMU is minimal, equating to less than 1 percent of any HUC. In contrast, protected status of HUCs in this PMU along the South Fork Clearwater River each have approximately 10 percent of their area protected through the designation of a Wild and Scenic River reach. Ownership is predominantly private, with limited Federal, State, and Tribal holdings. Dominant land cover is forested, although agricultural/range lands make up at least 25 percent of all HUCs, making consideration of both land uses important in future planning.

Habitat quality for both spring chinook salmon and steelhead has been rated as Poor throughout this PMU, and is primarily constrained by large stream size, high temperatures, and sedimentation. No direct ratings of habitat quality for other aquatic focal species are available within this PMU. Water quality concerns listed under §303(d) impact only the South Fork Clearwater River portion, which is listed for habitat alteration and temperature concerns.

PMU PR-2 has a variety of cover types, but is equally dominated by mixed mesic forests with western red cedar and mixed xeric forests with Douglas-fir. Other significant cover types include agriculture, shrubs, and ponderosa pine.

The terrestrial focal species Jessica's aster and the culturally important lomatium have been documented by the CDC to occur in this PMU. Jessica's aster is a perennial representative of prairie grasslands. All of the locations of Jessica's aster in this PMU are on private property. Threats to this species in this PMU consist of grazing, destruction of habitat, and competition with introduced species. Lomatium is a perennial found in open areas with little herbaceous cover in canyon grasslands. Many locations of lomatium are on private land. Lomatium is threatened by roadside disturbance, gravel pit/quarry work and weevil attacks. This PMU may contain high quality ponderosa pine habitats, prairie grassland remenants and wetland habitats in need of inventory, protection and/or restoration.

The only wildlife focal species documented by the CDC in this PMU is fisher. Fishers prefer complex structure with multiple canopies, understory shrubs and a large amount of woody debris, and avoids open spaces. Threats to this species include clearcutting and habitat destruction which causes fragmentation.

Grazing potential is considered Low to Moderate, and potential impacts from mining activity are thought to be minimal. Both surface erosion and landslide hazards are generally classified as Very High in this PMU, making both sediment sources important considerations in future management.

Road densities are generally Moderate to High, with high densities associated with municipal road systems in populated areas (Orofino, Kamiah). Road densities within the PSSZ are High throughout the PMU, illustrating the prevalence of streamside roads and highways. Although a combination of relatively high inherent landslide potentials and road densities exists, the overall risk of road related landslides is thought to be relatively low due to the prevalence of well maintained rural and urban (not forest) roads.

Peak runoff is expected during May in this PMU, with low flows during September. Typical of mainstem rivers, flows are relatively stable through these reaches, with average September flows expected to represent between 19 and 27 percent of mean annual discharge. Allowable water use is widespread through HUCs within this PMU, but given the relative stream size, is thought to have minimal influence on aquatic biota. The highest allowable water use by HUC within this PMU is approximately 5,900 AFY (equating to approximately 8 cfs delivered throughout the year).

9.1.3 PMU PR-3

Primary Distinguishing Characteristic(s)

These thirteen HUCs comprise the headwaters of the Potlatch River (Figure 114) and contain the largest contiguous area of forested land cover in the Lower Clearwater AU. Ownership is highly mixed and include substantial percentages of Federal, State, corporate (Potlatch Corp.), and other private holdings.

General Description

Lands contained within this PMU have no protected status designations, and multiple disturbances substantially impact this PMU. Road densities are generally High, and densities within the PSSZ typically range from High to Very High. Grazing potential is High throughout much of the PMU, which is overlapped by numerous grazing allotments managed by the USFS. Additional (unquantified) grazing is known to occur on State and Potlatch Corp. lands, and is presumed to occur on other privately held properties as well. Although adequate records were not available to quantitatively describe impacts, timber harvest activity is known to have been substantial throughout much of this PMU.

Relatively high surface erosion and landslide hazards combine in the eastern half of this PMU to create substantial sediment production concerns. High to Very High surface erosion hazards are typical of lands contained within the entire PMU, which, combined with previously described impacts, may substantially impact aquatic ecosystems. Based on a lack of information available regarding road age and construction, it is not possible to assess the impacts of existing road networks to mass wasting. However, inherent landslide hazards are rated from Very Low to High, with Moderate to High rankings generally associated with the eastern half of the PMU where road densities are highest.

Habitat quality for wild steelhead trout (the only aquatic focal species known to utilize the area) has been rated as fair in the East Fork Potlatch River, and as poor throughout the remainder of this PMU. Sedimentation is the primary defined constraint to steelhead trout use.

Water quality concerns in this PMU listed under §303(d) include thermal modification, habitat alteration, sediment, flow, and pathogens. Modeling suggests that temperature conditions are generally suitable for use by A-run steelhead trout, although they may be marginal in some areas. Brook trout populations are widespread within the PMU, and have the potential to compete with juvenile steelhead trout. Hydrologic modeling suggests that relative discharge from this area (0.80-1.79 cfs/sq. mile of drainage area) is substantially higher than other tributary systems within the Lower Clearwater AU (0.20-0.80 cfs/sq. mile). Runoff is anticipated to be relatively flashy, with base flows expected to represent only 10-18 percent of the mean annual flow. Peak and low flows within this PMU can be expected during May and August, respectfully.

PMU PR-3 has a variety of cover types, but is dominated by forests. The forests of PR-3 include mixed mesic forests that include western red cedar, mixed xeric forests dominated by Douglas-fir, grand fir forests and western hemlock forests.

No terrestrial plant focal species observances have been documented by the CDC for PR-3. The only terrestrial animal focal species documented by the CDC in this PMU is the fisher. Fishers prefer complex structure with multiple canopies, understory shrubs and a large amount of woody debris, and avoids open spaces. Threats to fishers include clearcutting and habitat destruction which causes fragmentation.

9.1.4 PMU PR-4

Primary Distinguishing Characteristic(s)

This PMU is made up of seven HUCs (Figure 114) and is distinguished from other PMUs by potentially substantial impacts of water withdrawls. Withdrawls are associated primarily (not entirely) with the Lewiston Orchards Irrigation District, and may impact HUCs within this PMU either directly or indirectly.

General Description

Ownership throughout the PMU is dominated by private holdings although Tribal holdings are substantial in some HUCs (>25% of the land area). Lands contained within this PMU have no protected status designations, and land cover is predominantly agriculture/range but dominated by forest cover in the headwaters of Sweetwater and Webb creeks. Grazing potential ranges from Low to Moderate.

Surface erosion and landslide hazards throughout this PMU are typically Very High and Low, respectively. Road densities are Moderate, but range from Moderate to High in the PSSZ suggesting a prevalence of valley bottom roads. Existing roads are generally part of rural road networks (i.e. gravel or paved), with the only concentration of forest type roads found in the headwaters of Sweetwater and Webb creeks.

Waterways within this PMU are generally accessible and used by A-run steelhead trout although they are believed to be blocked from the headwaters of Sweetwater Creek and absent from Lindsay Creek. Habitat quality for steelhead trout has been rated as Fair throughout most of this PMU, and as Poor in the lower reaches of Lapwai Creek. Constraints to steelhead trout use within this area include high temperatures, dewatering, passage concerns, sedimentation, and channelization. Water quality concerns in the PMU listed under §303(d) include temperature, thermal modification, habitat alteration, sediment, flow, pathogens, bacteria, pesticides, and synthetic organics. Modeling for this assessment suggests that temperature conditions in this PMU are expected to regularly exceed established standards for use by steelhead trout, and may limit population success. The status of brook trout population(s) within this PMU is unknown.

Allowable water use within this PMU is substantial, ranging as high as 53,000 AFY (equivalent to approximately 73 cfs) within individual HUCs. Water use predominantly impacts surface water resources, and is typically consumptive in nature, with water either withdrawn from the system or stored for later withdrawl. As is discussed earlier in this document, water withdrawl is limited by existing canal structures, and does not generally exceed 40 cfs (See section 4.8). Some HUCs within this PMU experience only indirect influences of upstream water withdrawl(s).

9.1.5 PMU PR-5

Primary Distinguishing Characteristic(s)

This PMU consists of 27 HUCs (Figure 114) distinguishable from other areas in the subbasin by unique hydrologic conditions, including extremely flashy flows, and the earliest occurrence of peak flows (March) in the Clearwater subbasin.

General Description

Lands contained within this PMU have no protected status designations, and ownership is dominated by private holdings. Federal, State, and Tribal holdings within this PMU are limited, and individually comprise less than 25% of any individual HUC. With limited exception, HUCs contained within this PMU are dominated by agricultural/rangeland uses. Forest cover is dominant in only two HUCs in the head of the Lawyers Creek drainage, and subdominant (>25% of land area) in only 3 other HUCs within this PMU (Threemile, Butcher and Lawyers creeks).

Road densities are generally classified as Moderate, with near stream densities (within the PSSZ) ranging from Low to High. Inherent landslide hazards are considered Very Low throughout the majority of this PMU, and surface erosion hazards are High to Very High. Although grazing potential is Moderate near the mouths of Lawyers and Cottonwood creeks, it is considered Low throughout the majority of the PMU. Mining impacts due to mines or mining claims are negligible.

Although peak flows in this PMU are anticipated earlier than other portions of the subbasin (March), timing of low flows (August) is consistent with much of the Lower Clearwater AU. On average, baseflow (minimum monthly discharge) equates to less than 10 percent of the mean annual discharge throughout this PMU, illustrating the extremely flashy nature of runoff from this area. Relative discharge (0.2-0.6 cfs/sq. mi. of drainage area) of subwatersheds in this PMU is low relative to much of the subbasin, but similar to that from other agriculturally dominated areas in the Lower Clearwater AU.

Steelhead trout are absent from the upper portion of the Cottonwood Creek drainage, but present throughout the majority of other drainages in this PMU. Habitat condition for steelhead trout has been classified as Poor throughout the usable portions of Lawyers and Cottonwood creeks, and as Fair in Threemile and Butcher creeks. Primary constraints to steelhead use in this PMU have been defined as high temperatures and dewatering in Lawyers Creek, and passage impediments and sedimentation throughout the entire PMU. Modeling conducted for this assessment suggests that temperature conditions throughout the majority of this PMU are likely to exceed established standards for areas used by steelhead trout, and may therefore limit population success. Water quality concerns, which are widespread in this PMU and listed under §303(d), include thermal modification, habitat alteration, sediment, flow, and pathogens. Pesticides, oil/grease, and synthetic organics are listed under §303(d) as impacting select stream reaches within this PMU.

Terrestrial plant focal species documented by the CDC to occur within PR-5 are Palouse goldenweed and spatious monkeyflower. No wildlife focal species occurances have been documented by the CDC in PR-5. Palouse goldenweed is a perennial forb representative of prairie grassland habitat. Threats to this species include grazing, herbicide drift, and diminishing habitat quality. Palouse goldenweed is extremely sensitive to disturbance. Spatious monkeyflower is an annual representative of riparian and wet meadow habitats. It is mostly found in microsites of open grasslands and forest openings with enhanced moisture and shade. Threats to spatious monkeyflower include livestock trampling and weedy invaders. This PMU may contain a variety of high quality wildlife habitats, including high quality ponderosa pine, prairie grassland remenants and wetland habitats, in need of inventory, protection and/or restoration.

9.1.6 PMU PR-6

Primary Distinguishing Characteristic(s)

HUCs delineated within this PMU are distinguishable from other areas of the subbasin by a combination of factors with the potential to impact aquatic and terestrial resources in a cumulative manner. HUCs within this PMU have substantial amounts of agricultural/range lands (dominant or subdominant cover) coupled with Very High surface erosion hazard, Moderate to High landslide hazard, and Moderate to High road densities (both overall and within the PSSZ).

Species Specific Notes

Both A and B run steelhead trout are found within this PMU. B-run steelhead trout utilize portions of this PMU which lie within the Lolo/Middle Fork AU, whereas A-run steelhead trout utilize those portions within the Lower Clearwater AU. B-run steelhead trout within this PMU are influenced by hatchery practices.

Spring chinook salmon are known to utilize those portions of this PMU which lie within the Lolo/Middle Fork AU. Spawning and rearing is known to occur in both the Lolo and Clear creek drainages.

Bull trout are known to utilize those portions of this PMU which lie within the Lolo/Middle Fork AU. No information is available regarding the status of bull trout populations in these areas. However, areas within this PMU which contain bull trout populations are considered to be at the fringes of suitable habitat for the species, and it is unlikely that population levels are high.

Westslope cutthroat trout are known to utilize those portions of this PMU which lie within the Lolo/Middle Fork AU and essentially represent the western boundary of the species' distribution in the subbasin. Populations of westslope cutthroat trout are considered "depressed" where they exist within this PMU.

Brook trout are known to exist in each major drainage within this PMU, although specific information regarding population status is unknown. Although known to exist in the mainstem Potlatch River, no information is available regarding status or distribution throughout most tributaries in the drainage (and in this PMU).

General Description

This PMU consists of 14 HUCs which either lie within, or border along the Lower Clearwater AU (Figure 114). The HUCs within this PMU represent four separate clusters including areas in the lower Potlatch River drainage and Hatwai Creek, and areas near the mouths of Big/Little Canyon creeks, Lolo Creek, and the Middle Fork Clearwater River. Agricultural/range lands predominate in this PMU, and form the dominant (>50%) and subdominant (>25%) cover in 11 and 3 HUCs, respectively. Ownership throughout these areas is dominated by private holdings, with limited state, Tribal, or Federal properties. Lands throughout this PMU typically do not have any protected status, with the exception of the Middle Fork Clearwater River (Wild and scenic river reach) and the lower reaches of Lolo Creek (area of critical environmental concern). Overall grazing impacts are generally defined as Moderate to Low throughout this PMU, but as is the case with most areas in the Lower Clearwater AU, impacts may be concentrated along steep canyons.

Surface erosion hazards are classified as Very High and inherent landslide potentials range from Moderate to High throughout this PMU, suggesting substantial potential for cumulative sediment impacts from land use and management activities. Overall road densities are Moderate throughout the majority of this PMU and High in HUCs along the Middle Fork Clearwater River and Clear Creek. Near stream road densities (within the PSSZ) range from Moderate to Very High throughout the PMU, and are highest near the mouth of the Middle Fork Clearwater River.

Hydrology throughout the PMU is generally typical of that in the Lower Clearwater AU, with peak runoff during April and lowest runoff generally occurring during August. Like much of the subbasin, flow stability is thought to be low, with the minimum mean monthly discharge representing 10-18 percent of the mean annual discharge. Flow stability may be slightly higher in the Middle Fork Clearwater River (19-27%) and slightly lower in the mainstem Potlatch River (0-9%). Direct water use from HUCs within this PMU is limited, generally representing an average withdrawl rate of less than 2 cfs with the exception of Clear Creek (up to 17,000 AFY; 23 cfs).

Basic modeling conducted during this assessment suggests that temperature conditions throughout this PMU are likely to be marginal, at best, for salmonid use and may limit success of all species. Habitat quality has been rated as Poor to Fair for anadromous species throughout this PMU, and has not been rated for resident species where they occur. Constraints to use by anadromous species include high temperatures, dewatering, and sedimentation. Steep gradient is thought to inhibit use of Lolo Creek by spring chinook salmon, but is not thought to inhibit use by steelhead trout. Concerns listed under §303(d) as potentially impacting beneficial uses throughout this PMU include sediment, thermal modification, habitat alteration, flow and pathogens. Oil and grease, synthetic organics, and pesticides potentially impact beneficial uses in more localized areas, particularly portions of the Potlatch River designated within this PMU.

Terrestrial plant focal and culturally important species documented by the CDC to occur in PR-6 include Palouse goldenweed, lomatium, and Jessica’s aster. No terrestrial wildlife focus species occurrences are documented by the CDC in PR-6. Palouse goldenweed is a perennial forb representative of prairie grassland habitat. Threats to this species include grazing, herbicide drift, and diminishing habitat quality. Palouse goldenweed is extremely sensitive to disturbance. Lomatium is a perennial found in open areas with little herbaceous cover in canyon grasslands. Many locations of Lomatium are on private land in this PMU. Lomatium is threatened by roadside disturbance, gravel pit/quarry work and weevil attacks. Jessica’s aster is a perennial representative of prairie grasslands. All of the locations of Jessica’s aster in this PMU are on private property. Threats to this species in the PMU consist of grazing, destruction of habitat, and competition with introduced species.

9.1.7 PMUs PR-7 and PR-8

Primary Distinguishing Characteristic(s)

These two highly similar PMUs represent agriculturally dominated areas not delineated into other PMUs, and include substantial portions of the Camas Prairie and Potlatch River drainages (Figure 114). Although conditions within these two PMUs are nearly identical, two categories are defined to represent HUCs with >75% agricultural/range cover (PR-7) from those containing 25-50% forested cover (PR-8).

General Description

The 36 HUCs delineated into these PMUs are nearly all dominated by agricultural land cover, and are evenly subdivided to represent the amount of interspersed forest cover: those with only minor amounts (<25%) of forest cover are included in PR-7. Those HUCs with more substantial (25-50%) forest cover are included in PR-8.

Lands contained within these PMUs do not benefit from protected status designations, and ownership is predominantly (>75%) private throughout virtually all HUCs. Relatively small Tribal, State, and Federal holdings exist throughout these PMUs, with Tribal holdings being most substantial.

Surface erosion from agricultural and range lands is presumed to be the dominant source of sediment delivered to stream channels throughout these PMUs. Surface erosion hazards are considered Very High throughout the majority of HUCs in the PMUs. Grazing potential is considered Low, and likely concentrated on steep canyon walls near streams. Inherent landslide hazards are considered Very Low to Low, and associated road densities are typically Moderate (ranging from Low to Very High) throughout the HUCs (both overall and within the PSSZ).

Habitat conditions for steelhead trout are variable throughout these PMUs, having been rated from Poor to Good depending on location. Poor habitat condition is typical of portions of these PMUs contained within the Potlatch River, Little Canyon Creek, and Cottonwood Creek drainages. Fair habitat conditions are found in portions of Lapwai, Jacks, Bedrock, and Pine Creeks, and habitat conditions in much of Big Canyon Creek have been rated as Good for steelhead trout. Major constraints to steelhead trout use throughout these areas include high temperatures, dewatering, and sedimentation. Other concerns affecting limited areas within these PMUs include channelization (Lapwai Creek), streambank degradation (Cottonwood Creek), poor instream cover and lack of quality pools (Jacks, Bedrock, and Little Canyon creeks). Modeling for this assessment indicates that temperatures throughout these PMUs are potentially limiting to steelhead trout population(s).

Stream segments throughout these PMUs are listed for water quality concerns under §303(d). Common factors delineated as potentially limiting beneficial uses include sediment, thermal modification, habitat alteration, flow, pesticides, and pathogens.

Hydrologic regimes within these PMUs are consistent with those throughout much of the northwestern portions of the Clearwater subbasin. Peak flows are expected in April and lowest flows in August. Relative annual discharge ranges from 0.20 to 0.60 cfs/square mile of drainage area, which is consistent with other agriculturally dominated areas in the subbasin. Annual hydrographs are generally unstable, with minimum mean monthly discharge representing only 10-18 percent of mean annual discharge, which is relatively common throughout the subbasin. Allowable water use from these PMUs involves a mix of ground and surface water rights which are not thought to have substantial impacts to aquatic biota. Combined surface and groundwater uses generally equate to an average withdrawl rate of less than one cfs from any HUC.

Terrestrial plant focal species documented by the CDC to occur in PR-7 and PR-8 include Jessica's aster and Palouse goldenweed. Jessica's aster is a perennial representative of prairie grasslands. All of the locations of Jessica's aster in this PMU are on private property. Threats to this species in the PMU consist of grazing, destruction of habitat, and competition with introduced species. Palouse goldenweed is a perennial forb representative of prairie grassland habitat. Threats to this species include grazing, herbicide drift, and diminishing habitat quality. Palouse goldenweed is extremely sensitive to disturbance. No terrestrial animal focal species occurances have been documented by the CDC in PR-7 and PR-8.

9.2 PMUs Predominated by Mixed Ownership

A total of six PMUs have been delineated with the prefix "MX" to signify areas of highly mixed ownership including Federal, state, corporate, and other private holdings (Figure 115). Areas of highly mixed ownership exist throughout the majority of the Lower North Fork and Lolo/Middle Fork AUs, and in portions of the Upper North Fork and Lochsa AUs. Throughout much of this area, ownership is dominated by state and private corporation land holdings, with Federal and other private holdings being present, but of relatively limited importance. In limited instances where management issues overlap, PMUs delineated here may encompass small numbers of HUCs dominated by Federal (rather than mixed) ownership. This has been done to minimize redundancy in PMU descriptions where the same units have been defined across multiple ownership areas.

Future management options and issues within these mixed ownership areas are distinct in that diverse ownership and land use patterns will presumably result in different planning scenarios from those on other lands in the subbasin. Potlatch Corp. and Plum Creek Timber Company are the two corporations which maintain substantial land holdings in these areas of the Clearwater subbasin. Both corporations will be influential in defining future management strategies and options aimed at maintenance or restoration of aquaticand terrestrial resources in areas within and surrounding their operating areas.

Primary characteristics used to differentiate PMUs within mixed ownership areas include dominant and subdominant owners, natural and induced disturbance regimes, and relative importance of sediment sources.

Table 68 summarizes differences in primary characteristics between the six defined PMUs. Textual descriptions are provided below and include discussion of additional details regarding conditions within each PMU as they relate to focal species and habitat.

Table 68. Comparison of primary characteristics used to differentiate PMUs delineated throughout mixed ownership areas within the Clearwater subbasin. Characteristics in bold print are primary defining characteristics of each PMU

	Ownership		Potential Disturbance			
PMU	Dominant	Sub-Dom.	Road Density	Landslide Hazard	Surface Eros. Hazard	Primary Sediment source
MX-1	Mixed	Mixed	Mod.-V High	**Mod.-V High**	**Mod.-V High**	Landslide/Surface
MX-2	Potlatch	Mixed	Mod.-V High	**Mod.-V High**	**Mod.-V High**	Landslide/Surface
MX-3	**Potlatch**	State	High-V High	**V Low-Low**	**Very Low**	Limited
MX-4	**State/Priv.**	State/Priv.	High-V High	**Low**	**High**	**Surface Erosion**
MX-5	Federal	**Plum Ck.**	Low-V High	V Low-Low	V Low-High	Variable
MX-6	Federal	**Plum Ck.**	Mod.-V High	V Low-Mod.	Low-Mod.	Variable

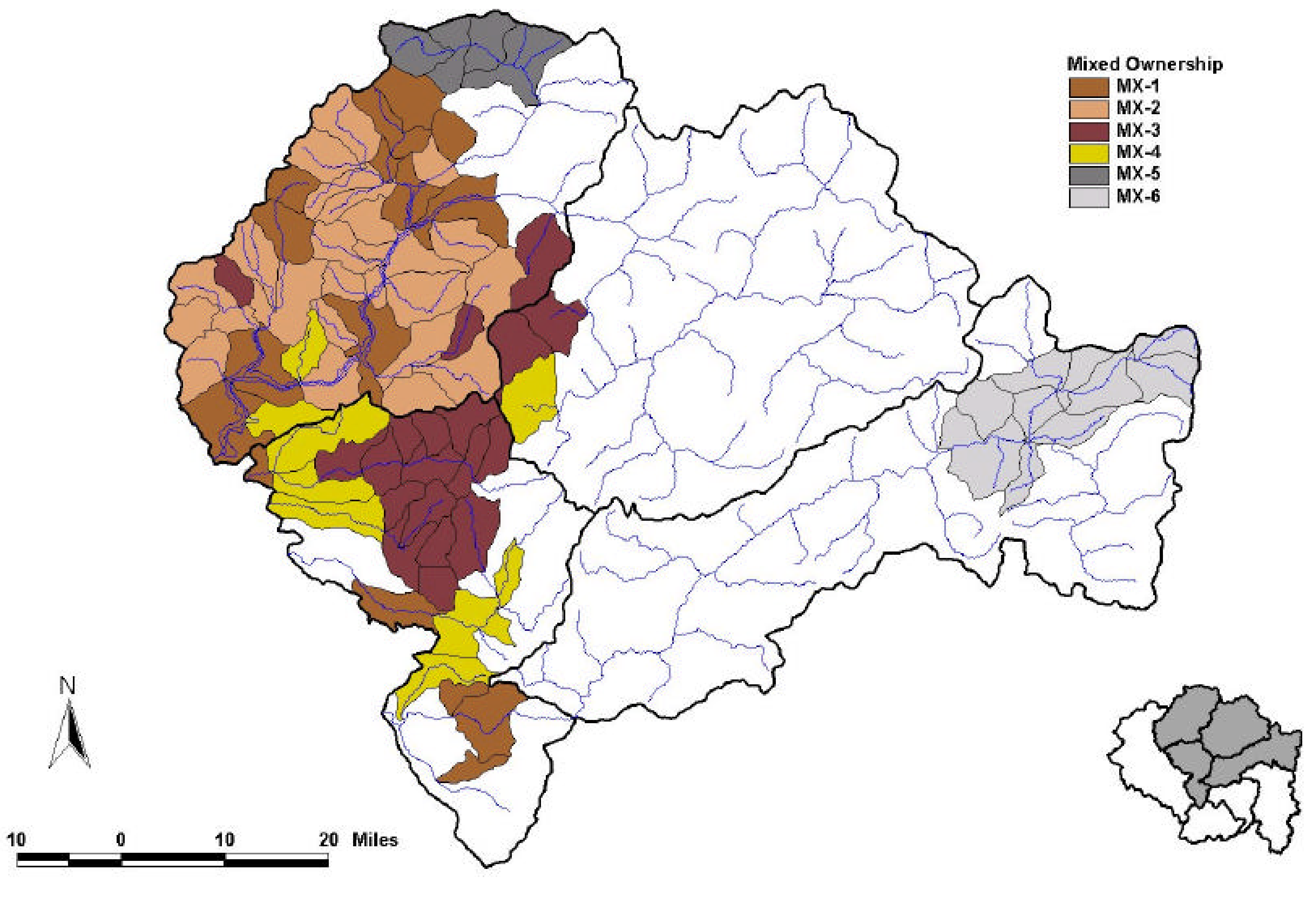

Figure 115. Potential Management Units (PMUs) delineated within areas of highly mixed ownership in the Clearwater subbasin

These PMUs are displayed separately to emphasize the substantial differences in management concerns in areas dominated by mixed ownership patterns relative to other areas of the subbasin. PMUs within this area were defined with the following distinctions in mind and, unless noted, these characteristics will apply to all PMUs defined in this area

1. Anadromous species are excluded from many of the mixed ownership areas within the Clearwater subbasin. Exceptions exist in portions of the Lochsa, Lolo/Middle Fork, and Lower Selway AUs
2. Based on current distribution, historical suggestions, landscape characteristics, and modeled temperature characteristics, much of the mixed ownership area represents, at best, marginal habitat for bull trout. Other aquatic focal species either are, or presumed to historically have been, relatively widely distributed throughout these areas, although no information is available regarding past population levels.
3. Properties owned by Plum Creek Timber Company are intermixed with Federally owned lands whereas those owned by Potlatch Corp. are intermixed primarily with state and privately owned property. This distinction will likely result in different planning strategies within the operating areas of each corporation, and PMUs have been delineated accordingly
4. Land cover throughout these PMUs is predominantly forested with little influence of agricultural and rangeland uses
5. Tribal land holdings within these PMUs is limited or nonexistent. The entire Clearwater subbasin is, however, within the Nez Perce Tribe Ceded Territory.

9.2.1 PMUs MX-1 and MX-2

Primary Distinguishing Characteristic(s)

These two PMUs are distinguishable from other areas of the subbasin by their combination of mixed ownership pattern, high road densities, high landslide hazard ratings, and often times, coincidentally high surface erosion hazards (Table 68). They are distinguishable from one another based on the prevalence of corporate ownership, which accounts for less than 25% of HUCs within MX-1, and is the dominant or subdominant (>25%) ownership in MX-2.

Species Specific Notes

B-run steelhead trout utilize all accessible HUCs within MX-1, with migration and overwintering use of mainstem rivers (Lochsa, Selway, Middle Fork Clearwater), and spawning and rearing use of associated tributary streams in these same drainages. Population status of steelhead trout is "depressed" throughout this PMU. MX-2 exists only in the North Fork Clearwater River drainage above Dworshak Dam, and is not accessible to steelhead trout.

Spring chinook salmon are blocked from areas defined within MX-2, and use in MX-1 is limited to migration through the mainstem Middle Fork Clearwater, Lochsa, and Selway rivers, and spawning and rearing in portions of Clear Creek, Pete King Creek, and lower O'Hara Creek.

Bull trout are found in only a few locations within these PMUs including O'Hara Creek, the headwaters of Clear Creek, portions of the Little North Fork Clearwater River system, and the North Fork Clearwater and tributaries upstream of Dworshak Reservoir. Although not clearly documented in distribution maps, bull trout are also presumed to utilize much of Dworshak Reservoir. No known "stronghold" populations of bull trout exist within these PMUs which, as mentioned earlier, are thought to exist near the outer limits of the bull trout's natural range within the Clearwater subbasin.

With the exception of the headwaters of the Elk River system, westslope cutthroat trout are distributed throughout the areas defined by these two PMUs. However, few HUCs are defined as having strong populations of westslope cutthroat trout. HUCs in which strong population status is defined typically have a relatively high degree of protected status and are located in the North Fork Clearwater AUs and in Pete King and Canyon creeks in the Lochsa AU.

Little information exists regarding brook trout presence or status in portion of these PMUs in the Middle Fork Clearwater, lower Lochsa, and lower Selway river drainages although the species in known to exist in these areas. Within the North Fork AUs, brook trout are widely distributed throughout these two PMUs although population status is largely unknown. Strong populations of brook trout are known to occur in the Elk Creek, Beaver Creek, and Washington Creek drainages. Brook trout in the Elk Creek system are highly sought after by anglers and are managed differently than other brook trout populations by IDFG.

General Description

9.2.2 PMUs MX-1 and MX-2

Primary Distinguishing Characteristic(s)

These two PMUs are distinguishable from other areas of the subbasin by their combination of mixed ownership pattern, high road densities, high landslide hazard ratings, and often times, coincidentally high surface erosion hazards (Table 68). They are distinguishable from one another based on the prevalence of corporate ownership, which accounts for less than 25% of HUCs within MX-1, and is the dominant or subdominant (>25%) ownership in MX-2.

Species Specific Notes

B-run steelhead trout utilize the limited number of accessible HUCs within MX-1, with migration and overwintering use of the Middle Fork Clearwater, and spawning and rearing use of Lolo Creek. Where they exist, population status of steelhead trout is “depressed” throughout these PMUs. Spring chinook salmon use in MX-1 is limited to migration through the mainstem Middle Fork Clearwater River. MX-2 exists only in the North Fork Clearwater River drainage above Dworshak Dam, and is not accessible to anadromous species.

Bull trout in these PMUs are found only in portions of the Little North Fork Clearwater River system. Although not clearly documented in distribution maps, bull trout are also presumed to utilize much of Dworshak Reservoir. No known “stronghold” populations of bull trout exist within these PMUs which, as mentioned earlier, are thought to exist near the outer limits of the bull trout’s natural range within the Clearwater subbasin.

With the exception of the headwaters of the Elk River system, westslope cutthroat trout are distributed throughout the areas defined by these two PMUs. Status of westslope cutthroat trout populations within these PMUs is not well defined, and strong populations defined in only one HUC (headwaters of Floodwood Creek system).

Within the North Fork AUs, brook trout are widely distributed throughout these two PMUs although population status is largely unknown. Strong populations of brook trout are known to occur in the Elk Creek, Beaver Creek, and Washington Creek drainages. Brook trout in the Elk Creek system are highly sought after by anglers, and are managed differently than other brook trout populations by IDFG.

General Description

A total of 38 HUCs are incorporated into these two PMUs, with 16 delineated as MX-1, and 22 delineated as MX-2 (Figure 115). The two PMUs will be discussed simultaneously since landscape conditions and impacts are similar between them. However, future planning should consider these two areas as distinct based on differences in management or restoration strategies likely to result from the differing influence of corporate ownership between them.

HUCs within these two PMUs encompass much of the lower North Fork Clearwater River drainage near Dworshak Reservoir, and spotty portions of Lolo Creek, and the Middle Fork Clearwater River and its tributaries.. Brook trout are relatively widely distributed throughout both PMUs, and may compete with native species where they co-exist. Protected status of these areas is typically minimal, but ranges from 25-45% in 3 HUCs which have relatively high influence of Federal ownership (2 in upper Floodwood Creek, one on Middle Fork Clearwater River). Protected status is generally associated with designation of wild and scenic river reaches or inventoried roadless areas which border the mixed ownership areas.

Land cover throughout these PMUs is typically forest. Landslide hazards range from Moderate to Very High and although surface erosion hazards are variable throughout these areas, they are most commonly rated as High to Very High. Land use impacts, thought to be related primarily to forest management, are believed to be substantial throughout these PMUs as indexed by relative road densities. Both overall and near-stream (PSSZ) road densities range from Moderate to Very High, with Moderate densities typically associated with those HUCs which have partial protected status. Road densities in unprotected portions of those HUCs are similar to those throughout these PMUs (High to Very High).

Grazable lands are common surrounding the Middle Fork Clearwater River, and the USFS manages grazing allotments which impact portions of these PMUs in the Clear, Yakus, Long Meadow, and Elk creek drainages. Based on information available for this assessment, it is unclear to what degree grazing is allowed on state or corporately owned property within these PMUs.

Ecological hazards associated with mines is thought to be negligible throughout this Management Unit. However, mining claim densities are Moderate in the central Middle Fork Clearwater River. The current status and use of mining claims in these areas is unknown, but will need to be considered during future planning efforts.

Modeling conducted as part of the limiting factor analysis in this assessment suggests that temperature regimes throughout these PMUs are most conducive to use by westslope cutthroat trout and steelhead, with limited potential for chinook salmon or bull trout use. Constraints identified in NPPC databases for spring chinook and steelhead trout (in accessible areas) include sediment and steep gradients in potential spawning and rearing areas, and high temperatures in migration corridors. Streams within these PMUs are commonly listed on the §303(d) list for potential beneficial use restrictions due to sediment. Listed streams are most commonly located in the areas surrounding Dworshak Reservoir, and other common §303(d) concerns include habitat alteration and flow. Many of the streams within the Elk River drainage are listed for additional concerns including nutrients, thermal modification, and pathogens.

Hydrologic regimes in these PMUs is generally typical of much of the Clearwater subbasin, with peak flows occurring in April or May, and base flows in September. Hydrologic modeling conducted by Lipscomb (1998) suggests that annual hydrographs are typically more stable in areas surrounding Dworshak Reservoir than throughout the remainder of the subbasin, with baseflows equal to between 37 and 46 percent of the mean annual discharge.

With few exceptions, water use is not typically a substantial influence on aquatic biota within these PMUs as most HUCs have allowable water use equating to less than 1,200 AFY (1.5 cfs). Substantial water rights (1.1 million AFY; 1,522 cfs) exist at the head of the Middle Fork Clearwater River, but are designated for maintenance of instream flows and intended to benefit local biota. Substantial water rights are maintained for the operation of both Dworshak and Elk River reservoirs.

9.2.3 PMU MX-3

Primary Distinguishing Characteristic(s)

Mixed ownership generally with either dominant or subdominant ownership by Potlatch Corp. The 19 HUCs contained within this PMU have High to Very High road densities on lands with both surface erosion and inherent landslide hazards which are Very Low to Low.

Species Specific Notes

Both steelhead trout and spring chinook salmon are known to utilize only one HUC (Jim Brown Creek) within this PMU where their population status is defined as depressed for both species. In contrast, brook trout are widely distributed and limited information on population status suggests that populations are strong throughout much of this PMU.

As was mentioned earlier, most of the mixed ownership area exists within the outer limits of the bull trout's natural range in the Clearwater subbasin. Bull trout are known to be present in only 2 HUCs in this PMU, and populations are not thought to be strong in either. Both HUCs containing bull trout are located above Dworshak Reservoir in the North Fork Clearwater River drainage.

Westslope cutthroat trout are widespread in this PMU, but presumed to be absent from the Jim Ford Creek watershed. Only one population stronghold is known to exist within the PMU, in Beaver Creek, a tributary to the upper most reaches of Dworshak Reservoir.

General Description

Lands within this PMU do not have any status designations resulting in their being classified as protected. Ownership is highly mixed throughout this PMU, and generally dominated by Potlatch Corp. although state and private holdings are substantial in some areas. Land cover is typically forested throughout this PMU, and land use activities revolve primarily around forest management. Road densities, both within the PSSZ and overall, are rated as High to Very High throughout these HUCs, illustrating the intensive management commonly realized in these areas. Ecological hazards associated with mining activity are generally minimal throughout this PMU, although Moderate hazards are noted in portions of Orofino Creek and in the Reeds Creek subwatershed.

Both surface erosion hazard and inherent landslide hazards are typically Very Low to Low in these areas, suggesting a potentially more limited impact from intensive management than is realized in surrounding PMUs (MX-1 and MX-2). However, it was not possible to define the relative impact of high road densities on mass wasting or surface erosion during this assessment.

Habitat quality has not been rated for any aquatic focal species within this PMU and the lack of known strong populations suggests that habitat quality may not be optimal for any focal species. Sediment is widely listed under §303(d) as potentially impacting beneficial uses throughout this PMU. Portions of Jim Ford and Lolo creeks are also listed for possible impairment due to thermal modification, habitat alteration, flow and pathogens. Temperature modeling suggests that conditions throughout this PMU are typically likely to be suitable or marginal for use by steelhead and westslope cutthroat trout, but may limit use by spring chinook salmon and bull trout.

Hydrologic regimes within this PMU are typical of surrounding areas within the Clearwater subbasin, with peak and low flows typically occurring during April and August/September, respectively. Relative discharge and flow stability within the PMU are also generally consistent with that in the central portions of the subbasin. Allowable water use is widespread throughout this PMU, and is typically very low from individual HUCs (< 724 AFY or 1 cfs). However, the widespread nature of allowable water use, particularly throughout the Lolo/Middle Fork AU, has the potential to result in cumulative impacts from withdrawls in the Orofino, Jim Ford, and Lolo Creek drainages. A single HUC located in the upper reaches of Orofino Creek has water rights for a notable amount of water (11,200 AFY; 15.5 cfs), although it is unclear what the intended or actual use of this water is for.

The only terrestrial plant focal species documented by the CDC to occur in PMU MX-3 is Clearwater phlox. Clearwater phlox is a representative of wet meadows and riparian areas. It is associated with wet grasslands surrounded by forests. Threats to Clearwater phlox include destruction of habitat, grazing, disease, and infection of two different rusts.

Terrestrial animal focal species documented by the CDC to occur in MX-3 include fisher, wolverine and Coeur d' Alene salamander. Threats to the fisher include clearcutting and habitat destruction which causes fragmentation. The wolverine is a scavenger representative of montane coniferous forests. It is associated with subalpine basins with little overhead canopy cover. Threats to this species include habitat fragmentation and loss of ungulate wintering areas. Coeur d' Alene salamander feeds on benthic insects and is found under forest litter, bark and logs. It is associated with seepages, splash zones and streamsides near talus. Coeur d' Alene salamander is threatened by habitat fragmentation, water diversion and pollution, and fire.

9.2.4 PMU MX-4

Primary Distinguishing Characteristic(s)

Within the mixed ownership area, this PMU includes eight HUCs (Figure 115) distinguished by a relatively limited influence of Potlatch Corp. holdings, with state and private holdings generally dominating ownership. Land use impacts are high (road densities are High to Very High), surface erosion hazards are High, and inherent landslide hazards are Low.

Species Specific Notes

B-run steelhead trout utilize all accessible HUCs within this PMU for spawning and rearing purposes, with the possible exception of Maggie Creek which is known to be used by A-run steelhead trout. Population status of steelhead trout is "depressed" throughout this PMU, and all B-run populations within this PMU are influenced by hatchery production.

Spring chinook salmon are found in this PMU only in the Lolo Creek system. As is the case throughout the entire subbasin, spring chinook status is defined as "depressed" and populations are influenced by hatchery production.

Bull trout are known to be present in this PMU only in Lolo Creek, where the population is defined as depressed. As was previously mentioned, most of the mixed ownership area is thought to exist at the outer limits of the bull trout's natural range in the Clearwater subbasin.

Westslope cutthroat trout are widespread in this PMU, but presumed to be absent from the Jim Ford and Whiskey Creek watersheds. Where information regarding status is available, westslope cutthroat trout populations are considered "depressed" throughout this PMU.

Brook trout are widely distributed throughout this PMU although no information is available regarding their presence/absence in Maggie Creek (Lolo/Middle Fork AU) or Cranberry Creek (Lower North Fork AU). Brook trout populations are not thought to be strong in the central portions of the Lolo Creek drainage, and the status of populations elsewhere in this PMU is unknown.

General Description

The influence of protected status on lands throughout this PMU is minimal. State and private ownerships combine to play a more prominent role in this PMU than others in the mixed ownership area. The overall influence of ownership by Potlatch Corp. is greatly reduced in this PMU relative to others in the mixed ownership area.

Land cover is predominantly forested throughout this PMU, and land use activities revolve primarily around forest management. Road networks are composed primarily of natural surfaced forest roads, and road densities both overall and within the PSSZ are rated as High to Very High throughout these HUCs.

While inherent landslide hazards are considered Very Low to Low, surface erosion hazards are generally High suggesting that surface losses may have a more substantial impact to aquatic resources than mass wasting. However, the potential for increased mass wasting impacts related to land use patterns and related road networks throughout this PMU is not clear based on information available.

In the single HUC utilized by spring chinook salmon, habitat quality has been rated Poor to Good, generally increasing moving upstream through Lolo Creek. Habitat quality ratings for steelhead trout range from Poor (Orofino, Whiskey, and Jim Ford creeks) to Good (Lolo and Clear creeks). Habitat quality for other aquatic focal species has not been rated, however the lack of known strong populations suggests that habitat quality may not be optimal for other aquatic focal species.

Temperature modeling suggests that conditions are likely to be suitable or marginal for use by steelhead and westslope cutthroat trout throughout this PMU, and most likely exceed established temperature criteria for use by bull trout and chinook salmon. Sedimentation is a widely recognized factor limiting fish populations throughout this PMU, and sediment is the most widely listed factor under §303(d) as potentially impacting beneficial uses. Temperature, thermal modification, habitat alteration, flow, pathogens, oil and grease, and bacteria are listed as potentially impacting beneficial uses in all or portions of the Lolo, Jim Ford, and Orofino creek watersheds.

Hydrologic regimes in this PMU are typical of the central portions of the subbasin, with relatively low flow stability, peak flows expected in April or May, and low flows during August and September. Allowable water use is typically limited within individual HUCs in this PMU, but is widespread. Due to widespread water use, cumulative impacts of water withdrawls may present an important management concern in the Lolo, Jim Ford, and Orofino Creek watersheds.

The only terrestrial plant focal species documented by the CDC to occur in PMU MX-4 is Jessica's aster. Jessica's aster is a perennial representative of prairie grasslands. All of the locations of Jessica's aster in this PMU are on private property. Threats to this species in this PMU consist of grazing, destruction of habitat, and competition with introduced species.

The only terrestrial animal focal species documented by the CDC to occur in MX-4 is the fisher. The fisher prefers complex structure with multiple canopies, understory shrubs, and a large amount of woody debris. It avoids open spaces. Threats to this species include clearcutting and habitat destruction, which causes fragmentation. Since fishers avoid open spaces, fragmentation causes isolated populations.

9.2.5 PMU MX-5

Primary Distinguishing Characteristic(s)

Four HUCs encompassing the Plum Creek Timber Company operating area in the Lower North Fork AU. Land holdings form a "checker-board" pattern with Plum Creek Timber Company lands interspersed amongst predominantly Federal ownership. Delineation of this PMU is based on ownership maps presented by Hicks et al. (1999) and Sugden and Light (1997), which are thought to more accurately depict corporate ownership than information presented elsewhere in this assessment.

Species Specific Notes

Bull trout are present throughout this PMU with a strong population defined in 1 of 4 HUCs. The PMU is located in the Little North Fork Clearwater River drainage, which contains the only known strongholds for bull trout above Dworshak Dam (defined in a total of 4 HUCs).

Westslope cutthroat trout status and distribution in this PMU is similar to that of bull trout, with presence in all HUCs, and strongholds in 1 of 4 HUCs within the PMU. Although, westslope cutthroat trout populations throughout the North Fork Clearwater River drainage are predominantly defined as strong, the stronghold contained within this PMU is isolated from others in the drainage.

Brook trout are known to be widespread throughout this PMU although no information exists on their population status. Brook trout may compete with both westslope cutthroat trout and bull trout in this area.

General Description

Land cover throughout this PMU is forested, and ownership is predominantly Federal. Protected status of HUCs within this PMU is variable, ranging from 6 to 70 percent of individual HUCs, with the lowest degree of protection in the two central HUCs. Watershed protection is due to a variety of designations including wild and scenic river, wilderness study area, area of critical environmental concern, and inventoried roadless areas. Despite the substantial overlap of protected areas in this PMU, land use activities are thought to be substantial in nonprotected areas, as indexed by road densities. Overall road densities range from Moderate to High, and those within the PSSZ range from High to Very High in all HUCs.

Potential impacts from disturbance are variable throughout this PMU. Inherent landslide hazards are considered Very Low in all except the eastern most HUC (Moderate). Surface erosion hazards range from Very Low to High dependent on the HUC. Grazing is not known to occur within this PMU, and probable mining impacts are believed to be minimal in all except the eastern most HUC which contains a Moderate number of mining claims. The current status or use of claims in this HUC could not be determined.

No direct aquatic habitat quality ratings or information were available regarding this area. Based on elevation and canopy cover characteristics, it is thought that temperature conditions throughout this PMU are suitable for use by both bull trout and westslope cutthroat trout. Overall water and habitat quality is thought to be adequate, as no stream segments are listed as having impaired beneficial uses on the most recent §303(d) list. This area is thought to maintain a more stable hydrograph than most areas in the subbasin, which may be beneficial to use by spawning and rearing salmonids.

No terrestrial plant focal species are documented by the CDC to occur in MX-5. Wildlife focal species with documented sitings in this PMU include fisher and wolverine. Threats to the fisher include clearcutting and habitat destruction which causes fragmentation. Wolverine is a scavenger representative of montane coniferous forests. It is associated with subalpine basins with little overhead canopy cover. Threats to this species include habitat fragmentation and loss of ungulate wintering areas.

9.2.6 PMU MX-6

Primary Distinguishing Characteristic(s)

Ten HUCs encompassing the Plum Creek Timber Company operating area in the headwaters of the Lochsa AU. Land holdings form a “checker-board” pattern with Plum Creek Timber Company lands interspersed amongst the predominantly Federal ownership.

Species Specific Notes

B-run steelhead trout utilize all accessible HUCs within this PMU for spawning and rearing purposes. Population status of steelhead trout is “depressed” throughout this PMU, and populations within this area are not influenced by hatchery production.

This PMU makes up nearly one half of the current chinook salmon spawning and rearing areas within the Lochsa AU. Spring chinook salmon are found throughout the majority of this PMU, with migration and overwintering use in the mainstem Lochsa River, and spawning and rearing use throughout the tributary habitats.

Although found throughout this PMU, bull trout populations are depressed, as is the case throughout the upper Lochsa AU. This PMU lies adjacent to the only known bull trout stronghold in the Lochsa AU, which is defined in the Fishing Creek drainage.

Westslope cutthroat trout populations are considered strong throughout the majority of the Lochsa AU including this entire PMU. No information is available regarding the distribution or status of brook trout in this PMU.

General Description

Land cover throughout this PMU is forested, and ownership is predominantly Federal although holdings by Plum Creek Timber Company typically comprise at least 25 percent of each HUC. Protected status of HUCs within this PMU is variable, ranging from 0 to 74 percent, with the greatest degree of protection afforded in the two southwestern most HUCs which are substantially overlapped by inventoried roadless areas. Despite the substantial overlap of protected areas with this PMU, land use activities are thought to be substantial in nonprotected areas. Overall road densities range from Moderate to High, and those within the PSSZ generally range from High to Very High.

Grazing is not known to occur, and mining impacts are believed to be minimal throughout this PMU. Inherent landslide hazards are considered Very Low or Low, and surface erosion hazards range from Low to Moderate. The relationship between relatively high existing road densities and sedimentation hazard ratings is unclear, but should be considered during future planning.

Habitat quality for steelhead trout in this PMU has been rated as Good to Excellent, whereas that for spring chinook salmon is more variable, ranging from Poor to Excellent. No direct habitat ratings for nonanadromous salmonid species are available. Based on elevation and canopy cover characteristics, temperature conditions throughout this PMU should be suitable for use by all aquatic focal species. The only stream segment listed as having impaired beneficial uses on the most recent §303(d) list is the mainstem Lochsa River, listed as impaired by high temperatures.

Local hydrology differs from much of the Clearwater subbasin, but is typical of the high elevation mountainous regions in the Lochsa and Selway drainages. Peak and low flows are expected in June and October, respectively. Annual hydrographs are relatively stable, with minimum mean monthly flows expected to represent between 28 and 36 percent of mean annual discharge. Only limited water use is allowed from the mainstem Lochsa River and, if maximized, would equate to an average withdrawl rate of less than 1 cfs over the course of a year.

No terrestrial plant focal species documented by the CDC occur in MX-6. Terrestrial animal focal species known to be found in this PMU include fisher and wolverine. Threats to the fisher include clearcutting and habitat destruction, which causes fragmentation. The wolverine is a scavenger representative of montane coniferous forests. It is associated with subalpine basins with little overhead canopy cover. Threats to this species include habitat fragmentation and loss of ungulate wintering areas.

9.3 PMUs Predominated by Federal Ownership

A total of eight PMUs have been delineated in predominantly Federally owned and managed areas of the Clearwater subbasin (Figure 116) which includes the majority of the Upper North Fork and Lochsa AUs, and all of the South Fork and Upper and Lower Selway AUs. PMUs delineated within these areas are defined with the prefix "FD." Primary characteristics used to differentiate PMUs within this area include natural and induced disturbance regimes and the type and relative degree of protection afforded to land area within each PMU.

Table 69 summarizes differences in primary characteristics between the eight defined PMUs. Textual descriptions are provided below, and include discussion of additional details regarding conditions within each PMU as they relate to focal species and habitat.

Future management options and issues within these areas are distinct from those in other areas of the Clearwater subbasin because less diverse ownership and land use patterns coupled with multiple use management will presumably result in different management scenarios from those on other lands in the subbasin. PMUs within this area were defined with the following distinctions in mind and, unless noted, these characteristics will apply to all PMUs defined in federally owned and managed areas.

1. Land cover throughout these PMUs is generally forested with some areas of mountainous rangelands interspersed, and lands are managed primarily by the USFS in conjunction with cooperating entities (State of Idaho, Nez Perce Tribe).
2. Lands managed by the USFS are typically managed for multiple use, and may therefore require more diverse planning strategies than those managed primarily for forestry (mixed ownership areas) or agriculture (Lower Clearwater AU).
3. Large tracts of land within this area are designated as wilderness or inventoried roadless areas, and have therefore been subject to minimal anthropogenic impacts with the exception of long-term fire suppression.
4. Areas dominated by federal ownership/management typically maintain the highest quality habitat in the Clearwater subbasin for all aquatic focal species. This is influenced by a combination of natural landscape characteristics and past land management patterns within these areas.
5. The entire Clearwater subbasin, including all Federally owned lands, lie within the Nez Perce Tribe Ceded Territory.

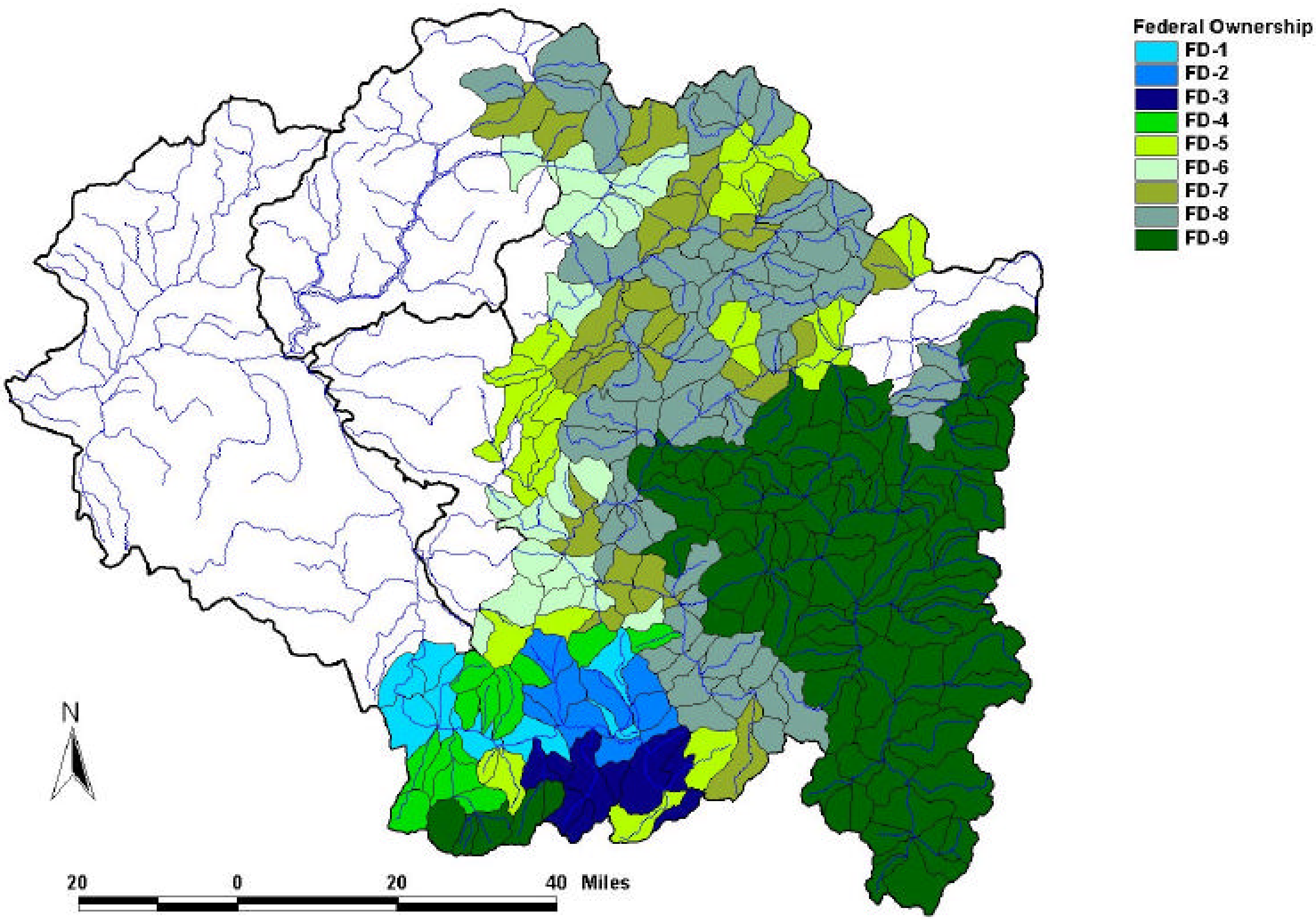

Figure 116. Potential Management Units (PMUs) delineated within areas of predominantly Federal ownership in the Clearwater subbasin

Table 69. Comparison of primary characteristics (or combinations) used to differentiate PMUs throughout Federally owned lands within the Clearwater subbasin. Characteristics in bold are primary defining characteristics of each PMU

	Potential Disturbance			Natural Hazards		Protection
PMU	Mining	Grazing	Road Density	Landslides	Surface Erosion	Type and Degree
FD-1	**Mod.-V High**	**Mod.-High**	**Mod.-V High**	Low	**Mod.-High**	Minimal
FD-2	**Mod.-V High**	**High**	**Mod.-V High**	Very Low	Very Low	Minimal
FD-3	**Mod.-V High**	**Minimal**	Low-V High	Very Low	Very Low	Minimal
FD-4	Minimal	**High**	Mod.-High	V Low-Low	Very Low	Variable
FD-5	Minimal	Minimal	**Mod.-High**	V Low-Low	Variable	Variable
FD-6	Minimal	Minimal	**Mod.-V High**	**Mod.-V High**	Variable	Variable
FD-7	Minimal	N/A	**Low-Mod.**	Low-V High	Low-Mod.	**Inv. Roadless; >75%**
FD-8	Minimal	N/A	Minimal	V Low-Mod	V Low-Mod.	**Inv. Roadless; >90%**
FD-9	Minimal	N/A	Minimal	V Low-Low	V Low-Mod.	**Wilderness; >95%**

9.3.1 PMUs FD-1 and FD-2

Primary Distinguishing Characteristic(s)

These PMUs are highly similar and differentiated only by differences in surface erosion hazard ratings (Table 69), and will therefore be discussed simultaneously. Both PMUs are found exclusively within the South Fork Clearwater River drainage (Figure 116), and are highly impacted by multiple land use activities including mining, grazing, and roading. Mass wasting hazards are considered Low throughout both units, and surface erosion is likely to be more substantial in FD-1 (Moderate-High hazard) than in FD-2 (Very Low hazard).

Species Specific Notes

B-run steelhead trout utilize the mainstem South Fork Clearwater River below Mill Creek for migration and overwintering purposes. All other HUCs within these PMUs are believed to provide spawning and early rearing habitats. Steelhead trout population status is defined as depressed throughout these PMUs, and populations within this area are commonly influenced by hatchery releases.

Mainstem habitats in the South Fork Clearwater River below Leggett Creek are believed to provide primarily migration and overwintering habitat for spring chinook salmon. Within these PMUs, tributary habitats throughout the South Fork Clearwater drainage provide spawning and early rearing habitats. Spring chinook salmon are found throughout the majority of these PMUs and population status is considered depressed (as is the case throughout the entire Clearwater subbasin).

Although found in all HUCs contained within these PMUs, bull trout populations are considered depressed throughout. Portions of PMU FD-2 border a known bull trout stronghold defined in the Newsome Creek watershed, which may have implications for future planning. Mainstem habitats in the South Fork Clearwater River and near the mouths of the American and

Red rivers are used by bull trout primarily for overwintering and migration. Habitats throughout the remainder of these PMUs are used for spawning and rearing by bull trout.

Fluvial bull trout populations are considered to be substantially depressed (more so than resident populations) throughout the South Fork Clearwater drainage. Fluvial populations are thought to have been most substantially impacted by sedimentation and associated losses of mainstem overwintering habitats (Paradis et al. 1999b).

Westslope cutthroat trout populations are present throughout these PMUs, but considered depressed. The South Fork Clearwater River below Mill Creek is used by westslope cutthroat trout primarily for overwintering and migration. Habitats throughout the remainder of these PMUs are used for spawning and rearing.

Similarly to bull trout, fluvial westslope cutthroat trout populations are considered to be substantially depressed throughout the South Fork Clearwater drainage, and most substantially impacted by sedimentation resulting in loss of mainstem overwintering habitats (Paradis et al. 1999b).

Introduced brook trout populations exist throughout these two PMUs, and may negatively impact native salmonid populations through direct or indirect competition. Although generally widely distributed, brook trout populations are not currently believed to be particularly strong or well established within these PMUs.

General Description

Protected status of lands within these PMUs is minimal, and the influence of various land uses is substantial. Road densities (overall and within the PSSZ) and mining influences both range from Moderate to Very High throughout HUCs within these PMUs. Potential mining impacts in these areas are typically rated as Moderate to High for both mines and mining claims although the degree to which these ratings are dependent upon one another is unclear based on available data (See section 4.10.9 for discussion of potential differences between mines and mining claims). Grazing potential is also substantial throughout these PMUs, ranging from Moderate to High due to the overlapping of HUCs with grazing allotments managed by the USFS.

Relative surface erosion hazards differ between these two PMUs, and are the primary characteristic for distinguishing them. Surface erosion hazards are rated Moderate to High within FD-1, and as Very Low throughout FD-2. Typical of areas throughout the South Fork Clearwater AU, landslide hazards are generally characterized as Low (FD-1) or Very Low (FD-2) within these PMUs. These characteristics suggest that, with regard to sediment production, FD-1 is more likely to experience impacts related to land use activities than are areas within FD-2, and that those impacts are (in general) more likely to be due to surface erosion than mass wasting events. In general, FD-2 is anticipated to be less likely to realize substantial sediment production due to land use activities.

No direct habitat ratings for nonanadromous salmonid species are available, although detailed description of conditions is available in Paradis et al. (1999b). Habitat quality ratings for steelhead trout in these PMUs range from Poor to Excellent. In general, the best and worst habitat conditions for steelhead trout in these PMUs is thought to occur in the Newsome Creek watershed (Good-Excellent) and mainstem South Fork Clearwater River (Poor-Fair). Spring chinook salmon habitat quality ratings range from Poor to Good, and follow a similar pattern to that for steelhead trout, with the worst habitat conditions in the mainstem South Fork Clearwater River. Good habitat for spring chinook salmon is defined in various reaches throughout the Newsome Creek and American River watersheds.

Sedimentation is the most commonly defined factor impacting use of streams within these PMUs by anadromous species, and the same is presumably true for nonanadromous species. Poor instream cover may constrain fish success in much of the American River watershed, and use of the mainstem South Fork Clearwater River is thought to be constrained by stream size and potentially high temperatures in its lower reaches. Basic modeling suggests that high temperatures may limit use by some species (particularly spring chinook salmon and bull trout) in the lower mainstem reaches (below Silver Creek). Temperatures in the upper mainstem (above Silver Creek) and in tributary habitats throughout these PMUs are thought to be suitable for use by all aquatic focal species throughout the year.

Impairment of beneficial uses (§303(d) listings) within these PMUs are most common in FD-1 (particularly the mainstem reaches of the South Fork Clearwater River) and are related to impacts of sedimentation, high temperature, and habitat alteration. Within FD-2, the only stream segments listed as potentially impaired under §303(d) are within the Newsome Creek watershed, and are listed for sediment impacts.

Hydrology within these PMUs is similar to that within much of the Clearwater subbasin. Peak and low flows are expected in May and September, respectively, and annual hydrographs are moderately stable, with minimum mean monthly flows expected to represent between 19 and 27 percent of mean annual discharge. Water use within these PMUs is most substantial from subwatersheds associated with Leggett Creek, Elk Creek, and the lower American River, although the relative impact that water withdrawls have on aquatic biota are unknown. Allowable water use from each of these areas is approximately 3,000 AFY (approximately 4.0 cfs). Allowable water use from other subwatersheds within these PMUs is thought to have a negligible overall impact to aquatic resources, as it does not typically exceed 235 AFY (0.35 cfs) from tributary systems, or 1,000 AFY (1.25 cfs) from mainstem reaches.

The land cover of both FD-1 and FD-2 is predominantly forested. There is a mixture in both of mixed mesic and mixed xeric forests, along with ponderosa pine, lodgepole pine, grand fir, Douglas-fir and western red cedar.

No CDC documentation of terrestrial plant focal species occur in FD-1 or FD-2. Two terrestrial animal focal species have been documented by the CDC in FD-1: the fisher and wolverine. Threats to fisher include clearcutting and habitat destruction, which causes habitat fragmentation. Threats to wolverine include habitat fragmentation and loss of ungulate wintering areas. Only one terrestrial animal focal species has been documented by the CDC to occur in FD-2, the fisher

9.3.2 PMU FD-3

Primary Distinguishing Characteristic(s)

This PMU includes 9 HUCs (Figure 116) differentiated from others in federally dominated ownership areas based primarily on the relative influence of mining activity as a potential disturbance regime (Table 69). Potential impacts from mining activity are Moderate to High throughout this PMU, whereas those from other potential disturbances are generally low or variable. Road densities are variable throughout the PMU and grazing potential is minimal. Based on relative landslide and surface erosion hazards, impacts of natural disturbance processes are thought to be Very Low throughout this PMU.

Species Specific Notes

B-run steelhead trout utilize all HUCs within this PMU for spawning and early rearing. Steelhead trout population(s) are depressed throughout this PMU, and populations within this area are commonly influenced by hatchery releases.

Spring chinook salmon and populations within this area are commonly influenced by hatchery practices or outplants of excess hatchery adults. Spring chinook utilize all HUCs within this PMU for spawning and early rearing with the exception of Trapper Creek (upper Red River) from which they are absent. As is the case throughout the entire Clearwater subbasin, status of spring chinook salmon population(s) are depressed throughout this PMU.

Bull trout are known to be present in all HUCs within this PMU for which information is available. The status of populations is generally depressed, although a stronghold exists in this PMU in upper Crooked River. In addition, a bull trout stronghold is defined in upper Tenmile Creek which, although not included, lies immediately upstream of this PMU. Bull trout populations in this PMU are likely dominated by resident life histories, as fluvial bull trout populations are considered to be substantially depressed throughout the South Fork Clearwater drainage due to sedimentation and associated losses of mainstem overwintering habitats (Paradis et al. 1999b).

Westslope cutthroat trout populations are present throughout this PMU with strongholds located in Tenmile Creek and upper Crooked River. All areas in this PMU are used by westslope cutthroat trout for spawning and rearing. Similarly to bull trout, fluvial westslope cutthroat trout populations are considered substantially depressed throughout the South Fork Clearwater drainage (Paradis et al. 1999b), and populations within this PMU are likely dominated by resident life history strategies.

Brook trout populations are known or suspected to be present in all subwatersheds in this PMU. Brook trout may negatively impact native salmonid populations through direct or indirect competition, although the degree to which this occurs in this PMU is not known. Even though widespread, brook trout populations are not thought to be strong within this PMU.

General Description

Protected status of lands within this PMU is minimal, and the primary induced disturbance is mining activity (current and/or historic). Mining influences related to both the overall number of mining claims and the ecological hazards of individual mines ranges from Moderate to Very High throughout this PMU. Grazing is not known to occur and road densities are variable throughout this PMU. Road densities (overall and within the PSSZ) are Low in subwatersheds associated with Tenmile Creek and the east and west forks of Crooked River. Overall road densities in other HUCs within this PMU are typically Moderate to High, and those within the PSSZ are generally High, illustrating the prevalence of roads near stream channels in some areas.

Both surface erosion hazards and inherent landslide hazards are rated as Very Low throughout this PMU, suggesting that in the absence of induced disturbance, sedimentation impacts would likely be minimal in these areas. Based on available information, it is not clear the degree the natural sediment regimes have been directly or cumulatively altered by land use activities in this PMU.

No ratings of nonanadromous salmonid habitat quality are available, although condition descriptions pertaining to this area are available in Paradis et al. (1999b). Habitat quality ratings for steelhead trout in this PMU range from Fair to Excellent, with the majority being rated as Good. Excellent steelhead habitat exists in all major drainages within this PMU (Red and Crooked River, and Tenmile Creek) but is most prevalent in Tenmile Creek and those tributaries to Crooked River which have not been heavily impacted by mining activity. Habitat quality for spring chinook salmon is generally rated as Fair to Good, with no discernable spatial pattern in the distribution of habitat quality.

Constraints to fish populations vary spatially throughout this PMU. Sedimentation is thought to be the most widespread constraint to aquatic species, and is cited throughout most of the Red River watershed in the NPPC database. However, sediment impacts are not typically listed as impairing beneficial uses under §303(d) listings within this PMU (the single exception being Dawson Creek in the Red River drainage). Steep channel gradients have been identified as impacting use by spring chinook salmon in portions of the Red River, Crooked River, and Tenmile Creek watersheds. Gradient impacts to steelhead trout are less widespread, and only noted within this PMU in portions of the Red River watershed. Channelization and resultant loss of instream cover/habitat due to past dredge mining activities combine to impact the use of the mainstem Crooked River by all aquatic focal species. Temperature was not cited as a limiting factor to fish populations within this PMU, and modeling suggests that temperatures throughout the PMU should be suitable for use by all aquatic focal species given current canopy cover conditions.

Hydrology within this PMU is typical of much of the South Fork Clearwater River drainage, with peak flows expected during May, low flows during September, and moderately stable annual hydrographs relative to other areas in the Clearwater subbasin (minimum mean monthly flows are 19 to 27 percent of mean annual discharge). Allowable water use within this PMU is most substantial in the central Red River subwatershed (approximately 4,000 AFY; 5.5 cfs) and, when combined with that in the upper Red River subwatersheds (approximately 1,600 AFY; 2.25 cfs), may have the potential to negatively influence aquatic ecosystems in the Red River system. Allowable water use from the Crooked River drainage is relatively substantial for areas within the Clearwater subbasin (approximately 3,000 AFY; 4.0 cfs), and may also have the potential to impact aquatic system function. However, the degree to which water is actually being utilized within this PMU (rather than allowable use), and the relative capacity of these systems to accommodate water uses is not known. Impacts to biota related to water use are therefore speculative, and presented only for consideration in future planning efforts.

The land is predominantly covered by forests in this PMU. Mixed mesic and mixed xeric forests make up a large percent of the land, along with subalpine fir forests, lodgepole pine and grand fir.

There are no CDC documented occurrences of terrestrial plant focal species in FD-3. Terrestrial animal focal species documented by the CDC to occur in this PMU include fisher, wolverine, flammulated owl and black-backed woodpecker. Threats to fisher include clearcutting and habitat destruction, which causes habitat fragmentation. Since fisher avoids open spaces, fragmentation causes isolated populations. Wolverine is a scavenger representative of montane coniferous forests. It is associated with subalpine basins with little overhead canopy cover. Threats to this species include habitat fragmentation and loss of ungulate wintering areas. Flammulated owl is an obligate cavity nester, strongly associated with mid-elevation old growth ponderosa pine forests. Flammulated owl is threatened by the loss of late successional forests, and of secondary roads. Black-backed woodpecker is a cavity nester found in a variety of habitats such as old subalpine fir stands, montane forests and riparian woodlands. Its preferred habitat is old growth lodgepole pine or a recently burned forest with standing dead trees. Threats to the species include anything that reduces the number of snags, including the removal of snags for firewood, salvage logging and fire suppression.

9.3.3 PMU FD-4 and FD-5

Primary Distinguishing Characteristic(s)

These PMUs are highly similar and differentiated from each other only by differences in potential grazing impacts. They therefore will be discussed simultaneously. Both PMUs are distinguished from other areas of the subbasin by the combination of their predominantly federal ownership with minimal protected status, low potential for natural disturbance impacts (inherent landslide or surface erosion hazards), and minimal mining impacts. Areas defined as FD-4 (12 HUCs) are overlapped by USFS grazing allotments and therefore subject to High grazing potential; those defined as FD-5 (22 HUCs) have minimal influence of grazing (Table 69).

Species Specific Notes

B-run steelhead trout utilize all accessible HUCs within this PMU for spawning and rearing purposes (blocked areas exist in the North Fork Clearwater River drainage, Orofino Creek, and Wing-Twenty Creek). Population status of steelhead trout is depressed throughout the PMUs.

Spring chinook salmon and populations within this area are commonly influenced by hatchery practices or out plants of excess hatchery adults. Spring chinook are known to utilize the majority of accessible areas within these PMUs, with exceptions noted in the Lochsa AU. In the Lochsa AU, the Fishing Creek drainage is the only HUC used by spring chinook salmon for spawning and rearing purposes. Elsewhere in the subbasin, HUCs within this PMU are generally used for spawning and rearing by spring chinook salmon except where exclusions exist (North Fork Clearwater River drainage, Orofino Creek, and Wing-Twenty Creek).

Bull trout occur in the majority of HUCs in these PMUs, but are sporadically absent from some for unknown reasons. Where present, bull trout use the HUCs within these PMUs for spawning and rearing purposes. The most notable absence is from the cluster of headwater tributaries in the Lolo Creek drainage.

Population levels are typically depressed although strongholds do exist within each of these PMUs. A single bull trout stronghold is defined within FD-4, located in the Baldy Creek subwatershed (Newsome Creek watershed) and is one of four defined strongholds within the South Fork AU, and the only one not within a wilderness area boundary. The Fishing Creek subwatershed is the only defined stronghold within the Lochsa AU, and is included in FD-5.

Westslope cutthroat trout populations are present throughout these PMUs and spawning and rearing is known to occur in all areas. Within FD-4, population(s) are considered strong throughout the Johns Creek watershed and in the headwaters of Mill Creek and Meadow Creek, and depressed elsewhere. Within FD-5, population(s) are considered strong in all HUCs (except Osier Creek) within the Upper North Fork and Lochsa AUs, and depressed throughout the Lolo/Middle Fork and South Fork AUs.

Limited information exists regarding the presence or status of introduced brook trout populations throughout these PMUs. Brook trout are presumed absent from the Kelly Creek drainage but present elsewhere in the Upper North Fork AU. No information is available regarding brook trout populations in the upper Lochsa AU. Where information exists in the Lolo/Middle Fork and South Fork AUs, brook trout are typically widespread with variable population strengths.

General Description

HUCs contained within FD-4 are located in, or border on, the South Fork AU (Figure 116). Those defined within FD-5 are more widespread, typically forming small clusters of HUCs within the Upper North Fork, Lochsa, Lolo/Middle Fork, Lower Selway, and South Fork AUs. Both PMUs typically share borders with wilderness or roadless areas, resulting in a variable degree of protected status where HUCs overlap with the protected areas. Individual HUCs within these PMUs have protected status designations applied to between 0 and 72 percent of their land area.

Induced disturbance impacts within these PMUs are related primarily to roads and, in FD-4, grazing. Mining impacts from mines or claims are thought to be minimal, which is an important distinction separating these PMUs from others defined within the South Fork AU. Overall road densities within both PMUs generally range from Moderate to High, with densities in the PSSZ ranging from Moderate to Very High. The primary exceptions to this are in the central portions of Johns Creek (Low densities overall and within the PSSZ) and in Horse Creek (Lower Selway AU; Low density in PSSZ). Potential for impacts due to grazing in FD-4 is considered high due to substantial overlap of HUCs by grazing allotments managed by the USFS.

Inherent landslide hazards throughout these two PMUs are generally considered Very Low or Low suggesting that natural landslides are not likely to substantially impact aquatic resources. Surface erosion hazard ratings are generally Very Low in FD-4, and variable (Very Low-High) throughout FD-5. Within FD-5, surface erosion hazards are highest within the Lolo Creek and Clear Creek watersheds. Based on available information, it is unclear to what degree the natural sediment regimes have been directly or cumulatively altered by land use activities (e.g. high road densities) in these PMUs.

No ratings of nonanadromous salmonid habitat quality are available for areas encompassed by these PMUs. Habitat quality for steelhead trout in these PMUs has been rated from Fair (Eldorado Creek) to Excellent, with the majority being rated as Good to Excellent. Habitat quality for spring chinook salmon is rated as Fair throughout the majority of these PMUs, with Good habitat identified in Eldorado Creek and portions of Lolo Creek.

Sedimentation and, in some areas, steep channel gradients are the principal constraints to fish populations identified throughout these PMUs. Sedimentation has been identified as an issue throughout the Lolo Creek watershed (including all tributaries), and in Mill and Meadow creeks in the South Fork AU. However, sediment impacts are not listed as impairing beneficial uses under §303(d) listings within these PMUs (the single exception being Cougar Creek in the South Fork Clearwater River drainage). Steep channel gradients have been identified as potentially limiting fish use in some reaches within the Lolo, Clear, and Johns creek drainages.

Temperature was not cited as a limiting factor to fish populations within these PMUs, and modeling suggests that temperatures throughout should typically be suitable for use by all aquatic focal species given current canopy cover conditions. In portions of the Lolo Creek drainage however, temperature conditions are expected to exceed established standards for use by bull trout and chinook salmon.

Peak flows throughout these PMUs is typically expected during May, except in the upper Lochsa River tributaries (June). Low flows are generally expected in September and/or October. Within these PMUs, flow stability is lowest in the Upper North Fork AU and Lolo Creek drainage (minimum mean monthly flows are 10 to 18 percent of mean annual discharge), highest in the Lochsa AU (28-36 percent), and intermediate in the South Fork AU (19-27 percent). Water use is not permitted from most areas within these PMUs, and is minimal where allowed (<300 AFY; 0.5 cfs).

The land cover of PMUs FD-4 and FD-5 is mostly forested. A variety of cover types make up these PMUs including lodgepole pine, ponderosa pine, grand fir, Douglas-fir and western red cedar.

No CDC documented occurrences of terrestrial plant focal species were found in these PMUs. Terrestrial animal focal species documented by the CDC to occur in FD-4 include fisher, flammulated owl, and white-headed woodpecker. Threats to fisher include clearcutting and habitat destruction, which causes habitat fragmentation. Flammulated owl is threatened by the loss of late successional forests, and by secondary roads. White-headed woodpecker is an insectivorous cavity nester that prefers soft, well-decayed snags. In this PMU, it almost always is found in large diameter ponderosa pine. White-headed woodpecker prefers open canopy forests with mature trees. Some threats to this species include forest fragmentation through habitat degredation, logging, and road construction.

9.3.4 PMU FD-6

Primary Distinguishing Characteristic(s)

This PMU includes 17 HUCs differentiated from others in federally dominated ownership area(s) based primarily on the combination of mixed ownership pattern, high road densities, high inherent landslide hazard ratings, and variable but often times coincidentally high surface erosion hazards (Table 69). Potential impacts from grazing are typically minimal, but may be of local consideration where Forest Service allotments overlap with this PMU.

Species Specific Notes

Portions of this PMU exist in the North Fork Clearwater drainage above Dworshak Dam and are not accessible to anadromous species. B-run steelhead trout utilize all accessible HUCs within FD-6, with migration and overwintering use of HUCs on the Middle Fork Clearwater and Selway rivers, and spawning and rearing use of all other accessible HUCs. Population status of steelhead trout is "depressed" throughout this PMU. Spring chinook salmon use is limited to migration through the mainstem Middle Fork Clearwater and Selway rivers, and spawning and rearing in portions of Clear Creek, Pete King Creek, and lower O'Hara Creek.

Bull trout use only a few locations within these PMUs for spawning and rearing, including O'Hara Creek and the headwaters of Clear Creek, and the North Fork Clearwater and tributaries upstream of Dworshak Reservoir. The mainstem rivers (North Fork, Selway and Middle Fork) are used by bull trout for migration and overwintering. No known "stronghold" populations of bull trout exist within this PMU.

Westslope cutthroat trout are distributed throughout the PMU, but with strong populations defined only in Pete King and Canyon creeks. HUCs in these drainages have a relatively high degree of protected status relative to other areas within this PMU.

Little information exists regarding brook trout presence or status in portion of these PMUs in the Middle Fork Clearwater, lower Lochsa, and lower Selway river drainages, although the species in known to exist in these areas. Within the North Fork AUs, brook trout are widely distributed throughout the PMU, although population status is largely unknown.

General Description

This PMU is largely comprised of HUCs along the North Fork Clearwater River above Dworshak Reservoir, and of other HUCs surrounding portions of the Middle Fork Clearwater River and the lower reaches of the Lochsa and Selway Rivers. Brook trout are relatively widely distributed throughout the PMU, and may compete with native species where they coexist.

Protected status of these areas is variable, ranging from 0-70% of individual HUCs, with 10 HUCs being more than 20% protected. Protected status is generally associated with designation of wild and scenic river reaches or inventoried roadless areas.

Land cover throughout the PMU is typically forest. Landslide hazards range from Moderate to Very High, and although surface erosion hazards are variable throughout the PMU, many individual HUCs have ratings of High to Very High. Land use impacts, thought to be related primarily to forest management, are believed to be substantial throughout these PMUs as indexed by relative road densities. Both overall and near-stream (PSSZ) road densities range from Moderate to Very High, with Moderate densities typically associated with those HUCs which have partial protected status. Road densities in unprotected portions of those HUCs are similar to those throughout these PMUs (High to Very High).

Grazable lands are common near the Middle Fork Clearwater River, and the USFS manages grazing allotments which impact portions of the PMU in the Pete King, Clear, and Yakus creek drainages. Ecological hazards associated with mines is thought to be negligible throughout this PMU. However, mining claim densities are Very High in the Pete King Creek drainage, and Moderate in HUCs associated with Canyon Creek in the Lochsa AU, and Quartz Creek in the Upper North Fork AU. The current status and use of mining claims in these areas is unknown and will need to be considered during future planning efforts.

Modeling conducted as part of the limiting factor analysis suggests that temperature regimes throughout the PMU are most conducive to use by westslope cutthroat trout and steelhead, with limited potential for chinook salmon or bull trout. Constraints identified in NPPC databases for spring chinook and steelhead trout (in accessible areas) include sediment, steep gradients, and limited gravel quantity in potential spawning and rearing areas, and high temperatures in migration corridors. Although not widely listed on the §303(d) list for potential beneficial use restrictions, some streams in this PMU are listed due to sediment concerns.

Hydrologic regimes in these PMUs is generally typical of much of the Clearwater subbasin, with peak flows occurring in April or May, and base flows in September. Hydrologic modeling conducted by Lipscomb (1998) suggests that annual hydrographs are typically more stable in areas surrounding Dworshak Reservoir than throughout the remainder of the subbasin, with baseflows equal to between 37 and 46 percent of the mean annual discharge.
With few exceptions, water use is not typically a substantial influence on aquatic biota within these PMUs, as most HUCs have allowable water use equating to less than 1,200 AFY (1.5 cfs). Substantial water rights (1.1 million AFY; 1,522 cfs) exist at the head of the Middle Fork Clearwater River, but are designated for maintenance of instream flows and intended to benefit local biota.

9.3.5 PMU FD-7

Primary Distinguishing Characteristic(s)

All HUCs within this PMU have between 74 and 90 percent of their land area designated as inventoried roadless area. Although lands are predominantly protected, localized impacts to aquatic and terrestrial resources may occur in unprotected areas. Future planning efforts should consider these areas in relation to surrounding PMUs in order to determine if and where beneficial project opportunities exist and/or where continued protection is important.

Species Specific Notes

B-run steelhead trout in accessible areas within this PMU are not influenced by hatchery production. Populations utilize the mainstem Lochsa and Selway rivers for migration and overwintering, and are considered depressed in tributary habitats for spawning and rearing purposes in these same drainages.

Spring chinook salmon populations within this area are commonly influenced by hatchery practices or out plants of excess hatchery adults. Use of this PMU by spring chinook salmon for purposes other than migration and overwintering is highly limited and occurs only in the headwaters of the Lochsa River and Meadow Creek (Lower Selway AU).

Bull trout are found in the majority of HUCs within this PMU, using mainstem habitats for migration and overwintering, and tributary habitats for spawning and rearing. Strong bull trout populations within this PMU are defined in the Little North Fork Clearwater River and in the headwaters of Meadow Creek (Lower Selway AU). Both of these stronghold areas adjoin additional strongholds defined in other PMUs. Bull trout populations in tributary habitats elsewhere in this PMU are depressed.

Westslope cutthroat trout populations are generally considered strong throughout this PMU in areas used for spawning and rearing. As with other species, mainstem river corridors are primarily used by westslope cutthroat trout for overwintering and migration purposes.

Information regarding the distribution and status of brook trout populations within this PMU is limited. Brook trout are known to be present throughout the mainstem North Fork Clearwater River and some of its tributaries (Little North Fork Clearwater River, and Quartz, Skull, and Isabella creeks) and in the headwaters of Meadow Creek (Lower Selway AU). Brook trout are presumed absent from the Weitas and Kelly creek watersheds, and from mainstem habitats in the Lochsa and Lower Selway AUs. No information is available regarding brook trout distributions or status in upper Lochsa AU tributaries.

General Description

This PMU encompasses 21 HUCs distributed throughout the Upper and Lower North Fork, Lochsa, and Lower Selway AUs. Given the highly protected status of lands within this PMU, discussion presented here will focus only on those issues thought to be most important for future management and planning strategies.

Planning and managment opportunities related to focal species may be limited and localized in nature due to the predominance of protected areas within this PMU. These areas are often intermixed with other PMUs, and generally form the boundary areas between more heavily protected and more heavily managed areas. Future planning strategies involving this PMU will need to balance the need for both protection and management areas within the subbasin.

Road densities within this PMU are rated Low or Moderate for individual HUCs, both overall and within the PSSZ. However, due to the substantial influence of roadless areas, road networks within these HUCs are often patchy, and densities may be very high in limited areas within individual HUCs.

Surface erosion hazards from lands throughout this PMU are generally rated as Low to Moderate. Inherent landslide hazards are more variable, ranging from Low to Very High and, combined with moderate road densities in some areas, may negatively influence aquatic and terrestrial habitats. Potential impacts due to relatively high landslide hazards coupled with moderate road densities are most likely in HUCs in the lower Lochsa and Selway river drainages, and those which border PMU MX-1 in the North Fork Clearwater River drainage.

Beneficial uses are listed as impaired by sedimentation under §303(d) listings in a variety of streams within this PMU, most typically those associated with areas of increased road density. Listed stream segments include all or portions of Cool, Cold Springs, Cougar, Dog, Isabella, Swamp, Sugar, and Middle creeks in the North Fork Clearwater River drainage, and Slide and Island creeks in the Lower Selway AU.

Limited information is available regarding habitat quality for aquatic focal species in this PMU. In areas accessible to anadromous species, habitat ratings for steelhead trout range from Poor to Excellent, whereas those for spring chinook salmon ranges from Poor to good. In both cases, the best and worst habitats are delineated in the upper Lochsa River tributaries, and the lower Lochsa and Selway river mainstems, respectively. No information is available regarding overall habitat condition for resident species in the North Fork Clearwater drainage.

There are no CDC documented terrestrial plant focal species occurrences in FD-7. Terrestrial animal focal species documented by the CDC to occur in this PMU include fisher, wolverine, northern goshawk, and Coeur d' Alene salamander. Threats to fisher include clearcutting and habitat destruction, which causes habitat fragmentation. Threats to wolverine include habitat fragmentation and loss of ungulate wintering areas. Threats to northern goshawk include timber harvest, fire suppression, and grazing, which reduce the complexity of community structure. Coeur d' Alene salamander is threatened by habitat fragmentation, water diversions, water pollution, and fire.

9.3.6 PMUs FD-8 and FD-9

Primary Distinguishing Characteristic(s)

Lands within these two PMUs are almost entirely protected, having at least 90 percent of their land area designated as inventoried roadless area (FD-8) or wilderness area (FD-9). Although the level of future protection afforded under these two designations may differ substantially, the two PMUs are presented together as areas which are, to date, largely undisturbed by land management activities other than fire suppression.

Species Specific Notes

B-run steelhead trout in accessible areas within these PMUs are not influenced by hatchery production with the exception of a limited number of HUCs in the South Fork AU associated with the Gospel Hump wilderness area. With the exception of the headwaters of the Upper and Lower North Fork AUs and the White Sands Creek drainage (Lochsa AU), steelhead trout are found in all HUCs within these PMUs. Populations utilize the mainstem Lochsa and Selway rivers for migration and overwintering, and tributary habitats in these PMUs for spawning and rearing. Although steelhead trout population status is depressed or unknown in large portions of these PMUs, all know strong population areas for steelhead trout within the Clearwater subbasin are located within these largely protected areas.

Spring chinook salmon and populations within this area are commonly influenced by hatchery practices or out plants of excess hatchery adults. Spring chinook are widely distributed throughout these PMUs, but are absent from a substantial number of HUCs. Steep channel gradients and passage impediments have been documented as constraints to spring chinook salmon in various areas throughout these PMUs and probably account for their absence from most areas of current absence. As is the case throughout the Clearwater subbasin, spring chinook salmon have been reintroduced following their extirpation, and population levels are currently considered depressed throughout their range.

The distribution of bull trout within these PMUs is widespread, but not contiguous. Most notably, bull trout are absent from numerous subwatersheds in the upper and central portions of the Lochsa AU. Although absent from some HUCs, bull trout are widely distributed throughout all portions of these PMUs in other AUs in the Selway, South Fork, and North Fork

Clearwater river drainages. Of 18 HUCs identified as having strong bull trout populations within the Clearwater subbasin, 14 are located within these highly protected PMUs. Bull trout populations utilize the mainstem Lochsa and Selway rivers for migration and overwintering, and tributary habitats throughout the remainder of these PMUs for spawning and rearing.

Westslope cutthroat trout populations are present in all HUCs within these PMUs, and are considered strong in most areas used for spawning and rearing. Population levels are considered depressed throughout some areas in the Lochsa and Selway river systems, although the reasons for this are unclear. Mainstem river corridors are used by subadult and nonspawning fluvial forms of westslope cutthroat trout for overwintering and migration purposes (respectively).

Introduced brook trout may compete with native salmonids in areas where they coexist. Brook trout are widely distributed throughout the wilderness and inventoried roadless areas in the Clearwater subbasin, with strong populations defined in portions of the Upper and Lower Selway, Lochsa, and Upper North Fork AUs. Although brook trout are widely distributed throughout the South Fork AU, they are currently presumed absent from areas within the Gospel Hump wilderness area. Brook trout are also presumed absent from the largely contiguous expanse of inventoried roadless areas in the Weitas and Kelly Creek drainages in the Upper North Fork AU.

General Description

Aside from the introduction of nonnative species (see notes on brook trout above), fire suppression is the principal land use activity potentially influencing ecosystems within these PMUs. Discussion of the impacts of fire suppression on aquatic systems is beyond the scope of this assessment, but is noted as a potentially important consideration in future planning efforts.

Other impacts related to land uses are typically thought to be minimal in these PMUs. Road densities and potential grazing impacts are typically considered low throughout these PMUs. Mining impacts are typically minimal, with the exception of a few HUCs within the North Fork Clearwater drainage which have had moderate numbers of mining claims established within their boundaries. It is not known, however, the degree of mining activity that has occurred associated with these claim areas, nor how it may have impacted aquatic and terrestrial resources.

Habitat quality for steelhead trout has been rated almost exclusively as Excellent throughout these PMUs, with the exception of mainstem portions of the Lochsa and Selway rivers (Good). Spring chinook salmon habitat quality is more variable, and typically ranges from Fair to Good, with Excellent habitat defined only in limited high elevation (accessible) portions of the Clearwater subbasin. Habitats within the Lochsa and Selway drainages are most commonly rated as Fair and Good, respectively, for spring chinook salmon. No habitat ratings are available for nonanadromous aquatic focal species throughout these PMUs.

The only terrestrial plant focal species documented by the CDC to occur in FD-8 is spacious monkeyflower. Spacious monkeyflower is an annual representative of riparian and wet meadow habitats. It is mostly found in microsites of open grasslands and forest openings with enhanced moisture and shade. Threats to Spacious monkeyflower include livestock trampling and weedy invaders. No terrestrial plant focal species is known to be found in FD-9.

Wildlife focal species documented by the CDC to occur in FD-8 and FD-9 include fisher, wolverine and Coeur d' Alene salamander. Threats to fisher include clearcutting and habitat destruction which causes habitat fragmentation. Threats to wolverine include habitat fragmentation and loss of ungulate wintering areas. Coeur d' Alene salamander is threatened by habitat fragmentation, water diversion and pollution, and fire.

9.4 Highly Protected Areas of Special Concern

In the Clearwater subbasin, a relatively limited number of HUCs are subject to special circumstances which might influence future planning. These generally include areas with a high degree of protected status, which also face potential impacts from land use activities. Typical potential impacts include mining, roading, or grazing within protected areas (Figure 117).

Potential mining impacts within highly protected areas are noted in five HUCs located in the North Fork Clearwater River drainage. These HUCs incorporate portions of Foehl Creek, the central mainstem and headwaters of the North Fork Clearwater River, and the headwaters of Kelly Creek (Figure 117). Within four of these HUCs, potential impacts are generally related to mining claim densities which range from Moderate to High (100-500 claims per HUC). The relative impact of mining claim activity in these areas will be dependent upon the status of claims and the amount of activity associated with each claim. Neither of these factors is clear based on available information. In the headwaters of the North Fork Clearwater River, mining impacts are considered Moderate, and associated with ecological hazard ratings of existing mines (which may or may not be active). Although six mines exist within this HUC, the relative ecological hazard ratings (as assigned by ICBEMP) are highest associated with the Clearwater Mine (11), and the Hoodoo Pass Mine (9).

Impacts of roads in HUCs with a high degree of protected status are noted in 13 HUCs in the Upper North Fork and Lochsa AUs (Figure 117). These HUCs are most commonly defined within PMU FD-7, in which 75-90% of the HUC is designated as inventoried roadless area. Road densities in these HUCs are considered Low to Moderate, but those within the PSSZ are Moderate to High suggesting a prevalence of near-stream road networks. These ratings likely underestimate the actual road densities which, due to the predominantly roadless nature, are confined to only limited areas within each HUC. Planners are advised to consider the potential impacts of dense road networks in subwatersheds which are primarily protected from disturbance, particularly where those road networks are located in the headwater portions of a subwatershed and have the potential to impact downstream reaches.

In the Lower Selway and South Fork AUs, four HUCs are highlighted for special consideration of grazing potential in areas of otherwise highly protected status (Figure 117). Each of the designated HUCs has over 70% of its land area designated as inventoried roadless. These HUCs are substantially (25-100%) overlapped by grazing allotments managed by the Nez Perce National Forest. The current use or status of these grazing allotments is not known and will require further consultation with the USFS. However, subbasin planners should consider relative impacts of grazing to aquatic and terrestrial resources in otherwise undisturbed areas.

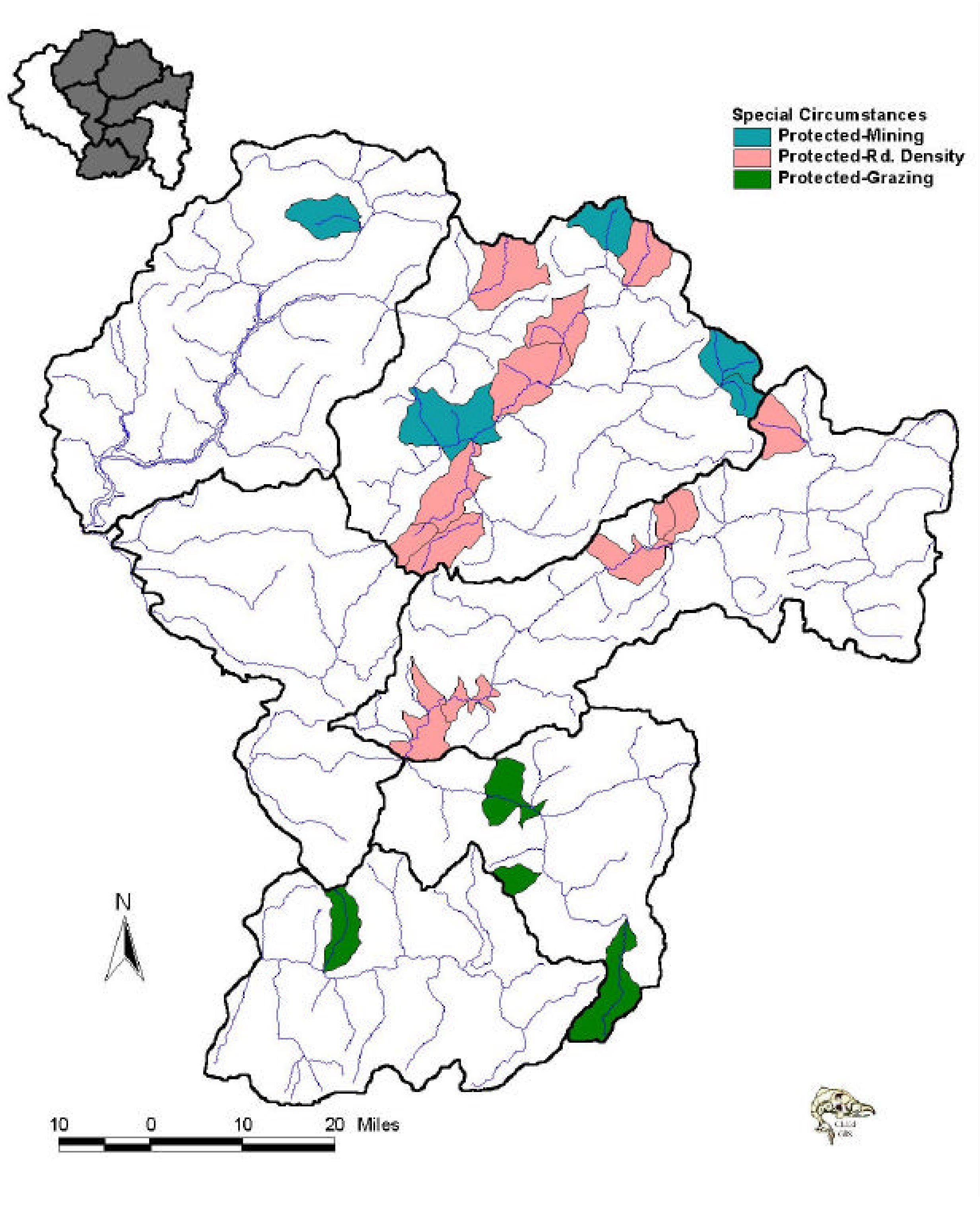

Figure 117. Highly protected areas of special concern within the Clearwater subbasin

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Appendix A - Summary of GIS data layers used in the Clearwater subbasin assessment and their associated sources and scales

Table 70. GIS data layers used in the Clearwater subbasin assessment.

General Description	Source	Scale/Resolution
States	ICBEMP	1:100,000
Counties	ICBEMP	1:100,000
Cities	ICBEMP	1:100,000
HUCs – 4th code	ICBEMP	1:100,000
HUCs – 6th code	ICBEMP	1:100,000
Assessment Units	WSU	1:100,000
Digital Elevation Model (DEM)	USGS	30m grid cells
Major Rivers	ICBEMP	1:2,000,000
Streams	Streamnet	1:250,000
Streams	Streamnet	1:100,000
Flow Variation	Lipscomb (1998)	
Dams	IDWR	1:100,000
303(d) listed stream segments	Updated from ICBEMP	1:100,000
Lithology	IDWR	1:500,000
Mines (Hazard Ratings)	ICBEMP	Point data
Mine Claim Density	ICBEMP	1:500,000
Precipitation	PRISM	2.25 minute
Avg. Annual Temperature	ICBEMP	None given
Land Cover (Use)	Idaho GAP data from Univ. of Idaho Landscape Dynamics Lab	1:100,000
Land Ownership	Idaho Gap NPT – Land Services Dept. Potlatch Corporation	1:100,000 1:24,000 1:24,000
Historic Vegetation	ICBEMP	1km grid cells
Current Vegetation (for comparison to historic)	ICBEMP	1km grid cells
Current Vegetation	Idaho GAP	30m grid cells
Vegetation Structural Stage - Current	ICBEMP	1km grid cells
Vegetation Structural Stage - Historic	ICBEMP	1km grid cells
Starthistle Distribution	Idaho Weed Watchers	Unspecified
Knapweed Distribution	Idaho Weed Watchers	Unspecified
Historic Fire Regime	ICBEMP	1km grid cells
Current Fire Regime	ICBEMP	1km grid cells
Fire History	USFS (NPNF and CNF)	Variable

General Description	Source	Scale/Resolution
Sensitive Plants/ Animals	IDFG-CDC	Point data
Fish Distributions/Status	Derived	6th Field HUC
Carrying Capacity (Steelhead and Spring Chinook)	NPPC Presence/Absence database (Streamnet)	1:250,000
Habitat Quality (Steelhead and Spring Chinook)	NPPC Presence/Absence database (Streamnet)	1:250,000
Constraints (Steelhead and Spring Chinook)	NPPC Presence/Absence database (Streamnet)	1:250,000
Index of Culvert Numbers	WSU	1:100,000
Section 7 Watersheds	ICBEMP	1:500,000
Bull Trout Key watersheds	WSU	1:100,000
Critical Habitat – Fall Chinook	WSU	1:250,000
Roads	USFS road layers (USFS property) USGS quad map layers (Non-USFS property)	1:24,000 1:24,000
Protected Areas (Excludes Roadless Areas)	ICBEMP	1:24,000 – 1:500,000
Inventoried Roadless Areas	USDA Forest Service	1:24,000 – 1:198,000
Grazing Allotments	USDA Forest Service (NPNF and CNF)	Unspecified
Grazeable lands	USGS GIRAS database	1:250,000

Appendix B - Maps showing water quality limited stream segments listed on IDEQ's 1998 303(d) list

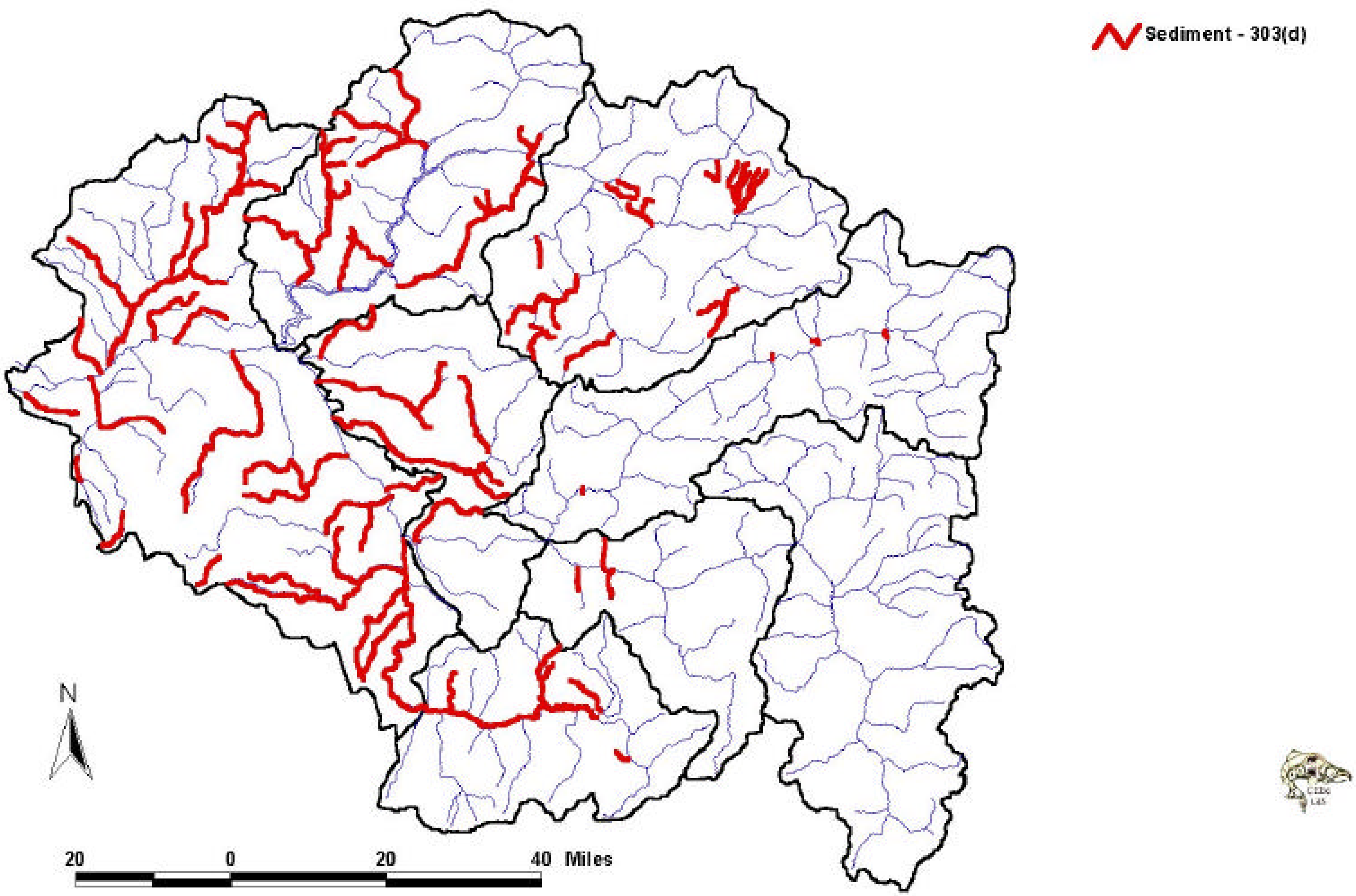

Figure 118. Distribution of water quality limited stream segments listed on the 1998 303(d) list by IDEQ for impairment due to sediment

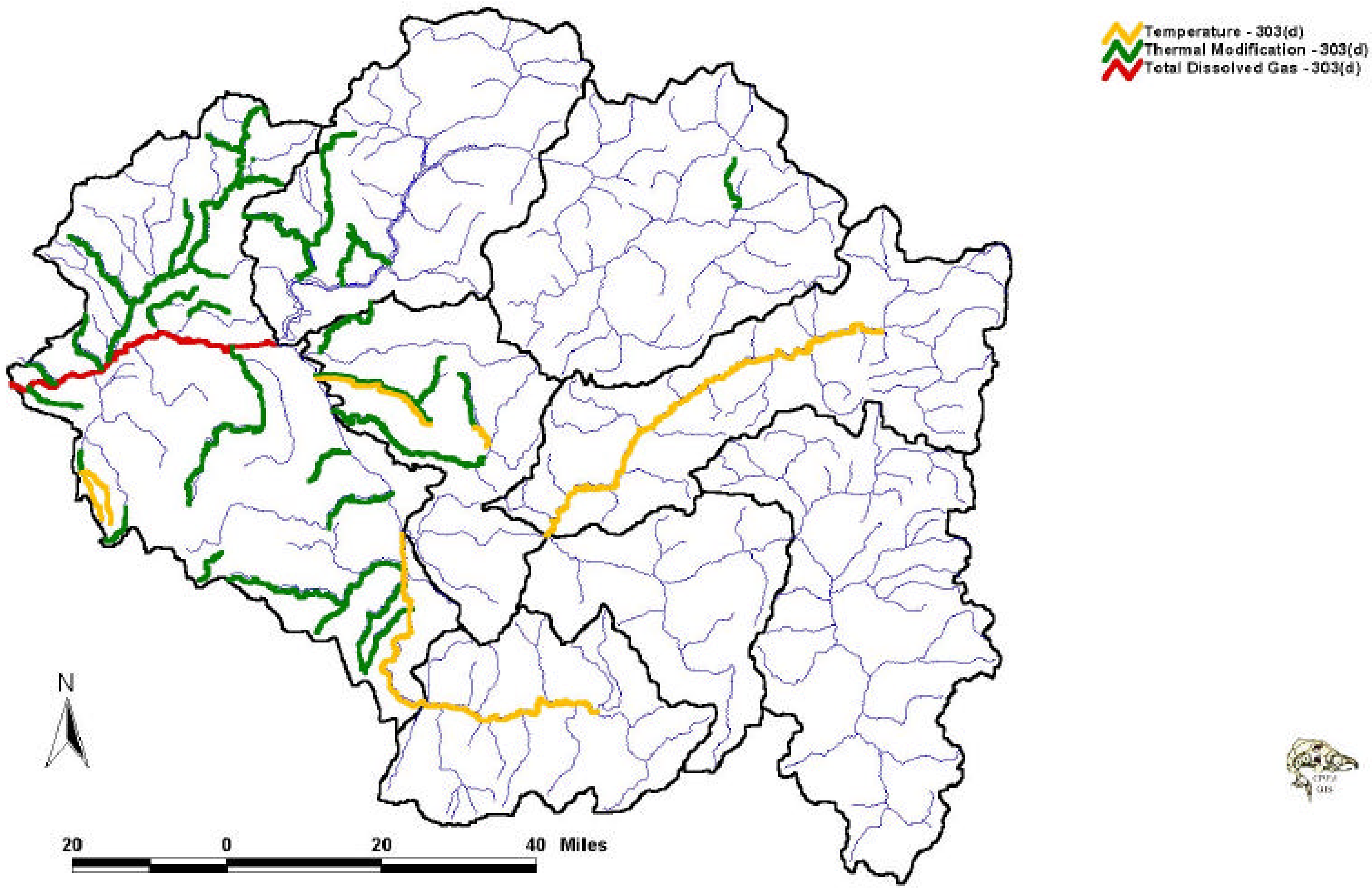

Figure 119. Distribution of water quality limited stream segments listed on the 1998 303(d) list by IDEQ for impairment due to temperature, thermal modification, and total dissolved gas

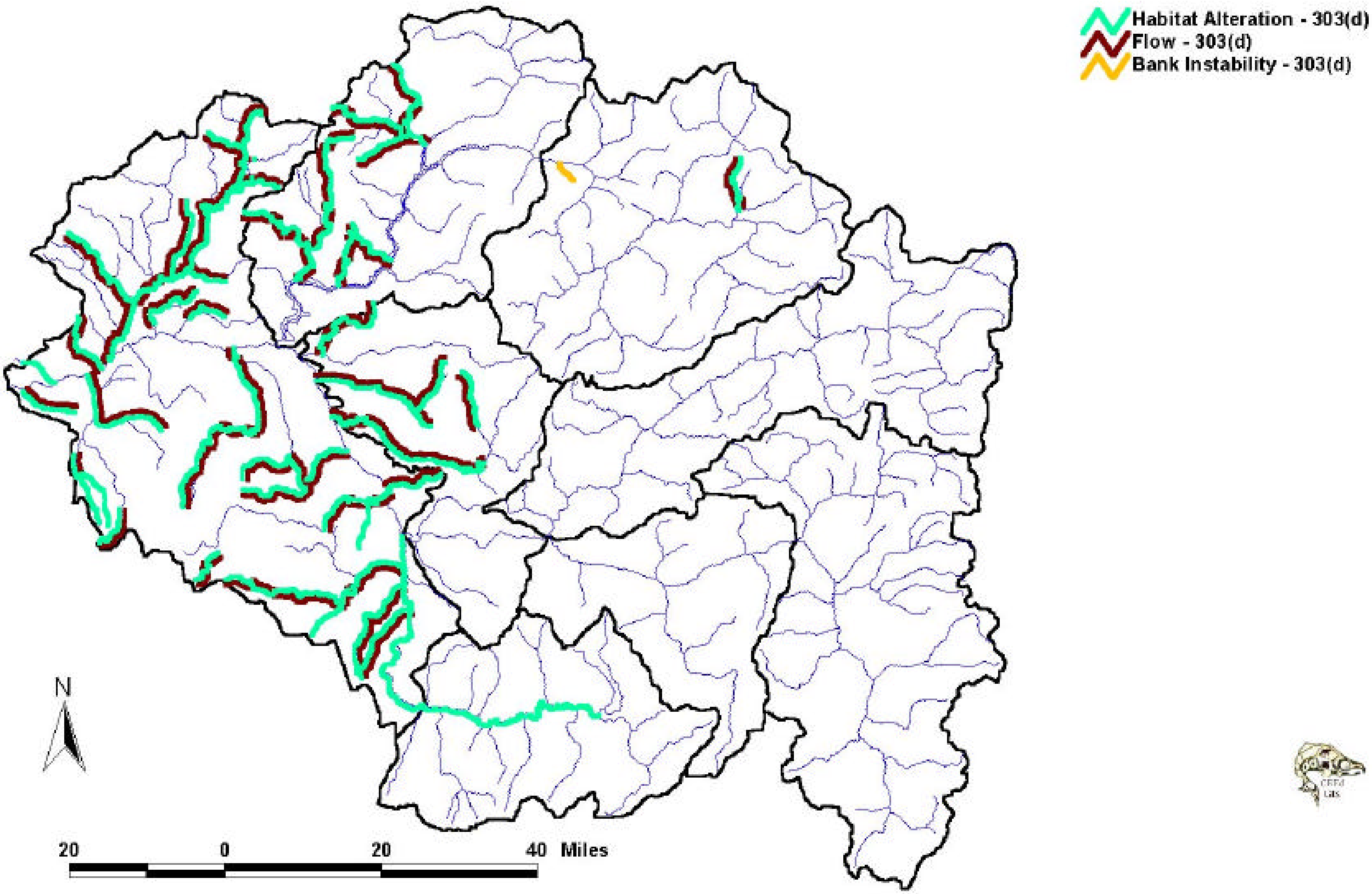

Figure 120. Distribution of water quality limited stream segments listed on the 1998 303(d) list by IDEQ for impairment due to habitat alteration, flow, and bank instability

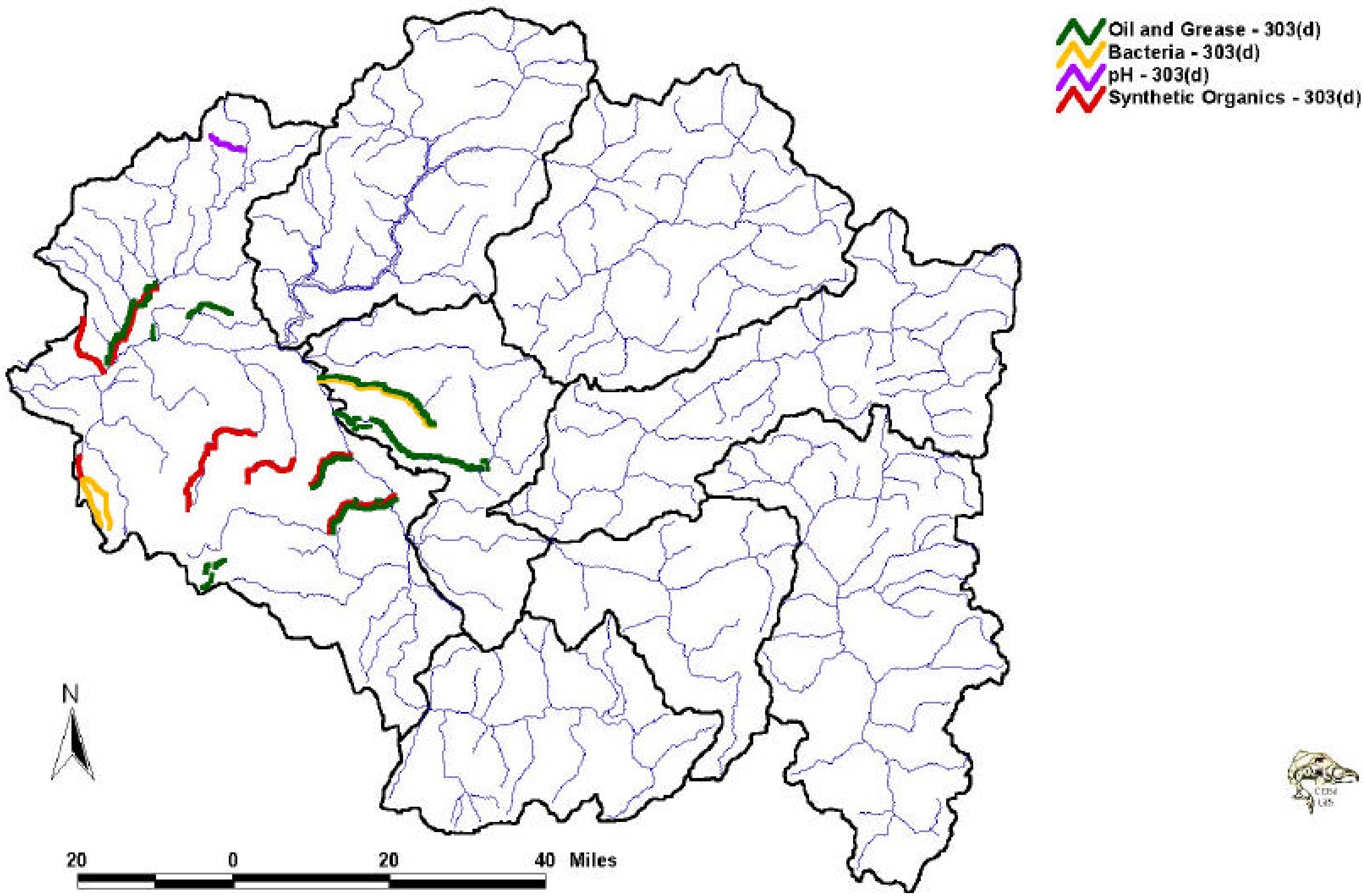

Figure 121. Distribution of water quality limited stream segments listed on the 1998 303(d) list by IDEQ for impairment due to oil and grease, bacteria, pH, and synthetic organics

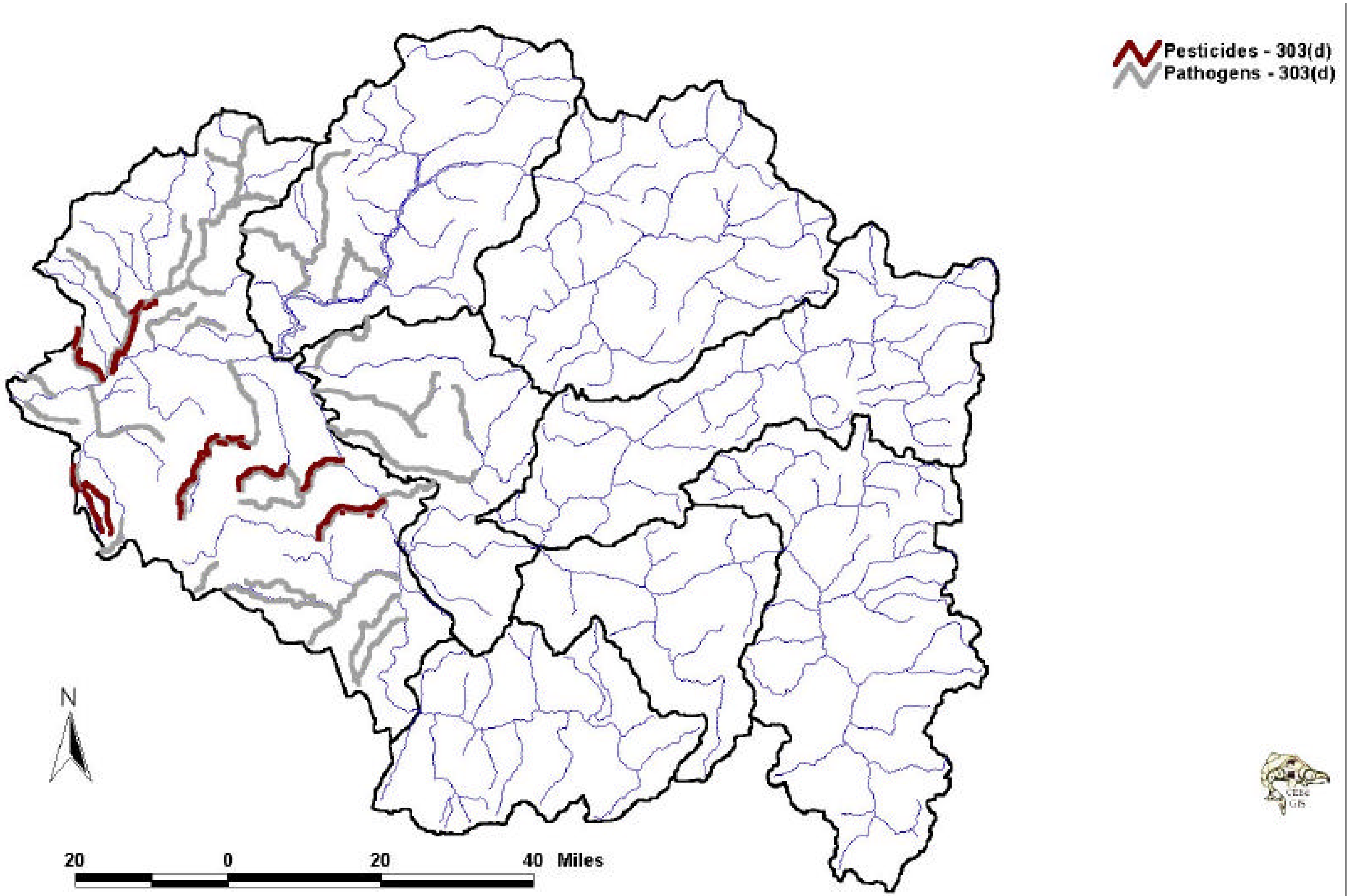

Figure 122. Distribution of water quality limited stream segments listed on the 1998 303(d) list by IDEQ for impairment due to pesticides and pathogens

Appendix C - Cover types by 4^{th}, 5^{th} and 6^{th} field HUC's

Appendix C is an Excel file containing vegetative cover data by 4^{th}, 5^{th} and 6^{th} field HUC's. It is available as a seperate file in conjunction with the Species /Habitat Matrix. It is available on a CD titled "Draft Clearwater Terrestrial Assessment – Appendices and Associated Tables (contact the Nez Perce Tribe via asondenna@nezperce.org to obtain these data on CD). The CD contains (1) the species-habitat matrix; (2) Appendices C, D, E, and F; (3) GAP models used to create the cover maps, and (4) maps of potential breeding habitat for the terrestrial focal species described in this document.

These data are displayed as square kilometers of each cover type by HUC. These data were derived from GAP data so should be viewed with some caution[5]. They are provided here for general use by land managers in designing research or management projects.

[5] The matrix is derived from GAP 2 Analysis models using ArcView 3.2. The models were converted from TIF files to grid themes with a 30 meter pixel coverage. The area of hypothesized habitat for each plant and animal species was then calculated using Spatial Analyst. The data received was entered and tabulated in Excel for the purpose of calculating vegetation cover area in acres and square kilometers.

These data were developed from the Idaho Gap Analysis Project. No guarantee expressed or implied is made regarding the accuracy or utility of the data. These data are meant to be used at a scale of 1:100,000 or smaller (such as 1:250,000 or 1:500,000) for the purpose of assessing the conservation status of animals and vegetation types over large geographic regions. Any analysis modeling using the 6th HUC is approaching the scale at which it was not intended.

Appendix D – Special status plants (including non-vascular species)

The Clearwater subbasin is inhabited by numerous rare and unique plant species (Table 71). Varying climates, steep topography, and a large elevational gradient all contribute to the diversity of habitats occupied by these rare species. This appendix is provided to give the reader a general overview of the rare or unique species found in the Clearwater subbasin. All of the species listed here are tracked by the Idaho Conservation Data Center in Boise, as well as local land management agencies. All should be considered sensitive and treated accordingly. Collecting or damage of habitats or populations should be avoided.

Rare plant species within the Clearwater subbasin are split into three major groups:

1. GLOBALLY RARE = Species and varieties or subspecies (taxa) rare throughout their range.
2. STATE RARE = Taxa rare within the political boundaries of Idaho, but more common elsewhere.
3. REVIEW = Global and State rare taxa which may be of conservation concern in Idaho, but lack sufficient data to base a recommendation regarding their appropriate classification.

Global conservation ranks used to assign taxa to the first two groups are based on a system developed by The Nature Conservancy and used by the Natural Heritage and Conservation Data Center network. This is a one-through-five ranking system. For the INPS list, G1-G3 taxa are considered GLOBALLY RARE, while G4 or G5 taxa that are rare in Idaho are assigned to one of the STATE RARE categories.

GLOBALLY RARE SPECIES

Globally Rare species are assigned to one of four INPS categories: Globally Extinct (GX), Global Priority 1 (G1), Global Priority 2 (G2), or Global Priority 3 (G3). The Global ranks are defined below. In addition, each globally rare species that is not currently listed as Endangered or Threatened under the federal Endangered Species Act receives a Threat Priority rank. This one-through-twelve rank is based on the old U.S. Fish and Wildlife Service (USFWS) Listing Priority criteria explained below. In the past, these rankings have helped the INPS make recommendations to the USFWS for the federal Candidate list, as well as for Conservation Agreements, as part of the Idaho Conservation Effort.

DEFINITIONS
USFWS Status:

ENDANGERED = taxa in danger of extinction throughout all or a significant portion of their range (none in Idaho).

THREATENED = taxa likely to become endangered in the foreseeable future throughout all or a significant portion of their range.

CANDIDATE = taxa for which substantial biological information exists on file to support a proposal to list as Endangered or Threatened, but no proposal has yet been published in the Federal Register.

Global Rank:

G = Global rank indicator; denotes rank based on rangewide status.
T = Trinomial rank indicator; denotes rangewide status of variety or subspecies.
X = Considered extinct throughout its range.
1 = Critically imperiled because of extreme rarity or because of some factor of its biology making it especially vulnerable to extinction (typically 5 or fewer occurrences).
2 = Imperiled because of rarity or because of other factors demonstrably making it very vulnerable to extinction (typically 6 to 20 occurrences).
3 = Rare or uncommon, but not imperiled (typically 21 to 100 occurrences).
4 = Not rare and apparently secure, but with cause for long-term concern (usually more than 100 occurrences).
5 = Demonstrably widespread, abundant, and secure.

STATE RARE SPECIES

State Rare species are assigned to one of five categories: Possibly Extirpated, State Priority 1, State Priority 2, Sensitive, or Monitor.

Possibly Extirpated = Taxa which are known in Idaho only from historical (pre-1920) records or are considered extirpated from the state.

State Priority 1 = A taxon in danger of becoming extinct or extirpated from Idaho in the foreseeable future if identifiable factors contributing to its decline continue to operate; these are taxa whose populations are present only at critically low levels or whose habitats have been degraded or depleted to a significant degree.

State Priority 2 = A taxon likely to be classified as Priority 1 within the foreseeable future in Idaho, if factors contributing to its population decline or habitat degradation or loss continue.

Sensitive = A taxon with small populations or localized distributions within Idaho that presently do not meet the criteria for classification as Priority 1 or 2, but whose populations and habitats may be jeopardized without active management or removal of threats.

Monitor = Taxa that are common within a limited range as well as those taxa which are uncommon, but have no identifiable threats (for example, certain alpine taxa).

Many species also receive Sensitive (S) or Watch (W) rankings by Federal agencies such as the Forest Service or Bureau of Land Management.

Table 71. Alphabetical listing of rare or sensitive plant species known to occur within the Clearwater subbasin from <http://www2.state.id.us/fishgame/info/cdc/cdc.htm>

LATIN NAME	**COMMON NAME**	**Global Rank**	**State Rank**	**FS or BLM**
Allotropa virgata	Candystick	G4	S3	S
Asplenium trichomanes	Maidenhair spleenwort	G5	S1	S
Aster jessicae	Jessica's Aster	G2	S2	S (BLM)
Astragalus paysonii	Payson's milkvetch	G3	S3	S
Blechnum spicant	Deerfern	G5	S3	S
Botrychium crenulatum	Crenulate moonwort	G3	S1	S
Botrychium lanceolatum var. lanc.	Lance-leaf grape-fern	G5T4	S3	S
Botrychium minganense	Mingan moonwort	G4	S3	S
Botrychium montanum	Mountain moonwort	G3	S1	S (FS)
Botrychium pinnatum	Northern grape-fern	G4?	S2	S
Botrychium simplex	Least moonwort	G5	S1	S
Buxbaumia aphylla (moss)	Leafless bug-on-a-stick	G2G3	SH	S
Buxbaumia viridis (moss)	Green bug-on-a-stick	G4	~	S (FS)
Calochortus nitidus	Broadfruit mariposa	G3	S3	S
Cardamine constancei	Constance's bittercress	G3	S3	S
Carex buxbaumii	Buxbaum's sedge	G5	S3	S
Carex hendersonii	Henderson's sedge	G5	S3	S
Carex leptalea	Bristle-stalked sedge	G5	S2	S (FS)
Cetraria subalpina (lichen)	Subalpine cetraria	G2G3	?	S
Cladonia andereggii (lichen)	Anderegg's cladonia	G1	S1	S
Cornus nuttallii	Pacific dogwood	G4	S1	S
Corydalis caseane ssp. hastata	Case's corydalis	G5T3	S3	~
Cypripedium fasciculatum	Clustered ladyslipper	G4	S3	S
Dasynotus daubenmirei	Dasynotus	G2	S3	S (FS)
Dodecatheon dentatum	White shooting star	G4	S3	W (BLM)
Douglasia idahoensis	Idaho douglasia	G2	S2	S (FS)
Eburophyton austiniae	Phantom orchid	G4	S3	W (BLM)
Haplopappus hirtus var. sonchifolius	Sticky goldenweed	G4T3	S1	S

LATIN NAME	COMMON NAME	Global Rank	State Rank	FS or BLM
Haplopappus liatriformis	Palouse Goldenweed	G2	S2	S (BLM)
Hookeria lucens (moss)	Light hookeria	G5	S1	S (FS)
Hypogymnia apinnata (lichen)	Tube lichen	G4	S1	S (BLM)
Lobaria hallii (lichen)	Hall's lungwort	G4	S1	S (BLM)
Lomatium dissectum var. dissectum	Fern-leaved desert parsley	G5T5	S3	W (BLM)
Lomatium salmoniflorum	Salmon-flowered desert parsley	G3	S2	S
Mertensia bella	Oregon bluebells	G4	S3	~
Mimulus alsinoides	Chickweed monkeyflower	G5	S1	S (FS)
Mimulus ampliatus	Spacious monkeyflower	G1	S1	S
Mimulus clivicola	Bank monkey-flower	G4	S3	S (BLM)
Pentagramma triangularis spp. triang.	Gold-back fern	G5T5	S1	S (FS)
Petasites frigidus var. palmatus	Sweet coltsfoot	G5T5	S1	S (FS)
Petasites sagittatus	Arroeleaf coltsfoot	G5	S3	S (FS)
Phlox idahonis	Clearwater Phlox	G1	S1	~
Pilophorus acicularis (lichen)	Nail lichen	G4	S1	S (BLM)
Polypodium glycyrrhiza	Licorice fern	G5	S1	S (FS)
Pseudocyphellaria anthraspis (lichen)	White-dot lichen	G4	S1	~
Psilocarphus tenellus	Slender woolly-heads	G4	SH	S (BLM)
Rhizomnium nudum	Naked-stem rhizomnium	?	~	S (FS)
Rubus spectabilis	Salmonberry	G5	S1	~
Silene spaldingii	Spalding's silene	G2	S1	S (BLM)
Sphaerophorus globosus (lichen)	Tuckermann's ball-bearing lichen	G5	S1	~
Synthyris platycarpa	Evergreen kittentail	G3	S3	S (FS)
Tauschia tenuissima	Leiberg's tauschia	G3	S3	W (BLM)
Thelypteris nevadensis	Sierra wood-fern	G4	S1	S (FS)
Triantha occidentalis ssp. brevistyla	Short-styled triantha	G5T4	S1	S (FS)
Trientalis latifolia	Western starflower	G5	S3	S (FS)
Trifolium plumosum var. amplifolium	Plumed clover	G4T2	S2	S (BLM)
Waldsteinia idahoensis	Idaho barren strawberry	G3	S3	S

Table 72. Rare or sensitive plant species in the Clearwater subbasin listed in rank order based on rarity and known threats from <http://www2.state.id.us/fishgame/info/cdc/cdc.htm>

LATIN NAME	COMMON NAME	Global Rank	State Rank	FS or BLM
Cladonia andereggii (lichen)	Anderegg's cladonia	G1	S1	S
Phlox idahonis	Clearwater Phlox	G1	S1	~
Mimulus ampliatus	Spacious monkeyflower	G1	S1	S
Silene spaldingii	Spalding's silene	G2	S1	S (BLM)
Haplopappus liatriformis	Palouse Goldenweed	G2	S2	S (BLM)
Aster jessicae	Jessica's Aster	G2	S2	S (BLM)
Douglasia idahoensis	Idaho douglasia	G2	S2	S (FS)
Dasynotus daubenmirei	Dasynotus	G2	S3	S (FS)
Buxbaumia aphylla (moss)	Leafless bug-on-a-stick	G2G3	SH	S
Cetraria subalpina (lichen)	Subalpine cetraria	G2G3	?	S
Botrychium montanum	Mountain moonwort	G3	S1	S (FS)
Botrychium crenulatum	Crenulate moonwort	G3	S1	S
Calamagrostis tweedyi	Cascade reed grass	G3	S1	S (BLM)
Sedum borschii	Borch's stonecrop	G3	S2	~
Lomatium salmoniflorum	Salmon-flowered desert parsley	G3	S2	S
Sullivantia hapemanii var hapemanii	Hapeman's sullivantia	G3T3	S2	~
Calochortus nitidus	Broadfruit mariposa	G3	S3	S
Cardamine constancei	Constance's bittercress	G3	S3	S
Astragalus paysonii	Payson's milkvetch	G3	S3	S
Synthyris platycarpa	Evergreen kittentail	G3	S3	S (FS)
Tauschia tenuissima	Leiberg's tauschia	G3	S3	W (BLM)
Astragalus paysonii	Payson's milkvetch	G3	S3	S
Waldsteinia idahoensis	Idaho barren strawberry	G3	S3	S
Synthyris platycarpa	Evergreen kittentail	G3	S3	S (FS)
Tauschia tenuissima	Leiberg's tauschia	G3	S3	W (BLM)
Phacelia lyallii	Lyall's phacelia	G3G4	S2	~
Buxbaumia viridis (moss)	Green bug-on-a-stick	G4	~	S (FS)
Cornus nuttallii	Pacific dogwood	G4	S1	S
Pilophorus acicularis (lichen)	Nail lichen	G4	S1	S (BLM)
Pseudocyphellaria anthraspis (lichen)	White-dot lichen	G4	S1	~
Hypogymnia apinnata (lichen)	Tube lichen	G4	S1	S (BLM)

LATIN NAME	COMMON NAME	Global Rank	State Rank	FS or BLM
Lobaria hallii (lichen)	Hall's lungwort	G4	S1	S (BLM)
Thelypteris nevadensis	Sierra wood-fern	G4	S1	S (FS)
Haplopappus hirtus var. sonchifolius	Sticky goldenweed	G4T3	S1	S
Botrychium pinnatum	Northern grape-fern	G4?	S2	S
Trifolium plumosum var. amplifolium	Plumed clover	G4T2	S2	S (BLM)
Dodecatheon dentatum	White shooting star	G4	S3	W (BLM)
Eburophyton austiniae	Phantom orchid	G4	S3	W (BLM)
Cypripedium fasciculatum	Clustered ladyslipper	G4	S3	S
Mertensia bella	Oregon bluebells	G4	S3	~
Mimulus clivicola	Bank monkey-flower	G4	S3	S (BLM)
Allotropa virgata	Candystick	G4	S3	S
Botrychium minganense	Mingan moonwort	G4	S3	S
Psilocarphus tenellus	Slender woolly-heads	G4	SH	S (BLM)
Botrychium simplex	Least moonwort	G5	S1	S
Hookeria lucens (moss)	Light hookeria	G5	S1	S (FS)
Mimulus alsinoides	Chickweed monkeyflower	G5	S1	S (FS)
Polypodium glycyrrhiza	Licorice fern	G5	S1	S (FS)
Rubus spectabilis	Salmonberry	G5	S1	~
Sphaerophorus globosus (lichen)	Tuckermann's ball-bearing lichen	G5	S1	~
Asplenium trichomanes	Maidenhair spleenwort	G5	S1	S
Pentagramma triangularis spp. triang.	Gold-back fern	G5T5	S1	S (FS)
Petasites frigidus var. palmatus	Sweet coltsfoot	G5T5	S1	S (FS)
Carex leptalea	Bristle-stalked sedge	G5	S2	S (FS)
Blechnum spicant	Deerfern	G5	S3	S
Carex buxbaumii	Buxbaum's sedge	G5	S3	S
Carex hendersonii	Henderson's sedge	G5	S3	S
Petasites sagittatus	Arroeleaf coltsfoot	G5	S3	S (FS)
Trientalis latifolia	Western starflower	G5	S3	S (FS)
Corydalis caseane ssp. hastata	Case's corydalis	G5T3	S3	~
Triantha occidentalis ssp. brevistyla	Short-styled triantha	G5T4	S1	S (FS)
Botrychium lanceolatum var. lanc.	Lance-leaf grape-fern	G5T4	S3	S
Lomatium dissectum var. dissectum	Fern-leaved desert parsley	G5T5	S3	W (BLM)
Rhizomnium nudum	Naked-stem rhizomnium	?	~	S (FS)

Appendix E – Species/Habitat Matrix

A species/habitat matrix was developed as part of this analysis and is included on the accompanying CD; The file is titled “Assmnt_App_E_Spp_Habitat_matrix”. This matrix displays all vertebrate species known to occur within the Clearwater subbasin and their relationship to major vegetative cover types. These data are displayed as square Km of habitat by vegetation type. Cover types include: urban, agricultural land, foothills grassland, disturbed grassland, riparian non-forest, riparian forest, mountain meadows, shrubs, cottonwood, aspen and conifer, western hemlock, western red cedar, subalpine fir, grand fir, lodgepole pine, ponderosa pine, Douglas-fir, western larch, whitebark pine, burnt standing timber, water, barren land, and perennial ice or snow (cloud or cloud shadow).

These cover types were derived by combining GAP 2 cover values into larger groupings for analysis. The matrix is derived from GAP 2 Analysis models using ArcView 3.2. The models were converted from TIF files to grid themes with a 30 meter pixel coverage. The area of hypothesized habitat for each plant and animal species was then calculated using Spatial Analyst. The data received was entered and tabulated in Excel for the purpose of calculating vegetation cover area in acres and square kilometers.

These data were developed from the Idaho Gap Analysis Project. No guarantee expressed or implied is made regarding the accuracy or utility of the data. These data are meant to be used at a scale of 1:100,000 or smaller (such as 1:250,000 or 1:500,000) for the purpose of assessing the conservation status of animals and vegetation types over large geographic regions. Any analysis modeling using the 6th HUC is approaching the scale at which it was not intended.

The matrix is intended to depict broad relationships between specific species and general vegetative cover types. The format of this matrix is designed to provide the reader with a simple way to find out which animals occur within which cover types and the relative amount of breeding habitat contained within each cover type. All known vertebrate species are listed in the left-hand column while cover types are listed across the top of the page. Simple follow a species across or a column down to determine the information needed.

Appendix F - State, Federally Listed, or Candidate Widlife Species in the Clearwater subbasin*.

Scientific Name	Common Name	State	Forest Service	BLM	Federal
Accipiter gentilis	Northern Goshawk	Species of Concern	Sensitive	Sensitive	N/A
Acipenser transmontanus	White Sturgeon	Species of Concern	N/A	Sensitive	Species of Concern
Aegolius funereus	Boreal Owl	Species of Concern	N/A	Sensitive	N/A
Antrozous pallidus	Pallid Bat	N/A	N/A	N/A	N/A
Bartramia longicauda	Upland Sandpiper	Species of Concern	N/A	Sensitive	N/A
Bufo boreas	Western Toad	Species of Concern	Sensitive	Sensitive	Species of Concern
Canis lupus	Gray Wolf	Endangered	N/A	N/A	Endangered
Chlidonias niger	Black Tern	Species of Concern	N/A	N/A	N/A
Cicindela columbica	Coumbia River Tiger Beetle	N/A	N/A	N/A	N/A
Corynorhinus townsendii	Townsend’s Big-eared bat	Species of Concern	N/A	N/A	Species of Concern
Coccyzus americanus	Yellow-billed Cuckoo	Species of Concern	N/A	Sensitive	N/A
Coccyzus erythropthalmus	Black-billed Cuckoo	P	N/A	N/A	N/A
Cryptomastix magnidentata	Mission Creek Oregonian	N/A	N/A	Sensitive	N/A
Cypseloides niger	Black Swift	N/A	N/A	Sensitive	N/A
Diadophis punctatus	Ringneck Snake	Species of Concern	N/A	Sensitive	N/A
Elgaria Coerulea	Northern Alligator Lizard	N/A	N/A	N/A	Watch
Euderma maculatum	Spotted Bat	Species of Concern	N/A	Sensitive	N/A
Falco peregrinus anatum	American Peregrine Falcon	Endangered	N/A	N/A	N/A
Fisherola nuttalli	Shortface Lanx	N/A	N/A	N/A	N/A
Fluminicola columbiana	Columbia Pepplesnail	N/A	N/A	Sensitive	Watch
Gavia immer	Common Loon	Species of Concern	Sensitive	N/A	N/A
Glaucidium gnoma	Northern Pygmy-owl	Species of Concern	N/A	N/A	N/A
Gulo gulo	Wolverine	Species of Concern	Sensitive	Sensitive	N/A
Haliaeetus leucocephalus	Bald Eagle	Endangered	N/A	N/A	Threatened
Histrionicus histrionicus	Harlequin Duck	Species of Concern	Sensitive	Sensitive	N/A
Lanius ludovicianus	Loggerhead Shrike	Species of Concern	N/A	Sensitive	Species of Concern
Lynx canadensis	Lynx	Species of Concern	N/A	Sensitive	Threatened
Martes pennanti	Fisher	Species of Concern	Sensitive	Sensitive	N/A
Myotis ciliolabrum	Western Small-footed Myotis	N/A	N/A	Sensitive	N/A
Myotis evotis	Long-eared Myotis	N/A	N/A	Sensitive	N/A
Myotis thysanodes	Fringed Myotis	Species of Concern	N/A	Sensitive	N/A

Scientific Name	Common Name	State	Forest Service	BLM	Federal
Myotis volans	Long-legged Myotis	N/A	N/A	Sensitive	N/A
Myotis yumanensis	Yuma Myotis	N/A	N/A	Sensitive	N/A
Numenius americanus	Long-billed Curlew	N/A	N/A	Sensitive	Species of Concern
Onchorhynchus mykiss	Steelhead	N/A	N/A	N/A	Threatened
Onchorhynchus tshawytscha	Chinook Salmon	Threatened/Endangered	N/A	N/A	N/A
Oreortyx pictus	Mountain Quail	Species of Concern	Sensitive	Sensitive	Species of Concern
Otus flammeolus	Flammulated Owl	Species of Concern	Sensitive	Sensitive	N/A
Picoides albolarvatus	White-headed Woodpecker	Species of Concern	Sensitive	Sensitive	N/A
Picoides arcticus	Black-backed Woodpecker	Species of Concern	Sensitive	Sensitive	N/A
Picoides tridactylus	Three-toed Woodpecker	Species of Concern	N/A	Sensitive	N/A
Pipistrellus hesperus	Western Pipistrelle	Species of Concern	N/A	N/A	Watch
Plethodon idahoensis	Coeur d'Alene Salamander	Species of Concern	Sensitive	Sensitive	N/A
Rana luteiventris	Spotted Frog	Species of Concern	N/A	Sensitive	Candidate
Rana pipiens	Northern Leopard Frog	Species of Concern	Sensitive	Sensitive	Species of Concern
Salvelinus confluentus	Bull Trout	N/A	N/A	N/A	Threatened/Endangered
Sitta pygmaea	Pygmy Nuthatch	Species of Concern	N/A	Sensitive	N/A
Synaptomys borealis	Northern Bog Lemming	Species of Concern	Sensitive	N/A	N/A
Strix nebulosa	Great Gray Owl	Species of Concern	N/A	Sensitive	Watch
Strix varia	Barred Owl	Proposed	N/A	N/A	N/A
Ursus arctos horribilis	Grizzly Bear	Threatened	N/A	N/A	Threatened

* Sources: ICDC 1998, U.S. Fish and Wildlife Service 2000d, Idaho Department of Fish and Game 1991.

Appendix G - Sources used to delineate limiting factors for fish in the Clearwater subbasin

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Clearwater subbasin Bull Trout Technical Advisory Team (1998a). *Bull Trout Assessment for the Lochsa and Selway Subbasins (Including the Middle Fork of the Clearwater Upstream of the South Fork).*

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Clearwater subbasin Bull Trout Technical Advisory Team (1998d). *South Fork Clearwater River Subbasin Bull Trout Problem Assessment*. Prepared for the state of Idaho.

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Appendix H - Figures depicting limiting factors for fish in the Clearwater subbasin

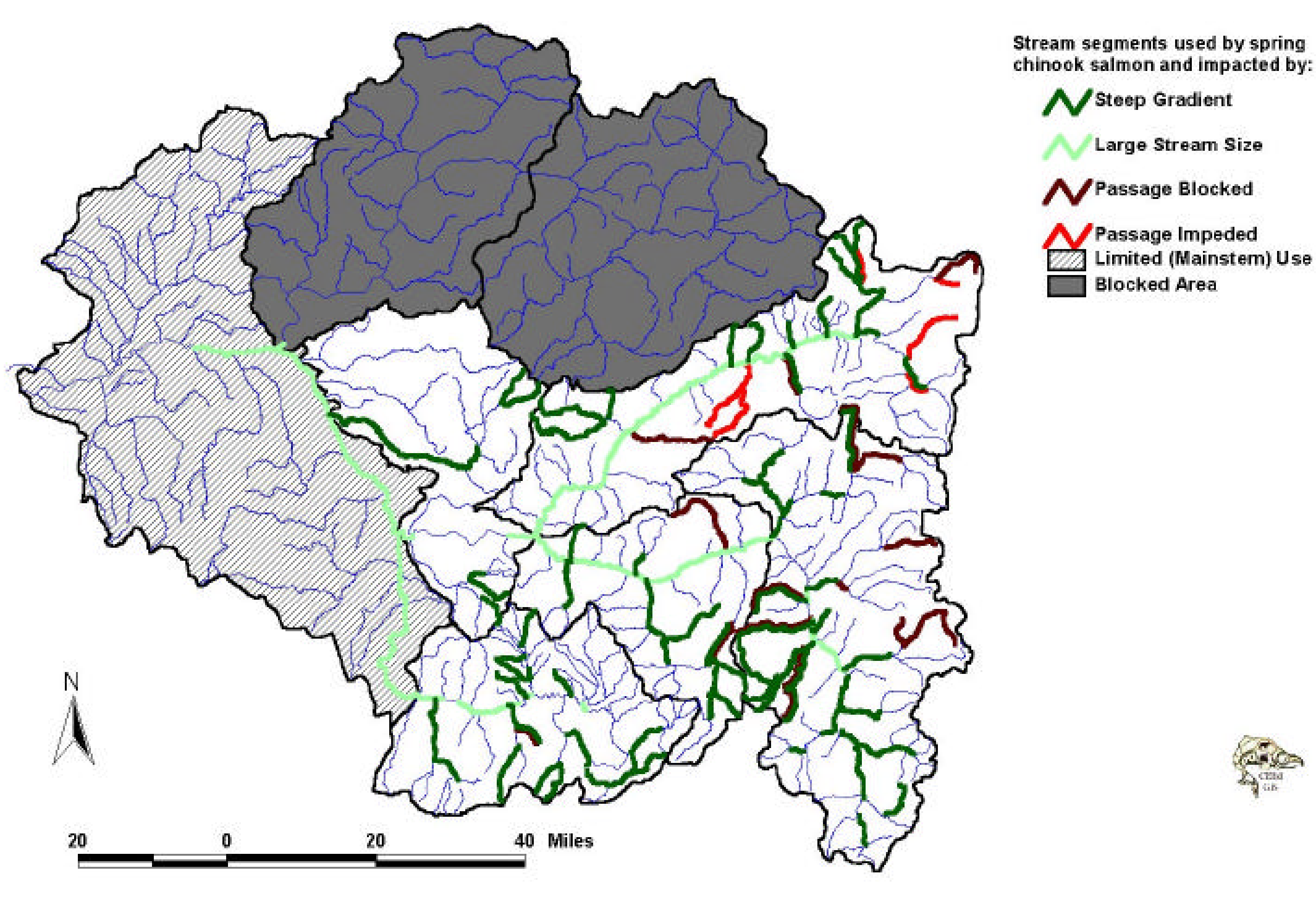

Figure 123. Clearwater subbasin stream segments where chinook salmon populations may be constrained by steep gradients, large stream size, or blocked or impeded passage (Pacific States Marine Fisheries Commission 2001)

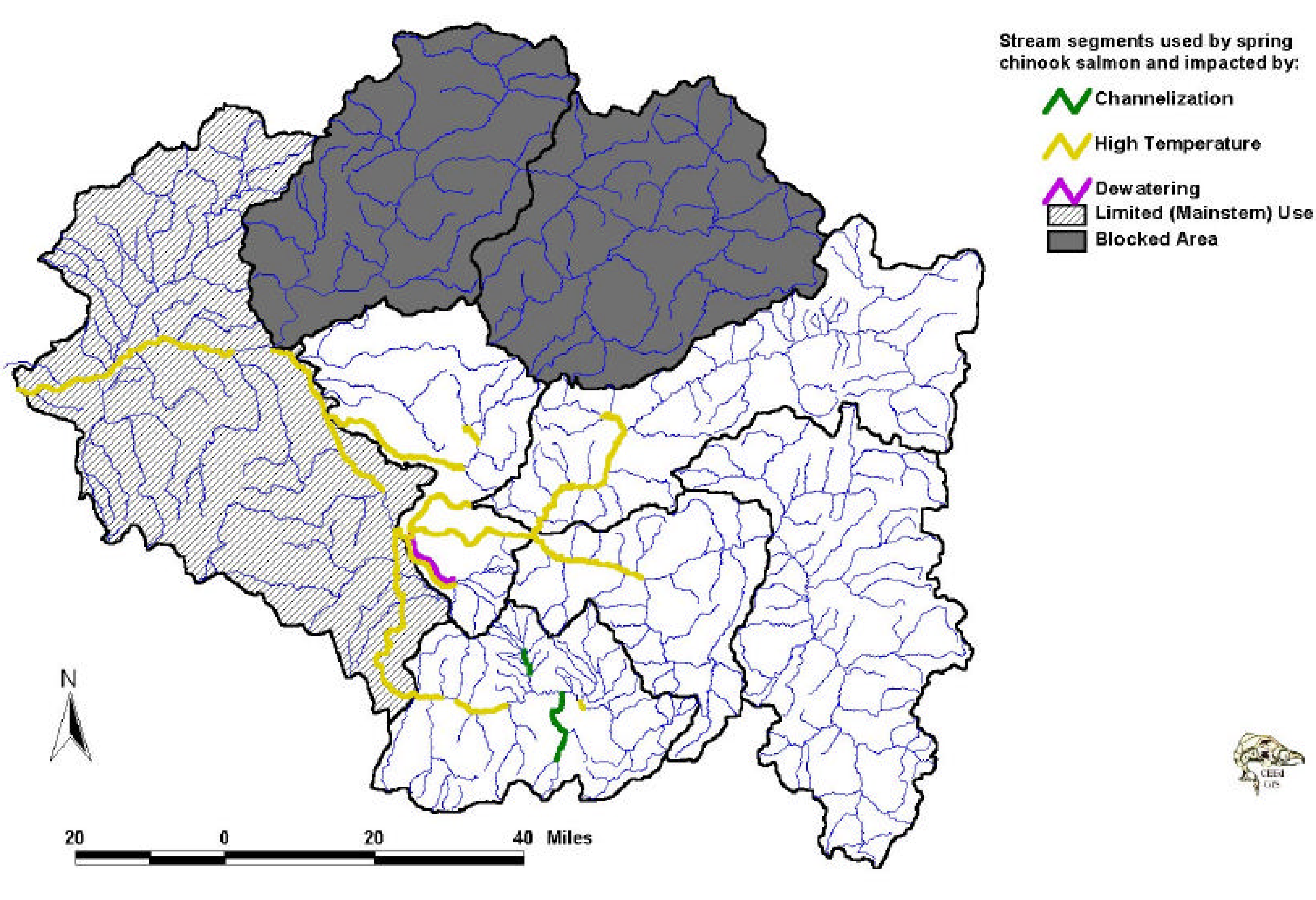

Figure 124. Clearwater subbasin stream segments where chinook salmon populations may be constrained by channelization, high temperatures, or dewatering (Pacific States Marine Fisheries Commission 2001)

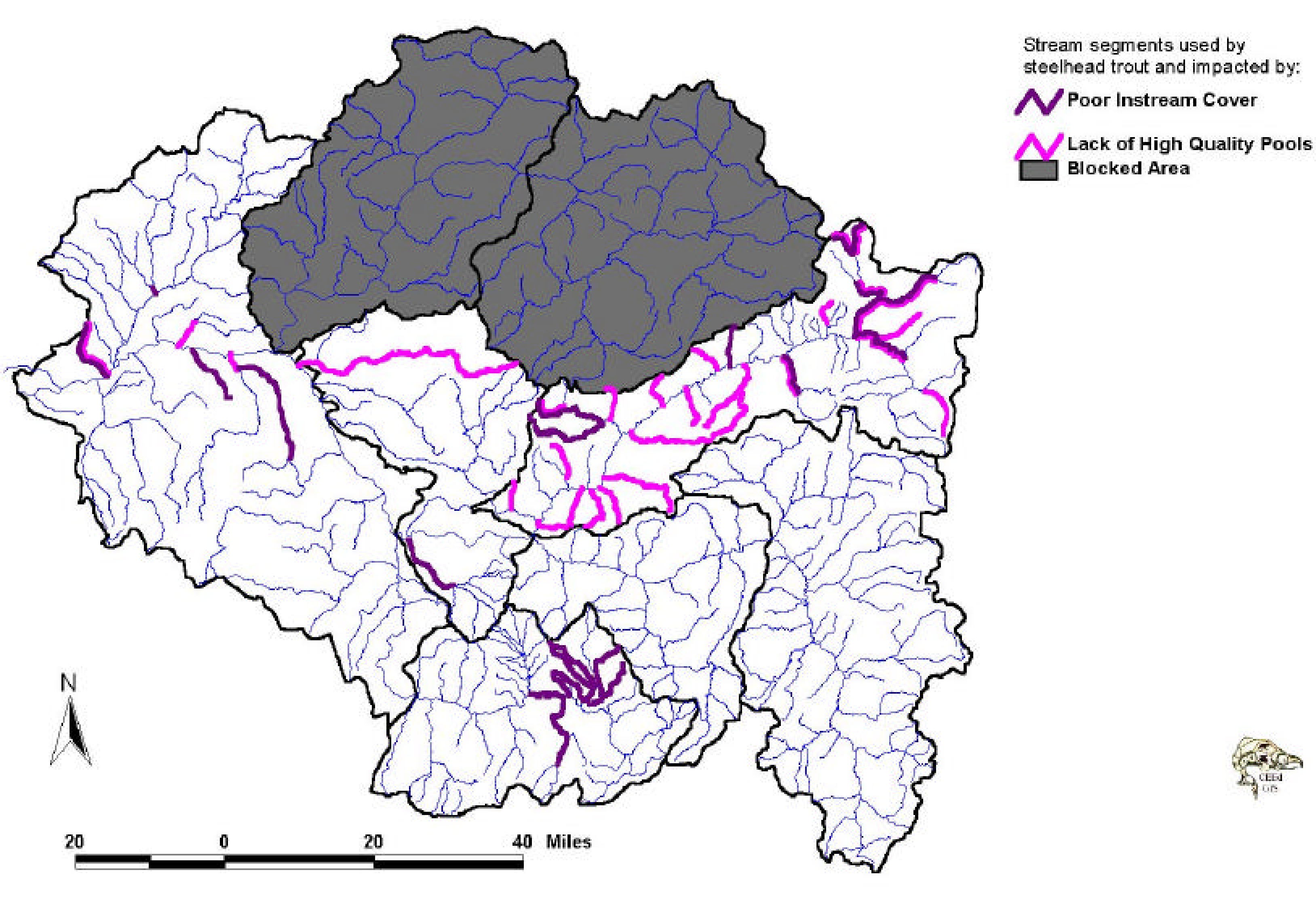

Figure 125. Clearwater subbasin stream segments where chinook salmon populations may be constrained by poor instream cover or lack of high quality pools (Pacific States Marine Fisheries Commission 2001)

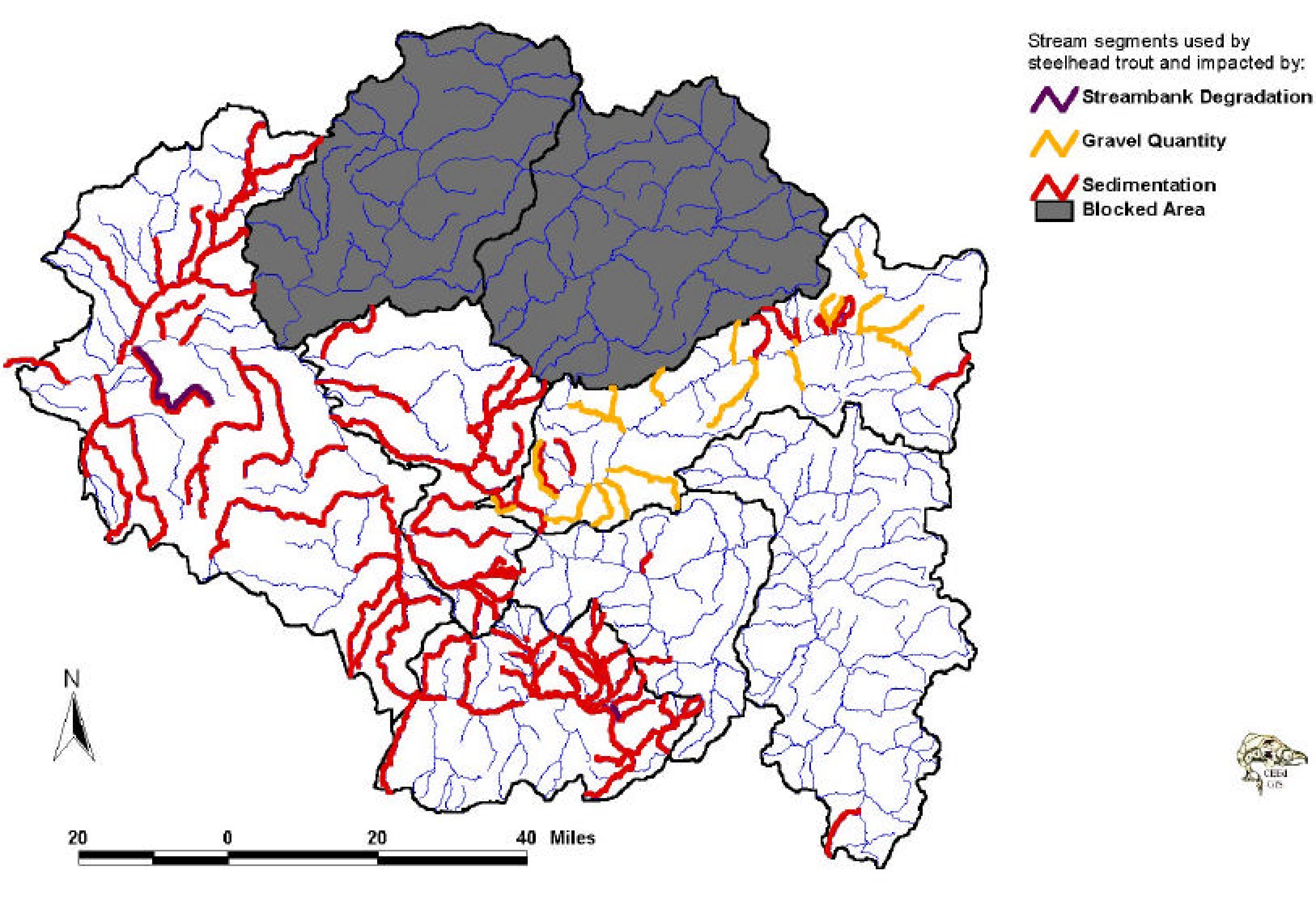

Figure 126. Clearwater subbasin stream segments where chinook salmon populations may be constrained by streambank degradation, limited gravel quantity or sedimentation (Pacific States Marine Fisheries Commission 2001)

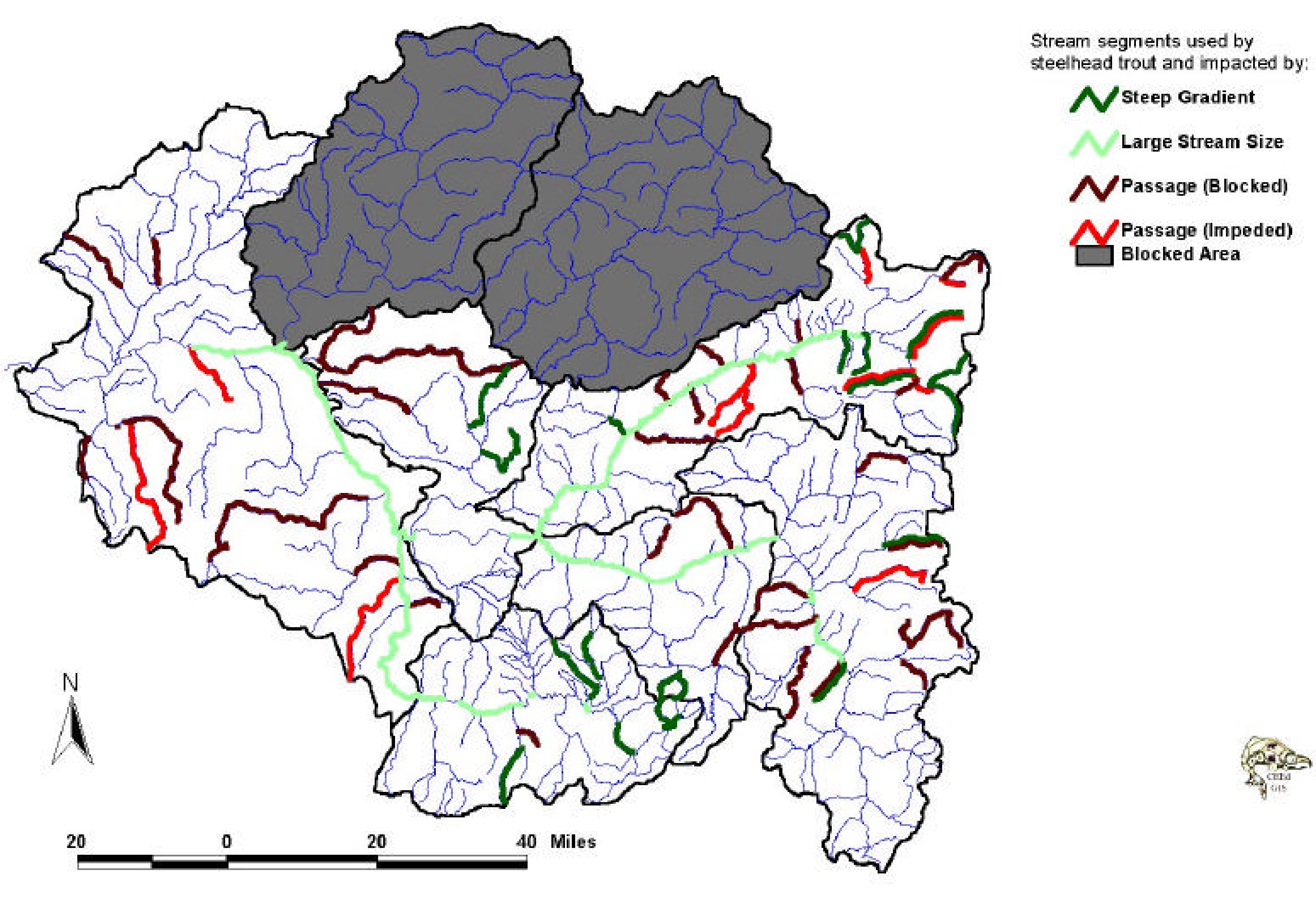

Figure 127. Clearwater subbasin stream segments where steelhead trout populations may be constrained by steep gradients, large stream size, or blocked or impeded passage (Pacific States Marine Fisheries Commission 2001)

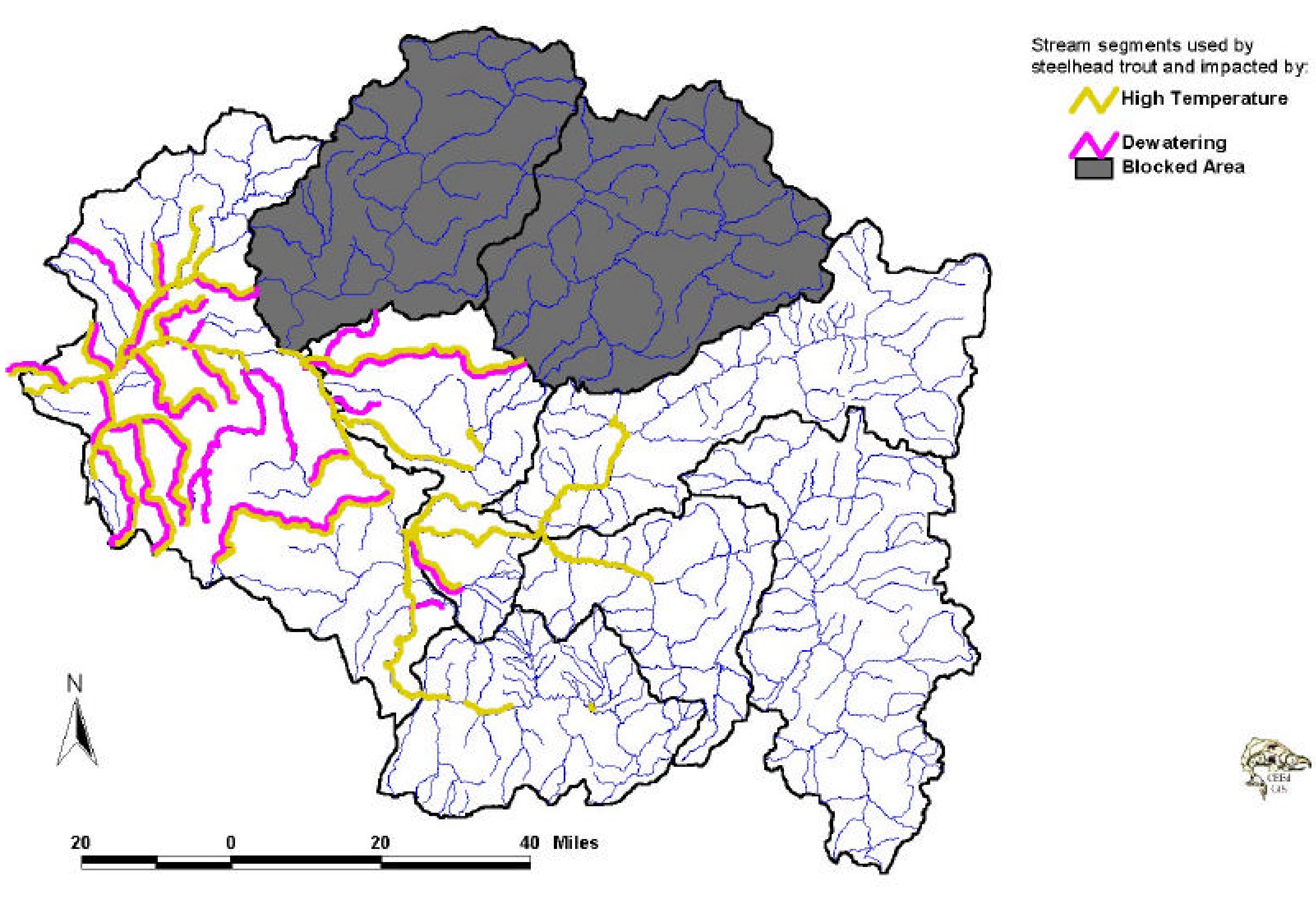

Figure 128. Clearwater subbasin stream segments where steelhead trout populations may be constrained by high temperatures, or dewatering (Pacific States Marine Fisheries Commission 2001)

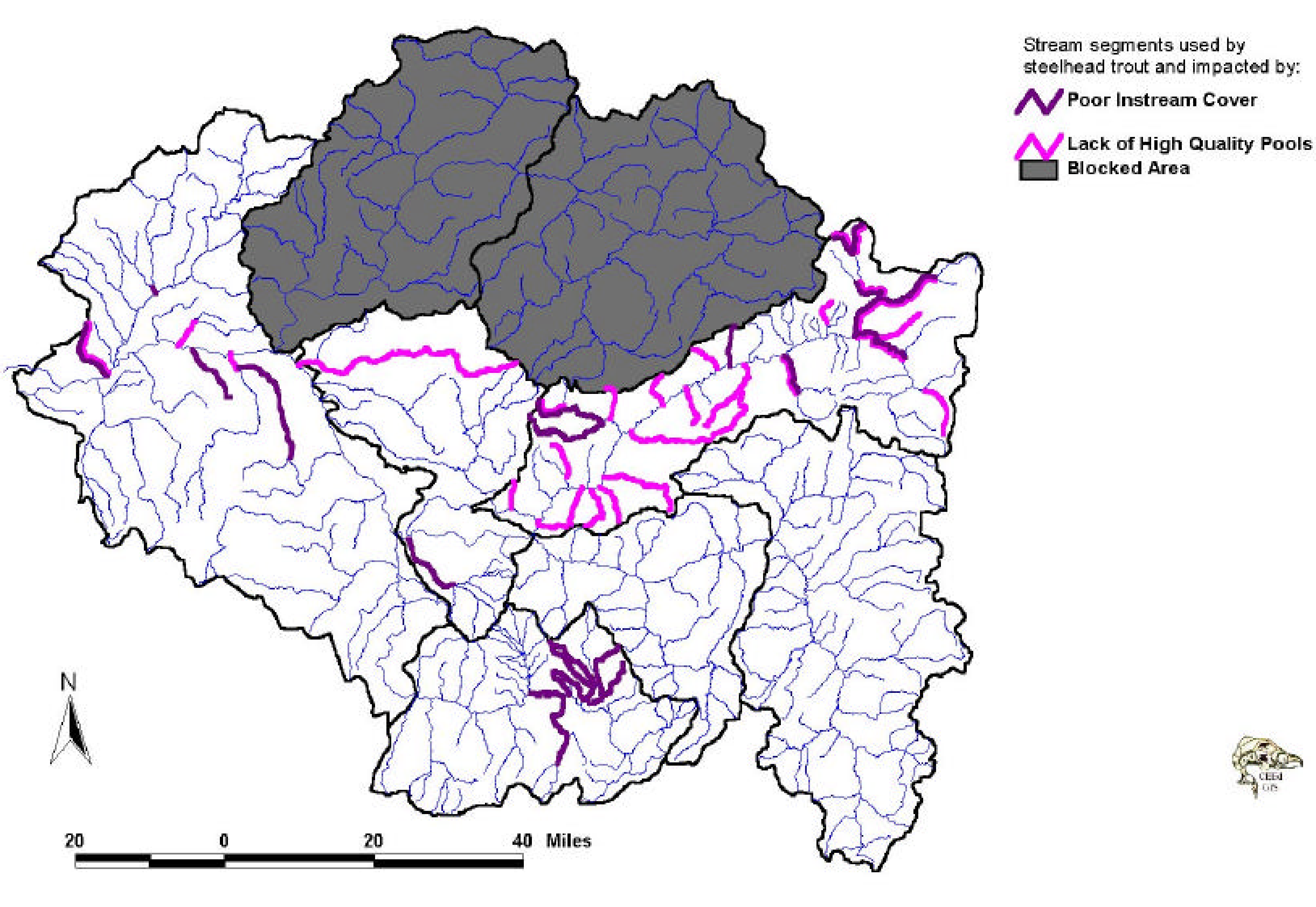

Figure 129. Clearwater subbasin stream segments where steelhead trout populations may be constrained by poor instream cover or lack of high quality pools (Pacific States Marine Fisheries Commission 2001)

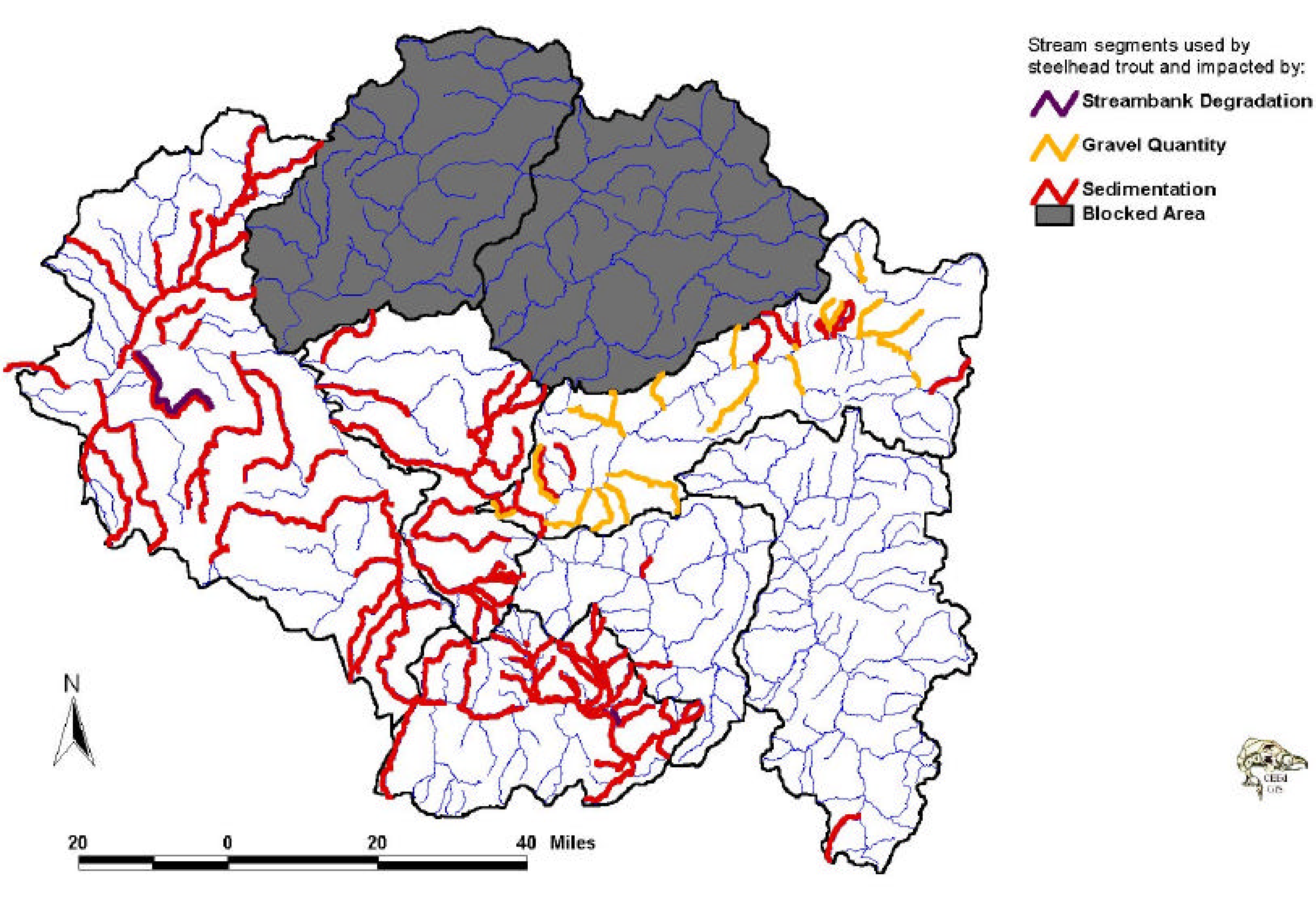

Figure 130. Clearwater subbasin stream segments where steelhead trout populations may be constrained by streambank degradation, limited gravel quantity or sedimentation (Pacific States Marine Fisheries Commission 2001)

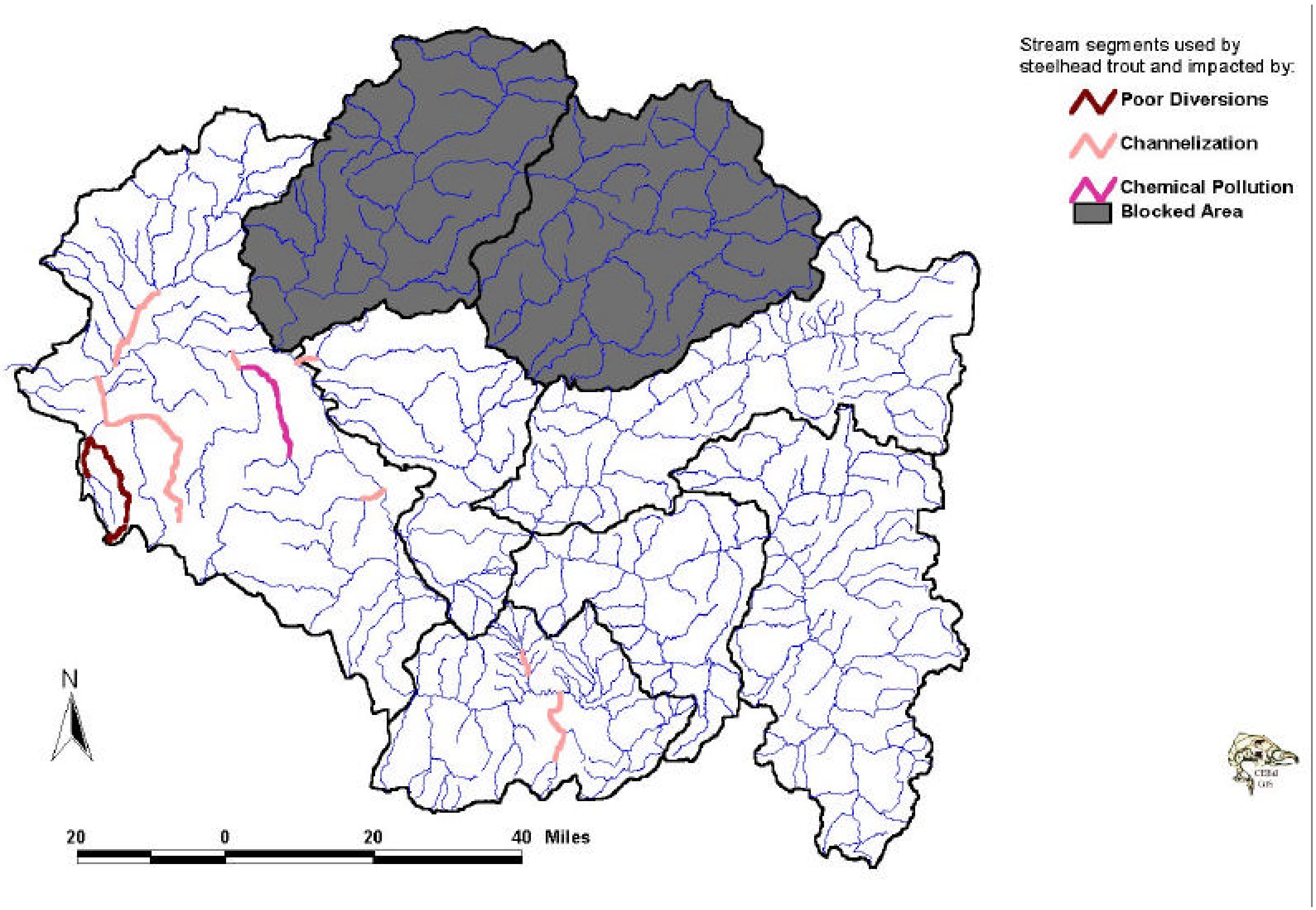

Figure 131. Clearwater subbasin stream segments where steelhead trout populations may be constrained by poor diversions, channelization, or chemical pollution (Pacific States Marine Fisheries Commission 2001)