SECTION 14 – Table of Contents

14 Pend Oreille Subbasin Assessment – Aquatic

14.1 Species Characterization and Status[1]

Over 30 species of fish, comprising 12 native and 20 nonnative species, are found in the Pend Oreille Subbasin today (Table 14.1). Many are important to the region for economic, aesthetic, cultural, recreational, and ecological values.

Table 14.1. Fish species currently present in the Pend Oreille Subbasin

Species	Origin	Location	Status
Largescale sucker (*Catostomus catastomus*)	N	L,R,T	C/U
Longnose sucker (*C. macrocheilus*)	N	L,R,T	C/U
Slimy sculpin (*Cottus cognatus*)	N	L,R,T	C/U
Torrent sculpin (*C. rhotheus*)	N	L,R,T	C/U
Peamouth (*Mylocheilus caurinus*)	N	L,R	C/U
Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)	N	L,R,T	C/S-D
Pygmy whitefish (*Prosopium coulteri*)	N	L	U/U
Mountain whitefish (*P. williamsoni*)	N	L,R,T	C/S-D
Northern pike minnow *(Ptychocheilus oregoninsis)*	N	L,R	A/S
Longnose dace (*Rhinichthys cataractae*)	N	L,R,T	C/U
Redside shiner (*Richardsonius balteatus*)	N	L,R,T	C/U
Bull trout (*Salvelinus confluentus*)	N	L,R,T	A/S-D
Black bullhead *(Ameiurus melas)*	E	L.R	U
Brown bullhead (*A. nebulosis*)	E	L,R	C/S
Lake whitefish (*Coregonus clupeaformus*)	E	L	A/S
Northern pike (*Esox lucius*)	E	L,R	C/I
Tiger muskie (*E. lucius x E. masquinogy*)	E	L,R	O/D
Channel catfish (*Ictalurus punctatus*)	E	L,R	O/D
Pumpkinseed (*Lepomis gibbosus*)	E	L	C/S
Bluegill (*L. macrochirus*)	E	L	O/I
Burbot (*Lota lota)*	E	L,R	O/D
Smallmouth bass (*Micropterus dolomieui*)	E	L,R	C/S-D
Largemouth bass (*M. salmoides*)	E	L,R	C/S-D
Rainbow trout (*Oncorhynchus mykiss*)	E	L,R,T	A/S
Kokanee salmon (*O. nerka*)	E	L,R,T	C/D
Yellow perch (*Perca flavescens*)	E	L,R	A/S
Crappie (*Pomoxis spp*.)	E	L,R	C/S
Lake trout (*Salvelinus namaycush*)	E	L	C/I
Brook trout (*S. fontinalis*)	E	T	C/I
Brown trout (*Salmo trutta*)	E	L,R,T	C/S
Walleye (*Sander vitreus*)	E	L,R	O/D
Tench (*Tinca tinca*)	E	L,R	C/I

E=Exotic, N=Native, L=Lake, R=River, T=Tributary, A=Abundant, C=Common, O=Occasional, U=Unknown, S=Stable, I=Increasing, D=Declining

[1] Large portions of Section 14.1 were contributed to by the Pend Oreille Subbasin Summary Report (2001) pp. 10-14, 25-59, 70-74, 89-116, 129-134, 151-166.

14.1.1 Native Species

In addition to the species listed in Table 14.1, the historic native salmonid community also included Chinook salmon and steelhead trout prior to the construction of Grand Coulee Dam. These species were known to migrate upstream to the Salmo River (Canadian-U.S. border) (Baxter 2004), but were restricted mostly to the lower reaches of the Pend Oreille River by either one or combination of natural falls/rapids, Z Canyon at RM 19 (formerly known as Big Eddy Canyon) and/or Metaline Falls at RM 27 (Stone 1883; Rathbun 1895; J. Maroney, Fisheries Biologist, KNRD, personal communication, 2004).

Stone (1883) found no evidence of salmon or anadromous fish reaching Lake Pend Oreille. Stone (1883) further believed the first rapid (Z Canyon) prevented anadromous fish from entering the Pend Oreille system. However, historical observations and interpretations of potential natural barriers such as Z Canyon and Metaline Falls were not always consistent. Other observations by Gilbert and Evermann (1895, page 31) and Rathbun (1895) describe Metaline Falls to be “the most serious obstruction” on the Pend Oreille River and “that no [potential] obstructions were *below* Big Eddy Canyon [Z Canyon] … nearly as serious as Big Eddy Canyon or Metaline Falls” (Gilbert and Evermann 1895). Rathdun (1895) concluded the “possible effect of this obstruction [Metaline Falls] upon the movements of salmon was not determined satisfactorily, although Dr. Gorham inclined to the opinion that it would be insurmountable in its present state …” In contrast, Gilbert and Evermann (1895) concluded neither Z Canyon nor Metaline Falls was a barrier to anadromous upstream migration although they did not record or document any anadromous species above these natural falls/rapids. Gilbert and Evermann (1895) only documented the abundance of trout and char (bull trout) above Z Canyon and Metaline Falls.

14.1.2 Artificial Production

This section provides a chronological history of artificial production in the Upper Pend Oreille, Lower Pend Oreille, and Priest River subbasins illustrating the transformation of fish communities and dynamics through time. After the overview of artificial production, more information is provided on specific nonnative species including rainbow trout, lake trout, lake whitefish, brook trout, brown trout, and other warmwater species. Sections 14.6 and 14.7 discuss the historic and current status of the nonnative focal species, kokanee and largemouth bass.

14.1.2.1 Upper Pend Oreille Subbasin

Fish stocking during the past 100 years has influenced fish populations in Lake Pend Oreille. Lake Superior whitefish were the first-known nonnative species stocked in Lake Pend Oreille during the late 1890s to feed a growing population of white settlers. Many of the warmwater species found in lowland lakes and some of the nonnative salmonids like brook trout were stocked in the early 1900s. In 1925, the U.S. Fish Commission stocked lake trout into Lake Pend Oreille (Entz and Maroney 2001).

Kokanee salmon dispersed downstream from Flathead Lake, Montana into Lake Pend Oreille during the winter flood of 1933. This species provided the largest fisheries in the state of Idaho through the 1960s. The population started a long-term decline in 1966 concurrent with deeper drawdowns of the lake from dam operations at Albeni Falls (Maiolie and Elam 1993; Paragamian and Ellis 1994). In 1985, the Cabinet Gorge Kokanee Hatchery was built with funding from Bonneville Power Administration (BPA) and Washington Water Power (now Avista Corporation) to mitigate for dam related losses. Hatchery stocked kokanee have helped prevent a total kokanee collapse, but population recovery and meeting the harvest goal of 750,000 kokanee annually will depend on restoration of the wild portion of the kokanee population (Entz and Maroney 2001). Lake Pend Oreille kokanee are further discussed in Section 14.6.

After kokanee salmon were well established, the Idaho Department of Fish and Game (IDFG), in cooperation with the Bonner County Sportsmen Association, introduced Kamloops rainbow trout into Lake Pend Oreille in 1941 and 1942. These fish came from Kootenay Lake, British Columbia, and they soon created a world-class fishery with the existing world record 16.8 kg rainbow caught in 1947. The IDFG supplemented the rainbow trout population with a locally developed Kamloops rainbow broodstock during the 1960s through the 1970s. Fingerlings stocked during the 1980s until 1992 were derived from a local non-captive broodstock collected in the Clark Fork River and from fry received from Kootenay Lake (Table 14.2). All rainbow trout stocking was discontinued in 1992 due to the concern over piscivorous species population expansions.

Table 14.2. History of kokanee, cutthroat trout, rainbow trout, and bull trout stocking in Lake Pend Oreille, Idaho, 1986 through 1999

Year Class (KL/KE only)	KL eggs collected	Kokanee adults trapped	Year kok re-lease	KL	KE	CT	Predators	
				Fry released	Fry released	Fingerling released	Species released	Number released
1985	10,661,104	76,245	1986	5,010,248	None	10,058	KM	3,864
1986	9,102,142	59,181	1987	5,861,050	None	10,125	KM	6,930
1987	17,255,051	88,064	1988	13,027,000	None	None	KM	11,638
							K2	4,875
1988	14,155,998	69,163	1989	11,743,000	None	None	KM	13,351
							K2	22,172
							BU	2,000
1989	9,579,772	81,991	1990	7,758,000	None	None	K2	22,600
							BU	3,338
1990	6,038,108	61,913	1991	5,184,101	None	109,051	None	
1991	6,591,608	91,426	1992	5,515,190	None	101,368	K2	9,344
							BU	5,055
1992	7,498,513	106,876	1993	561,146	None	72,855	None	
1993	11,097,143	179,419	1994	9,902,543	None	86,160	None	
1994	16,613,806	160,321	1995	14,050,457	None	100,039	None	
1995	12,893,131	136,586	1996	10,661,003	100,000	88,995	None	

Year Class (KL/KE only)	KL eggs collected	Kokanee adults trapped	Year kok re-lease	KL	KE	CT	Predators	
				Fry released	Fry released	Fingerling released	Species released	Number released
1996	4,496,439	56,113	1997	3,720,697	None	92,227	None	
1997	601,661	16,204	1998	2,483,740	None	94,200	None	
1998	8,955,972	91,996	1999	7,127,261	1,121,059	109,475	None	
1999	22,383,530	225,540	2000	17,710,513	None		None	
Total	**157,923,978**	**1,501,038**		**120,315,949**	**1,221,059**	**874,553**	**KM**	**35,783**
							K2 **BU**	**58,991** **10,393**

BU - LPO bull trout, KE - early spawning kokanee, KL - late spawning kokanee, KM - LPO stock rainbow fingerlings, K2 - Kootenay L. BC rainbow

Limited numbers of bull trout were stocked during 1989, 1990, and 1992 (Table 14.2). These fish came from Trestle Creek and Gold Creek, and the Clark Fork spawning channel adjacent to the Cabinet Gorge Hatchery.

The limited wild population of westslope cutthroat trout in Lake Pend Oreille was supplemented with hatchery stocking primarily during the 1990s. The presence of infectious pancreatic necrosis (IPN) and a viral disease affecting young westslope cutthroat trout at the Clark Fork Hatchery caused IDFG to terminate the cutthroat trout stocking program in Lake Pend Oreille. A new broodstock is being developed at the Hayspur Hatchery, but it will likely be several years before production fish are again available for stocking.

14.1.2.2 Lower Pend Oreille Subbasin

Native and nonnative populations of salmonids and other species have been supplemented or introduced by means of hatchery plantings in the Pend Oreille River and its tributaries since before the turn of the century. Some fish, such as brown trout, were introduced to the Pend Oreille River via plantings in the 1890s from an original Scottish strain (Hisata, as cited in Ashe and Scholz 1992). A table summarizing WDFW fish planting in the Pend Oreille River (between Box Canyon and Albeni Falls dams) and its tributaries from 1933-1994 is available in the Box Canyon Final License Application, Appendix E3.1-2 (2000). In Box Canyon Reservoir alone, approximately 226,328 rainbow trout were planted from 1935 to 1953. An additional 48,445 cutthroat trout were planted during this period (Bennett and Liter 1991). A total of 32,500 cutthroat trout were planted in the Pend Oreille River in 1939. Hatchery plantings into the Pend Oreille River were discontinued in the late 1950s due to poor angler harvest. Net pen stocking and release of rainbow trout has continued intermittently in the Pend Oreille River at Ione, Ruby, Metaline, and other locations. Intermittent tributary stocking of hatchery brook trout continued into the 1990s (Bennett and Garrett 1994).

The WDFW operates a native westslope cutthroat trout egg collection facility at Kings Lake. Trout eggs collected at this site are utilized for fry and yearling trout stocking efforts of lakes within the Lower Pend Oreille Subbasin and other areas within the IMP.

Historically, WDFW operated a hatchery facility located on Skookum Creek from the early 1950s through the mid-1960s. Fish propagated at this facility included cutthroat trout, rainbow trout, and eastern brook trout and were stocked in various area lakes, streams, and the Pend Oreille River. Hatchery operations were discontinued at this site due to poor fish growth and performance resulting from extremely cold hatchery source water temperatures (WDFW Region One archive files).

Currently, there are two ongoing hatchery operations in Box Canyon Reservoir: (1) the Pend Oreille net pen operations in the Blueslide area and (2) the Kalispel Tribe's largemouth bass hatchery, located on the Flying Goose Ranch. The Blueslide net pens have been operated continuously since 1991. The number of rainbow trout planted was 20,000 in 1991; 60,000 in 1993; 40,000 in 1992, 1994, 1995 and 1996; 45,000 in 1998-2000; 15,000 in 2001; 45,000 in 2002; and 30,000 in 2003. Fish stocked in 2002 and 2003 were sterile (triploid) fish (Curt Vail, Fish Biologist, WDFW, personal communication, 2003). The Kalispel Natural Resource Department (KNRD) developed a largemouth bass hatchery, funded by BPA, to supplement populations of largemouth bass in Box Canyon Reservoir. Annual production goal is 150,000 bass of which 100,000 are fry and 50,000 are fingerlings. The goal is to create/sustain a productive bass fishery in Box Canyon Reservoir that is available to Tribal members and the public.

In addition, the Newport High School production project was conducted in 1990, 1992, and 1993 where the numbers of rainbow trout planted were 10,000, 20,000 and 10,000, respectively (Gary Yann, Newport High School, personal communication). Net pen operations have also been operated in the Metaline and Boundary pool areas by local cooperators working with WDFW during the 1990s. Blueslide Resort in cooperation with Metaline Chambers, Pend Oreille Public Utilities District (PUD), and WDFW operates a rainbow (triploid) net pen facility releasing 25,000 to 30,000 fish annually. Local lakes are also stocked with westslope cutthroat trout and rainbow trout fry from the WDFW Colville Hatchery.

Walleye were planted by WDFW in 1983 and 1984 with 500,000 and 253,000 larvae, respectively (Bennett and Liter 1991). The WDFW also planted 148-tagged adult walleye in 1987 (WDFW, Spokane, as cited in Ashe and Scholz 1992). During the course of past fisheries studies, several anglers reported catching walleye, but there were no confirmed sightings of walleye, nor were there any walleye caught during the fisheries studies (Ashe and Scholz 1992; Bennett and Liter 1991).

14.1.2.3 Priest River Subbasin

Fish stocking during the last 100 years has influenced fish populations in the Priest River Subbasin. Many of the warmwater species found in lowland lakes and some nonnative salmonids were hauled to Idaho in the early 1900s in milk cans on the Burlington Northern Railroad. The initial introduction and consequent spreading of brook trout throughout the Priest River Subbasin probably had the biggest impact to native westslope cutthroat trout (Entz and Maroney 2001). In 1925, the U.S. Fish Commission stocked lake trout into Priest Lake.

The IDFG supplemented native westslope cutthroat trout in Upper Priest Lake and Priest Lake by stocking both fry and fingerling cutthroat trout directly into the lakes and into some tributaries from the 1940s through 1991. In 1989, 1990 and 1991, the IDFG attempted a net pen rearing program for cutthroat trout to provide a fishery for adipose-clipped cutthroat while requiring mandatory release of wild fish. This program was discontinued due to very poor returns of hatchery fish. Stocking records for the time period from 1976 to 1991 are summarized in Table 14.3. No cutthroat trout or kokanee have been stocked since 1991.

Table 14.3. Kokanee and cutthroat trout stocking history for Priest Lake, Idaho 1976-1991

	Cutthroat Trout		
Year	**Fingerlings**	**Fry**	**Kokanee**
1991	86,072	0	0
1990	95,284	0	0
1989	54,500	129,045	2,628,504
1988	0	900,105	1,924,774
1987	49,125	600,434	0
1986	247,080	0	1,263,554
1985	338,650	68,137	2,294,591
1984	266,216	300,440	3,714,880
1983	151,700	0	2,779,420
1982	142,845	0	925,368
1981	38,802	0	0
1980	0	4,104	0
1979	0	0	1,780,525
1978	0	0	62,424
1977	0	0	1,072,560
1976	0	0	0
Total	**1,470,274**	**2,002,265**	**18,446,600**

Stocking records did not distinguish between the Henry’s Lake cutthroat trout broodstock (Yellowstone cutthroat trout), and the King’s Lake cutthroat trout broodstock (westslope cutthroat trout) until 1982. The King’s Lake westslope cutthroat trout broodstock was formed using adfluvial westslope cutthroat trout from Priest Lake in the early 1940s, but it is unknown when fish from this native broodstock were used in place of the nonnative Henry’s Lake stock. Limited genetic sampling has not shown any sign of introgression with nonnative cutthroat or rainbow trout.

Rainbow trout were also widely stocked as fry, fingerling, and catchable fish in the Priest River Subbasin. The catchable rainbow trout were stocked in Granite Creek, the main tributary to Priest Lake on the west side, and in the Priest River below the Outlet Dam. The catchable rainbow trout stocking program was discontinued by 1982 in Granite Creek and in the Priest River by 1992.

Kokanee were established in Priest Lake during the 1950s from eyed eggs taken from the population in Lake Pend Oreille and stocked in shoreline gravel beds. A naturally reproducing population was established and supplementation was no longer necessary. Kokanee eventually invaded Upper Priest Lake and provided a limited fishery. During and after the collapse of the kokanee fishery in the late 1970s, IDFG stocked kokanee fry in an attempt to re-establish a kokanee fishery. Between 1977 and 1989, a total of 18.4 million kokanee fry were stocked in Priest Lake (Table 14.3), but predation by lake trout continued to overwhelm the kokanee prey base. Since 2001, when first observed, kokanee have been seen spawning in large numbers along the Priest Lake shorelines. In 2003, over 3000 kokanee spawners were observed in a single weekly count. Priest Lake and Upper Priest Lake kokanee are further discussed in section 14.6.

Brown trout were likely stocked in the Priest River and East River drainage prior to 1967. However, due to the lack of detailed documentation prior to 1967, it is unknown exactly when brown trout were stocked in the lower Priest River and the East River. Currently, there is a remnant population of brown trout in the East River drainage.

14.1.2.4 Rainbow Trout

Rainbow trout were first introduced into the Pend Oreille River system in 1919. Although there has been speculation that some rainbow trout may have originated from a native redband trout population, it is believed rainbow trout found in the Pend Oreille River and its tributaries are likely descendants of hatchery plantings in the early 1930s through the early 1950s (Entz and Maroney 2001). In what is now Box Canyon Reservoir, 226,328 rainbow trout were planted from 1935 to 1953. Today only triploid rainbow trout are stocked in the lower Pend Oreille drainage in the state of Washington. This management strategy was established to minimize the possible negative effects of rainbow trout hybridizing with native westslope cutthroat trout.

In Lake Pend Oreille, the Gerrard strain rainbow trout, which are predaceous and grow to large sizes, were first introduced in 1941. In Lake Pend Oreille, Vidergar (2000) found that 77 percent of the diet of rainbow trout larger than 275 mm is kokanee. Trophy rainbow trout exceeding 10 kg are caught every year and attract anglers from all over the country. Long-term management goals for the lake include continuing to provide a trophy rainbow trout fishery and utilizing kokanee salmon as a forage base. Bag limits, size restrictions, and season restrictions for rainbow trout were recently expanded to encourage angler harvest and reduce predation on the depressed kokanee population. These measures are intended to be short-term until the kokanee population shows signs of recovery as demonstrated by an increasing population trend. Resident rainbow trout contribute to the lower Clark Fork fishery, and rainbow trout are widely distributed in tributaries to Lake Pend Oreille and the lower Clark Fork River. Rainbow trout pose a threat of hybridization with westslope cutthroat trout, with hybrids being common in some portions of the Subbasin.

In the Priest River drainage, rainbow trout were widely stocked as fry, fingerling, and catchable fish. Catchable rainbow trout were stocked in Granite Creek, the main tributary to Priest Lake on the west side, and in the Priest River below the Outlet Dam. By 1982 and 1992, the catchable rainbow trout stocking program was discontinued in Granite Creek and in the Priest River, respectively (Entz and Maroney 2001). However, IDFG continues to stock isolated small ponds in the Subbasin with rainbow trout to provide harvest opportunities for unskilled anglers (N. Horner, Regional Fisheries Manager, IDFG, personal communication, 2003).

14.1.2.5 Lake Trout

In 1925, the U.S. Fish Commission first introduced lake trout into Lake Pend Oreille. Lake trout dispersing from Flathead Lake, and possibly Upper Priest Lake and Priest Lake, likely contributed to the Lake Pend Oreille lake trout population. Lake trout are well established in Lake Pend Oreille and contribute to the sport fishery. They are considered to be a potentially significant threat to native fish and kokanee; therefore, the management emphasis is to reduce lake trout numbers through a year-round, no bag limit regulation.

Creel surveys in Lake Pend Oreille conducted by IDFG in 1985, 1991, and 2000 show estimated lake trout harvest increasing from zero in 1985, to fewer than 100 in 1991, to over 4,000 in 2000. The significant increase in lake trout harvest has occurred despite a nearly 20 percent drop in angler effort from 1991 to 2000. In 1991, catch rates for lake trout were estimated at over 10,000 hours per lake trout, compared with 78 hours per lake trout in 2000. In 2000, fishing regulations were liberalized to increase the harvest of lake and rainbow trout (the bag limit for lake trout has been removed, and for rainbow trout has been increased from two fish to six with no size limit and a year-round season).

Lake trout are thought to comprise 4 percent of the predator biomass and consume two percent of the kokanee production (Vidergar 2000). In 1999, a mark-and-recapture population estimate of lake trout (>405 mm fork length) estimated 1,792 fish with a 95 percent confidence interval of 1,054 to 5,982 (Vidergar 2000). By fall of 2001, researchers concluded that predation levels were still too high for kokanee forage base (Maiolie et al. 2002). In 2004, results from a mark-recapture study estimated 5,200 to 8,100 lake trout over 508 mm (>20 inches) in length present in Lake Pend Oreille (Peterson and Maiolie 2004).

Lake trout were also introduced into the Priest Lake system in 1925 (Bjornn 1957). Lake trout were largely forgotten until being “rediscovered” in 1952, when over 2,268 kg of lake trout were weighed in during a fishing derby sponsored by the Priest Lake Sportsmen Association. The lake trout population and fishery had relatively few, large fish until Mysis shrimp (*Mysis relicta*) were introduced from 1965 to 1968 (Bowles et al. 1991) (Figure 14.1).

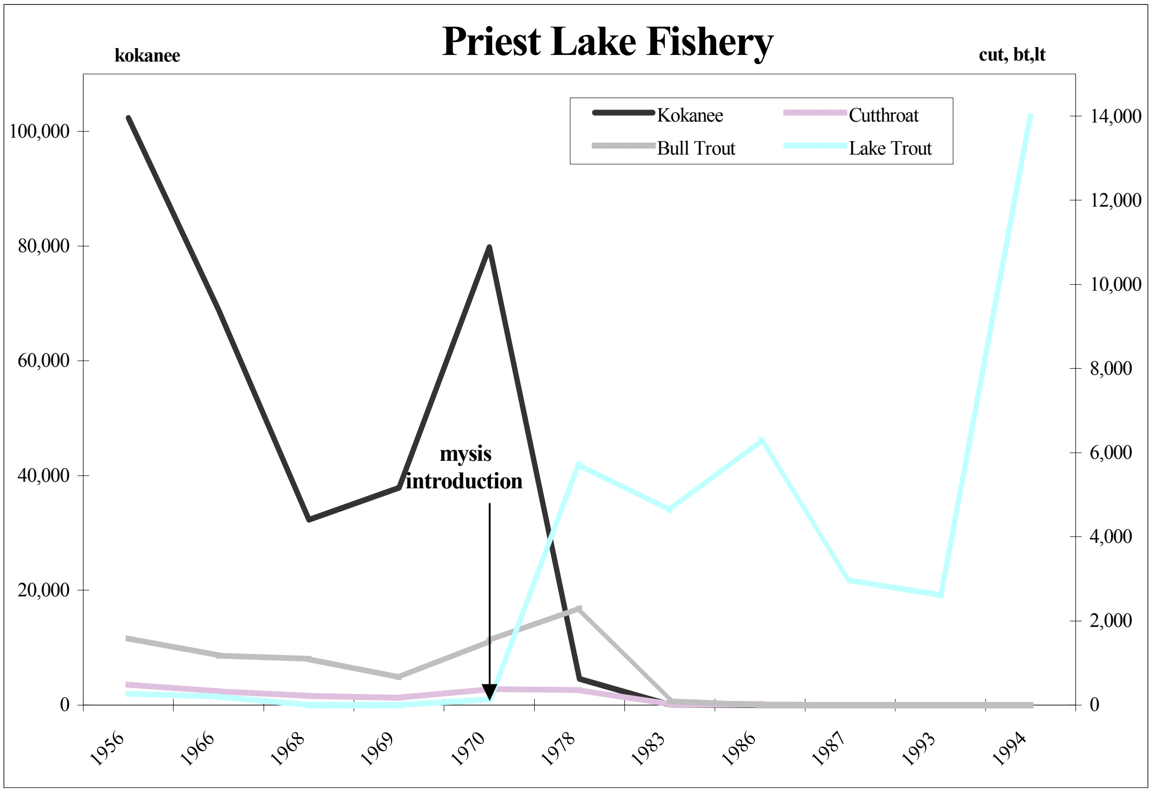


Figure 14.1. Estimated harvest of kokanee, cutthroat trout, bull trout, and lake trout in Priest Lake, Idaho from 1956 to1994

The presence of Mysis shrimp increased juvenile lake trout survival, increasing the population of lake trout, which then had adverse impacts on kokanee, bull trout, and cutthroat populations (Figure 14.1). Lake trout harvest increased to as much as 13,000 fish annually by 1994 (Davis et al. 2000) as interest shifted from the popular kokanee and cutthroat trout fisheries of the past to the only remaining harvest fishery. The average size of lake trout in the catch declined, primarily from the effects of increased exploitation (Figure 14.2). Young lake trout have now replaced kokanee as the primary forage fish for larger lake trout. The lake trout fishery is currently being managed as a yield fishery for fish in the 40 to 55 cm size range.

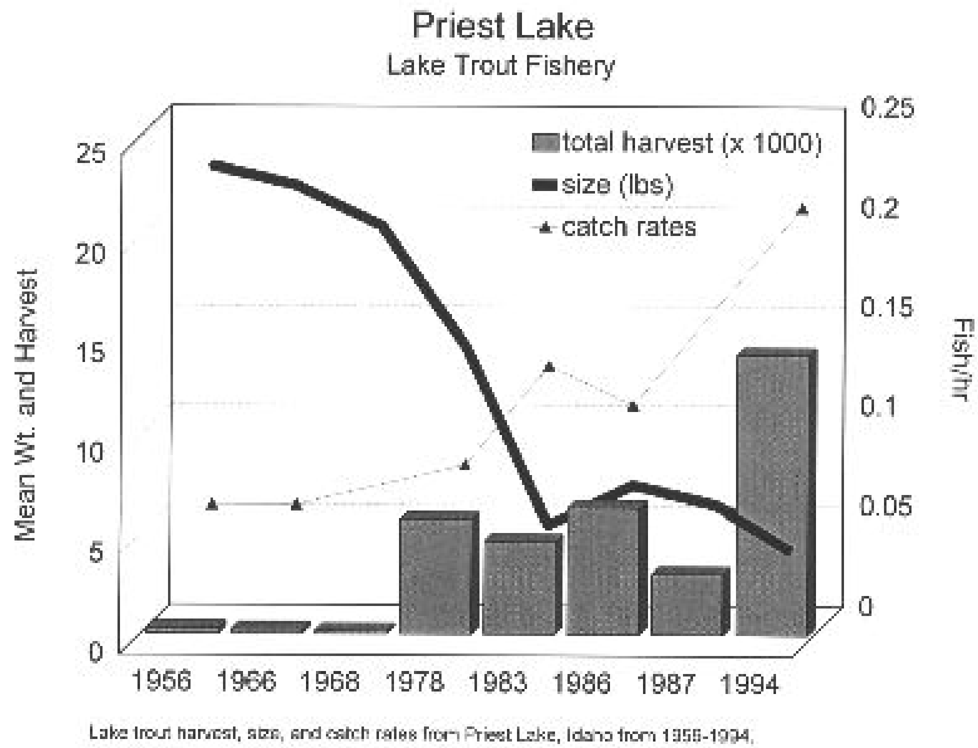


Figure 14.2. Lake trout size, harvest, and catch rates from Priest Lake, Idaho from 1956 to1994

Lake trout were absent from Upper Priest Lake during fishery surveys in 1956 (Bjornn 1957) and were still not present as late as 1979 (Rieman et al. 1979). Mauser (1986) reported lake trout were occasionally caught in Upper Priest Lake in 1985. Detailed angler diaries kept by two avid Upper Priest Lake anglers indicated lake trout were not uncommon in their catch by 1993, and their catch records show an increase in lake trout and decrease in bull trout the following years.

In 1997, IDFG conducted an intensive survey in Upper Priest Lake to assess lake trout population and bull trout abundance, and evaluate the feasibility of lake trout removal (Fredericks et al. 1997). Study results confirmed the presence of a well-established lake trout population. The size distribution of lake trout depicts a relatively young and expanding population. The collection of numerous juvenile lake trout suggests that they are reproducing successfully in Upper Priest Lake (Fredericks et al. 1997). Movement of sonic and spaghetti tagged lake trout demonstrated that migration between Upper Priest Lake and Priest Lake via the Thorofare is not uncommon (Fredericks 1999).

Lake trout suppression efforts have been partially successful in Upper Priest Lake through a program of intensive gill netting. In 1998, IDFG removed 912 lake trout from Upper Priest Lake by gill netting (Fredericks and Venard 2000). An additional 321 lake trout were removed in 1999. Ratios of bull trout to lake trout were similar in both years (about 5:100). However, return rates of tagged fish provided a clear indication that interchange of lake trout between the two lakes is common and the upper lake cannot be treated as a closed system.

In 1999 and 2000, a study was conducted on the seasonal and diel movement patterns of lake trout, cutthroat trout, and bull trout in the Thorofare (Venard 2001). Venard (2001) found lake trout ($n > 100$) migrated through the Thorofare primarily during the night and in the spring and fall when waters were cooler than during the summer. Cutthroat trout ($n > 100$) were captured mostly from April to October during the day and night. Although few bull trout ($n = 7$) were detected using the Thorofare, their diel and seasonal movements were analogous to lake trout (Venard 2001).

Lake trout reduction in Upper Priest Lake is the most viable option for protecting and restoring the Upper Priest Lake bull trout population. The reduction of lake trout is unlikely unless a method can be established to control lake trout immigration through the Thorofare, a stream channel connecting Upper Priest Lake with Priest Lake. However, a fish barrier preventing migration between the lakes may prevent bull trout and cutthroat trout migration to their natal spawning streams (Venard 2001). Options to reduce lake trout movement are complicated by the strong public sentiment against obstructing free boat passage between the lakes.

In 2002, a strobe light test was conducted in the Thorofare. Results from this test concluded lake trout could be stopped from migrating through the waterway (Liter and Maiolie 2003). Gill netting by IDFG over the last three years has shown this method of removal is feasible at lake trout control. Funding for these two projects are now being investigated.

Future management decisions for native westslope cutthroat trout and bull trout enhancement will be dependent on the success of keeping lake trout out of Upper Priest Lake and/or the possibility of replacing the lake trout fishery with another sport fishery, such as kokanee, that has no impact on native fish restoration. The current management direction is to continue the existing lake trout fishery in Priest Lake and attempt to maintain Upper Priest Lake as a refuge for native species. The influx of lake trout and the increased brook trout populations in tributary streams has seriously compromised the abundance and survival of native species. If Upper Priest Lake can be protected, then options to eventually restore Priest Lake may remain viable. But, if bull trout are extirpated in Upper Priest Lake, it is doubtful they can ever be successfully restored to this watershed.

14.1.2.6 Lake Whitefish

Ned Horner, Regional Fisheries Manager for IDFG, reported at a public meeting on February 28, 2004 that “lake whitefish were the most numerous fish caught during the deep water trap net assessment in Lake Pend Oreille conducted during the winter of 2003-2004. Lake whitefish were originally introduced into Lake Pend Oreille in the 1890s, but very few anglers target them. Although they appear to be quite abundant, little is known about their ecological role or relationship to other fish species in the lake.”

Potentially they could be managed as a sport fishery to help offset the declines in other fisheries. However, lack of knowledge prevents their effective management.

No studies, to our knowledge, document lake whitefish ecology in the Lake Pend Oreille system. It is unknown what limits their abundance. Lake whitefish food habits, age structure, and habitat usage have not been investigated. Research has discovered lake whitefish feed heavily on Mysis shrimp in Lake Pend Oreille, which may be causing a decline in Mysis shrimp abundance. Maiolie (2002) noted that the overall density of Mysis shrimp has been declining since 1980, and from 1998 to 2001 immature and adult Mysis shrimp densities declined from 426 Mysis shrimp/m^2 to 224 Mysis shrimp/m^2. The reason for the decline in Mysis shrimp is unknown, however, lake whitefish predation is a current leading theory (Maiolie, IDFG, personal communication, March 2003).

14.1.2.7 Brook Trout

Brook trout are nonnative and abundant throughout the Pend Oreille Subbasin. In the Priest River Subbasin, the U.S. Fish Commission introduced brook trout in the early 1900s. However, current management (since the mid-1990s) in the Priest River Subbasin only stock brook trout in selected isolated lakes. In Washington, stocking programs were established as early as 1920 when the northeastern counties in Washington managed the fishery (C. Vail, Fisheries Biologist WDFW, personal communication, 2003). By the 1930s, WDFW managed the fishery and continued an extensive brook trout stocking program in northeastern Washington. In 2001, WDFW received a project grant from the State of Washington Salmon Recovery Funding Board, to pursue removal of brook trout in a portion of Middle Branch LeClerc Creek (a tributary to Box Canyon Reservoir - Pend Oreille River), utilizing antimycin, to facilitate restoration of bull trout (C. Vail, Fisheries Biologist, WDFW, personal communication). Beginning in 2002, the Kalispel Tribe implemented a brook trout removal program using a backpack electrofisher in Mineral Creek, a tributary in the LeClerc watershed. A total of 2,941 brook trout were captured and removed (J. Maroney, Fisheries Biologist, KNRD, personal communication, 2004). Westslope cutthroat trout were less abundant; 880 cutthroat trout were captured and returned to Mineral Creek.

Currently, brook trout are well distributed throughout the Subbasin including the rivers (Pend Oreille, Salmo with the exception of the South Fork Salmo, and Priest rivers), tributaries, and Box Canyon Reservoir (Andonaegui 2003). Brook trout have been identified as one of the primary limiting factors for bull trout recovery in the Pend Oreille Subbasin (Andonaegui 2003). Their distribution overlaps throughout much of the historic range of bull trout and westslope cutthroat trout in the Pend Oreille Subbasin, including portions of nearly all spawning and rearing streams. Brook trout inhabit areas where the habitat is disturbed from land use practices. Behnke (1979) described how clear-cutting along two streams in the Smith River drainage of Montana increased erosion, sediment loads, and water temperatures; the westslope cutthroat trout population was eliminated in the disturbed area, and brook trout was the principle species. Of all the factors threatening bull trout and westslope cutthroat trout, hybridization and interspecific competition with introduced salmonids are among the most detrimental (Liknes and Graham 1988; Leary et al. 1991; Markle 1992).

In the Priest River Subbasin, brook trout abundance appears to be highest in tributaries on the west side of Priest Lake and the Priest River, where sediment loads are highest, due partially to geology. Limited population data are available for some drainages based on timber sale assessments by the USFS and Idaho Department of Lands (IDL) and stream surveys by IDFG. A thorough evaluation of brook trout abundance and distribution in the subbasin is needed to determine the probability of re-establishing native trout and char fisheries.

Research during the 1980s indicated that brook trout were having a negative effect on adfluvial westslope cutthroat trout production in Priest Lake tributary streams (Irving 1987, Strach and Bjornn 1989). Limited surveys by the USFS in west side tributaries indicate that brook trout may have increased in abundance and distribution. Work by University of Idaho graduate students during the mid-1980s (Irving 1987; Cowley 1987; Strach and Bjornn 1989) indicated the presence of brook trout in Priest Lake tributaries reduced densities of westslope cutthroat trout and the removal of brook trout could result in increased production of westslope cutthroat trout. However, recent brook trout removal experiments in three Upper Priest Lake tributaries had limited effect based on the amount of in-stream and overhead cover present and the difficulty in removing all fish (Fredericks et al. 2000). Brook trout were maturing as early as age one for male and age two for females, so missing large numbers of fry resulted in little population impact. Comprehensive surveys are needed in all tributaries to Upper Priest Lake and Priest Lake to determine the distribution and abundance of brook trout to better define native fish restoration options.

14.1.2.8 Brown Trout

The Scottish strain brown trout were first introduced to the Pend Oreille River via plantings conducted in the 1890s that continued into the 1990s (Hisata, as cited in Ashe and Scholz 1992). Brown trout are effective predators and can reduce a bull trout population through mortality. In the Washington portion of the lower Pend Oreille Subbasin, brown trout are currently only stocked in isolated lakes (with no stream outlets).

Brown trout populations appear to be the most common adfluvial salmonid species in the Pend Oreille River and tributaries. Although not as abundant, brown trout also occur in the lower Priest River and the East River. Their ability to tolerate warmer temperatures than other resident salmonids may be a partial explanation for this. Data collected during the two years of adfluvial trapping indicated that the streams likely to contain adfluvial populations included Indian Creek, Skookum Creek, Cee Cee Ah Creek (Entz and Maroney 2001), and Sullivan Creek (Andonaegui 2003).

Fisheries resources in Box Canyon Reservoir reach of the Pend Oreille River and its tributaries have been described by previous investigations conducted by researchers from the University of Idaho (Bennett and Liter 1991; Bennett and Garrett 1994) and Eastern Washington University (Ashe and Scholz 1992). Trout, although present in the reservoir, comprised less than one percent of the total fish captured using electroshocking, gill netting, and seining methods. Brown trout were the most abundant, with 492 captured from 1988 to 1990.

14.1.2.9 Warmwater Species

A variety of warmwater fish species have been introduced to the Pend Oreille Subbasin for the past century (Table 14.1). The majority of these warmwater species inhabit areas with warmer temperatures such as the mainstem Pend Oreille River reservoirs, low-velocity backwater sloughs, and inundated confluence zones of Pend Oreille River tributaries. Several warmwater fish species are also found in area lowland lakes within the subbasin. The data collected by Bennett and Liter (1991), Bennett and Garrett (1994), and Ashe and Scholz (1992) indicate that the most abundant game species in the Box Canyon Reservoir reach of the Pend Oreille River are yellow perch (37 percent of the total), pumpkinseed (21.1 percent), largemouth bass (7.7 percent), and black crappie (2.2 percent). The most abundant non-game species is tench (7.6 percent of the total) (Bennett and Liter 1991; Ashe and Scholz 1992). As a result of less suitable over-wintering habitat, warmwater fishes are lower in abundance above Albeni Falls Dam upstream to the outlet of Lake Pend Oreille compared to Box Canyon Reservoir (Karchesky 2002).

14.2 Focal Species Selection

The focal species selected in the Pend Oreille Subbasin include three native species (bull trout, westslope cutthroat trout, mountain whitefish) and two nonnative species (kokanee, largemouth bass). Each species was selected based on their ecological, cultural, and/or economic value. Focal species were selected based on criteria that were developed by the Council and the IMP Oversight Committee. The Subbasin Work Teams applied these criteria with input from the Ad-Hoc Technical Group to select the five species for the Pend Oreille Subbasin. For more information on the focal species selection process, refer to Section 3.

14.3 Focal Species – Bull Trout

Bull trout were selected as a focal species because of their historical and still potentially important value as a recreational fishery. In addition, bull trout were listed as a threatened species under the Endangered Species Act in June 1998. Bull trout are important ecologically because they are high up on the food chain feeding primarily on other fish. Bull trout are also an indicator species for habitat quality due to their sensitivity to habitat disturbance and specific habitat requirements.

14.3.1 Historic Status

Bull trout (adfluvial, fluvial, and resident life-history strategies) were once abundant in the Pend Oreille River and tributaries (Gilbert and Evermann 1895). The lack of man-made barriers allowed for fish movement and genetic interchange between stocks of bull trout in parts of the Clark Fork River, Pend Oreille River, Flathead River/Lake and Priest River/Lake (Gilbert and Evermann 1895). Historically, the Box Canyon Reach (upstream of Metaline Falls), extending from today's Box Canyon Reservoir upstream to the base of Albeni Falls Dam, was described as an excellent area for bull trout (Jordan and Evermann 1908, as cited in Geist et al. 2004). Individual Kalispel Tribal members reported bull trout as large as 660 mm (26 in) long and weighing 1.9 kg (5 pounds) or more (Gilbert and Evermann 1895). Bull trout were also historically documented in the lower Pend Oreille River tributaries including LeClerc Creek (Gilbert and Evermann 1895), Calispell Creek (Smith 1931), and Ruby Creek (USFWS 2003).

According to Spruell et al. (2003), it is probable that bull trout populations in the Lake Pend Oreille and Clark Fork River system (upper Columbia) were historically within a continuous habitat isolated from other Columbia River populations by a natural barrier fall, Metaline Falls. However, the genetic data alone cannot determine whether bull trout were able to migrate down or up the falls (P. Spruell, Geneticist, University of Montana, personal communication, 2004). Investigations into the genetic characteristics of the entire Columbia River basin indicate bull trout populations in the Methow, Yakima, and Wenatchee (mid-Columbia) drainages are more similar to the upper Columbia than populations in the lower Columbia (Deschutes and drainages downstream) (P. Spruell, Geneticist, University Montana, personal communication, 2004). Spruell (personal communication, 2004) provides a couple of hypotheses for this genetic similarity:

(1) There has been genetic exchange traversing the falls in the recent past.
(2) The populations were founded by a common group of fish and subsequently retain some level of genetic similarity due to this common founding event despite the fact they are unable to navigate the falls.

Historical abundance estimates are not available for bull trout population within the entire Pend Oreille Subbasin. However, a literature review by Pratt and Huston (1993) suggest that Lake Pend Oreille could support 10,000 bull trout spawners per year, while 1978 harvest records show 2,300 bull trout were taken in Priest Lake (Mauser et al. 1988).

14.3.2 Current Status

Bull trout are present in varying abundance in the Pend Oreille Subbasin. All three life history strategies are assumed to be present in the Subbasin, although the migratory habits of all populations have not been evaluated. Bull trout populations in the Upper Pend Oreille Subbasin remain relatively stable while other populations in the Lower Pend Oreille and Priest River subbasins are depressed (Andoneagui 2003). The decline of many bull trout populations within the Lower Pend Oreille and Priest River subbasins is largely attributed to interspecies competition with nonnative species, man-made barriers in tributaries, hydroelectric facilities on the mainstem, and habitat fragmentation, degradation, and loss (Andoneagui 2003). In the 1998 Salmonid Stock Inventory for bull trout and Dolly Varden (WDFW 1998), the WDFW classified the Pend Oreille bull trout population status in Washington as “unknown” and expressed concern over few individual bull trout observations in the lower Pend Oreille Subbasin.

Currently the Pend Oreille Subbasin is delineated into three geographical sections including: 1) the Upper Pend Oreille (extends above Albeni Falls Dam upstream to the lower Clark Fork River below Cabinet Gorge dam), 2) the Lower Pend Oreille (extends downstream of Albeni Falls to the Canadian border), and 3) the Priest River drainage. However, the geological barriers are not recognized by bull trout sub-populations within the Subbasin. For example, bull trout have been documented to over-winter in the Upper

Pend Oreille Subbasin (Lake Pend Oreille) and then migrate downstream to spawn in the Priest River drainage (Middle Fork East River) (Geist et al. 2004). The principal reason Lower and Upper Pend Oreille River are differentiated is a result of Albeni Falls Dam, a current fish passage barrier located on the Pend Oreille River. The USFWS (2000) noted in their Biological Opinion that Albeni Falls Dam:

> … is a barrier isolating about 50 miles of the Pend Oreille River and its tributaries from Lake Pend Oreille. These migratory bull trout sub-populations are believed dependent upon Lake Pend Oreille for sub-adult and adult rearing … Bull trout were abundant in the Pend Oreille River through 1957, and then abruptly their numbers decreased to the point that individual fish are now noteworthy. This abrupt decline correlates with the commencement of operation of Albeni Falls Dam in 1952. No other abrupt or widespread threat can be identified for this portion of the Pend Oreille River basin during the 1950s. In the absence of passage, migratory bull trout remaining in the Pend Oreille River will continue to be harmed.

14.3.2.1 Upper Pend Oreille Subbasin

Pratt and Huston (1993) documented life history traits of adfluvial bull trout in Lake Pend Oreille, its tributaries, and the lower Clark Fork River. Lower reaches of Lake Pend Oreille tributaries tend to be too warm to support bull trout and are resident of nonnative fish species (Pratt and Huston 1993). In contrast, the lower reaches of tributaries to the Clark Fork River (below Cabinet Gorge Dam) support bull trout concurrent with nonnative species (Pratt and Huston 1993). In addition, adfluvial bull trout that spawn in the Priest River drainage have been recently been documented over-wintering in Lake Pend Oreille and Pend Oreille River (Geist et al. 2004). This bull trout sub-population is further discussed under the Priest River Subbasin subheading.

Lake Pend Oreille bull trout utilize the lake and 40 percent of the lake tributaries (Pratt 1985, as cited in Pratt and Huston 1993). Populations of Lake Pend Oreille bull trout appear to be stable, however, this may change in the future due to the instability of bull trout populations from individual nursery streams (Pratt and Huston 1993). Despite the local population decline in some tributary spawning stocks, the Lake Pend Oreille bull trout are considered to be one of the strongest remaining populations in the U.S. with an estimated total adult population between 8,000 and 16,000 fish (Vidergar 2000). Lake Pend Oreille and its tributaries have historically provided a highly regarded sport fishery for bull trout, including trophy specimens. Estimated harvest peaked in the 1950s, as the last of the fish produced from adfluvial runs to Montana tributaries became available to anglers. Legal harvest of bull trout was discontinued beginning in 1996 due to the pending Endangered Species Act (ESA) listing and declining spawning runs in several tributaries. Kokanee were recently documented to be the principle food item of bull trout (n = 11) over 406 millimeters (mm), comprising 66 percent of the diet (Vidergar 2000).

Neraas and Spruell (2001, as cited in Spruell et al. 2003) have reported a substantial genetic divergence between bull trout populations in the lower Clark Fork River tributaries and Lake Pend Oreille tributaries. On a much smaller geographic scale, Spruell et al. (1999, as cited in Spruell et al. 2003) "found significant genetic divergence among bull trout populations from different tributaries within a single tributary to Lake Pend Oreille."

14.3.2.2 Lower Pend Oreille Subbasin

As a result of factors such as degraded habitat, loss of connectivity, construction of dams, and nonnative fish introductions, bull trout numbers are now depressed in the Pend Oreille River and its tributaries between Boundary and Albeni Falls dams (Geist et al. 2004; Andonaegui 2003). Reservoir temperatures often exceed 20 °C and may reach 25 °C in the summer (Geist et al. 2004) and total dissolved gas can exceed 110 percent at certain times of the year (Entz and Maroney 2001, Box Canyon Final License Application, page E2-64).

Between 1974 and 2002, 33 individual bull trout (both juvenile and adult) were observed in the Pend Oreille River and its tributaries between Boundary and Albeni Falls dams (Andonaegui 2003). Since the late 1980s, fish surveys have found ≤ 10 bull trout in the mainstem of the Pend Oreille River (Ashe and Scholz 1992; Ashe et al. 1991; Bennett and Liter 1991; Kalispel Tribe fish surveys). Many of the tributaries have not yet been surveyed for the presence or absence of bull trout (Andonaegui 2003). Between 1988 and 1990, five bull trout (four adults and one juvenile) of 52,812 fish were identified in the 55 mile long Box Canyon Reservoir (Ashe and Scholz 1992). Bennett and Liter (1991) found only two bull trout of 29,213 fish captured during a concurrent study (1989-1990) from randomly selected sites in the Box Canyon Reservoir. From 1988 to 2001, Kalispel Tribe has only captured eight bull trout during routine fish surveys conducted throughout the Box Canyon Reservoir. In 2001, Kalispel Tribe captured one bull trout near Indian Creek, a tributary to the lower Pend Oreille River, during a routine fish survey that had a clipped adipose and originated from Trestle Creek, a tributary to Lake Pend Oreille (Andonaegui 2003). In July 2003, 10 bull trout were captured within the Box Canyon Reservoir between Indian Creek and Albeni Falls Dam (Geist et al. 2004). Nine of the 10 bull trout captured were found in or near a culvert, 1.5 km downstream of the dam on the left bank. The culvert provided a thermal refugia during the summer months with water temperatures ranging between 11.8-13.8 °C compared to temperatures in the adjacent Pend Oreille River ranging from 18-22 °C (Geist et al. 2004). By August, water levels declined enough to prevent fish access to the thermal refugia (Geist et al. 2004). Geist et al. (2004) suggest these bull trout originated upstream above Albeni Falls Dam. Geist et al. (2004) contend fluvial or adfluvial bull trout that spawn in the tributaries of Pend Oreille River below Albeni Falls dam would have moved to cooler waters in their natal spawning areas rather than remain in the thermal refugia near the culvert just below the dam.

Currently, only small remnant bull trout populations are found in the LeClerc Creek complex and the South Fork of the Salmo River (USFWS, 2002). It is noteworthy that brook trout have not been documented within the boundaries of Washington state in the

South Fork of the Salmo River (Andonaegui 2003, USFWS 2002). Individual fish sighting have been documented in Indian Creek, Fourth of July Creek, Cedar Creek, Sullivan Creek, mouth of Slate Creek, mouth of Skookum Creek, Sweet Creek, Marshall Creek, Mill Creek, and in the Pend Oreille River upstream of the town of Newport (Andonaegui 2003; A. Scholz, Eastern Washington University, personal communication, 2003; S. Lembcke, WDFW, personal communication, 2003; USFWS 2002). It has not yet been determined if these individuals are solely resident, adfluvial or a combination of the two life history strategies.

In the Salmo River drainage (Canada), bull trout surveys were conducted by BC Hydro in 2003 (Baxter 2004). The streams surveyed were Clearwater Creek, Sheep Creek, the upper mainstem of the Salmo River, Stagleap Creek, and the upper South Salmo River. In late September and early October, Baxter (2004) counted a total of 105 bull trout redds and 38 bull trout spawners. Bull trout spawning activity was highest in Sheep Creek and the upper Salmo River/Clearwater Creek and most limited in the South Salmo watershed in 2003 (Baxter 2004). The limited use of the South Salmo watershed in 2003 may have been a reflection of the low water levels making accessibility to the upper reaches of the river more difficult (Baxter 2004). Overall, bull trout numbers appear to be increasing based on estimates of annual escapement (1998-2003) in the Salmo River, five years after the regulation change for no harvest was implemented in 1999 (Baxter 2004).

14.3.2.3 Priest River Subbasin

Bull trout populations appear to be severely depressed in the Priest River Subbasin (Fredericks et al. 2000, as cited in Andonaegui 2003). Bull trout have been documented and observed in the lakes (Upper Priest and Priest lakes) and some of their tributaries (Hughes Creek, Granite Creek), and Middle Fork East River, a tributary of the Priest River downstream of the Outlet Dam (PBTTAT 1998a). However, the extent and type of utilization by bull trout in these streams is not fully known.

In Upper Priest Lake and its tributaries, bull trout are nearly extirpated with the current population estimated at 116 adult fish (Venard 2001). Interspecies competition with and direct predation by lake trout are most likely the principal limiting factors. Refer back to the previous Section 14.1.2 under the subheading 14.1.2.5 Lake Trout for a more detailed discussion regarding the history of lake trout.

Fish surveys from 1982-1984 calculated an average density for bull trout in the west side Priest Lake drainage to be 3.4 fish/100m^2 in all habitat types (Andonaegui 2003). Bull trout harvest in Priest Lake and all tributaries was closed in 1984. Granite Creek, the main tributary to Priest Lake, still supports a few bull trout, but brook trout hybrids have also been observed in that drainage.

Currently bull trout can move between Upper Priest and Priest lakes via the Thorofare, small stream corridor between the lakes. During a study conducted in 1999 and 2000, 7 bull trout were observed in the Thorofare with total lengths ranging between 300 to 770 mm (Venard 2001). Although the number of individuals was few, this was a significant finding (~ 6 percent of the estimated population) considering the adult population of

Upper Priest Lake is estimated only to be slightly more than one hundred (IPNF 1998; Venard 2001).

Further downstream in the Middle Fork East River, the bull trout population is isolated from the upper portion of the Priest River drainage by the Outlet Dam at Priest Lake. The Middle Fork East River is the only tributary to the Priest River below the Outlet Dam known to support a bull trout population (DuPont and Horner, in press) (Figure 14.3). The spawning population is estimated to be less than 50 fish (Geist et al. 2004). The population uses about 10 km of the Middle Fork East River for spawning and rearing and no other bull trout population is known to be present within 50-stream km (Dupont and Horner, in press).

Juvenile bull trout are known to rear in about 8 km of stream in the Middle Fork East River drainage, with the majority of use occurring in about 3 km of stream (Figure 14.4) (Dupont and Horner, in press). Brook trout are in sympatry with bull trout in all of these stream reaches except for Uleda Creek (0.6 km reach) where the highest bull trout densities were found (Dupont and Horner, in press) (Figure 14.4). Prior to 2003, a man-made barrier about 0.6 km upstream from the mouth of Uleda Creek prevented bull trout upstream migration habitat that was considered high quality for bull trout spawning (Dupont and Horner, in press). In 2003, the barrier was removed (IDL in litt. 2003; S. Deeds, personal communication, 2004).

The bull trout population in Middle Fork East River displays a unique adfluvial life history (Geist et al. 2004; Dupont and Horner, in press). Sub-adult bull trout outmigrate from the East River downstream 34 km to the confluence of Priest River with Pend Oreille River, from the Pend Oreille River, the sub-adult bull trout swim upstream 37 km to Lake Pend Oreille (Figure 14.3) (Dupont and Horner, in press). Other bull trout populations are known to have an outlet spawning lifecycle similar to the Middle Fork East River bull trout (Thomas 1992; Herman 1997; Ringel and DeLaVergne 2000, as cited in DuPont and Horner, in press). However, none of these populations are believed to migrate more than 10 km downstream from the lake's outlet, and all spawn directly in the outlet stream or a short distance up a side tributary (Dupont and Horner, in press).

A radio telemetry study was attempted in spring of 2003 to monitor this downstream migration pattern and determine whether entrainment over Albeni Falls Dam is an issue (Geist et al. 2004). It has been suggested entrainment could occur if bull trout overshoot the outlet to Priest River when migrating downstream from Lake Pend Oreille or Pend Oreille. This study was unable to document or radio-tag sub-adult migration behavior in the Pend Oreille River. Questions still remain such as (taken from Geist et al. 2004):

1) When do bull trout move downstream?
2) What size does the migration occur?
3) Is bull trout migration timed so upstream movement in the Pend Oreille River is accomplished without being entrained?
4) Does entrainment occur?

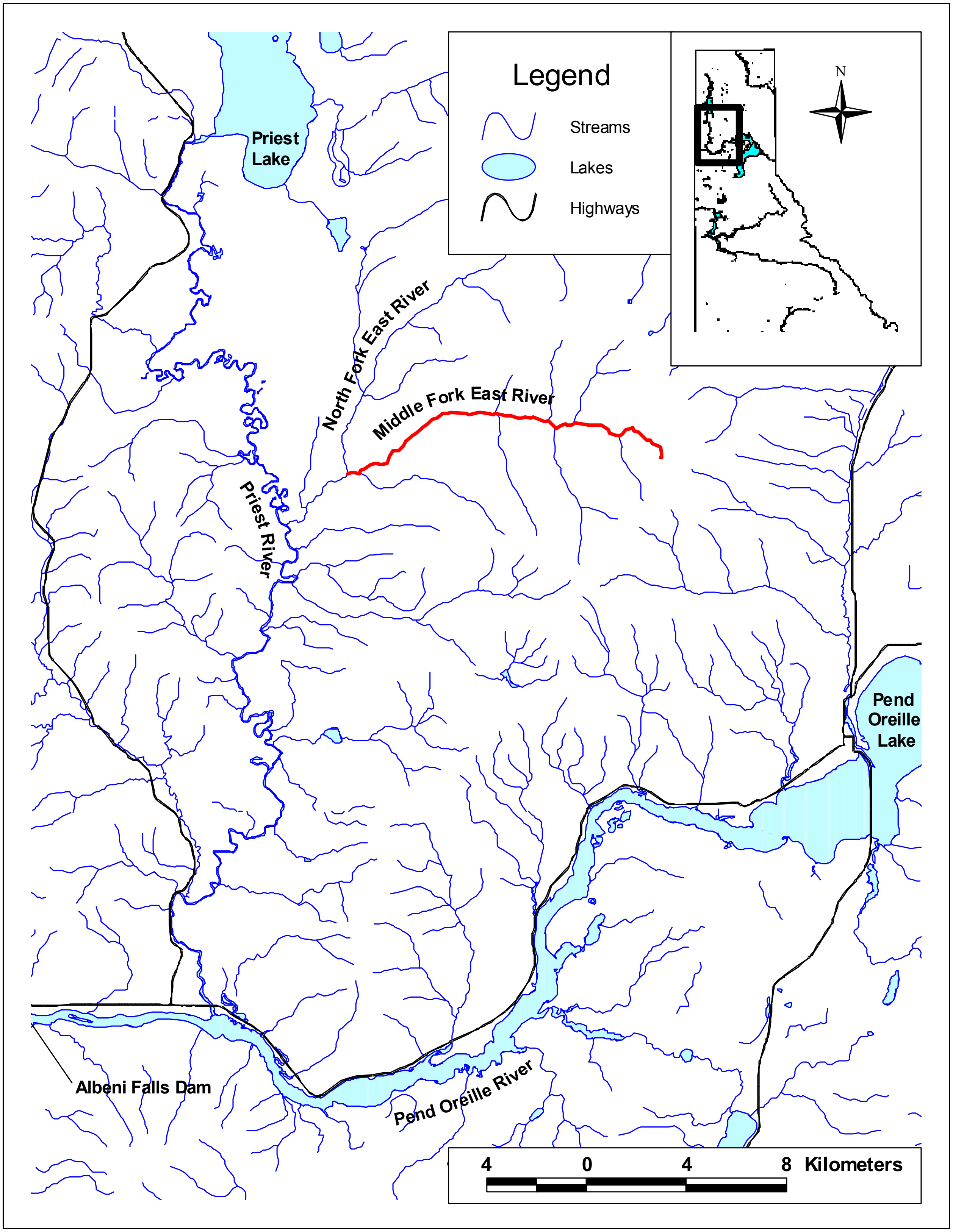


Figure 14.3. Location of Middle Fork East River, Idaho (*Source*: Dupont and Horner, in press)

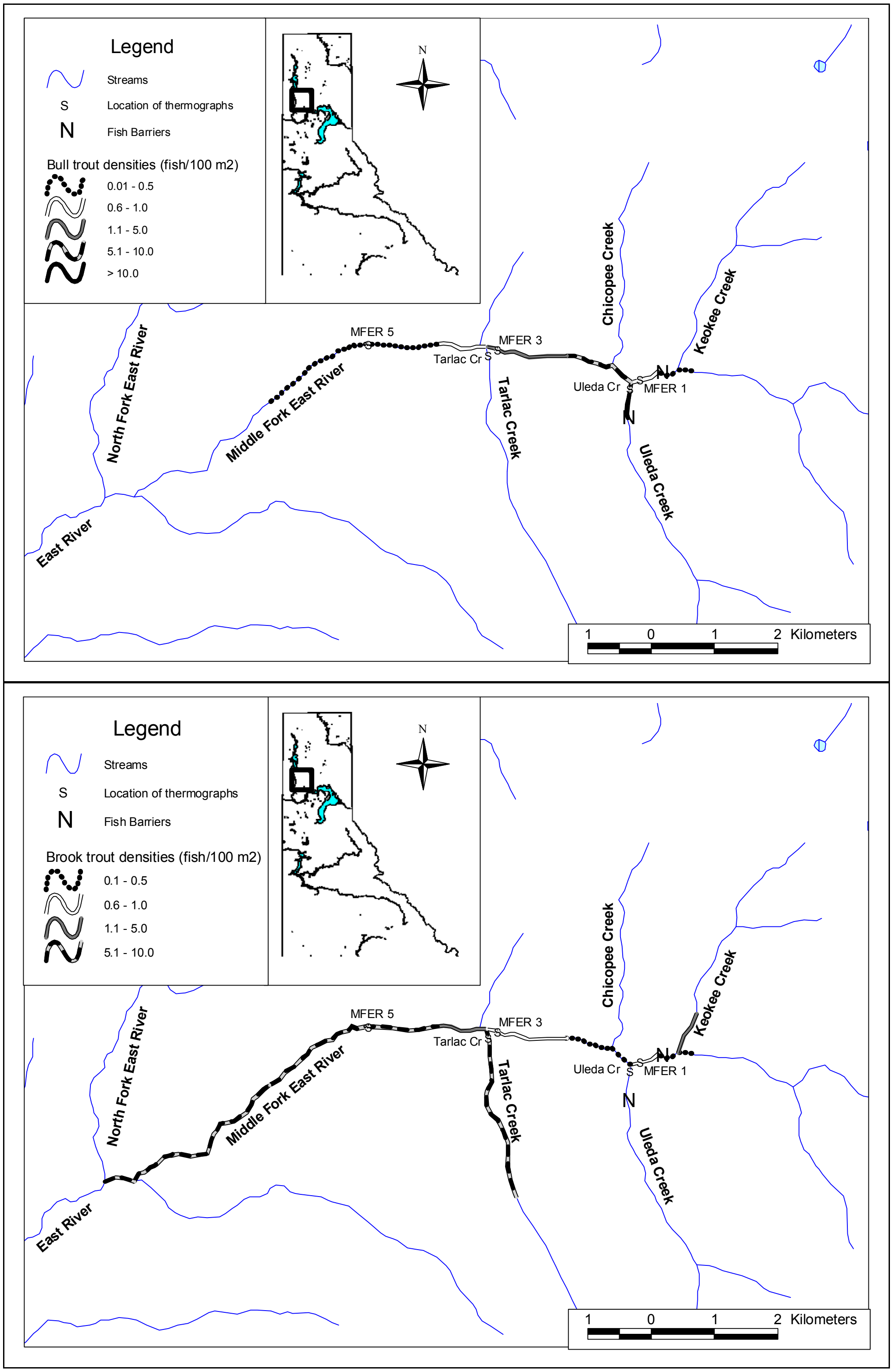


Figure 14.4. Estimated distribution and density of bull trout and brook trout in Middle Fork East River, Idaho based on sampling during 1986, 2001 and 2002. (*Source*: Dupont and Horner, in press)

14.3.2.4 Stocking
Information regarding past stocking and captive breeding of bull trout is available in the previous section on artificial production in the Upper Pend Oreille Subbasin Section 14.1.2. Currently, there are no stocking or captive breeding programs in the Pend Oreille Subbasin.

14.3.3 Limiting Factors Bull Trout
Based on Qualitative Habitat Assessment (QHA) results, the number of reaches and watersheds that currently contain bull trout has decreased by 57 percent from historic numbers. Historically there were 98 of 167 delineated reaches and watersheds within the Pend Oreille Subbasin that supported bull trout. Currently, that number has dropped by 56 reaches (Table 14.4) to only 42 reaches and watersheds supporting bull trout.

Table 14.4. List of 56 reaches where bull trout are not currently present, but were historically present. Reach rank refers to the degree of habitat change from reference to present conditions. (Reach Rank of 1 = greatest habitat alteration)

Reach Name	Reach Rank
Lower Calispell Creek	1
Lower Skookum Creek	6
Hoodoo Creek	7
Middle Branch LeClerc Creek	9
Rapid Lightning Creek	10
Davis/Kent Creeks	14
Lower Harvey Creek	15
Lower Tacoma Creek	15
Lower Cusick Creek	15
Brickel Creek	20
Lower Muddy Creeks	23
Indian Creek	23
South Fork Indian Creek	23
Lower Sand Creek	26
Middle West Branch LeClerc Creek	26
Lower Trimble Creek	26
North Fork East River	26
Maitlen Creek	30
Upper West Branch LeClerc Creek	31
McCloud Creek	33
Upper Cusick Creek	34
Pass Creek	35
Middle Creek	35
Middle Sullivan Creek	39
Soldier Creek	39
Upper East Branch LeClerc Creek	44
Kalispell Creek	46
Lower Lost Creek	48
South Skookum Creek	50
North Skookum Creek	50
Upper Tacoma Creek	52
Upper Ruby Creek	52
Renshaw Creek	54

Reach Name	Reach Rank
Lower Winchester Creek	55
Lower Cedar Creek	55
Upper Sullivan Creek	57
Upper Trimble Creek	57
Upper Lost Creek	57
Upper Big Muddy Creek	57
Caribou Creek	64
Upper Skookum Creek/Lakes	66
Lower Big Muddy Creek	66
Middle Harvey Creek	68
Sullivan Lake	73
North and Middle Fork Harvey Creek	74
Lower Ruby Creek	75
South Fork Tacoma Creek	78
Little Muddy Creek	78
South Fork Calispell Creek	82
Lower Small Creek	84
South Fork Lost Creek	87
Boulder Creek	87
East Fork Small Creek	92
Deemer/Leola Creek	93
Gypsy Creek	93
Jackson Creek	96

Table 14.5 ranks the reaches and watersheds according to those least representative of reference habitat conditions. Reach scores are also shown in the table to acknowledge the tight distribution of scores for areas regarded as having highly altered habitat. The most altered habitat traits for the top ranked areas include riparian condition, channel stability, habitat diversity, and fine sediments (Tables 14.5, also see Table 14.26).

Reaches with habitat characteristics most similar to reference conditions are shown in Table 14.6. The least impacted area in the Pend Oreille Subbasin is Salmo River (limited to area with the United States) in the lower Pend Oreille Subbasin. Portions of the Priest River Subbasin (Upper Priest Lake, Upper Priest River, Gold Creek, Granite Creek) also ranked high for the least amount of habitat alteration. Other areas that were ranked within the top 20 for protection include tributaries to the lower Clark Fork River below Cabinet Gorge Dam and tributaries to Lake Pend Oreille.

Table 14.5. Ranking of reaches with the largest deviation from the reference habitat conditions for bull trout in the Pend Oreille Subbasin. A reach rank equal to 1 has the greatest deviation from reference condition in comparison to other reaches. Reach scores range from 0 to 1, with 1 having the greatest deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute having the greatest deviation from reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes equally deviate the most from the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
7	Lower Calispell Creek	1	0.6	1	7	1	1	7	1	7	11	6	7	5
1	Main Pend Oreille River	2	0.5	1	1	4	1	9	5	10	10	5	8	5
166	Lightning Creek below Porcupine Creek	3	0.5	1	1	4	7	7	1	11	7	5	7	6
35	Lower Sullivan Creek	4	0.5	2	2	5	9	5	5	10	10	1	5	4
167	Clark Fork River (below Cabinet Gorge Dam)	5	0.5	4	6	2	9	8	4	10	10	7	1	3
54	Lower Skookum Creek	6	0.4	1	3	4	1	7	7	9	10	5	6	10
138	Middle Pack River	7	0.4	1	1	1	1	6	6	10	6	1	6	10
108	Hoodoo Creek	7	0.4	2	5	1	2	5	2	5	11	5	5	5
44	Middle Branch LeClerc Creek	9	0.4	2	4	2	1	8	8	10	10	5	5	7
154	Rapid Lightning Creek	10	0.4	1	1	1	8	1	1	11	9	1	1	10
111	Middle Fork East River	11	0.4	2	2	1	7	2	2	10	7	2	7	10
150	Grouse Creek	12	0.3	1	3	3	2	6	6	10	6	5	6	10
148	Lower Pack River	13	0.3	1	1	4	5	8	5	9	9	1	5	9
5	Davis/Kent Creeks	14	0.3	1	1	1	1	8	8	8	5	5	8	7
38	Lower Harvey Creek	15	0.3	2	2	1	4	6	6	8	8	8	8	4
74	Lower Tacoma Creek	15	0.3	2	2	2	1	6	6	6	6	5	6	6

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
76	Lower Cusick Creek	15	0.3	1	4	1	1	7	7	7	7	6	4	7
151	North Fork Grouse Creek	18	0.3	3	3	6	2	6	6	10	6	1	10	5
158	Granite Creek (LPO)	19	0.3	1	1	1	7	7	1	9	9	6	9	1
105	Brickel Creek	20	0.3	2	2	1	4	4	4	10	4	4	10	9
163	Twin Creek	21	0.3	1	2	2	2	5	5	9	8	5	9	9
165	Lightning Creek between Porcupine and Rattle Creek	22	0.3	1	1	1	9	6	1	9	6	6	9	5
83	Lower Muddy Creeks	23	0.3	3	5	1	1	7	7	7	7	3	5	7
120	Indian Creek	23	0.3	4	1	1	1	7	4	7	7	4	7	7
134	South Fork Indian Creek	23	0.3	4	1	1	1	7	4	7	7	4	7	7
36	Lower Sand Creek	26	0.3	2	4	2	1	4	4	9	9	4	9	8
42	Middle West Branch LeClerc Creek	26	0.3	1	3	3	1	6	3	10	10	6	9	8
71	Lower Trimble Creek	26	0.3	2	5	2	2	8	8	8	8	5	5	1
112	North Fork East River	26	0.3	2	4	1	2	4	4	10	4	4	10	9
10	Maitlen Creek	30	0.3	1	5	2	3	8	5	8	7	3	8	8
43	Upper West Branch LeClerc Creek	31	0.3	1	5	5	1	5	3	10	10	5	9	4
135	Upper Pack River	32	0.3	2	4	1	2	4	4	8	8	4	8	8
6	McCloud Creek	33	0.2	4	1	3	1	4	4	10	4	4	10	9
77	Upper Cusick Creek	34	0.2	1	1	1	1	8	8	8	8	5	5	7
45	Lower East Branch LeClerc Creek	35	0.2	1	2	2	2	6	6	9	9	2	8	9

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
32	Pass Creek	35	0.2	1	1	4	1	5	5	8	8	5	8	8
47	Middle Creek	35	0.2	2	2	5	1	4	5	8	8	7	8	8
161	(South) Gold Creek	38	0.2	3	3	3	2	3	3	9	9	9	1	8
31	Middle Sullivan Creek	39	0.2	1	4	1	1	4	4	8	8	4	8	8
139	Soldier Creek	39	0.2	9	3	2	1	3	3	10	3	3	3	10
160	North Gold Creek	41	0.2	1	4	1	1	4	4	9	9	8	4	11
153	South Fork Grouse Creek	42	0.2	3	3	1	3	3	3	9	3	2	9	9
3	Marshal Lake/Creek	42	0.2	2	2	1	2	2	2	10	2	2	10	2
126	Trapper Creek	44	0.2	1	1	4	4	9	4	9	4	4	9	3
46	Upper East Branch LeClerc Creek	44	0.2	2	3	3	1	3	3	10	10	3	8	9
162	Johnson Creek	46	0.2	4	1	1	1	5	5	9	7	7	9	11
119	Kalispell Creek	46	0.2	1	3	1	8	8	4	8	8	4	4	7
156	Strong Creek	48	0.2	3	4	4	4	8	1	8	8	7	8	1
81	Lower Lost Creek	48	0.2	2	4	4	1	6	6	6	6	2	6	6
52	South Skookum Creek	50	0.2	2	3	3	1	7	7	10	10	3	3	9
53	North Skookum Creek	50	0.2	2	3	3	1	7	7	10	10	3	3	9
75	Upper Tacoma Creek	52	0.2	2	4	2	1	7	7	7	7	4	7	6
79	Upper Ruby Creek	52	0.2	2	4	2	1	6	6	6	6	6	6	5
21	Renshaw Creek	54	0.2	1	3	3	2	3	3	8	8	3	8	8
64	Lower Winchester Creek	55	0.2	1	5	1	1	6	6	6	6	6	6	4

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
87	Lower Cedar Creek	55	0.2	1	4	1	1	7	7	7	7	4	7	6
131	Lion/Lucky Creek	57	0.2	1	4	2	2	7	4	7	7	4	7	7
50	Lower CCA Creek	57	0.2	2	7	3	1	3	3	8	8	3	8	8
29	Upper Sullivan Creek	57	0.2	2	4	1	2	4	4	7	7	7	7	7
72	Upper Trimble Creek	57	0.2	1	4	1	1	6	6	6	6	6	4	6
82	Upper Lost Creek	57	0.2	1	4	1	1	6	6	6	6	4	6	6
85	Upper Big Muddy Creek	57	0.2	1	4	1	1	6	6	6	6	4	6	6
56	Lower Indian Creek	63	0.2	3	4	1	1	6	6	6	6	4	6	6
155	Trestle Creek	64	0.2	1	1	1	1	9	1	9	9	8	1	7
127	Caribou Creek	64	0.2	2	8	1	2	8	2	8	2	2	8	7
55	Upper Skookum Creek/Lakes	66	0.2	2	4	2	1	6	6	6	6	4	6	6
84	Lower Big Muddy Creek	66	0.2	3	3	1	1	6	6	6	6	3	6	6
41	Lower West Brach LeClerc Creek	68	0.1	1	3	3	2	7	7	7	7	5	5	7
132	Two Mouth Creek	68	0.1	1	1	3	6	7	3	7	7	3	7	7
48	Lower Mill Creek	68	0.1	1	1	1	1	1	1	8	8	7	8	8
19	Sweet/Lunch Creek	68	0.1	1	3	3	1	5	5	8	8	5	8	8
39	Middle Harvey Creek	68	0.1	1	2	2	2	2	2	7	7	7	7	7
18	Sullivan Lake	73	0.1	6	2	2	2	1	6	8	8	8	8	5
40	North and Middle Fork Harvey Creek	74	0.1	1	1	1	1	1	1	7	7	7	7	7
78	Lower Ruby Creek	75	0.1	2	2	2	1	6	6	6	6	6	6	5

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
121	South Fork Granite and Sema Creek	76	0.1	1	1	6	1	7	1	7	7	1	7	7
88	Upper Cedar Creek	77	0.1	4	5	2	2	5	5	5	5	5	5	1
65	Upper Winchester Creek	78	0.1	2	2	2	1	5	5	5	5	5	5	5
164	Lightning Creek above Rattle Creek	78	0.1	1	1	1	7	1	7	7	5	5	7	7
73	South Fork Tacoma Creek	78	0.1	2	2	2	1	5	5	5	5	5	5	5
86	Little Muddy Creek	78	0.1	2	2	2	1	5	5	5	5	5	5	5
122	North Fork Granite Creek	82	0.1	1	1	4	4	7	1	7	7	4	7	7
58	South Fork Calispell Creek	82	0.1	2	2	1	2	5	5	5	5	5	5	5
67	Lower Small Creek	84	0.1	1	4	1	1	5	5	5	5	5	5	11
123	Gold Creek	85	0.1	5	4	1	5	5	2	5	5	2	5	5
57	Upper Indian Creek	85	0.1	1	1	1	1	5	5	5	5	5	5	5
27	Slate Creek	87	0.1	2	2	2	1	2	2	7	7	7	7	7
80	South Fork Lost Creek	87	0.1	4	1	1	1	5	5	5	5	5	5	5
128	Boulder Creek	87	0.1	6	3	3	3	1	1	6	6	6	6	6
91	Big/Blue Creeks	90	0.1	4	4	8	4	7	1	9	9	1	9	1
113	Binarch Creek	90	0.1	4	4	8	4	7	1	9	9	1	9	1
69	East Fork Small Creek	92	0.1	4	5	1	1	5	5	5	5	5	5	3
28	Deemer/Leola Creek	93	0.1	1	1	1	1	1	1	7	7	7	7	7
30	Gypsy Creek	93	0.1	1	1	1	1	1	1	7	7	7	7	7
125	Upper Priest River	95	0.0	1	1	1	5	5	1	5	5	5	5	5

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
129	Upper Priest Lake	96	0.0	4	1	1	4	4	1	4	4	4	4	4
124	Jackson Creek	96	0.0	4	1	1	4	4	1	4	4	4	4	4
14	Salmo River	98	0.0	1	1	1	1	1	1	1	1	1	1	1

Table 14.6. Ranking of streams whose habitat is most similar to the reference condition for bull trout in the Pend Oreille Subbasin in comparison to other reaches. A reach rank equal to 1 reveals the reach with current conditions most similar to reference conditions in comparison to other reaches. Reach score ranges from 0 to -1, with -1 having the least deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute being most similar to the reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes are equally the most similar to the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
14	Salmo River	**1**	-0.97	1	1	1	1	1	1	1	1	1	1	11
129	Upper Priest Lake	**2**	-0.94	1	8	8	1	1	8	1	1	1	1	11
125	Upper Priest River	**3**	-0.92	7	7	7	1	1	7	1	1	1	1	11
123	Gold Creek	**4**	-0.88	1	7	11	1	1	8	1	1	8	1	10
122	North Fork Granite Creek	**5**	-0.87	8	8	5	5	1	8	1	1	5	1	11
65	Upper Winchester Creek	**6**	-0.86	7	7	7	11	1	1	1	1	1	1	10
88	Upper Cedar Creek	**7**	-0.85	8	1	9	9	1	1	1	1	1	1	11
27	Slate Creek	**8**	-0.84	5	5	5	10	5	5	1	1	1	1	11
121	South Fork Granite and Sema Creek	**8**	-0.84	6	6	5	6	1	6	1	1	6	1	11
164	Lightning Creek above Rattle Creek	**10**	-0.84	7	7	7	1	7	1	1	5	5	1	11
41	Lower West Brach LeClerc Creek	**11**	-0.82	11	7	7	10	1	1	1	1	5	5	9
155	Trestle Creek	**12**	-0.81	5	5	5	5	1	5	1	1	4	5	11
132	Two Mouth Creek	**13**	-0.79	9	9	6	5	1	6	1	1	6	1	11

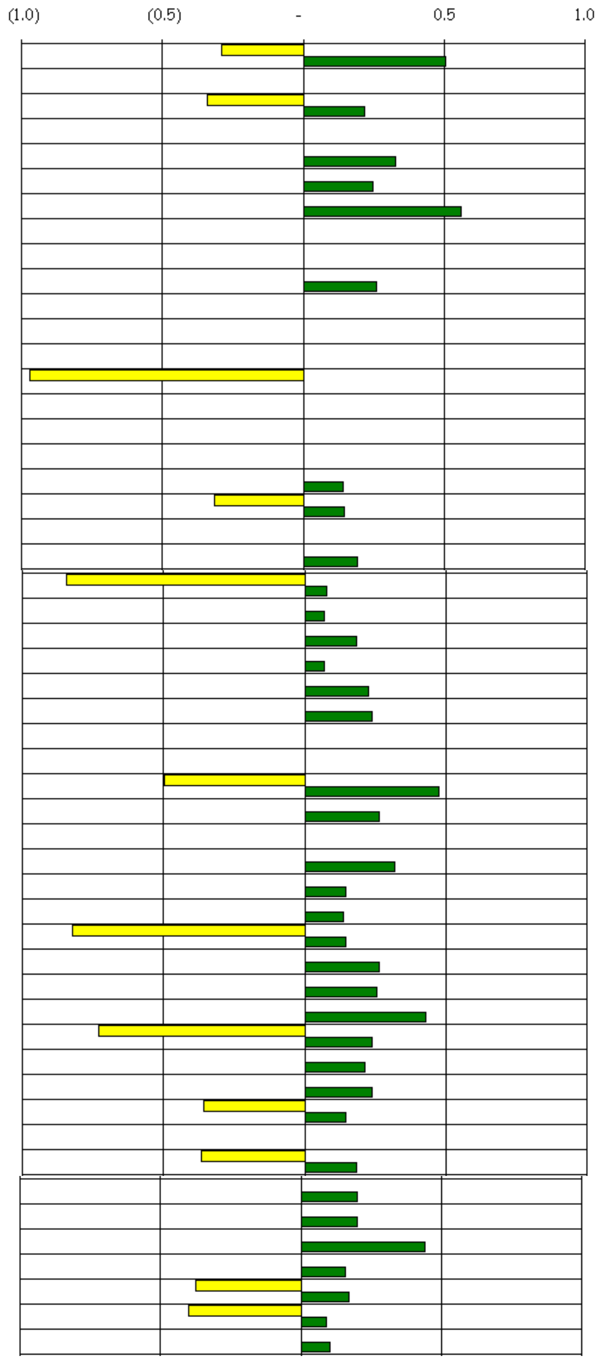
Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
156	Strong Creek	**14**	-0.77	9	6	6	6	1	10	1	1	5	1	11
126	Trapper Creek	**15**	-0.76	9	9	4	4	1	4	1	4	4	1	11
131	Lion/Lucky Creek	**15**	-0.76	10	5	8	8	1	5	1	1	5	1	11
153	South Fork Grouse Creek	**17**	-0.75	3	3	11	3	3	3	1	3	10	1	9
45	Lower East Branch LeClerc Creek	**18**	-0.73	11	7	7	7	4	4	1	1	7	3	6
160	North Gold Creek	**18**	-0.73	9	4	9	9	4	4	1	1	3	4	8
162	Johnson Creek	**18**	-0.73	8	9	9	9	5	5	1	3	3	1	7
161	(South) Gold Creek	**21**	-0.73	4	4	4	9	4	4	1	1	1	11	9
165	Lightning Creek between Porcupine and Rattle Creek	**22**	-0.69	7	7	7	1	4	7	1	4	4	1	11
163	Twin Creek	**23**	-0.69	11	8	8	8	4	4	1	3	4	1	7
135	Upper Pack River	**24**	-0.67	8	4	10	8	4	4	1	1	4	1	11
158	Granite Creek (LPO)	**25**	-0.66	7	7	7	4	4	7	1	1	6	1	11
150	Grouse Creek	**26**	-0.62	10	8	8	10	2	2	1	2	7	2	6
111	Middle Fork East River	**27**	-0.61	6	6	11	2	6	6	1	2	6	2	5
151	North Fork Grouse Creek	**28**	-0.55	5	5	3	7	7	3	1	11	10	1	9
35	Lower Sullivan Creek	**29**	-0.50	8	8	4	3	4	4	1	1	10	4	11
166	Lightning Creek below Porcupine Creek	**30**	-0.47	9	9	8	2	2	9	1	2	6	2	7

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
148	Lower Pack River	**31**	-0.46	7	7	5	7	6	2	1	11	7	2	4
167	Clark Fork River (below Cabinet Gorge Dam)	**32**	-0.44	6	4	9	2	6	6	1	3	4	10	11
138	Middle Pack River	**33**	-0.44	6	6	6	6	5	2	1	11	6	2	4
57	Upper Indian Creek	**34**	-0.40	8	6	8	8	7	1	1	11	1	1	1
56	Lower Indian Creek	**35**	-0.37	8	5	9	9	7	1	1	11	5	1	1
50	Lower CCA Creek	**36**	-0.37	9	4	7	10	7	5	1	11	5	1	1
48	Lower Mill Creek	**37**	-0.36	7	4	7	7	7	4	1	11	3	1	4
91	Big/Blue Creeks	**38**	-0.35	9	3	7	9	8	4	1	11	4	1	4
113	Binarch Creek	**38**	-0.35	9	3	7	9	8	4	1	11	4	1	4
3	Marshal Lake/Creek	**40**	-0.34	7	3	10	7	7	3	1	11	3	1	6
19	Sweet/Lunch Creek	**41**	-0.32	8	5	7	8	6	3	1	10	3	1	10
1	Main Pend Oreille River	**42**	-0.29	7	7	5	7	4	3	1	7	5	2	7

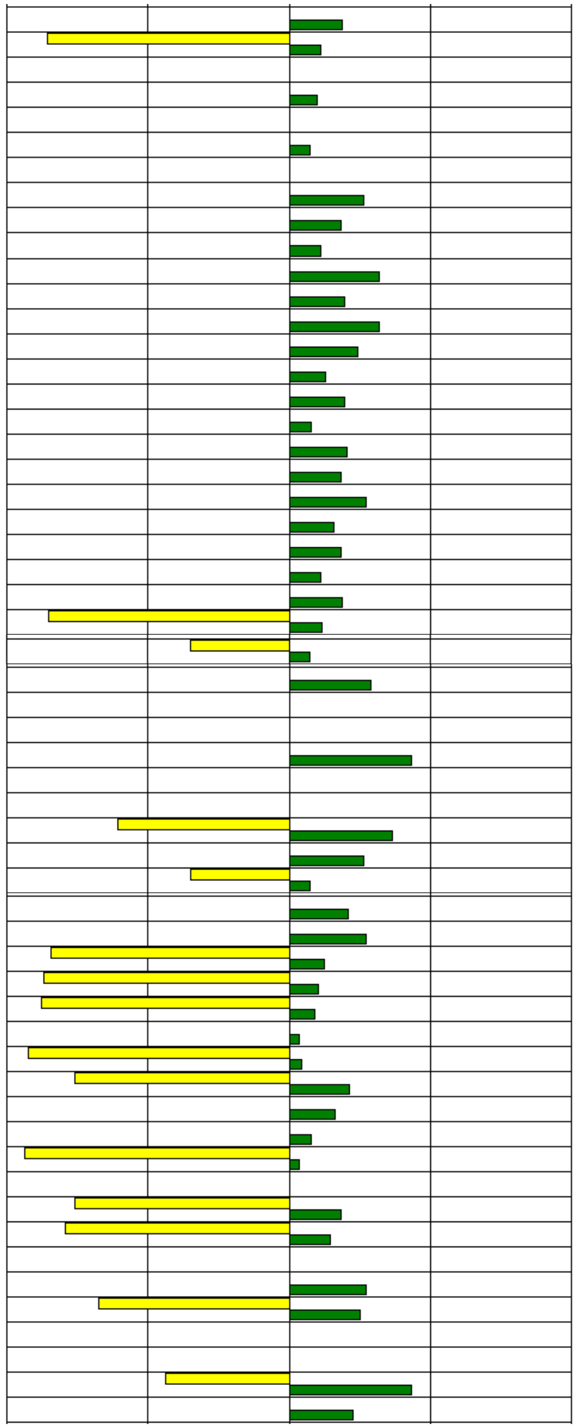
Table 14.7. Tornado diagram for bull trout in the Pend Oreille Subbasin. Degree of confidence for protection and current habitat conditions range from 0.0 to 1.0 with the greatest confidence equal to 1.0. Protection reach scores are presented on the left side and current habitat reach scores are presented on the right. Negative scores are in parentheses.

NP = Not present

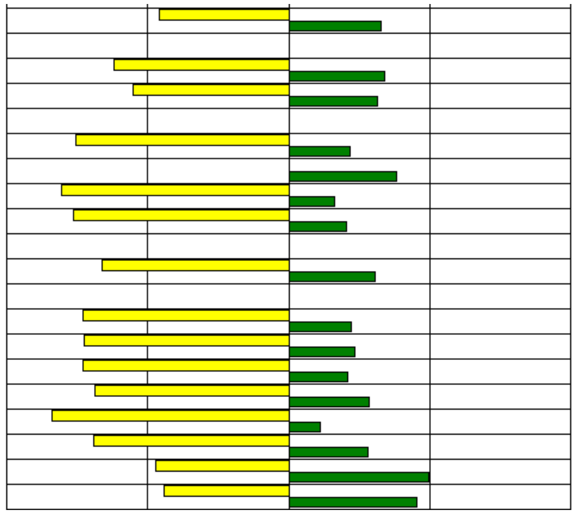
Sequence	Reach Name	Protection Confidence	Current Habitat Condition Confidence
1	Main Pend Oreille River	0.50	0.38
2	Bead Lake	NP	
3	Marshal Lake/Creek	0.42	0.21
4	Shearer Lake	NP	
5	Davis/Kent Creeks	0.42	0.21
6	McCloud Creek	0.50	0.25
7	Lower Calispell Creek	0.33	0.17
8	Kalispel Reservation	NP	
9	Dry Canyon	NP	
10	Maitlen Creek	0.30	0.15
11	Three Mile Creek	NP	
12	Lime Creek	NP	
13	Peewee/Russian Creek	NP	
14	Salmo River	0.50	0.25
15	Ledbetter Lake	NP	
16	Flume Creek	NP	
17	Pocahontas Creek	NP	
18	Sullivan Lake	0.50	0.25
19	Sweet/Lunch Creek	0.50	0.25
20	Power Plant	NP	
21	Renshaw Creek	0.50	0.25
27	Slate Creek	0.50	0.25
28	Deemer/Leola Creek	0.50	0.25
29	Upper Sullivan Creek	0.50	0.25
30	Gypsy Creek	0.50	0.25
31	Middle Sullivan Creek	0.50	0.25
32	Pass Creek	0.50	0.25
33	Mill Pond	NP	
34	North Fork Sullivan Creek	NP	
35	Lower Sullivan Creek	0.50	0.25
36	Lower Sand Creek	0.50	0.25
37	Upper Sand Creek	NP	
38	Lower Harvey Creek	0.50	0.25
39	Middle Harvey Creek	0.50	0.25
40	North and Middle Fork Harvey Creek	0.50	0.25
41	Lower West Brach LeClerc Creek	0.50	0.25
42	Middle West Branch LeClerc Creek	0.50	0.25
43	Upper West Branch LeClerc Creek	0.50	0.25
44	Middle Branch LeClerc Creek	0.50	0.25
45	Lower East Branch LeClerc Creek	0.50	0.25
46	Upper East Branch Leclerc Creek	0.50	0.25
47	Middle Creek	0.50	0.25
48	Lower Mill Creek	0.50	0.25
49	Upper Mill Creek	NP	
50	Lower CCA Creek	0.50	0.25
52	South Skookum Creek	0.50	0.25
53	North Skookum Creek	0.50	0.25
54	Lower Skookum Creek	0.50	0.25
55	Upper Skookum Creek/Lakes	0.33	0.17
56	Lower Indian Creek	0.33	0.17
57	Upper Indian Creek	0.50	0.25
58	South Fork Calispel Creek	0.50	0.25



64	Lower Winchester Creek	0.33	0.17
65	Upper Winchester Creek	0.50	0.25
66	Dorchester Creek	NP	
67	Lower Small Creek	0.33	0.17
68	Upper Small Creek	NP	
69	East Fork Small Creek	0.50	0.25
70	Cusick	NP	
71	Lower Trimble Creek	0.33	0.17
72	Upper Trimble Creek	0.33	0.17
73	South Fork Tacoma Creek	0.50	0.25
74	Lower Tacoma Creek	0.33	0.17
75	Upper Tacoma Creek	0.50	0.25
76	Lower Cusick Creek	0.33	0.17
77	Upper Cusick Creek	0.50	0.25
78	Lower Ruby Creek	0.50	0.25
79	Upper Ruby Creek	0.50	0.25
80	South Fork Lost Creek	0.50	0.25
81	Lower Lost Creek	0.50	0.25
82	Upper Lost Creek	0.50	0.25
83	Lower Muddy Creeks	0.33	0.17
84	Lower Big Muddy Creek	0.50	0.25
85	Upper Big Muddy Creek	0.50	0.25
86	Little Muddy Creek	0.50	0.25
87	Lower Cedar Creek	0.33	0.17
88	Upper Cedar Creek	0.50	0.25
91	Big/Blue Creeks	0.17	0.21
105	Brickel Creek	0.50	0.38
106	Blanchard Lake	NP	
107	Elmer Creek	NP	
108	Hoodoo Creek	0.50	0.38
109	Kelso	NP	
110	Pend Oreille River above Albeni Falls Dam	NP	
111	Middle Fork East River	0.50	0.38
112	North Fork East River	0.50	0.38
113	Binarch Creek	0.50	0.38
119	Kalispell Creek	0.50	0.38
120	Indian Creek	0.50	0.38
121	South Fork Granite and Sema Creek	0.50	0.38
122	North Fork Granite Creek	0.50	0.38
123	Gold Creek	0.50	0.38
124	Jackson Creek	0.17	0.21
125	Upper Priest River	0.50	0.38
126	Trapper Creek	0.50	0.38
127	Caribou Creek	0.50	0.38
128	Boulder Creek	0.17	0.21
129	Upper Priest Lake	0.17	0.21
130	Beaver Creek	NP	
131	Lion/Lucky Creek	0.50	0.38
132	Two Mouth Creek	0.50	0.38
133	Bear Creek	NP	
134	South Fork Indian Creek	0.17	0.21
135	Upper Pack River	0.33	0.29
136	Hunt Creek	NP	
137	Horton Creek	NP	
138	Middle Pack River	0.50	0.38
139	Soldier Creek	0.50	0.38



148	Lower Pack River	0.50	0.38
149	Sand Creek	NP	
150	Grouse Creek	0.50	0.38
151	North Fork Grouse Creek	0.50	0.38
152	Gold Creek (Pack River)	NP	
153	South Fork Grouse Creek	0.50	0.38
154	Rapid Lightning Creek	0.50	0.38
155	Trestle Creek	0.50	0.38
156	Strong Creek	0.50	0.38
157	Trout Creek	NP	
158	Granite Creek (LPO)	0.42	0.33
159	Cedar Creek	NP	
160	North Gold Creek	0.42	0.33
161	(South) Gold Creek	0.50	0.38
162	Johnson Creek	0.50	0.38
163	Twin Creek	0.33	0.29
164	Lightning Creek above Rattle Creek	0.50	0.38
165	ing Creek between Porcupine and Rattle Creek	0.50	0.38
166	Lightning Creek below Porcupine Creek	0.50	0.38
167	Clark Fork River (below Cabinet Gorge Dam)	0.50	0.42



The tornado diagram (Table 14.7) and maps (Map PO-1, Map PO-2, located at the end of Section 14) present the reach scores for both current habitat condition (ranging from zero to positive one, Map PO-1) and protection (ranging from zero to negative one, Map PO-2). Scores closest to negative one depict reaches that are most representative of reference habitat conditions. Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

The QHA model can only assess the quality of habitat within the subbasin. The model does not recognize biological significance or such factors such as abundance, stability, or sustainability of bull trout populations.

Local biologists agree that the QHA model does identify areas that are highly degraded, however, they do not feel decisions for restoration should only look at the areas with the greatest degree of habitat alteration. For example, the mainstem of the Pend Oreille River was ranked second for habitat modifications (Table 14.5), but the feasibility of restoring that section of river for bull trout habitat is limited and unrealistic. Lower Calispell Creek is another highly impacted area where restoration efforts may be disproportionate to the biological benefits for bull trout populations.

Instead biologists feel areas such as Lightening Creek below Porcupine Creek, that currently have a reasonable population of bull trout and somewhat intact habitat, would benefit most biologically from restoration efforts. Additionally, local biologists agree Lower Sullivan Creek, lower Clark Fork River, and Middle Branch LeClerc Creek would greatly benefit from restoration efforts. Restoration efforts have already commenced on much of LeClerc Creek, however, nonnative species rather than habitat has become the main limiting factor in the Middle Branch LeClerc Creek. Although nonnative species are a significant impediment to bull trout recovery, habitat issues are equally important to address. Both of these limiting factors are critical and deserve equal attention and concurrent management.

Another important point is that protection should be extended to reaches that have relatively large numbers of bull trout and/or intact habitat, such as Trestle Creek (ranked 12th), regardless of the QHA ranking order. This approach should also be considered for other tributaries.

Current activities related to protection and restoration of creeks include a watershed assessment for restoration of Lightening Creek (funded by Avista), and a multi-agency effort to assess Middle Pack River drainage and develop a bull trout restoration plan. In Washington state, streams that are listed in the Bull Trout Recovery Plan Draft have been identified as priority for restoration. The Draft Bull Trout Recovery Plan (USFWS 2003) has identified local populations in the Northeast Washington Recovery Unit under a recovered condition as: Slate Creek, Indian Creek, Sullivan Creek (including Sullivan Lake and tributaries), Mill Creek, Cedar Creek (Pend Oreille County), Tacoma Creek, Ruby Creek, Calispell Creek, and the LeClerc Creek complex (including Fourth of July Creek, East Branch LeClerc Creek, and West Branch LeClerc Creek).

Biologists agree that the best chance for bull trout recovery is in restoring habitats that have cold waters and some intact habitats. The consensus is that restoration and protection of tributary habitats that provide critical spawning habitat is key for bull trout recovery.

14.3.4 Current Management

The USFWS is the primary federal agency responsible for endangered species listed under the ESA. The USFWS has drafted a recovery plan and proposed critical habitat for the Northeast Washington Recovery Unit (Chapter 23) that encompasses the lower Pend Oreille River and tributaries and the Clark Fork Recovery Unit (Chapter 3) that encompasses the upper Pend Oreille River (above Albeni Falls Dam), Lake Pend Oreille, Priest Lake and tributaries (USFWS 2002, 2002a). The recovery plan recommends strategies "to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed through the species' native range so that the species can be delisted" (USFWS 2002a).

Within Washington state, WDFW has developed a statewide bull trout management plan (WDFW 2000) with the overall goal to restore and/or maintain the health and diversity of bull trout stocks and their habitats to and/or at self-sustaining levels that would allow recreational utilization within resource protection guidelines. The intent of the goal is to address stock health beyond numerical abundance by ensuring the long-term productive capacity of self-sustaining bull trout stocks and their habitats. The highest priority for management of native char will be resource protection. The specific objectives and strategies in this plan are grouped into several elements including population maintenance, fisheries management, and habitat maintenance. In addition, it describes the enforcement, monitoring, evaluation, and research efforts needed to meet the bull trout management goal and objectives.

Local citizens and agency representatives developed the *Idaho Bull Trout Conservation Plan* (Lake Pend Oreille Bull Trout Watershed Advisory Group 1999). The plan calls for restoring bull trout such that healthy local populations are well distributed around the Lake Pend Oreille Subbasin and that a harvestable surplus of fish will be available. Bull trout restoration is also a primary emphasis of the Lower Clark Fork Settlement Agreement (Settlement Agreement) forged by Avista and local, state, and federal entities as part of the re-licensing of Cabinet Gorge and Noxon Rapids dams. The Settlement Agreement includes provisions for restoring fish passage past Cabinet Gorge and Noxon Rapids dams to attempt to reconnect bull trout in Lake Pend Oreille with the Clark Fork River. This project includes trapping and radio tagging adult bull trout to assess their movements in the Clark Fork River below Cabinet Gorge Dam to identify the best potential locations for a permanent trap site or fish ladder entrance.

The Pend Oreille Lead Entity was created in 2000 under Washington's Salmon Recovery Act (RCW 77.85) to develop a strategy for restoration of native salmonid habitat within the lower Pend Oreille River and its tributaries and those tributaries, which drain into Priest River and Priest Lake, Idaho from Washington. In cooperation with local Technical and Citizens Advisory Groups, the Lead Entity submits protection, restoration, and assessment projects to the Salmon Recovery Funding Board annually for funding.

The Kalispel Tribe has a Fish and Wildlife Management Plan, which outlines the mission, goals, and objectives for sound resource management on and in the lands of the Kalispel Tribe. The goal for bull trout is to: protect, enhance, and restore native fish populations to maintain stable, viable levels, to ensure long-term, self-sustaining persistence, and to provide ecological, cultural, subsistence, and sociological benefits.

14.4 Focal Species – Westslope Cutthroat Trout

Westslope cutthroat trout were selected as a focal species because they are a native species that is threatened by exotic species and habitat degradation and its potential value in recreational fishing in the Pend Oreille Subbasin.

14.4.1 Historic Status

Shepard et al. (2003) estimate that 200 years ago westslope cutthroat trout occupied 56,600 miles of habitat within the five states of Washington (3,000 miles), Oregon (>1,000 miles), Idaho (19,000 miles), Montana (33,000 miles), and Wyoming (<100 miles). The Columbia River basin contained approximately 48 percent of this historical range that supported westslope cutthroat trout (Shepard et al. 2003). Historic range of westslope cutthroat in the Pend Oreille River, excluding Lake Pend Oreille, included 1,271 miles of stream habitat (Shepard et al. 2003).

There has been some debate as to the origin of westslope cutthroat trout populations documented in tributaries to the lower Pend Oreille River (McLellan and O'Connor 2000). Behnke (1992) concluded that the historic distribution of westslope cutthroat trout in the Clark Fork/Pend Oreille drainage extended downstream only as far as Albeni Falls Dam. Williams (1998) believed that the historic distribution actually extended as far downstream as Metaline Falls, suggesting that the westslope cutthroat trout populations in the tributaries of the lower Pend Oreille River above Metaline Falls were native. Gilbert and Evermann (1895) described a species that clearly resembles westslope cutthroat trout in Lake Pend Oreille at Sandpoint and the Pend Oreille River at various places between Newport and the mouth of the Salmon [Salmo] River.

Historically, westslope cutthroat trout comprised an important part of the sport fishery up until the 1960s. As a result of population declines, hatchery production was used through the 1990s to supplement wild stocks and provide a limited harvest fishery. Hybridization with rainbow trout, competition with kokanee for zooplankton, predation by brook trout and lake trout, loss of connectivity between populations due to hydropower dam construction, and loss of habitat from logging, dam and road construction have contributed to declines of westslope cutthroat trout (Fickeisen and Geist 1993).

14.4.2 Current Status

Currently within the Columbia River basin, westslope cutthroat trout are present in approximately 33,500 miles of the historic range (59 percent) with over 70 percent of the current habitats within federally managed lands (Shepard et al. 2003). Westslope cutthroat trout remain present in 18,000 miles (95 percent) and 2,000 miles (66 percent) of their historic habitats within Idaho and Washington, respectively (Shepard et al. 2003). In the Lower Pend Oreille Subbasin, 258 miles of tributaries have been identified as conservation habitat containing 13 populations of westslope cutthroat (Shepard et al. 2003).

Genetic assessment has been conducted on 6,100 miles of habitat (18 percent of occupied habitats) and results indicate that genetically unaltered westslope cutthroat trout occupy between 13-35 percent of currently available habitat (8-20 percent historical habitat) (Shepard et al. 2003). In 1999, WDFW collected genetic information for westslope cutthroat trout in eight Pend Oreille tributaries into Boundary Reservoir. The tributaries included Cedar, East and West Branches of LeClerc, Middle, upper and lower Mill, north Fork Sullivan, upper and lower Sullivan, and Slate creeks. The results indicated that genetically distinct populations of westslope cutthroat trout occurred in these Pend Oreille tributaries. The results also failed to detect introgression by any of the hatchery strains (Kings Lake, Twin Lake, and Yellowstone) of cutthroat trout examined (with the exception in Slate Creek), which supports the conclusion by Williams (1998) that the populations were native (McLellan and O’Connor 2000). Little genetic testing has been conducted in other areas of the Pend Oreille Subbasin (for example, Priest River drainage and Lake Pend Oreille) to describe the degree of introgression.

The limited wild population of westslope cutthroat trout in Lake Pend Oreille was supplemented with hatchery stocking primarily during the 1990s. The presence of IPN, infectious pancreatic necrosis, and a viral disease affecting young westslope cutthroat trout at the Clark Fork Hatchery caused the IDFG to terminate the cutthroat trout stocking program in Lake Pend Oreille.

Nonnative Yellowstone cutthroat trout fry and fingerlings were stocked in Upper Priest Lake and Priest Lake during the 1950s and 1960s. Catchable rainbow trout were also stocked into Granite Creek to provide a stream fishery. There is no evidence this stocking provided any benefit to the lake fishery. Ongoing genetic analysis of westslope cutthroat trout from Upper Priest Lake has not shown hybridization with either Yellowstone cutthroat or rainbow trout (N. Horner, Regional Fisheries Manager, IDFG, personal communication). For more information on stocking history refer to Section 14.1.2 on artificial production.

Westslope cutthroat trout are still widely distributed throughout the Pend Oreille Subbasin. In the Lower Pend Oreille Subbasin, cutthroat trout are primarily the resident form residing in the tributaries. Some of the fish exhibit their migratory form as they are found in the reservoir and have been observed in adfluvial traps. Nonnative fish are a clear threat to the continued existence of westslope cutthroat trout. Competition with introduced salmonids is often listed as a major reason for the decline of cutthroat populations (Linkes and Graham 1988). Brook trout are present in most tributaries to the lower Pend Oreille River.

Westslope cutthroat trout populations in the Priest and Upper Priest lakes have declined since the 1950s. Historically, fishing for westslope cutthroat trout was the primary attraction at Priest and Upper Priest lakes. By the time the first creel census was conducted in 1956, however, annual harvest of westslope cutthroat trout in Priest Lake had already declined to 3,500 fish with catch rates of 0.5 fish per hour (Bjornn 1957). Westslope cutthroat trout harvest ranged from 1,300 to 2,700 fish during the 1960s and 1970s, but dropped abruptly after 1978 (Table 14.8, Davis et al. 2000). Various restrictive regulations, including reduced limits, minimum size limits, and tributary fisheries closures were applied in both the lake and tributary streams to address harvest issues.

Westslope cutthroat trout harvest has been closed in Upper Priest Lake and Priest Lake since 1992. Upper Priest Lake has been managed with catch-and-release regulations since 1994. The tributary streams producing adfluvial westslope cutthroat trout in Priest Lake were closed to fishing from 1982 through 1991. Streams were then reopened in 1992 under very restrictive regulations that allowed harvest of resident westslope cutthroat and brook trout. Despite harvest restrictions, the westslope cutthroat trout fishery did not respond.

Westslope cutthroat trout fingerlings were stocked in Priest Lake between 1981 and 1991, but the lack of any apparent benefit caused a shift in management to wild trout in 1992 (N. Horner, Regional Fisheries Manager, IDFG, personal communication). The primary cause for the loss in wild adfluvial westslope cutthroat trout production from tributary streams is believed to be from the combined effects of brook trout invasion and the loss of spawning and rearing habitat due to habitat degradation. Predation by lake trout on westslope cutthroat trout smolts entering Priest Lake may have been the primary reason westslope cutthroat trout did not respond to restrictive regulations or hatchery supplementation (shown in Figure 14.1).

Table 14.8. Estimated effort and harvest, by species, in Priest Lake, Idaho, 1956-1994. Numbers in parentheses are the 1994 equivalents for the survey period of previous years creel censuses.

Census period	Year	Angler hours	Kokanee	Cutthroat	Bull trout	Lake trout	Total harvest	Overall success (fish/h)
April 30-October 15	1956	96,630 (48,984)	102,360	3,580	1,590	270 (10,758)	107,800	1.12
April 30-November 30	1966	64,604 (49,386)	68,884	2,387	1,173	199 (10,758)	72,643	1.12
May 18-September 6	1968	48,286 (36,652)	32,314	1,611	1,096	0 (5,711)	35,021	0.73
June 2-September 6	1969	46,819 (27,000)	37,880	1,256	650	0 (9,347)	39,786	0.85
May 16-October 2	1970	82,063 (46,216)	79,840	2,776	1,526	138 (9,347)	84,280	1.03
April 15-December 15	1978	99,157 (56,599)	4,593	2,585	2,320	5,724 (12,884)	15,222	0.15
April 16-December 15	1983	47,039 (56,599)	66	105	92	4,620 (12,884)	4,883	0.10
April 12-November 7	1986	71,516 (56,343)	0	134	0	6,295 (12,659)	6,429	0.09
May 9-July 17	1987	27,903 (25,001)	0	11	-	2,969 (2,422)	2,980	0.11
January 23-March1	1993	12,918 (0)	0	0	0	2,605 (0)	2,605	0.20
January 1-December 31	1994	62,602	0	0	00	13,987	13,987	0.22

14.4.3 Limiting Factors Westslope Cutthroat Trout

Historically, westslope cutthroat trout were present in 129 of 167 delineated reaches and watersheds in the Pend Oreille Subbasin. Currently, this number has dropped to 112 reaches and watersheds. Table 14.9 provides the names of the streams where westslope cutthroat trout are no longer present and corresponding rank for the relative deviation in habitat conditions from reference to current conditions.

Table 14.9. List of 17 reaches where westslope cutthroat trout are not currently present, but were historically present. Reach rank refers to the degree of habitat change from reference to present conditions, 1 = greatest habitat alteration.

Reach Name	Reach Rank
Lower Calispell Creek	2
Lower Cusick Creek	20
Lower Muddy Creeks	35
Upper Cusick Creek	47
McCloud Creek	52
Lower Lost Creek	64
Renshaw Creek	74
Upper Lost Creek	77
Upper Small Creek	84
Lower Big Muddy Creek	87
Flume Creek*	95
Three Mile Creek	103
Middle Fork Calispell Creek	103
Little Muddy Creek	103
Lower Small Creek	112
Lower North Fork Calispell Creek	118
Lime Creek	122

*R2 Consultants found a few westslope cutthroat trout in 1997 (Boundary Hydroelectric Project Bull Trout Field Investigations R2 Resource Consultants 1998).

Fine sediment, riparian condition, habitat diversity, and channel stability were the major habitat attributes that were most significantly altered from reference conditions (Table 14.10, also see Table 14.26). Habitat alterations are present throughout the subbasin to varying degrees. Sockwa Creek (highlighted in red in Map PO-3, located at the end of Section 14) appears to have experienced the greatest deviation from reference conditions in the subbasin.

Salmo River and watersheds in the Priest River drainage are ranked highest for protection indicating a lower level of habitat disturbance relative to the rest of the Subbasin (Table 14.11).

Table 14.10. Ranking of reaches with the largest deviation from the reference habitat conditions for westslope cutthroat in the Pend Oreille Subbasin. A reach rank equal to 1 has the greatest deviation from reference condition in comparison to other reaches. Reach scores range from 0 to 1, with 1 having the greatest deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute having the greatest deviation from reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes equally deviate the most from the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
114	Sockwa Creek	1	0.9	1	1	1	1	1	1	1	11	1	1	10
7	Lower Calispell Creek	2	0.6	1	8	1	1	6	1	8	11	6	8	5
1	Main Pend Oreille River	3	0.5	1	1	4	1	9	5	11	10	5	8	5
146	Syringa Creek	4	0.5	4	4	1	4	1	1	11	9	4	9	4
35	Lower Sullivan Creek	5	0.5	2	2	5	9	5	5	10	10	1	5	4
54	Lower Skookum Creek	6	0.4	1	3	4	1	7	7	9	10	5	6	10
44	Middle Branch LeClerc Creek	7	0.4	2	4	2	1	8	8	10	10	5	5	7
138	Middle Pack River	8	0.4	1	1	1	1	6	6	10	9	1	6	10
110	Pend Oreille River above Albeni Falls Dam	9	0.4	1	1	1	1	1	1	11	10	1	9	1
154	Rapid Lightning Creek	10	0.4	1	1	1	8	1	1	11	9	1	1	10
149	Sand Creek	11	0.4	1	1	1	1	8	1	11	10	1	8	7
111	Middle Fork East River	12	0.4	2	2	1	7	2	2	10	9	2	7	10
140	Hellroaring Creek	12	0.4	1	1	1	1	7	7	11	10	1	7	1
141	Caribou Creek	12	0.4	1	1	1	1	7	7	11	10	1	7	1
148	Lower Pack River	12	0.4	1	1	4	5	5	5	10	9	1	5	10

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
100	Upper Cocolalla Creek	16	0.3	2	6	1	6	6	6	11	10	2	2	5
144	Sand Creek	17	0.3	1	5	1	1	5	5	11	10	1	8	9
150	Grouse Creek	18	0.3	1	3	3	2	6	6	10	9	5	6	10
95	Algoma Area	19	0.3	1	1	1	1	8	1	9	9	1	9	7
38	Lower Harvey Creek	20	0.3	2	2	1	4	6	6	8	8	8	8	4
74	Lower Tacoma Creek	20	0.3	2	2	2	1	6	6	6	6	5	6	6
76	Lower Cusick Creek	20	0.3	1	4	1	1	7	7	7	7	6	4	7
117	Flat/Bear Paw Creeks	20	0.3	1	5	1	1	6	6	11	10	6	6	1
145	Little Sand Creek	20	0.3	6	5	1	1	1	6	11	10	6	6	1
5	Davis/Kent Creeks	25	0.3	1	1	1	1	8	8	8	6	5	8	7
158	Granite Creek (LPO)	26	0.3	1	1	1	7	7	1	9	9	6	9	1
99	Lower Cocolalla Creek	27	0.3	1	6	1	6	6	6	10	10	1	1	5
151	North Fork Grouse Creek	27	0.3	3	3	6	2	6	6	10	9	1	10	5
157	Trout Creek	27	0.3	1	1	1	4	4	8	10	9	4	10	7
49	Upper Mill Creek	30	0.3	1	4	3	2	6	6	9	9	4	9	8
118	Lamb Creek	31	0.3	4	5	2	1	5	5	9	9	9	5	3
152	Gold Creek (Pack River)	32	0.3	3	3	3	1	6	6	11	10	1	6	9
105	Brickel Creek	33	0.3	2	2	1	4	4	4	10	9	4	10	8
137	Horton Creek	33	0.3	8	3	2	1	4	4	10	8	4	10	7
83	Lower Muddy Creeks	35	0.3	3	5	1	1	7	7	7	7	3	5	7

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
120	Indian Creek	35	0.3	4	1	1	1	7	4	7	7	4	7	7
134	South Fork Indian Creek	35	0.3	4	1	1	1	7	4	7	7	4	7	7
103	Wright Area	38	0.3	6	6	6	1	1	1	11	10	1	6	5
36	Lower Sand Creek	39	0.3	2	4	2	1	4	4	9	9	4	9	8
42	Middle West Branch LeClerc Creek	39	0.3	1	3	3	1	6	3	10	10	6	9	8
71	Lower Trimble Creek	39	0.3	2	5	2	2	8	8	8	8	5	5	1
136	Hunt Creek	42	0.3	7	3	2	1	4	4	9	7	4	9	9
159	Cedar Creek	42	0.3	5	5	5	3	5	3	10	9	1	10	1
43	Upper West Branch LeClerc Creek	44	0.3	1	5	5	1	5	3	10	10	5	9	4
112	North Fork East River	45	0.3	2	4	1	2	4	4	10	9	4	10	8
135	Upper Pack River	46	0.3	2	4	1	2	4	4	8	8	4	8	8
77	Upper Cusick Creek	47	0.2	1	1	1	1	8	8	8	8	5	5	7
32	Pass Creek	48	0.2	1	1	4	1	5	5	8	8	5	8	8
37	Upper Sand Creek	48	0.2	3	4	2	1	4	4	8	8	4	8	8
45	Lower East Branch LeClerc Creek	48	0.2	1	2	2	2	6	6	9	9	2	8	9
47	Middle Creek	48	0.2	2	2	5	1	4	5	8	8	7	8	8
6	McCloud Creek	52	0.2	4	1	3	1	4	4	10	8	4	10	9
92	Riley Creek	52	0.2	2	7	5	1	7	5	7	7	2	7	4
93	Johnson Creek (Pend Oreille River)	52	0.2	1	5	5	1	8	5	8	8	1	8	4
161	(South) Gold Creek	52	0.2	3	3	3	2	3	3	9	9	9	1	8

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
31	Middle Sullivan Creek	56	0.2	1	4	1	1	4	4	8	8	4	8	8
160	North Gold Creek	57	0.2	1	4	1	1	4	4	9	9	8	4	11
116	Moores Creek	58	0.2	1	3	4	1	9	4	9	8	4	9	7
46	Upper East Branch LeClerc Creek	59	0.2	2	3	3	1	3	3	10	10	3	8	9
90	Pine/ Peewee Creeks	60	0.2	1	7	7	1	3	3	10	7	3	10	6
91	Big/Blue Creeks	60	0.2	1	7	7	1	3	3	10	7	3	10	6
113	Binarch Creek	60	0.2	1	7	7	1	3	3	10	7	3	10	6
119	Kalispell Creek	60	0.2	1	3	1	8	8	4	8	8	4	4	7
3	Marshal Lake/Creek	64	0.2	2	2	1	2	2	2	10	9	2	10	2
81	Lower Lost Creek	64	0.2	2	4	4	1	6	6	6	6	2	6	6
153	South Fork Grouse Creek	64	0.2	3	3	1	3	3	3	9	8	2	9	9
156	Strong Creek	64	0.2	3	4	4	4	8	1	8	8	7	8	1
162	Johnson Creek	68	0.2	4	1	1	1	5	5	9	8	7	9	11
52	South Skookum Creek	69	0.2	2	3	3	1	7	7	10	10	3	3	9
53	North Skookum Creek	69	0.2	2	3	3	1	7	7	10	10	3	3	9
126	Trapper Creek	69	0.2	1	1	4	4	9	4	9	8	4	9	3
75	Upper Tacoma Creek	72	0.2	2	4	2	1	7	7	7	7	4	7	6
79	Upper Ruby Creek	72	0.2	2	4	2	1	6	6	6	6	6	6	5
21	Renshaw Creek	74	0.2	1	3	3	2	3	3	8	8	3	8	8
64	Lower Winchester Creek	75	0.2	1	5	1	1	6	6	6	6	6	6	4

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
87	Lower Cedar Creek	75	0.2	1	4	1	1	7	7	7	7	4	7	6
29	Upper Sullivan Creek	77	0.2	2	4	1	2	4	4	7	7	7	7	7
50	Lower CCA Creek	77	0.2	2	7	3	1	3	3	8	8	3	8	8
72	Upper Trimble Creek	77	0.2	1	4	1	1	6	6	6	6	6	4	6
82	Upper Lost Creek	77	0.2	1	4	1	1	6	6	6	6	4	6	6
85	Upper Big Muddy Creek	77	0.2	1	4	1	1	6	6	6	6	4	6	6
89	Lost Lake Creek	77	0.2	1	1	1	1	5	5	5	5	5	5	5
131	Lion/Lucky Creek	77	0.2	1	4	2	2	7	4	7	7	4	7	7
68	Upper Small Creek	84	0.2	3	3	3	2	6	6	6	6	6	6	1
56	Lower Indian Creek	85	0.2	3	4	1	1	6	6	6	6	4	6	6
155	Trestle Creek	86	0.2	1	1	1	1	9	1	9	9	8	1	7
84	Lower Big Muddy Creek	87	0.2	3	3	1	1	6	6	6	6	3	6	6
127	Caribou Creek	88	0.2	2	8	1	2	8	2	8	7	2	8	6
19	Sweet/Lunch Creek	89	0.1	1	3	3	1	5	5	8	8	5	8	8
39	Middle Harvey Creek	89	0.1	1	2	2	2	2	2	7	7	7	7	7
41	Lower West Brach LeClerc Creek	89	0.1	1	3	3	2	7	7	7	7	5	5	7
48	Lower Mill Creek	89	0.1	1	1	1	1	1	1	8	8	7	8	8
51	Upper CCA Creek	89	0.1	1	7	3	1	3	3	8	8	3	8	11
132	Two Mouth Creek	89	0.1	1	1	3	6	7	3	7	7	3	7	7
16	Flume Creek	95	0.1	1	3	3	1	5	5	8	8	5	8	11

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
18	Sullivan Lake	95	0.1	6	2	2	2	1	6	8	8	8	8	5
40	North and Middle Fork Harvey Creek	97	0.1	1	1	1	1	1	1	7	7	7	7	7
133	Bear Creek	97	0.1	1	1	1	1	7	1	7	7	1	7	7
17	Pocahontas Creek	99	0.1	2	2	2	1	5	5	8	8	5	8	11
78	Lower Ruby Creek	100	0.1	2	2	2	1	6	6	6	6	6	6	5
121	South Fork Granite and Sema Creek	101	0.1	1	1	6	1	7	1	7	7	1	7	7
88	Upper Cedar Creek	102	0.1	4	5	2	2	5	5	5	5	5	5	1
11	Three Mile Creek	103	0.1	1	1	1	1	6	6	6	6	1	6	6
13	Peewee/Russian Creek	103	0.1	1	1	1	1	5	5	7	7	7	7	7
60	Middle Fork Calipsell Creek	103	0.1	2	2	2	1	5	5	5	5	5	5	5
65	Upper Winchester Creek	103	0.1	2	2	2	1	5	5	5	5	5	5	5
73	South Fork Tacoma Creek	103	0.1	2	2	2	1	5	5	5	5	5	5	5
86	Little Muddy Creek	103	0.1	2	2	2	1	5	5	5	5	5	5	5
58	South Fork Calispell Creek	109	0.1	2	2	1	2	5	5	5	5	5	5	5
63	Ten Mile Creek	109	0.1	4	5	2	2	5	5	5	5	5	1	5
122	North Fork Granite Creek	109	0.1	1	1	4	4	7	1	7	7	4	7	7
67	Lower Small Creek	112	0.1	1	4	1	1	5	5	5	5	5	5	11
57	Upper Indian Creek	113	0.1	1	1	1	1	5	5	5	5	5	5	5
123	Gold Creek	113	0.1	5	4	1	5	5	2	5	5	2	5	5
27	Slate Creek	115	0.1	2	2	2	1	2	2	7	7	7	7	7

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
80	South Fork Lost Creek	115	0.1	4	1	1	1	5	5	5	5	5	5	5
128	Boulder Creek	115	0.1	6	3	3	3	1	1	6	6	6	6	6
61	Lower North Fork Calispell Creek	118	0.1	2	2	2	1	5	5	5	5	5	5	11
69	East Fork Small Creek	119	0.1	4	5	1	1	5	5	5	5	5	5	3
28	Deemer/Leola Creek	120	0.1	1	1	1	1	1	1	7	7	7	7	7
30	Gypsy Creek	120	0.1	1	1	1	1	1	1	7	7	7	7	7
12	Lime Creek	122	0.1	1	1	1	1	5	5	8	8	5	8	11
34	North Fork Sullivan Creek	123	0.0	2	2	2	2	2	2	2	2	2	2	1
62	Upper North Fork Calispell Creek	123	0.0	2	4	2	1	4	4	4	4	4	4	4
125	Upper Priest River	123	0.0	1	1	1	5	5	1	5	5	5	5	5
124	Jackson Creek	126	0.0	4	1	1	4	4	1	4	4	4	4	4
129	Upper Priest Lake	126	0.0	4	1	1	4	4	1	4	4	4	4	4
130	Beaver Creek	126	0.0	4	1	1	4	4	1	4	4	4	4	4
14	Salmo River	129	0.0	1	1	1	1	1	1	1	1	1	1	1

Table 14.11. Ranking of streams whose habitat is most similar to the reference condition for westslope cutthroat trout in the Pend Oreille Subbasin in comparison to other reaches. A reach rank equal to 1 reveals the reach with current conditions most similar to reference conditions in comparison to other reaches. Reach score ranges from 0 to -1, with -1 having the least deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute being most similar to the reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes are equally the most similar to the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
14	Salmo River	1	-0.92	1	1	1	1	1	1	1	11	1	1	10
124	Jackson Creek	2	-0.89	1	7	7	1	1	7	1	11	1	1	10
129	Upper Priest Lake	2	-0.89	1	7	7	1	1	7	1	11	1	1	10
130	Beaver Creek	2	-0.89	1	7	7	1	1	7	1	11	1	1	10
62	Upper North Fork Calispell Creek	5	-0.88	7	1	7	9	1	1	1	11	1	1	10
125	Upper Priest River	5	-0.88	6	6	6	1	1	6	1	11	1	1	10
34	North Fork Sullivan Creek	7	-0.86	1	1	1	1	1	1	1	10	1	1	11
28	Deemer/Leola Creek	8	-0.86	4	4	4	4	4	4	1	11	1	1	10
30	Gypsy Creek	8	-0.86	4	4	4	4	4	4	1	11	1	1	10
80	South Fork Lost Creek	10	-0.84	6	7	7	7	1	1	1	11	1	1	10
128	Boulder Creek	10	-0.84	1	5	5	5	8	8	1	11	1	1	10
69	East Fork Small Creek	12	-0.84	7	1	8	8	1	1	1	10	1	1	11
57	Upper Indian Creek	13	-0.83	6	6	6	6	1	1	1	11	1	1	10
123	Gold Creek	13	-0.83	1	6	10	1	1	7	1	11	7	1	9
58	South Fork Calispell Creek	15	-0.82	6	6	10	6	1	1	1	11	1	1	9

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
63	Ten Mile Creek	**15**	-0.82	6	1	7	7	1	1	1	10	1	10	9
122	North Fork Granite Creek	**15**	-0.82	7	7	4	4	1	7	1	11	4	1	10
65	Upper Winchester Creek	**18**	-0.81	6	6	6	10	1	1	1	10	1	1	9
73	South Fork Tacoma Creek	**18**	-0.81	6	6	6	10	1	1	1	10	1	1	9
88	Upper Cedar Creek	**20**	-0.81	7	1	8	8	1	1	1	10	1	1	11
121	South Fork Granite and Sema Creek	**21**	-0.80	4	4	4	9	4	4	1	10	1	1	11
27	Slate Creek	**21**	-0.80	5	5	4	5	1	5	1	11	5	1	10
78	Lower Ruby Creek	**23**	-0.80	6	6	6	9	1	1	1	9	1	1	9
40	North and Middle Fork Harvey Creek	**24**	-0.79	4	4	4	4	4	4	1	11	1	1	10
18	Sullivan Lake	**25**	-0.78	4	6	6	6	9	4	1	10	1	1	10
39	Middle Harvey Creek	**26**	-0.78	6	6	6	10	3	3	1	10	3	1	9
41	Lower West Brach LeClerc Creek	**26**	-0.78	10	4	4	4	4	4	1	11	1	1	9
17	Pocahontas Creek	**26**	-0.78	10	6	6	9	1	1	1	10	4	4	8
127	Caribou Creek	**29**	-0.77	5	1	9	5	1	5	1	11	5	1	10
133	Bear Creek	**29**	-0.77	4	4	4	4	1	4	1	10	4	1	10
155	Trestle Creek	**31**	-0.76	4	4	4	4	4	4	1	10	3	1	10
48	Lower Mill Creek	**31**	-0.76	4	4	4	4	1	4	1	10	3	4	10
56	Lower Indian Creek	**33**	-0.75	8	5	9	9	1	1	1	9	5	1	7
13	Peewee/Russian Creek	**34**	-0.75	6	6	6	6	4	4	1	10	1	1	11
132	Two Mouth Creek	**35**	-0.75	8	8	5	4	1	5	1	10	5	1	11

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
29	Upper Sullivan Creek	**36**	-0.74	8	4	10	8	4	4	1	10	1	1	7
50	Lower CCA Creek	**36**	-0.74	9	3	4	10	4	4	1	10	4	1	8
72	Upper Trimble Creek	**36**	-0.74	8	5	8	8	1	1	1	8	1	5	7
85	Upper Big Muddy Creek	**36**	-0.74	8	5	8	8	1	1	1	8	5	1	7
89	Lost Lake Creek	**36**	-0.74	7	7	7	7	1	1	1	7	1	1	6
64	Lower Winchester Creek	**41**	-0.73	7	6	7	7	1	1	1	7	1	1	11
87	Lower Cedar Creek	**41**	-0.73	8	5	8	8	1	1	1	8	5	1	7
75	Upper Tacoma Creek	**43**	-0.73	7	5	7	11	1	1	1	9	5	1	9
79	Upper Ruby Creek	**43**	-0.73	7	6	7	11	1	1	1	7	1	1	7
52	South Skookum Creek	**45**	-0.72	8	4	4	10	2	2	1	10	4	4	9
53	North Skookum Creek	**45**	-0.72	8	4	4	10	2	2	1	10	4	4	9
126	Trapper Creek	**45**	-0.72	8	8	4	4	1	4	1	10	4	1	11
3	Marshal Lake/Creek	**48**	-0.72	3	3	9	3	3	3	1	11	3	1	10
153	South Fork Grouse Creek	**48**	-0.72	3	3	10	3	3	3	1	11	9	1	8
156	Strong Creek	**48**	-0.72	8	5	5	5	1	9	1	9	4	1	11
90	Pine/ Peewee Creeks	**51**	-0.72	8	6	6	8	3	3	1	10	3	1	11
91	Big/Blue Creeks	**51**	-0.72	8	3	4	8	4	4	1	8	4	1	8
113	Binarch Creek	**51**	-0.72	8	3	3	8	5	5	1	11	5	1	8
19	Sweet/Lunch Creek	**51**	-0.72	8	3	3	8	5	5	1	11	5	1	8
51	Upper CCA Creek	**51**	-0.72	8	3	3	8	5	5	1	11	5	1	8

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
46	Upper East Branch LeClerc Creek	**56**	-0.71	8	3	3	10	3	3	1	10	3	2	9
131	Lion/Lucky Creek	**56**	-0.71	9	4	7	7	1	4	1	9	4	1	11
116	Moores Creek	**58**	-0.70	8	7	4	8	1	4	1	11	4	1	8
31	Middle Sullivan Creek	**59**	-0.70	8	3	8	8	3	3	1	8	3	1	7
162	Johnson Creek	**60**	-0.69	7	8	8	8	4	4	1	11	3	1	6
92	Riley Creek	**61**	-0.69	7	1	5	11	1	5	1	7	7	1	10
93	Johnson Creek (Pend Oreille River)	**61**	-0.69	7	4	4	7	1	4	1	7	7	1	11
1	Main Pend Oreille River	**63**	-0.37	8	8	6	8	2	4	1	5	6	3	8
32	Pass Creek	**63**	-0.69	8	8	7	8	3	3	1	8	3	1	6
37	Upper Sand Creek	**63**	-0.69	8	3	9	11	3	3	1	9	3	1	7
45	Lower East Branch LeClerc Creek	**63**	-0.69	10	6	6	6	3	3	1	10	6	2	5
160	North Gold Creek	**63**	-0.69	8	3	8	8	3	3	1	8	2	3	7
161	(South) Gold Creek	**67**	-0.68	3	3	3	8	3	3	1	8	1	11	8
112	North Fork East River	**68**	-0.67	7	7	4	11	6	4	1	7	3	1	7
47	Middle Creek	**68**	-0.67	7	3	11	7	3	3	1	10	3	1	9
119	Kalispell Creek	**68**	-0.67	7	6	7	7	1	3	1	7	3	3	7
43	Upper West Branch LeClerc Creek	**71**	-0.67	8	3	3	8	3	7	1	8	3	2	11
159	Cedar Creek	**72**	-0.66	3	3	3	7	3	7	1	10	9	1	11
36	Lower Sand Creek	**73**	-0.66	7	3	7	11	3	3	1	7	3	1	7
42	Middle West Branch LeClerc Creek	**73**	-0.66	8	5	5	8	3	5	1	8	3	2	8

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
71	Lower Trimble Creek	**73**	-0.66	7	4	7	7	1	1	1	7	4	4	11
103	Wright Area	**76**	-0.66	2	2	2	6	6	6	1	10	6	2	11
120	Indian Creek	**77**	-0.65	4	9	9	9	1	4	1	8	4	1	7
134	South Fork Indian Creek	**77**	-0.65	4	9	9	9	1	4	1	8	4	1	7
105	Brickel Creek	**79**	-0.65	7	7	11	3	3	3	1	10	3	1	7
137	Horton Creek	**79**	-0.65	3	7	9	11	4	4	1	9	4	1	7
152	Gold Creek (Pack River)	**81**	-0.64	5	5	5	8	2	2	1	11	8	2	8
118	Lamb Creek	**82**	-0.63	7	3	9	10	3	3	1	8	1	3	11
135	Upper Pack River	**82**	-0.63	7	3	10	7	3	3	1	7	3	1	11
49	Upper Mill Creek	**84**	-0.63	11	5	7	10	3	3	1	7	5	1	7
99	Lower Cocolalla Creek	**85**	-0.62	6	2	6	2	2	2	1	6	6	6	11
151	North Fork Grouse Creek	**85**	-0.62	6	6	3	8	3	3	1	8	11	1	10
157	Trout Creek	**85**	-0.62	7	7	7	4	4	3	1	10	4	1	11
158	Granite Creek (LPO)	**88**	-0.62	6	6	6	3	3	6	1	6	5	1	11
5	Davis/Kent Creeks	**89**	-0.61	8	8	8	8	1	1	1	7	5	1	6
38	Lower Harvey Creek	**90**	-0.61	8	8	10	6	4	4	1	6	1	1	11
74	Lower Tacoma Creek	**90**	-0.61	8	8	8	11	1	1	1	7	5	1	6
117	Flat/Bear Paw Creeks	**90**	-0.61	7	6	7	7	2	2	1	10	2	2	11
145	Little Sand Creek	**90**	-0.61	2	6	7	7	7	2	1	10	2	2	11
136	Hunt Creek	**94**	-0.60	3	7	8	10	4	4	1	8	4	1	11

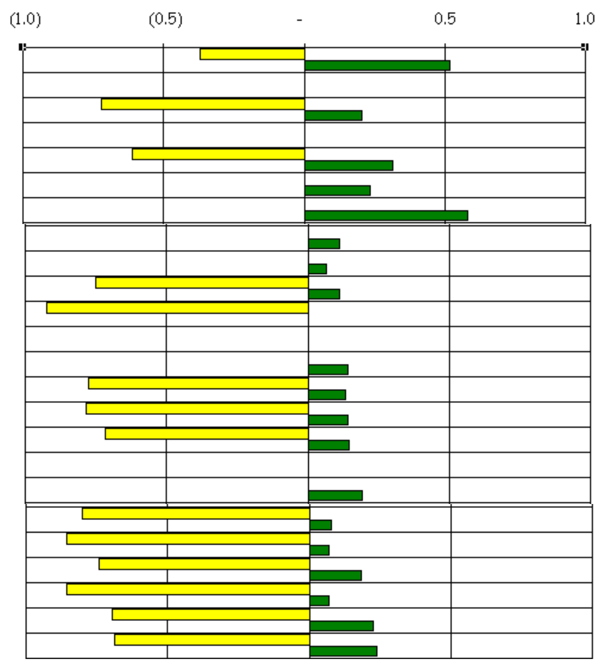
Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
95	Algoma Area	**95**	-0.60	4	4	4	4	3	4	1	4	4	1	11
100	Upper Cocolalla Creek	**96**	-0.59	6	2	11	2	2	2	1	9	6	6	10
150	Grouse Creek	**97**	-0.58	10	7	7	10	2	2	1	9	6	2	5
111	Middle Fork East River	**98**	-0.57	5	5	11	2	5	5	1	10	5	2	4
140	Hellroaring Creek	**98**	-0.57	5	5	5	5	2	2	1	10	5	2	11
141	Caribou Creek	**98**	-0.57	5	5	5	5	2	2	1	10	5	2	11
149	Sand Creek	**101**	-0.56	4	4	4	4	2	4	1	10	4	2	11
144	Sand Creek	**102**	-0.55	6	3	6	11	3	3	1	10	6	2	6
110	Pend Oreille River above Albeni Falls Dam	**103**	-0.53	3	3	3	3	3	3	1	10	3	2	11
148	Lower Pack River	**103**	-0.53	8	8	6	8	2	2	1	7	8	2	5
154	Rapid Lightning Creek	**105**	-0.52	3	3	3	2	3	3	1	10	3	3	11
138	Middle Pack River	**106**	-0.50	7	7	7	7	2	2	1	6	7	2	5
44	Middle Branch LeClerc Creek	**107**	-0.50	9	7	9	11	2	2	1	6	4	4	8
54	Lower Skookum Creek	**108**	-0.48	10	9	8	10	2	2	1	6	6	5	4
35	Lower Sullivan Creek	**109**	-0.45	8	8	3	2	3	3	1	3	10	3	11
146	Syringa Creek	**110**	-0.45	3	3	7	3	7	7	1	7	3	2	11
114	Sockwa Creek	**112**	0.00	1	1	1	1	1	1	1	1	1	1	1

The tornado diagram (Table 14.12) and maps (Map PO-3, Map PO-4, located at the end of Section 14) present the reach scores for both current habitat condition (ranging from zero to positive one, Map PO-3) and protection (ranging from zero to negative one, Map PO-4). Scores closest to negative one depict reaches that are most representative of reference habitat conditions. Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

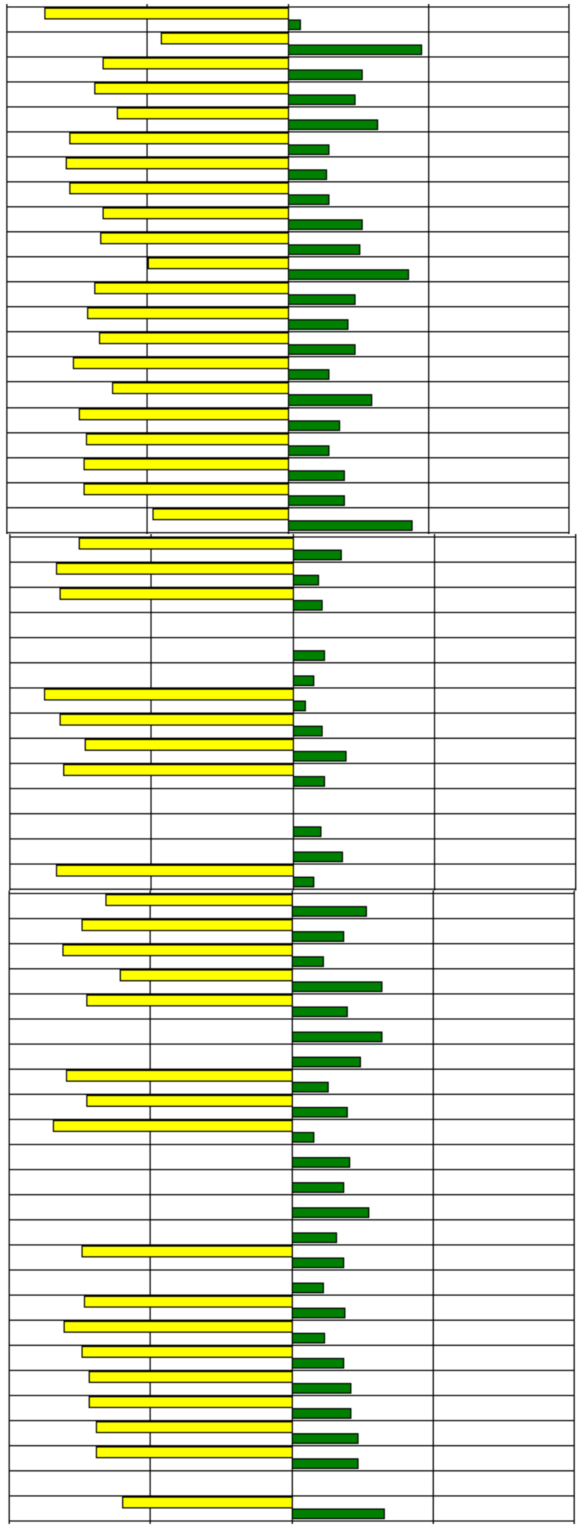
Table 14.12. Tornado diagram for westslope cutthroat trout in the Pend Oreille Subbasin. Degree of confidence for protection and current habitat conditions range from 0.0 to 1.0 with the greatest confidence equal to 1.0. Protection reach scores are presented on the left side and current habitat reach scores are presented on the right. Negative scores are in parentheses.

NP = Not present

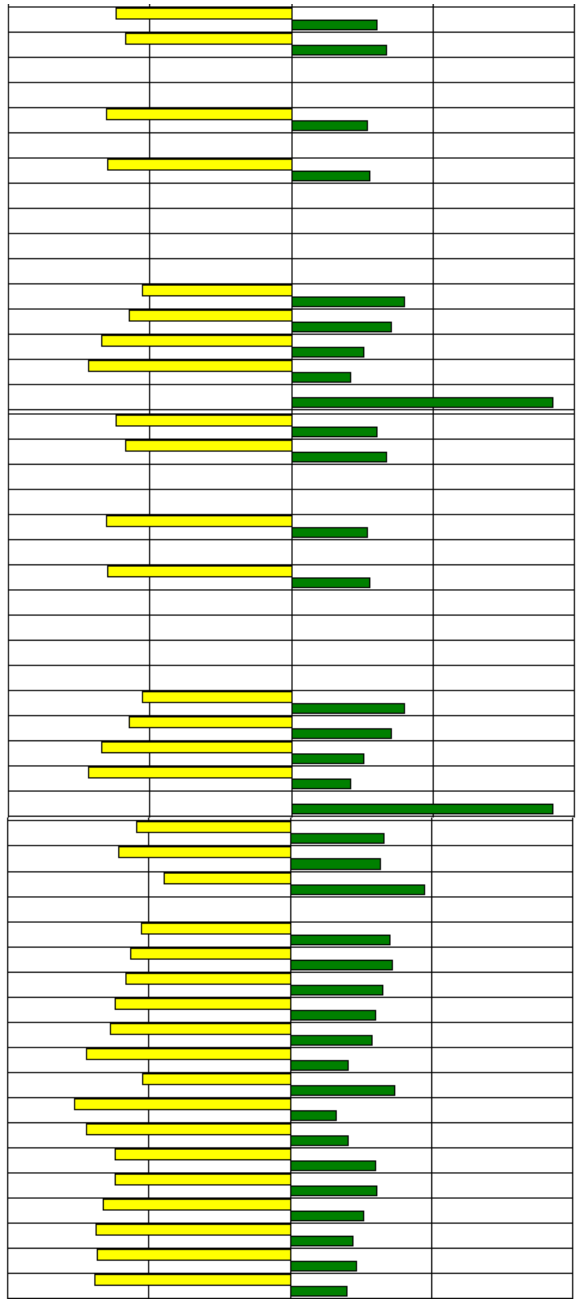
Sequence	Reach Name	Protection Confidence	Current Habitat Conditions Confidence
1	Main Pend Oreille River	0.50	0.38
2	Bead Lake	NP	
3	Marshal Lake/Creek	0.42	0.21
4	Shearer Lake	NP	
5	Davis/Kent Creeks	0.42	0.21
6	McCloud Creek	0.50	0.25
7	Lower Calispell Creek	0.33	0.17
11	Three Mile Creek	0.33	0.17
12	Lime Creek	0.50	0.25
13	Peewee/Russian Creek	0.50	0.25
14	Salmo River	0.50	0.25
15	Ledbetter Lake	NP	
16	Flume Creek	0.50	0.25
17	Pocahontas Creek	0.50	0.25
18	Sullivan Lake	0.50	0.25
19	Sweet/Lunch Creek	0.50	0.25
20	Power Plant	NP	
21	Renshaw Creek	0.50	0.25
27	Slate Creek	0.50	0.25
28	Deemer/Leola Creek	0.50	0.25
29	Upper Sullivan Creek	0.50	0.25
30	Gypsy Creek	0.50	0.25
31	Middle Sullivan Creek	0.50	0.25
32	Pass Creek	0.50	0.25



34	North Fork Sullivan Creek	0.50	0.25
35	Lower Sullivan Creek	0.50	0.25
36	Lower Sand Creek	0.50	0.25
37	Upper Sand Creek	0.50	0.25
38	Lower Harvey Creek	0.50	0.25
39	Middle Harvey Creek	0.50	0.25
40	North and Middle Fork Harvey Creek	0.50	0.25
41	Lower West Brach LeClerc Creek	0.50	0.25
42	Middle West Branch LeClerc Creek	0.50	0.25
43	Upper West Branch LeClerc Creek	0.50	0.25
44	Middle Branch LeClerc Creek	0.50	0.25
45	Lower East Branch LeClerc Creek	0.50	0.25
46	Upper East Branch Leclerc Creek	0.50	0.25
47	Middle Creek	0.50	0.25
48	Lower Mill Creek	0.50	0.25
49	Upper Mill Creek	0.50	0.25
50	Lower CCA Creek	0.50	0.25
51	Upper CCA Creek	0.50	0.25
52	South Skookum Creek	0.50	0.25
53	North Skookum Creek	0.50	0.25
54	Lower Skookum Creek	0.50	0.25
56	Lower Indian Creek	0.33	0.17
57	Upper Indian Creek	0.50	0.25
58	South Fork Calispel Creek	0.50	0.25
59	Power Lake	NP	
60	Middle Fork Calipsel Creek	0.50	0.25
61	Lower North Fork Calispell Creek	0.50	0.25
62	Upper North Fork Calispell Creek	0.50	0.25
63	Ten Mile Creek	0.33	0.17
64	Lower Winchester Creek	0.33	0.17
65	Upper Winchester Creek	0.50	0.25
66	Dorchester Creek	NP	
67	Lower Small Creek	0.33	0.17
68	Upper Small Creek	0.50	0.25
69	East Fork Small Creek	0.50	0.25
71	Lower Trimble Creek	0.33	0.17
72	Upper Trimble Creek	0.33	0.17
73	South Fork Tacoma Creek	0.50	0.25
74	Lower Tacoma Creek	0.33	0.17
75	Upper Tacoma Creek	0.50	0.25
76	Lower Cusick Creek	0.33	0.17
77	Upper Cusick Creek	0.50	0.25
78	Lower Ruby Creek	0.50	0.25
79	Upper Ruby Creek	0.50	0.25
80	South Fork Lost Creek	0.50	0.25
81	Lower Lost Creek	0.50	0.25
82	Upper Lost Creek	0.50	0.25
83	Lower Muddy Creeks	0.33	0.17
84	Lower Big Muddy Creek	0.50	0.25
85	Upper Big Muddy Creek	0.50	0.25
86	Little Muddy Creek	0.50	0.25
87	Lower Cedar Creek	0.33	0.17
88	Upper Cedar Creek	0.50	0.25
89	Lost Lake Creek	0.33	0.17
90	Pine/ Peewee Creeks	0.17	0.21
91	Big/Blue Creeks	0.17	0.21
92	Riley Creek	0.50	0.38
93	Johnson Creek (Pend Orielle River)	0.17	0.21
94	Smith/Carr Creeks	NP	
95	Algoma Area	0.17	0.21



99	Lower Cocolalla Creek	0.50	0.38
100	Upper Cocolalla Creek	0.50	0.38
101	Fish Creek	NP	
102	East of Edgemere	NP	
103	Wright Area	0.17	0.21
104	Spirit Lake	NP	
105	Brickel Creek	0.50	0.38
106	Blanchard Lake	NP	
107	Elmer Creek	NP	
108	Hoodoo Creek	NP	
109	Kelso	NP	
110	Pend Oreille River above Albeni Falls Dam	0.17	0.21
111	Middle Fork East River	0.50	0.38
112	North Fork East River	0.50	0.38
113	Binarch Creek	0.50	0.38
114	Sockwa Creek	-	0.13
99	Lower Cocolalla Creek	0.50	0.38
100	Upper Cocolalla Creek	0.50	0.38
101	Fish Creek	NP	
102	East of Edgemere	NP	
103	Wright Area	0.17	0.21
104	Spirit Lake	NP	
105	Brickel Creek	0.50	0.38
106	Blanchard Lake	NP	
107	Elmer Creek	NP	
108	Hoodoo Creek	NP	
109	Kelso	NP	
110	Pend Oreille River above Albeni Falls Dam	0.17	0.21
111	Middle Fork East River	0.50	0.38
112	North Fork East River	0.50	0.38
113	Binarch Creek	0.50	0.38
114	Sockwa Creek	-	0.13
144	Sand Creek	0.50	0.38
145	Little Sand Creek	0.50	0.38
146	Syringa Creek	0.17	0.21
147	Boyer Slough	NP	
148	Lower Pack River	0.50	0.38
149	Sand Creek	0.50	0.38
150	Grouse Creek	0.50	0.38
151	North Fork Grouse Creek	0.50	0.38
152	Gold Creek (Pack River)	0.50	0.38
153	South Fork Grouse Creek	0.50	0.38
154	Rapid Lightning Creek	0.50	0.38
155	Trestle Creek	0.50	0.38
156	Strong Creek	0.50	0.38
157	Trout Creek	0.42	0.33
158	Granite Creek (LPO)	0.42	0.33
159	Cedar Creek	0.42	0.33
160	North Gold Creek	0.42	0.33
161	(South) Gold Creek	0.50	0.38
162	Johnson Creek	0.50	0.38



14.4.4 Current Management

The USFWS (2002) has recently decided not to list westslope cutthroat trout as a threatened species under the ESA (Federal Register 65:20120). Management and conservation strategies are the responsibility of each state under their respective state law. Protection of westslope cutthroat trout habitat and restoration of historic habitat is imperative to the health and expansion of westslope cutthroat trout in the Lower Pend Oreille Subbasin (C. Vail, Fisheries Biologist WDFW, personal communication, 2004). Westslope cutthroat trout restoration projects, including fish passage, are a key component of the Native Salmonid Restoration Plan (NSRP) in the Settlement

Agreement with Avista Corporation. In the Pend Oreille Subbasin, westslope cutthroat trout in streams and rivers will be managed primarily as a wild trout fishery with restrictive regulations.

Within the Washington portion of the Pend Oreille Subbasin, WDFW manages trout fisheries in several isolated lowland lakes utilizing a native westslope cutthroat trout stock, which originated from Granite Creek and Kalispell Creek, which are tributaries to Priest Lake. The broodstock for management efforts utilizing this stock of fish are maintained at Kings Lake in Pend Oreille County (Crawford 1979; J. Whalen, WDFW, personal communication, 2003).

14.5 Focal Species – Mountain Whitefish

Mountain whitefish are a native salmonid distributed throughout the Pend Oreille Subbasin. Although there is very little data regarding the historical distribution, population sizes, seasonal distribution, or migratory patterns of this species in the Subbasin, biologists feel that this species is very important from an ecological standpoint and has potential for greater recreational value. Mountain whitefish often comprises a large proportion of fish biomass in streams (Pettit and Wallace 1975) and contributes to the prey base for other salmonids (for example, bull trout) that occupy the same habitats.

14.5.1 Historic Status

Mountain whitefish occupy both lotic and lentic environments. McPhail and Troffe (2001) describe the historic geographical distribution of mountain whitefish to be extensive in the Columbia River basin. However, mountain whitefish appear to be absent from coastal drainages with the exception of the Puget Sound and the westside river drainages of the Olympic Mountains (McPhail and Troffe 2001).

Mountain whitefish are native to the Pend Oreille Subbasin, however little is known about the specifics of their historical distribution or population sizes. According to McPhail and Troffe (2001) mountain whitefish populations may complete their life cycle exclusively in lakes, rivers, or migrate between lakes and rivers within a drainage system. Mountain whitefish are a forage item for bull trout. As a consequence bull trout may influence the population dynamics, foraging behavior, and growth rates of mountain whitefish (McPhail and Troffe 2001).

14.5.2 Current Status

Few studies exist that describe abundance, distribution, and life history strategies of mountain whitefish in the Pend Oreille Subbasin. Previous investigations by the University of Idaho (Bennett and Liter 1991; Bennett and Garrett 1994) and Eastern Washington University (Ashe and Scholz 1992) found that mountain whitefish were the most numerous salmonid in Box Canyon Reservoir, with 4,385 captured (5.4 percent of the total). A study conducted by Downs et al. (2003) between 1999-2001 estimated mountain whitefish populations (>200 mm) to range between 1,963-26,613 fish. This population estimate was based on a mark-recapture study conducted on the lower Clark Fork River below Cabinet Gorge Dam to the inlet of Foster side-channel (Downs et al. 2003).

In the Lower Pend Oreille Subbasin, mountain whitefish inhabit predominantly lotic environments including the mainstem and tributaries of the Pend Oreille River. They are found primarily in riffle areas in summer and large pools in winter. Tributaries of the Pend Oreille River in Washington are used for spawning and early rearing. These include but are not limited to LeClerc Creek, including East Branch and West Branch, Sand Creek, Sweet Creek, North Fork Skookum Creek, Cee Cee Ah Creek, Cedar Creek, Ruby Creek (Kalispel Tribe 2000). Since mountain whitefish are fall/winter spawners they could likely use any tributary available to them since water temperatures are favorable at that time of year (Whalen, WDFW, personal communication, 2003).

14.5.3 Limiting Factors Mountain Whitefish

Based on QHA results, mountain whitefish identified to be historically present in 62 of 167 delineated reaches and watersheds in the Subbasin. The current distribution has decreased to 23 reaches (63 percent decline). Table 14.13 shows the reaches where mountain whitefish are no longer present and corresponding rank for the degree of habitat deviation from reference conditions. It should be noted in 2003 (after information had been collected for the QHA), WDFW captured mountain whitefish in an adfluvial trap in lower Harvey Creek (WDFW, unpublished data 2003).

Table 14.13. List of 39 reaches where mountain whitefish are not currently present, but were historically present. Reach rank refers to the degree of habitat change from reference to present conditions, 1 = greatest habitat alteration.

Reach Name	Reach Rank
Lower Calispell Creek	1
Middle Branch LeClerc Creek	4
Lower Harvey Creek*	6
Lower Cusick Creek	7
Lower Tacoma Creek	8
Lower Trimble Creek	10
Lower Sand Creek	11
Upper West Branch LeClerc Creek	11
Lower Muddy Creeks	14
Middle Creek	16
Upper Cusick Creek	17
Pass Creek	18
Marshal Lake/Creek	23
Upper Tacoma Creek	27
Upper Ruby Creek	28
Lower Lost Creek	29
Lower Winchester Creek	30
Renshaw Creek	31
Upper Trimble Creek	33
Lost Lake Creek	35
Upper Lost Creek	37
Upper Big Muddy Creek	37
Lower Big Muddy Creek	40
Lower Mill Creek	41
Middle Harvey Creek	42
Upper Cedar Creek	43
North and Middle Fork Harvey Creek	45
Pocahontas Creek	48

Reach Name	Reach Rank
Upper Winchester Creek	49
South Fork Tacoma Creek	49
Little Muddy Creek	49
Three Mile Creek	52
South Fork Calispell Creek	53
Slate Creek	54
South Fork Lost Creek	56
East Fork Small Creek	57
Lower Small Creek	58
Lime Creek	61
Salmo River	62

*Mountain whitefish were captured during WDFW's adfluvial trapping in Harvey Creek (WDFW, unpublished data 2003).

The most disturbed areas appear to be geographically located in the lower Pend Oreille Subbasin (Table 14.14). Fine sediment was the principle change in habitat from reference conditions (see Table 14.26).

Stream habitats that are most similar to reference conditions are primarily concentrated in the Priest River Subbasin and lower Pend Oreille Subbasin (Table 14.15).

The tornado diagram (Table 14.16) and maps (Map PO-5, Map PO-6, located at the end of Section 14) present the reach scores for both current habitat condition (ranging from zero to positive one, Map PO-5) and protection (ranging from zero to negative one, Map PO-6). Scores closest to negative one depict reaches that are most representative of reference habitat conditions. Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

Table 14.14. Ranking of reaches with the largest deviation from the reference habitat conditions for mountain whitefish in the Pend Oreille Subbasin. A reach rank equal to 1 has the greatest deviation from reference condition in comparison to other reaches. Reach scores range from 0 to 1, with 1 having the greatest deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute having the greatest deviation from reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes equally deviate the most from the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
7	Lower Calispell Creek	1	0.4	6	10	4	1	4	2	6	11	6	6	2
1	Main Pend Oreille River	2	0.4	6	2	4	1	9	5	11	10	6	6	3
35	Lower Sullivan Creek	3	0.3	9	2	7	7	3	6	10	10	5	3	1
44	Middle Branch LeClerc Creek	4	0.3	7	2	3	1	6	9	10	10	7	3	5
54	Lower Skookum Creek	5	0.3	5	2	4	1	5	8	9	10	5	3	10
38	Lower Harvey Creek	6	0.2	7	3	4	1	5	6	8	8	8	8	1
76	Lower Cusick Creek	7	0.2	5	3	3	1	7	7	7	7	6	2	7
74	Lower Tacoma Creek	8	0.2	4	2	3	1	6	6	6	6	5	6	6
5	Davis/Kent Creeks	9	0.2	4	2	3	1	8	8	8	5	5	8	7
71	Lower Trimble Creek	10	0.2	6	5	3	2	8	8	8	8	6	3	1
36	Lower Sand Creek	11	0.2	7	4	2	1	2	5	9	9	7	9	5
43	Upper West Branch LeClerc Creek	11	0.2	6	5	6	1	3	3	10	10	6	6	2
42	Middle West Branch LeClerc Creek	13	0.2	7	2	5	1	3	3	10	10	7	7	6
83	Lower Muddy Creeks	14	0.2	6	5	2	1	7	7	7	7	3	3	7
6	McCloud Creek	15	0.2	9	2	4	1	3	5	10	6	6	10	8

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
47	Middle Creek	16	0.2	5	2	5	1	2	4	8	8	7	8	8
77	Upper Cusick Creek	17	0.2	6	2	3	1	8	8	8	8	6	3	5
32	Pass Creek	18	0.2	6	2	4	1	3	5	8	8	6	8	8
45	Lower East Branch LeClerc Creek	19	0.2	7	2	4	1	3	6	9	9	4	7	9
46	Upper East Branch LeClerc Creek	20	0.2	8	3	5	1	2	4	10	10	5	5	9
91	Big/Blue Creeks	21	0.1	5	8	9	1	2	3	10	5	5	10	3
113	Binarch Creek	21	0.1	5	8	9	1	2	3	10	5	5	10	3
3	Marshal Lake/Creek	23	0.1	6	4	2	1	2	5	8	8	6	8	8
31	Middle Sullivan Creek	23	0.1	9	4	4	1	1	6	10	7	7	10	1
52	South Skookum Creek	25	0.1	7	3	4	1	4	8	10	10	4	2	8
53	North Skookum Creek	25	0.1	7	3	4	1	4	8	10	10	4	2	8
75	Upper Tacoma Creek	27	0.1	6	2	2	1	7	7	7	7	5	7	4
79	Upper Ruby Creek	28	0.1	5	3	2	1	6	6	6	6	6	6	4
81	Lower Lost Creek	29	0.1	4	3	4	1	6	6	6	6	2	6	6
64	Lower Winchester Creek	30	0.1	5	4	3	1	6	6	6	6	6	6	2
21	Renshaw Creek	31	0.1	6	6	4	1	2	3	8	8	4	8	8
50	Lower CCA Creek	31	0.1	5	3	5	1	2	4	8	8	5	8	8
72	Upper Trimble Creek	33	0.1	5	4	2	1	6	6	6	6	6	2	6
87	Lower Cedar Creek	34	0.1	4	3	2	1	7	7	7	7	4	7	6
89	Lost Lake Creek	35	0.1	4	2	3	1	5	5	5	5	5	5	5

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
18	Sullivan Lake	36	0.1	7	3	5	2	1	6	8	8	8	8	4
82	Upper Lost Creek	37	0.1	4	3	2	1	6	6	6	6	4	6	6
85	Upper Big Muddy Creek	37	0.1	4	3	2	1	6	6	6	6	4	6	6
56	Lower Indian Creek	39	0.1	5	3	2	1	6	6	6	6	4	6	6
84	Lower Big Muddy Creek	40	0.1	5	3	2	1	6	6	6	6	4	6	6
48	Lower Mill Creek	41	0.1	6	3	5	1	1	4	8	8	6	8	8
39	Middle Harvey Creek	42	0.1	6	3	5	1	1	4	7	7	7	7	7
88	Upper Cedar Creek	43	0.1	4	5	3	2	5	5	5	5	5	5	1
19	Sweet/Lunch Creek	44	0.1	5	2	3	1	3	6	8	8	7	8	8
40	North and Middle Fork Harvey Creek	45	0.1	5	2	4	1	6	6	6	6	6	6	3
78	Lower Ruby Creek	45	0.1	6	3	5	1	1	4	7	7	7	7	7
41	Lower West Brach LeClerc Creek	47	0.1	3	2	3	1	7	7	7	7	6	3	7
17	Pocahontas Creek	48	0.1	6	2	3	1	3	5	8	8	6	8	11
65	Upper Winchester Creek	49	0.1	4	2	3	1	5	5	5	5	5	5	5
73	South Fork Tacoma Creek	49	0.1	4	2	3	1	5	5	5	5	5	5	5
86	Little Muddy Creek	49	0.1	4	2	3	1	5	5	5	5	5	5	5
11	Three Mile Creek	52	0.1	5	2	3	1	6	6	6	6	3	6	6
58	South Fork Calispell Creek	53	0.1	4	2	2	1	5	5	5	5	5	5	5
27	Slate Creek	54	0.1	6	3	5	1	2	4	7	7	7	7	7
57	Upper Indian Creek	55	0.1	4	2	3	1	5	5	5	5	5	5	5

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
80	South Fork Lost Creek	56	0.1	4	2	3	1	5	5	5	5	5	5	5
69	East Fork Small Creek	57	0.1	4	5	3	1	5	5	5	5	5	5	2
67	Lower Small Creek	58	0.0	4	3	2	1	5	5	5	5	5	5	11
125	Upper Priest River	59	0.0	4	1	3	5	5	2	5	5	5	5	5
129	Upper Priest Lake	60	0.0	4	1	3	4	4	2	4	4	4	4	4
12	Lime Creek	61	0.0	6	2	3	1	3	5	8	8	6	8	11
14	Salmo River	62	0.0	1	1	1	1	1	1	1	1	1	1	1

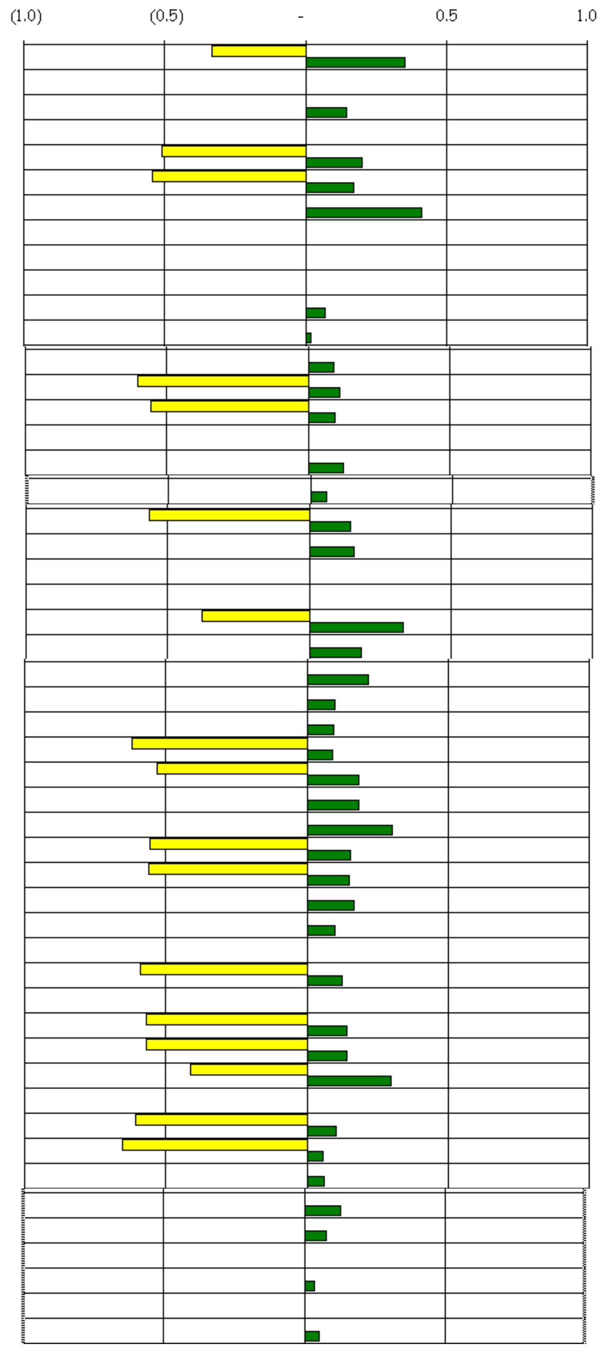
Table 14.15. Ranking of streams whose habitat is most similar to the reference condition for mountain whitefish in the Pend Oreille Subbasin in comparison to other reaches. A reach rank equal to 1 reveals the reach with current conditions most similar to reference conditions in comparison to other reaches. Reach score ranges from 0 to -1, with -1 having the least deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute being most similar to the reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes are equally the most similar to the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
129	Upper Priest Lake	1	-0.69	11	6	10	1	1	7	1	8	8	1	5
125	Upper Priest River	2	-0.69	11	6	10	1	1	7	1	8	8	1	5
57	Upper Indian Creek	3	-0.66	11	7	10	4	1	5	1	8	8	1	5
41	Lower West Brach LeClerc Creek	4	-0.62	11	7	10	6	1	4	1	8	9	3	4
78	Lower Ruby Creek	5	-0.62	11	5	10	6	1	4	1	6	6	1	6
56	Lower Indian Creek	6	-0.61	11	6	10	7	1	4	1	7	9	1	4
18	Sullivan Lake	7	-0.60	11	6	10	3	4	5	1	7	7	1	7
87	Lower Cedar Creek	8	-0.60	11	6	10	7	1	4	1	7	9	1	5
50	Lower CCA Creek	9	-0.59	11	5	9	6	3	6	1	6	9	1	4
52	South Skookum Creek	10	-0.57	11	6	9	7	2	4	1	7	9	3	4
53	North Skookum Creek	10	-0.57	11	6	9	7	2	4	1	7	9	3	4
31	Middle Sullivan Creek	12	-0.57	11	5	10	6	3	6	1	6	9	1	4
91	Big/Blue Creeks	13	-0.57	11	4	8	5	3	5	1	9	9	1	5
113	Binarch Creek	13	-0.57	11	4	8	5	3	5	1	9	9	1	5
46	Upper East Branch LeClerc Creek	15	-0.56	11	5	9	6	3	6	1	6	9	2	4
45	Lower East Branch LeClerc Creek	16	-0.56	11	8	9	5	3	6	1	6	9	2	4
19	Sweet/Lunch Creek	17	-0.56	10	6	9	4	3	5	1	7	8	1	11
6	McCloud Creek	18	-0.54	11	7	10	5	3	5	1	7	7	1	4
42	Middle West Branch LeClerc Creek	19	-0.53	11	7	10	4	3	8	1	4	9	2	4
5	Davis/Kent Creeks	20	-0.51	11	9	10	8	1	4	1	6	6	1	5

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
54	Lower Skookum Creek	**21**	-0.41	10	8	8	10	2	5	1	5	7	4	3
35	Lower Sullivan Creek	**22**	-0.38	10	8	7	2	3	6	1	3	9	3	11
1	Main Pend Oreille River	**23**	-0.33	8	8	6	8	2	5	1	4	6	3	8

Table 14.16. Tornado diagram for mountain whitefish in the Pend Oreille Subbasin. Degree of confidence for protection and current habitat conditions range from 0.0 to 1.0 with the greatest confidence equal to 1.0. Protection reach scores are presented on the left side and current habitat reach scores are presented on the right. Negative scores are in parentheses.

NP = Not present



Sequence	Reach Name	Protection Confidence	Current Habitat Condition Confidence
1	Main Pend Oreille River	0.50	0.38
2	Bead Lake	NP	
3	Marshal Lake/Creek	0.42	0.21
4	Shearer Lake	NP	
5	Davis/Kent Creeks	0.42	0.21
6	McCloud Creek	0.50	0.25
7	Lower Calispell Creek	0.33	0.17
8	Kalispel Reservation	NP	
9	Dry Canyon	NP	
10	Maitlen Creek	NP	
11	Three Mile Creek	0.33	0.17
12	Lime Creek	0.50	0.25
17	Pocahontas Creek	0.50	0.25
18	Sullivan Lake	0.50	0.25
19	Sweet/Lunch Creek	0.50	0.25
20	Power Plant	NP	
21	Renshaw Creek	0.50	0.25
27	Slate Creek	0.50	0.25
31	Middle Sullivan Creek	0.50	0.25
32	Pass Creek	0.50	0.25
33	Mill Pond	NP	
34	North Fork Sullivan Creek	NP	
35	Lower Sullivan Creek	0.50	0.25
36	Lower Sand Creek	0.50	0.25
38	Lower Harvey Creek	0.50	0.25
39	Middle Harvey Creek	0.50	0.25
40	North and Middle Fork Harvey Creek	0.50	0.25
41	Lower West Brach LeClerc Creek	0.50	0.25
42	Middle West Branch LeClerc Creek	0.50	0.25
43	Upper West Branch LeClerc Creek	0.50	0.25
44	Middle Branch LeClerc Creek	0.50	0.25
45	Lower East Branch LeClerc Creek	0.50	0.25
46	Upper East Branch Leclerc Creek	0.50	0.25
47	Middle Creek	0.50	0.25
48	Lower Mill Creek	0.50	0.25
49	Upper Mill Creek	NP	
50	Lower CCA Creek	0.50	0.25
51	Upper CCA Creek	NP	
52	South Skookum Creek	0.50	0.25
53	North Skookum Creek	0.50	0.25
54	Lower Skookum Creek	0.50	0.25
55	Upper Skookum Creek/Lakes	NP	
56	Lower Indian Creek	0.33	0.17
57	Upper Indian Creek	0.50	0.25
58	South Fork Calispel Creek	0.50	0.25
64	Lower Winchester Creek	0.33	0.17
65	Upper Winchester Creek	0.50	0.25
66	Dorchester Creek	NP	
67	Lower Small Creek	0.33	0.17
68	Upper Small Creek	NP	
69	East Fork Small Creek	0.50	0.25

71	Lower Trimble Creek	0.33	0.17
72	Upper Trimble Creek	0.33	0.17
73	South Fork Tacoma Creek	0.50	0.25
74	Lower Tacoma Creek	0.33	0.17
75	Upper Tacoma Creek	0.50	0.25
76	Lower Cusick Creek	0.33	0.17
77	Upper Cusick Creek	0.50	0.25
78	Lower Ruby Creek	0.50	0.25
79	Upper Ruby Creek	0.50	0.25
80	South Fork Lost Creek	0.50	0.25
81	Lower Lost Creek	0.50	0.25
82	Upper Lost Creek	0.50	0.25
83	Lower Muddy Creeks	0.33	0.17
84	Lower Big Muddy Creek	0.50	0.25
85	Upper Big Muddy Creek	0.50	0.25
86	Little Muddy Creek	0.50	0.25
87	Lower Cedar Creek	0.33	0.17
88	Upper Cedar Creek	0.50	0.25
89	Lost Lake Creek	0.33	0.17
90	Pine/ Peewee Creeks	NP	
91	Big/Blue Creeks	0.17	0.21

14.5.4 Current Management
Within the Pend Oreille Subbasin, mountain whitefish are currently managed under statewide size and daily bag limits for recreational fishing for this species, which identify no minimum size and a daily limit of 15 fish (Washington) and 25 fish (Idaho). Biologists have recognized the ecological and recreational importance of mountain whitefish and are aware of the many data gaps associated with this species. To avoid over exploitation of this species and create a baseline for future management strategies, more information is needed regarding life history strategies, population sizes, abundance, capacity, and genetic integrity.

14.6 Focal Species – Kokanee
Kokanee are not native to the Pend Oreille Subbasin but have established themselves as a keystone species in Lake Pend Oreille since being introduced through emigration from Flathead Lake in the 1930s. Kokanee are an important food item for bull trout, rainbow trout, lake trout, bald eagles, and other wildlife. In addition, kokanee provide cultural and recreational value.

14.6.1 Historic Status of Kokanee
Kokanee from Whatcom Lake, Washington were introduced into Flathead Lake, Montana in 1916. The species moved downstream into Lake Pend Oreille in a flood in 1933 (N. Horner, IDFG, personal communication, July 2003). Sustainable populations were established by the 1950s in Lake Pend Oreille and Priest Lake. Kokanee were also introduced in Sullivan Lake and Bead Lake in the early 1900s; however, the origin of these kokanee is unknown.

14.6.1.1 Lake Pend Oreille Kokanee
The Lake Pend Oreille kokanee fishery was one of the most significant kokanee fisheries in the western U.S. and Canada from the 1940s to the 1970s (Bowles et al. 1991). From 1951 to 1965, kokanee harvest averaged 1 million fish annually with a high of 1.3 million

fish in 1953. This made Lake Pend Oreille the largest fishery in Idaho. Kokanee abundance began declining dramatically in 1966 concurrent with deeper drawdowns of the lake (Maiolie and Elam 1993) and the introduction of Mysis shrimp (*Mysis relicta)* (Figure 14.5). Further discussions about the decline of kokanee and efforts to rebuild the population in Lake Pend Oreille are presented in the next section, 14.6.2 Current Status.

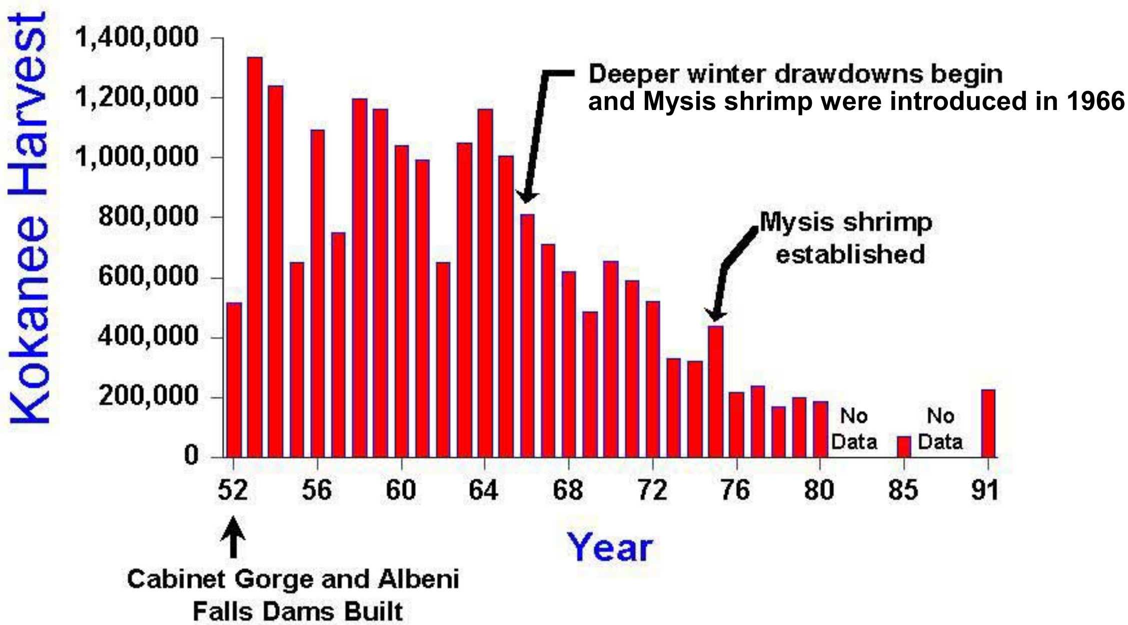


Figure 14.5. Decline in kokanee harvest from Lake Pend Oreille, Idaho concurrent with the deeper winter drawdowns and introduction of Mysis shrimp in the 1966. The establishment of Mysis shrimp occurred in the 1970s.

14.6.1.2 Priest Lake Kokanee

Kokanee were introduced into Priest Lake in the late 1940s from the same stock that colonized Lake Pend Oreille. They provided a very popular high yield fishery from the early 1950s until the early 1970s (Bowles et al. 1991) (refer to Figure 14.1). From 1956 to 1970 the average annual kokanee harvest was over 60,000 fish (Rieman et al. 1979, as cited in Bowles et al. 1991). Mysis shrimp were introduced to Priest Lake from 1965 to 1968 and became well established by the early 1970s concurrent with the increase in lake trout, which benefited from Mysis shrimp forage (Bowles et al. 1991). The kokanee fishery in Priest Lake collapsed in 1976, eight years after the introduction of Mysis shrimp (Bowles et al. 1991). Lake trout predation is believed to be the principal factor for fishery collapse (Bowles et al. 1991). In 2001, a substantial number of kokanee were observed spawning on a historic spawning bed in Priest Lake. Since then, the numbers have increased to where in 2003, over 3000 kokanee were recorded in single spawner counts along the shoreline of Priest Lake. Refer to Section 14.1.2, Artificial Production under subheading Priest River for more information regarding kokanee in Priest Lake.

14.6.1.3 Sullivan Lake Kokanee

The first documented stocking of kokanee in Washington state was in Sullivan Lake in 1904 when the U.S. Bureau of Fisheries planted 10,000 fry of unknown origin (Crawford 1979). Since then, kokanee were only stocked from 1933-1944 and once in 1976 by WDFW (Table 14.17) (WDFW, unpublished data).

Table 14.17. WDFW kokanee stocking records in Sullivan Lake 1933-1944, and 1976

Lake	Year	Number	Lake	Year	Number
Sullivan	1933	110000	Sullivan	1942	852700
Sullivan	1934	86000	Sullivan	1943	1500000
Sullivan	1935	75625	Sullivan	1943	60000
Sullivan	1936	54000	Sullivan	1944	190500
Sullivan	1936	23840	Sullivan	1944	76200
Sullivan	1937	60000	Sullivan	1944	228500
Sullivan	1937	15000	Sullivan	1945	92009
Sullivan	1938	200000	Sullivan	1945	184018
Sullivan	1939	227450	Sullivan	1945	92009
Sullivan	1940	73666	Sullivan	1945	337337
Sullivan	1941	208800	Sullivan	1976	197960

(*Source:* WDFW, unpublished data).

14.6.1.4 Bead Lake Kokanee

Historical stocking records from WDFW (unpublished data) indicate kokanee were stocked in Bead Lake between 1933 and 1949 (Table 14.18).

Table 14.18. The year and number of kokanee stocked in Bead Lake between 1933 and 1949

Lake	Year	Number	Lake	Year	Number
Bead	1933	216287	Bead	1945	249900
Bead	1934	175000	Bead	1945	373000
Bead	1935	140000	Bead	1945	374000
Bead	1935	60000	Bead	1945	183910
Bead	1935	56000	Bead	1946	149950
Bead	1935	23420	Bead	1946	199900
Bead	1936	150000	Bead	1946	399800
Bead	1937	99615	Bead	1946	178850
Bead	1938	150000	Bead	1947	323800
Bead	1938	77108	Bead	1947	237950
Bead	1939	318580	Bead	1947	12639
Bead	1940	299700	Bead	1947	8500
Bead	1941	828465	Bead	1947	33797

Lake	Year	Number
Bead	1941	362830
Bead	1941	147400
Bead	1942	229800
Bead	1943	850150
Bead	1943	100000
Bead	1943	98000
Bead	1944	99900
Bead	1944	99900
Bead	1944	99900
Bead	1944	99900
Bead	1944	99900
Bead	1944	99900
Bead	1944	99099
Bead	1944	99900
Bead	1944	99900
Bead	1944	144500

Lake	Year	Number
Bead	1947	22228
Bead	1947	7200
Bead	1947	5850
Bead	1947	17600
Bead	1947	9798
Bead	1948	15106
Bead	1948	33000
Bead	1948	27334
Bead	1948	244000
Bead	1949	36791
Bead	1949	35990
Bead	1949	64716

(*Source*: WDFW unpublished data)

14.6.2 Current Status

In the Pend Oreille Subbasin, kokanee salmon are currently present in Bead Lake, Sullivan Lake, Mill Pond, Priest Lake, Upper Priest Lake, and Lake Pend Oreille. Populations in Lake Pend Oreille had dropped significantly and are currently showing signs of recovery. The Priest Lake population, which had collapsed in the 1970s, may be making a comeback with spawner counts increasing over the last three years. Upper Priest Lake populations appear to remain depressed. Bead and Sullivan lakes have self-sustaining populations, however the Sullivan Lake kokanee population was enhanced in 2002 and 2003 through manual egg collection, rearing of fry in the Colville Hatchery, and release of fingerlings back into the lake.

14.6.2.1 Lake Pend Oreille Kokanee

Kokanee salmon populations in Lake Pend Oreille have declined precipitously since the mid-1960s (Figure 14.6). The kokanee population in Lake Pend Oreille is monitored annually by mid-water trawling and hydroacoustics. In 1999, kokanee abundance (ages 1 to 5) hit an all-time low of 2.8 million, with a biomass with a biomass of 249 metric tons, an annual production rate of 256 metric tons, and an annual yield to all sources of mortality of 271 metric tons (Maiolie et al. 2002). For comparison, abundance (ages 1 to 5) was 7.3 million kokanee in 1996, with a biomass of 353 metric tons, an annual production rate of 278 metric tons, and an annual yield of 275 metric tons (IDFG files). By 2003, kokanee abundance had turned the corner and recovered to pre-1997 flood estimates with total abundance (ages 1 to 5) estimated at 5.7 million (Maiolie et al. 2002).

These recent declines in kokanee abundance are considered very serious since even the higher abundance observed in 2003 was only at one-quarter of the population's recovery goal for an adult population size of 3.75 million. This estimate for an adult population size would allow for a harvest goal of 750,000 fish per year. In an effort to re-establish a harvestable kokanee population, the kokanee fishery has been closed since 2000.

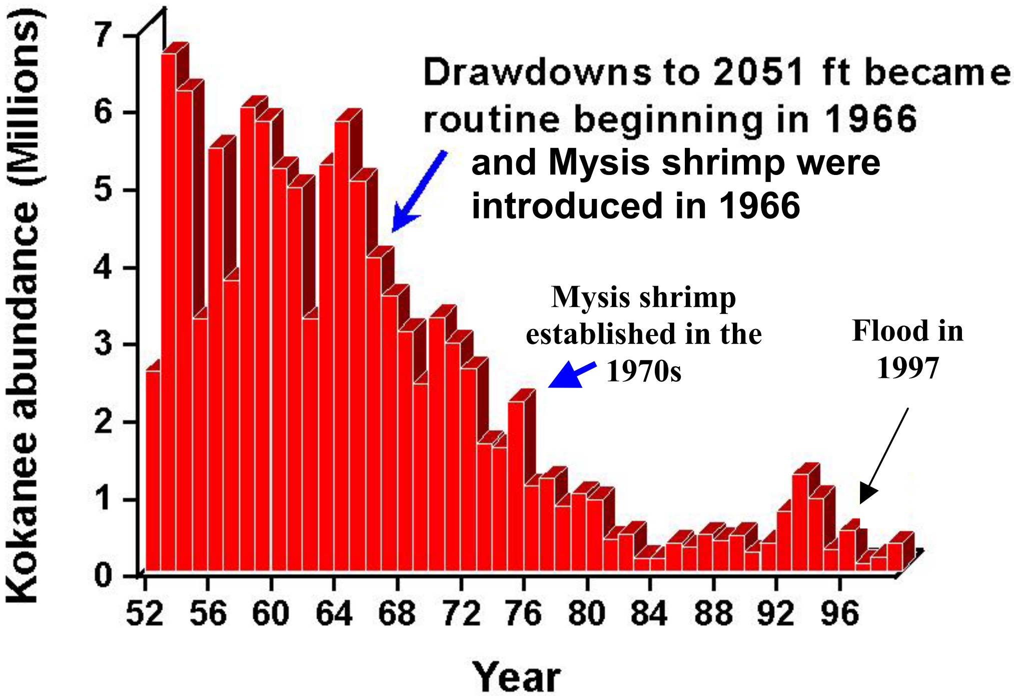


Figure 14.6. Estimates of kokanee abundance in Lake Pend Oreille, Idaho

There are several factors that have been identified with the decline of kokanee including competition by Mysis shrimp with kokanee fry for cladoceran zooplankters (Rieman and Falter 1981; Rieman and Bowler 1980), reductions of shoreline spawning gravels from dam operations (Maiolie et al. 2002; Fredericks et al. 1995; Paragamian and Ellis 1994; Maiolie and Elam 1993; Bowles et al. 1991), an increasing effect of predation as a result of the kokanee population being low (Maiolie et al. 2002), and a possible increase of predatory fish as a result of the Mysis shrimp prey base (M. Maiolie, Fisheries Biologist, IDFG, personal communication, 2003).

In general Mysis shrimp introduction in northern Idaho has resulted in both positive and negative effects on the fish community (Bowles et al. 1991). The overall management strategy associated with Mysis shrimp introduction in North America lakes has been to enhance the forage base for kokanee (Northcote 1991). However, long-term effects have often been detrimental (Bowles et al. 1991; Northcote 1991). Kokanee declines have been documented to be a result of competition between kokanee fry and Mysis shrimp for cladoceran zooplankters such as *Daphnia* spp. and *Bosmina longirostris* (Rieman and Falter 1981; Rieman and Bowles 1980). Higher mortality of smaller kokanee is consistent with the hypothesis Mysis shrimp adversely affect kokanee during their post-emergent stage of development while larger kokanee fry probably are able to feed more effectively on alternative forage items (Bowles et al. 1991). However, Clarke and Bennett (2002) found (in an in situ net pen experiment in Lake Pend Oreille) growth and survival of emergent kokanee fry was possible on a diet dominated by copepods rather than cladoceran, thus contesting the previously mentioned hypothesis.

Mysis shrimp were introduced to Lake Pend Oreille in 1966 and in 1970 totaling between 50,000 to 300,000 Mysis shrimp (Rieman and Falter 1981). Water samples were not initiated until September 1969 (Rieman 1976), and Mysis shrimp were not detected in the water samples until 1972, six years after the initial introduction (Bowles et al. 1991). Shortly thereafter in 1976 (ten years after initial introduction), the Mysis shrimp population reached carrying capacity (Rieman and Falter 1981). Other studies have also shown within a period of 6 to 10 years after initial introduction, Mysis shrimp can establish a dense population (Langeland et al. 1991; Martinez and Bergersen 1991; Naesje et al. 1991). Additionally, this trend was observed in Flathead Lake located in northwest Montana, where Mysis shrimp approached carrying capacity within 10 years of introduction. In Lake Pend Oreille, records show kokanee harvest had decreased to one-third its former level before Mysis shrimp became well established in the 1970s (Figure 14.5).

Once Mysis shrimp were well established in Lake Pend Oreille (mid-1970s), it was hypothesized that Mysis shrimp were out-competing kokanee fry for cladoceran zooplankters (Rieman and Bowler 1980, Rieman and Falter 1981) since the adult kokanee numbers continued to decline after some adjustments were made to Albeni Falls Dam operations in the mid-1970s. Later it was concluded that Mysis shrimp provided no benefit for older age-classes of kokanee and provided "no indication of negative effects [to kokanee] either" (Bowles et al. 1991).

The establishment of Mysis shrimp in Lake Pend Oreille resulted in a less dramatic reduction in cladoceran zooplankters compared to Lake Tahoe where the kokanee population decline followed the establishment of Mysis shrimp (Bowles et al. 1991). In contrast to Lake Tahoe, the morphological characteristics of kokanee in Lake Pend Oreille, such as weight and length of kokanee, did not decline after the establishment of Mysis shrimp (Bowles et al. 1991) and the competition between Mysis shrimp and age-1 and older kokanee was concluded to be minimal (Maiolie et al. 2002; Clarke 1999; Bowles et al. 1991).

Fredericks et al. (1995) found significant declines in shoreline kokanee spawners, but no significant change in abundance of tributary spawning runs in the 1970s. From these data, Fredericks et al (1995) concluded kokanee abundance was related to survival and habitat of the shoreline spawning stock rather than competition from Mysis shrimp. Research by Maiolie et al. (2002) supported this conclusion and found zooplankton abundance was high enough to allow expansion of kokanee. High numbers of Mysis shrimp were not correlated to poorer kokanee egg-to-fry survival.

Historical population trends and harvest data from the 1950s and 1960s indicate winter pool elevation at Albeni Falls Dam affects both kokanee abundance and harvest (Maiolie and Elam 1993). Between 1955 and 1965, winter minimum elevations were about 626.7 m for flood control, while beginning in 1966 the lake was drawn down to 625.3 m to enhance power production (Maiolie and Elam 1993). The change in drawdown (in 1966) occurred concurrent with the previously mentioned introduction of Mysis shrimp (Reiman and Falter 1981). The annual drawdown level necessary for adequate flood control downstream remains in dispute. Residents of Pend Oreille County (Cusick Valley) remain concerned regarding management of lake levels upstream, specifically for Lake Pend Oreille and the potential flooding impacts downstream. Reducing the flood storage of one or several of the reservoirs upstream may in effect change the timing of higher spring flows and incrementally increase the potential frequency and duration of flooding downstream in places such as the lower Pend Oreille River Valley. Refer to Section 18, Pend Oreille Management Plan, to see how objectives and strategies incorporate concerns regarding the flooding issue in the lower Pend Oreille River Valley. Refer to Appendix J for more information regarding flooding concerns expressed by participants in the Pend Oreille Subbasin Work Team, as well as other IMP Subbasin planning participants.

There are two issues regarding winter drawdown and kokanee survival and abundance including the date at which the minimum winter elevation is stabilized (November 15th) and the actual winter pool elevation (Fredericks et al. 1995). Stabilizing the winter minimum elevation helps improve egg-to-fry survival while the winter pool elevation determines the area and location of suitable spawning gravels for kokanee (Fredericks et al. 1995). Historically when the winter pool level was higher than 625 m, kokanee were observed spawning in all shoreline areas of Lake Pend Oreille (Jeppson 1960). Consistent annual drawdowns of the lake to about 625m (2051 ft) exposes much of the historic shoreline gravel and limits kokanee spawning habitat (Fredericks et al. 1995; Maiolie and Elam 1993). Fredericks et al. (1995) estimated an area of 231,000 m^2 of suitable spawning gravel (<35 percent fine sediment) exists below the lake elevation of 626.7 m with 85 percent (196,000 m^2) of the suitable spawning gravel located between the lake elevations 625.1 m and 626.7 m. However, under current operations the lake elevation in September is drawn down to 625.1 m from the summer pool elevation of 628.6 m, which prevents access to 85 percent of the potential spawning habitat along the shoreline (Fredericks et al. 1995). Substrate below the winter pool elevation (625.1 m) consists of more large cobble and fine sediments (Maiolie and Elam 1993).

Currently, Lake Pend Oreille kokanee primarily spawn in the south end in Scenic Bay and near Bayview where spawning gravel are exposed to greater wave activity (Fredericks et al. 1995). Wave action sorts and cleans the gravel on the shorelines creating silt-free areas for kokanee spawning. Hassemer (1984, as cited in Maiolie and Elam 1993) estimated about 10 percent of the redds found were in areas of clean gravel and the remaining kokanee were spawning in poorer substrate, cleaning 1 to 4 cm of fine sediment before reaching clean gravel. Maiolie and Elam (1993) found historic spawning areas with high quality, clean wave-washed gravel was above the water line during winter drawdown (~625 m). As a result of lower winter pool elevations, the quality of available spawning substrate in these once prominent spawning grounds declined and substrate below the waterline contained more fine sediments (Maiolie and Elam 1993). Suitable spawning gravels were defined as areas with fine sediments (< 6 mm) representing less than 35 percent of the substrate (Fredericks et al. 1995). Gravel surveys conducted in

1994 determined that an increase of 1.6 m in the winter pool level (lake elevation raised to 626.7 m) would result in an increase in the amount of suitable kokanee spawning gravel by 560 percent from 35,370 m^2 at 625.1 m to 197,685 m^2 at 626.7 m (Fredericks et al. 1995). The additional spawning area would support an estimated additional 1.6 million female kokanee, which translates to a potential increase of about 390,000 female kokanee per 0.3 m increase in elevation (Fredericks et al. 1995). The expansion of spawning locations would also reduce potential for competition among fry (Fredericks et al. 1995).

The Council directed the USACE to change the winter elevation of Lake Pend Oreille beginning in 1996. The lake was to be kept above an elevation of 626 m (2055 ft) for three winters. The IDFG investigated the effect of changed lake levels on kokanee production, the movements of shoreline gravel and sediment, and changes in the abundance of warmwater fish species in the Pend Oreille River. The higher winter lake level (626 m) provided an additional 160,767 m^2 of suitable gravel available for kokanee (Fredericks et al. 1995). Kokanee utilized the newly available gravel for spawning and the survival rate for kokanee eggs-to-fry increased from 1.4 percent in 1995 to 9.6 percent in 1998, 6.0 percent in 1999, 10 percent in 2000, and 7 percent in 2001 (Maiolie et al. 2002). Summary results through 2001 are available in the completion report prepared for BPA by Maiolie et al. (2002).

Maiolie et al. (2002) also investigated questions regarding predation levels, the lake's energy budget, zooplankton, food availability for kokanee, Mysis shrimp, and Eurasian water milfoil (*Myriophyllum spicatum*). The study found survival rates of kokanee egg-to-fry improved with the higher winter pool elevation. In addition, locations of suitable spawning gravels changed and expanded with the higher winter pool elevation. Growth and food resources were not limiting for any age class of kokanee. However, predation was found to be high and limiting kokanee abundance in 2000 and 2001 (Maiolie et al. 2002). However by 2003, survival rates of kokanee improved. Kokanee biomass in the lake is increasing, indicating the population is recovering. The higher winter pool elevation also increased the numbers of warmwater fish in the Pend Oreille River (above Albeni Falls Dam) (Maiolie et al. 2002; Karchesky 2002). Lake levels were not found to influence the presence or absence of Eurasian milfoil, which is already well established in the Pend Oreille River above Albeni Falls Dam (Maiolie et al. 2002).

In addition to spawning habitat as a limiting factor, the growth of other exotic populations may be considered. There are a number of predatory fishes (lake trout, bull trout, and Kamloops trout) residing in Lake Pend Oreille contributing to the complexity of the lake's ecology. Recent lake trout population estimates show only 5,200 to 8,100 lake trout over 20 inches in length reside in Lake Pend Oreille (Peterson and Maiolie 2004), indicating a relatively low abundance of lake trout (M. Maiolie, Fisheries Biologist, IDFG, personal communication, 2004). Thus, lake trout predation is not considered a significant factor in depressing kokanee populations (M. Maiolie, Fisheries Biologist, IDFG, personal communication, 2004). Some believe the introduction of the Mysis shrimp in the mid-1960s were beneficial to the lake trout populations in Lake Pend Oreille while adversely impacting kokanee much like the case in Priest Lake (refer to

Bowles et al. 1991) (refer to Section 14.1.2 under subheading Priest River and Section 14.6.1 under subheading Priest Lake). However, the current abundance estimates of lake trout in Lake Pend Oreille (Peterson and Maiolie 2004) does not support this argument, since the lake trout population remains low after 80 years in the lake.

14.6.2.2 Priest Lake and Upper Priest Lake Kokanee

Currently, there are not enough kokanee in Priest Lake to contribute to the fishery. Based on information presented by Bowles et al. (1991), the rehabilitation of the kokanee fishery in Priest Lake did not appear possible in 1991. However, kokanee appear to be making a comeback in Priest Lake without hatchery enhancement. In 2003, over 3000 kokanee spawners were observed along the shoreline in a single weekend count (IDFG files). Spawner counts remained high for three weeks (IDFG files). Refer to Section 14.1.2 Artificial Production under subheading Priest River for more information regarding kokanee in Priest Lake.

In Upper Priest Lake, the last kokanee population survey was conducted in 1989 and estimated 15,700 kokanee (M. Maiolie, Fisheries Biologist, IDFG, personal communication, 2004). Currently, kokanee are still observed spawning on the shoreline and in tributaries in Upper Priest Lake (M. Maiolie, Fisheries Biologist, IDFG, personal communication, 2004). Kokanee are also present in lake trout stomach samples.

14.6.2.3 Sullivan Lake Kokanee

Sullivan Lake is important biologically for its self-sustaining kokanee population. However, the kokanee population has been enhanced the last couple of years (2002 and 2003) through manual egg collection, off site rearing at the Colville Hatchery, and planting fingerlings back in the lake (C. Vail, WDFW, personal communication, 2004). Genetic analysis by Dr. Scholz (Eastern Washington University) confirmed that the Sullivan Lake kokanee are not from the Lake Whatcom stock, but are distantly similar to the Rimrock Lake stock in WDFW Region 2 (C. Vail, WDFW, personal communication, 2004). Sullivan Lake kokanee spawn in Harvey Creek, which flows into the lake at its south end. In 2002 a pilot study was conducted to estimate the kokanee spawning population in Harvey Creek. A sum total of 3,498 unmarked kokanee were collected in the up and downstream traps, including the adjusted carcass count and the supplemental collections (McLellan, WDFW, personal communication, 2003). However, WDFW suspects the abundance of kokanee spawners was underestimated due to technical problems with the trap and will repeat this survey in fall of 2003 with a modified method.

Factors limiting kokanee in Sullivan Lake include a scarcity of stream spawning habitat and the fluctuation of lake level controlled by Sullivan Lake Dam during the spawning season (Andonaegui 2003). Sullivan Lake Dam was originally constructed in 1910 as a wood crib dam and raised the natural lake level 25 feet. The wood crib dam was replaced with a concrete structure in 1922 and does not have a fish passage facility. The dam continues to raise the natural lake level by about 25 feet between June and October. Approximately 1,000 feet of suitable spawning habitat exists in lower Harvey Creek before flows become subsurface. Approximately 12 miles of suitable habitat is presently inaccessible to kokanee above this barrier. The streambed condition may be due to disruption of the hydraulic capability of the stream to move its bedload by the artificially higher level of the lake. However, it is unclear whether Harvey Creek has experienced an altered flow regime (USFS 1999ce, as cited in Andonaegui 2003).

Currently, there are also some kokanee present in Mill Pond. These kokanee spawn and rear in Sullivan Creek. Biologists have not determined whether this is a remnant kokanee population of sockeye prior to hydro development on the Pend Oreille River or originate from historical stocking conducted (Andonaegui 2003). Kokanee have not been stocked in Eastern Washington streams since the mid-1980s (USFS 1996).

14.6.2.4 Bead Lake Kokanee

At present, the Bead Lake fish community consists of kokanee, peamouth, northern pikeminnow, lake trout, pygmy whitefish, burbot, and largescale suckers (Figure 14.7). Currently, there are an estimated 39,755 kokanee (> 150mm) in Bead Lake based on a hydroacoustic and gill net survey conducted in September 1999 by WDFW (Polacek et al. 1999, unpublished data). The majority of kokanee spawn along the shoreline. Sexually mature kokanee spawners range in size 238-311 mm (Polacek et al. 1999, unpublished data) and do not appear to have changed size over the past two decades (C. Vail, Fisheries Biologist, WDFW, personal communication, 2004).

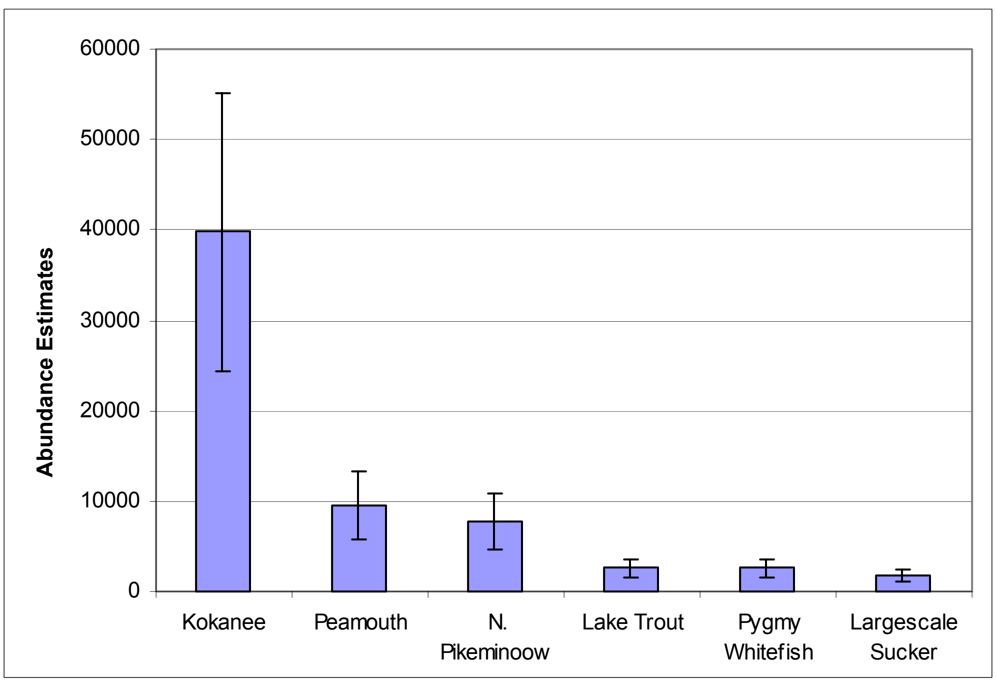


Figure 14.7. Estimated abundance numbers (± 2 standard errors of acoustic abundance) for species greater than 150 mm (Source: Polacek et al. 1999, unpublished data). Burbot were undetected during survey, but observed by local anglers.

The lake habitat is generally of high quality with cool water temperatures and low levels of fine material. Where spawning material is available, it has a low level of embeddedness. However, the littoral habitat having a more gentle topography and suitable substrate material is along the private shoreline. The rest of the lake has a steepened shoreline unsuitable for spawning habitat with very little riparian or littoral habitat.

At present spawning habitat does not appear to be a limiting factor based on field observations (C. Vail, Fisheries Biologist, WDFW, personal communication, 2004). However, human activities are present in the drainage and could potentially influence spawning habitat in the future. The majority of residential development occurs on the shoreline and the loss of riparian vegetation, soil erosion, and potential increase in nutrients from old septic leakage could negatively impact kokanee spawners in the future.

14.6.3 Limiting Factors Kokanee Salmon

Kokanee are a lake species that often utilize riverine habitat for spawning and rearing, thus were included in the QHA approach to identify potential limiting factors to the life stage, spawning and incubation. The QHA method does not evaluate the condition of lake habitats, rather it only considers riverine habitat. Shoreline spawners would thus be excluded from this analysis since this life strategy uses lake habitat. Habitat disturbances impacting kokanee related to or caused by lake level changes were not examined and cannot be addressed through the QHA method. Details of the QHA process are provided in Section 3. Historically, kokanee were not present in the Pend Oreille Subbasin. However, for the purposes of analyzing the species with the QHA, it was necessary to rank the "historic" habitat for the species in the reaches where they presently exist. (QHA will not produce output for reaches where the species is rated as not being present historically.) Another way to consider this was that "historically present" meant "pre-dam construction" for the purpose of kokanee analysis. Kokanee were rated as being historically present in 18 of 167 delineated reaches and watersheds in the Pend Oreille Subbasin. Present habitat conditions of all 18 reaches were compared to reference conditions.

The riverine habitat attributes that were altered the most included channel stability, fine sediments, and low flows (see Table 14.19, also see 14.26). Many of the most disturbed habitats include the lower Clark Fork River and tributaries to Lake Pend Oreille. Kokanee are no longer present in Hoodoo Creek and the Pend Oreille River above Albeni Falls Dam (Table 14.19). The reaches that are most representative of reference habitat conditions are randomly distributed throughout the Subbasin. Upper Priest Lake is ranked the least disturbed, followed by Lake Sullivan watershed and Lake Pend Oreille tributaries (Table 14.20).

The tornado diagram (Table 14.21) and maps (Map PO-7, Map PO-8, located at the end of Section 14) present the reach scores for both current habitat condition (ranging from zero to positive one, Map PO-7) and protection (ranging from zero to negative one, Map PO-8). Scores closest to negative one depict reaches that are most representative of reference habitat conditions. Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

Table 14.19. Ranking of reaches with the largest deviation from the reference habitat conditions for kokanee in the Pend Oreille Subbasin. A reach rank equal to 1 has the greatest deviation from reference condition in comparison to other reaches. Reach scores range from 0 to 1, with 1 having the greatest deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute having the greatest deviation from reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes equally deviate the most from the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
167	Clark Fork River (below Cabinet Gorge Dam)	1	0.4	10	5	6	8	3	3	10	6	9	1	2
166	Lightning Creek below Porcupine Creek	2	0.3	10	1	3	5	5	1	10	5	9	5	4
110	Pend Oreille River above Albeni Falls Dam	3	0.3	10	1	6	1	1	1	10	6	9	6	1
108	Hoodoo Creek	4	0.3	10	4	3	1	4	1	4	10	9	4	4
38	Lower Harvey Creek	5	0.2	7	1	4	2	5	5	7	7	7	7	2
158	Granite Creek (LPO)	6	0.2	8	1	4	4	4	1	8	8	7	8	1
5	Davis/Kent Creeks	7	0.2	7	1	3	1	7	7	7	4	6	7	5
159	Cedar Creek	8	0.2	9	4	7	2	4	2	9	4	7	9	1
161	(South) Gold Creek	9	0.2	8	3	6	2	3	3	8	8	8	1	7
163	Twin Creek	10	0.2	8	1	3	1	3	3	8	6	7	8	8
160	North Gold Creek	11	0.1	8	2	2	1	2	2	8	8	7	2	11
162	Johnson Creek	12	0.1	8	1	3	1	3	3	8	6	7	8	11
1	Main Pend Oreille River	13	0.1	8	2	8	8	4	2	8	7	4	4	1
155	Trestle Creek	14	0.1	8	1	6	1	8	1	8	8	7	1	5
18	Sullivan Lake	15	0.1	7	2	5	2	1	5	7	7	7	7	4
93	Johnson Creek (Pend Oreille River)	16	0.1	6	2	4	1	6	2	6	6	4	6	6

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
164	Lightning Creek above Rattle Creek	17	0.1	6	1	3	6	1	6	6	3	5	6	6
129	Upper Priest Lake	18	0.0	4	1	3	4	4	1	4	4	4	4	4

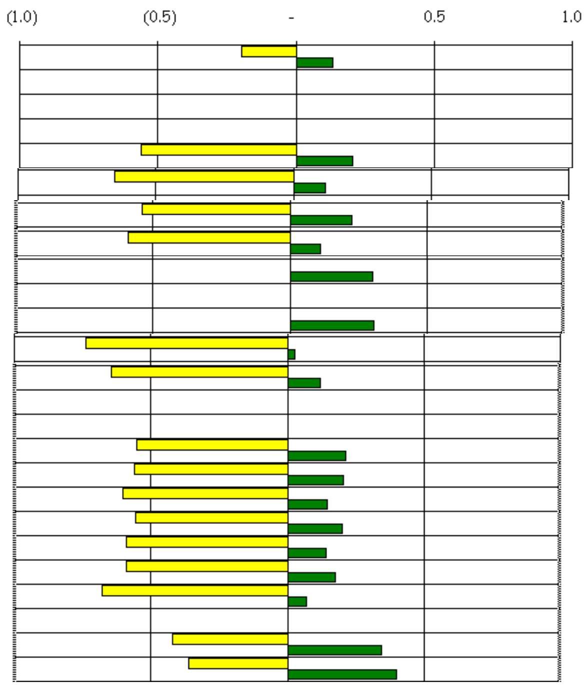
Table 14.20. Ranking of streams whose habitat is most similar to the reference condition for kokanee in the Pend Oreille Subbasin in comparison to other reaches. A reach rank equal to 1 reveals the reach with current conditions most similar to reference conditions in comparison to other reaches. Reach score ranges from 0 to -1, with -1 having the least deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute being most similar to the reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes are equally the most similar to the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
129	Upper Priest Lake	1	-0.74	11	6	9	1	1	6	1	1	10	1	8
164	Lightning Creek above Rattle Creek	2	-0.68	11	6	9	1	6	1	1	5	10	1	8
18	Sullivan Lake	3	-0.65	11	5	9	5	7	4	1	1	10	1	8
155	Trestle Creek	4	-0.64	11	4	9	4	1	4	1	1	10	4	8
160	North Gold Creek	5	-0.60	11	3	9	8	3	3	1	1	10	3	7
162	Johnson Creek	6	-0.59	11	7	9	7	4	4	1	3	10	1	6
93	Johnson Creek (Pend Oreille River)	7	-0.59	10	5	8	7	1	5	1	1	9	1	10
163	Twin Creek	8	-0.59	11	7	9	7	4	4	1	3	10	1	6
159	Cedar Creek	9	-0.56	11	3	8	6	3	6	1	3	10	1	9
5	Davis/Kent Creeks	10	-0.56	11	7	10	7	1	1	1	5	9	1	6
161	(South) Gold Creek	11	-0.56	11	3	8	6	3	3	1	1	9	9	6
158	Granite Creek (LPO)	12	-0.55	11	6	8	4	4	6	1	1	10	1	9
38	Lower Harvey Creek	13	-0.54	11	7	10	6	4	4	1	1	8	1	9
166	Lightning Creek below Porcupine Creek	14	-0.42	9	9	8	2	2	9	1	2	7	2	6
167	Clark Fork River (below Cabinet Gorge Dam)	15	-0.36	10	4	7	2	5	5	1	3	7	7	10
1	Main Pend Oreille River	16	-0.20	7	7	7	7	2	3	1	4	6	5	7

Table 14.21 Tornado diagram for kokanee salmon in the Pend Oreille Subbasin. Degree of confidence for protection and current habitat conditions range from 0.0 to 1.0 with the greatest confidence equal to 1.0. Protection reach scores are presented on the left side and current habitat reach scores are presented on the right. Negative scores are in parentheses.

NP = Not present

Sequence	Reach Name	Protection Confidence	Current Habitat Condition Confidence
1	Main Pend Oreille River	0.50	0.38
2	Bead Lake	NP	
3	Marshal Lake/Creek	NP	
4	Shearer Lake	NP	
5	Davis/Kent Creeks	0.42	0.21
18	Sullivan Lake	0.50	0.25
38	Lower Harvey Creek	0.50	0.25
93	Johnson Creek (Pend Orielle River)	0.17	0.21
108	Hoodoo Creek	0.50	0.38
109	Kelso	NP	
110	Pend Oreille River above Albeni Falls Dam	0.17	0.21
129	Upper Priest Lake	0.17	0.21
155	Trestle Creek	0.50	0.38
156	Strong Creek	NP	
157	Trout Creek	NP	
158	Granite Creek (LPO)	0.42	0.33
159	Cedar Creek	0.42	0.33
160	North Gold Creek	0.42	0.33
161	(South) Gold Creek	0.50	0.38
162	Johnson Creek	0.50	0.38
163	Twin Creek	0.33	0.29
164	Lightning Creek above Rattle Creek	0.50	0.38
165	ning Creek between Porcupine and Rattle Creek	NP	
166	Lightning Creek below Porcupine Creek	0.50	0.38
167	Clark Fork River (below Cabinet Gorge Dam)	0.50	0.42



14.6.4 Current Management

14.6.4.1 Lake Pend Oreille Kokanee

Beginning in 2000, an emergency closure was imposed on kokanee harvest to maximize the number of spawners available to rebuild the population in Lake Pend Oreille (M. Maiolie, Fisheries Biologist, IDFG personal communication, 2004). Concurrent with these actions, harvest limits on lake trout and rainbow were relaxed. Kokanee are currently showing signs of improvement in older age classes along with improved survival in fry (Maiolie et al. 2002). Biomass has increased the last three years and numbers of age 1 to 5 year old kokanee have increased over the last four years (agency files). Too high of a predation level and the 1997 flood set the population recovery back and masked the benefits of the improvement in fry survival. The IDFG's management goals are to recover the adult population size to 3.75 million where they can provide forage for trophy species and produce an annual harvest of 750,000 kokanee (IDFG 2001).

14.6.4.2 Priest Lake and Upper Priest Lake Kokanee

Currently, kokanee numbers in Priest Lake and Upper Priest Lake are too low to support a recreational or subsistence fishery and kokanee was closed to harvest. The status of kokanee is unknown for both lakes with the exception in Priest Lake where the number of spawners has been increasing over the last three years. If kokanee are to make a comeback in Priest Lake, the timing of the lake level drawdown needs to be better coordinated to ensure that the lake is down at its minimum level before kokanee spawning begins.

14.6.4.2 Sullivan Lake Kokanee

Sullivan Lake and Harvey Creek are biologically significant for its support of the kokanee population's genetic make-up and its future as a source of eggs and fish for other waters. WDFW is trying to determine if the egg production in various naturally reproducing kokanee populations, such as Sullivan Lake kokanee, is adequate to provide some eggs for stocking programs while maintaining the wild populations at their current levels (McLellan 2003).

14.6.4.3 Bead Lake Kokanee

Historically there was and currently remains limited public access to Bead Lake, although it has increased in the past few years. In order to evaluate the potential impacts from increased recreational use, a baseline study was conducted in September 1999 to estimate the kokanee population (Polacek et al. 1999, unpublished data). Future management decisions or adjustments will be considered or recommended based on deviations from the "baseline." Bead Lake kokanee egg production are not being considered for stocking programs since most of the kokanee are shoreline spawners and harvest of eggs would be too labor intensive.

14.7 Focal Species – Largemouth Bass

Largemouth bass was chosen as a focal species because of its value as a recreational and subsistence fishery. Over the past several decades, the largemouth bass fishery has received increasing interest from local Spokane and other statewide fishing clubs and has become an important fishery for Tribal and non-Tribal members.

14.7.1 Historic Status

Largemouth bass are not native to the Pend Oreille Subbasin and had no historical presence. In 1916, largemouth bass were introduced to Idaho where they continued to migrate into the Columbia River system.

14.7.2 Current Status

Largemouth bass are currently present in Boundary Reservoir (only one fish was observed, R2 Resource Consultants 1998), Box Canyon Reservoir (Ashe 1991), and upstream of Albeni Falls Dam to Lake Pend Oreille (Karchesky 2002). However, largemouth bass are most prevalent in Box Canyon Reservoir. Over-wintering habitat appears to be the primary limiting factor in largemouth bass distribution and abundance in the subbasin. Optimal over-wintering conditions for largemouth bass and other warmwater fishes include habitat with dissolved oxygen > 3 mg/L, water velocities < 0.01 m/s, and temperatures > 1 ˚C (Karchesky 2002).

Largemouth bass are the fourth most common species in Box Canyon Reservoir and have a high recreational value. Abundance is estimated at 600,000 fish, 8 percent of total fish population in the reservoir. Ashe (1991) indicated that largemouth bass growth rates during the first four years in Box Canyon Reservoir were lower than bass from other locations in the northern U.S. and, conversely, growth rates after the fourth year were comparable or even higher than those in other locations. Slower growth combined with a high rate of juvenile mortality associated with over-wintering has reduced the potential for the bass population within the reservoir. Other nonnative species such as yellow perch, pumpkinseed, northern pikeminnow, and adult largemouth bass can negatively impact hatchery supplementation efforts through predation. Once largemouth bass are large enough (age 1-2 years), they start to consume these predators.

In-stream habitat conditions created by Box Canyon Dam generally provide good largemouth bass habitat for spawning and rearing in spring, summer, and fall but not during winter (Fickeisen and Geist 1993). Juvenile over-wintering survival was determined to be the limiting factor for largemouth bass in the Box Canyon Reservoir (Ashe et al. 1991; Bennett and Liter 1991). Lack of cover is believed to be related to observed declines in standing crops of largemouth bass and may result in reduced food availability and higher predation on young-of-year (Brouha and von Geldern 1979). Box Canyon reservoir fluctuations measured at Cusick have had adverse effects on largemouth bass (Figures 14.8 to 14.10). Decreases in reservoir elevation during spawning may cause eggs to be exposed to air while increases in elevation during the same period may increase predator-related mortality. Reservoir fluctuations will result in a decrease in young-of-year age class, resulting in a decrease of overall population (Ashe and Scholz 1992). Over-winter habitat conditions need to provide at least 1.5 m of water depth and water velocities less than 0.06 m/s (Fickeisen and Geist 1993). Higher winter pool levels could result in a seven-fold increase in largemouth bass over-wintering area and a viable fishery (Bennett and DuPont 1990).

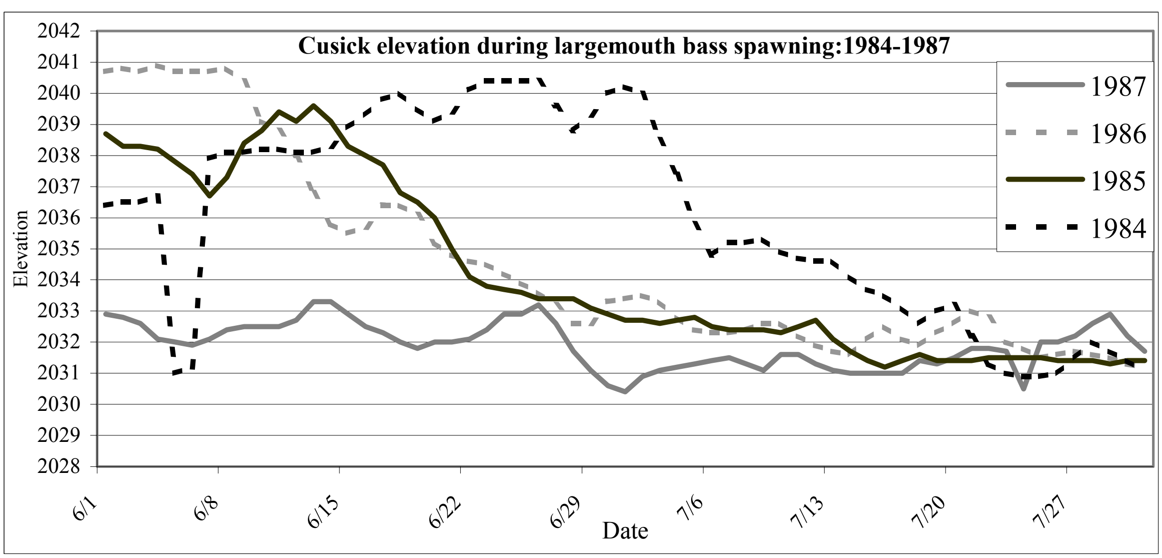


Figure 14.8. Cusick elevations during largemouth bass spawning, 1984 -1987

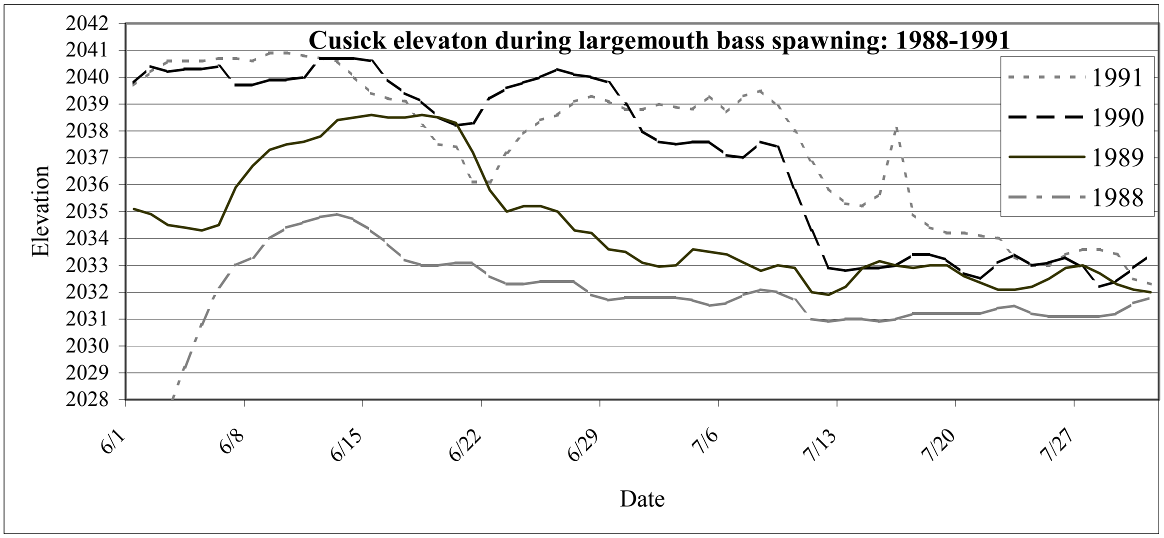


Figure 14.9. Cusick elevation during largemouth bass spawning, 1988 -1991

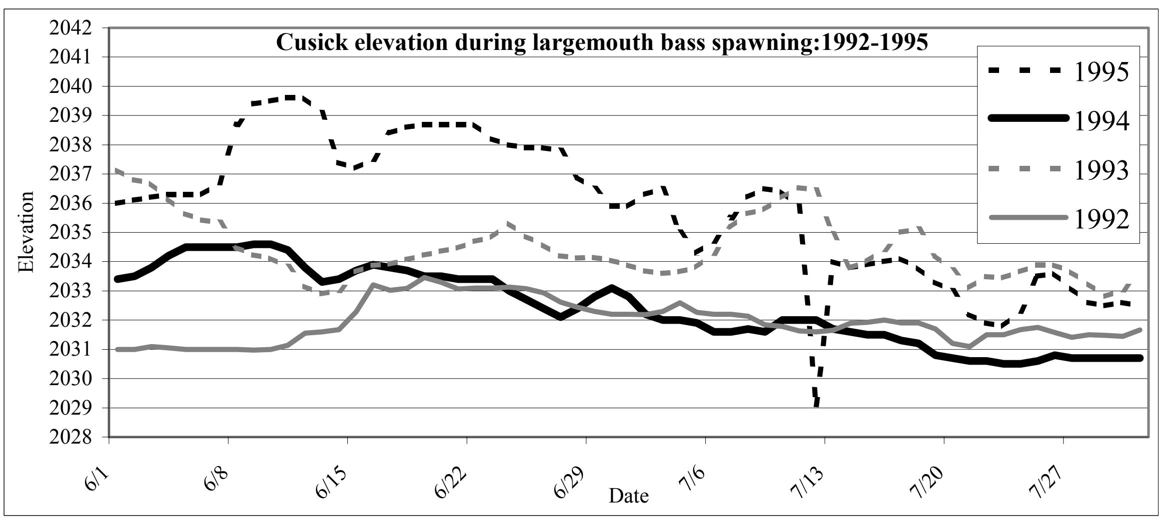


Figure 14.10. Cusick elevations during largemouth bass spawning, 1992 -1995

Although less abundant than in Box Canyon Reservoir, largemouth bass also provide an important recreational opportunity upstream of Albeni Falls Dam. The lack of available over-wintering habitat is suspected to be a limiting factor for largemouth bass above Albeni Falls Dam (Karchesky 2002). After the annual drawdown of 3.5 m (lake elevation 625.1 m) at Albeni Falls Dam, approximately four percent of the summer habitat is available and suitable for over-wintering (Dupont 1994, as cited in Karchesky 2002). From 1996 to 1998, the Council reduced the annual drawdown to 2.1 m (lake elevation 626.5 m), which provided an estimated 7.5 fold increase in available and suitable over-wintering habitat (Dupont 1994, as cited in Karchesky 2002). In 1999, Karchesky (2002) radio-tagged twenty adult largemouth bass and followed their movement through the 2.9 m winter drawdown conditions. He found adult largemouth bass moved to over-wintering areas in November where they remained until mid-March. These over-wintering habitats were found along the main river channel (Figure 14.11) and included areas with low velocity (<1 cm/s), aquatic vegetation, and favorable thermal conditions. Backwaters were not used, most likely because of limited access to these channels, low water levels, and less than favorable thermal conditions. Karchesky (2002) also found a change in size and age structure of largemouth bass from higher winter water levels resulting in an increase in abundance (indicated by an increase in catch per unit effort) of older individuals and an increase in catchable-sized largemouth bass. Year-classes produced during the high winter water years of 1996,1997, and 1998 accounted for 86 percent of the catch in 1999. However, with a lower water year in 1999, Karchesky (2002) found a disproportionately low number of age 0 largemouth bass and suggested a recruitment failure occurred.

14.7.3 Current Management

The Kalispel Tribe substituted largemouth bass for the loss of anadromous salmon as a result of the hydroelectric development on the Columbia River. Currently, the Kalispel Tribal Hatchery is the only entity artificially propagating largemouth bass for the Box Canyon Reservoir, which is funded by the BPA. Annual production goals for the hatchery are 100,000 largemouth bass fry and 50,000 fingerlings (Kalispel Tribe of Indians 2002). The hatchery facility started in 1996.

Within the Washington portion of the Pend Oreille Subbasin largemouth bass are currently managed by WDFW as essentially a self-sustaining population. The main stem of the Pend Oreille River is open year round to fishing.

For the Pend Oreille River above Albeni Falls Dam, higher winter lake level for kokanee will directly benefit largemouth bass abundance. Higher winter lake levels have shown to increase juvenile bass over-wintering survival and thereby recruitment to the overall abundance of largemouth bass.

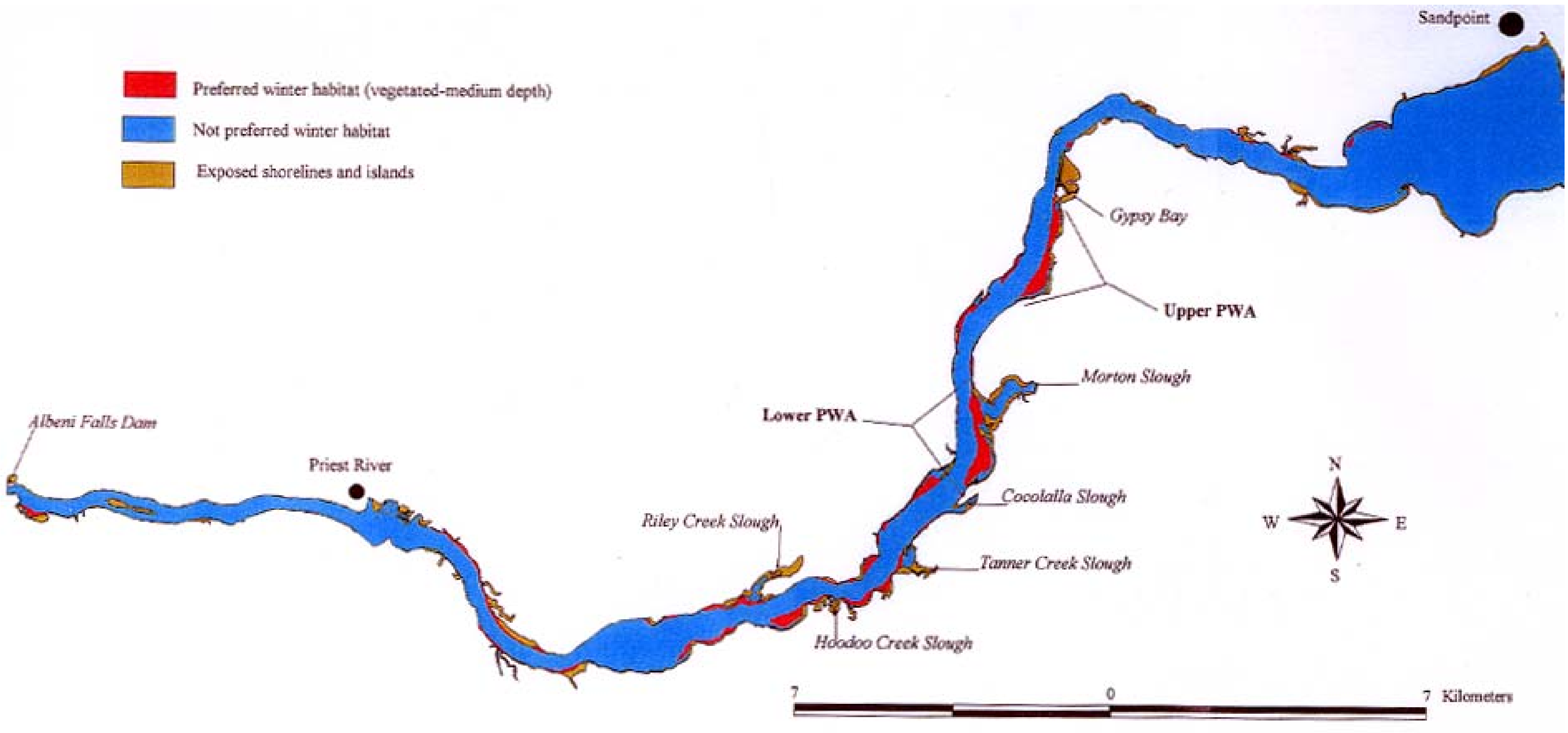


Figure 14.11. Largemouth bass over-wintering habitat between Albeni Falls Dam and the outlet of Lake Pend Oreille (at Sand Point), and their preferred wintering areas (PWA) based on radio telemetry data collected in 1999-2000. (*Source*: Karchesky 2002)

14.8 Environmental Conditions[2]

14.8.1 Environmental Conditions within the Subbasin

Euro-American settlement of the Clark Fork River Valley and Lake Pend Oreille was accompanied by forest clearing, agricultural development, logging, introduction of nonnative pests, mining, railroad construction, hydroelectric projects, and general urbanization (Entz and Maroney 2001). Natural and man-made fires, past timber harvest activities, and dams have heavily influenced the landscape in the Pend Oreille Subbasin. Native American inhabitants of the intermountain valleys also used wildfire as a game enhancement management tool (Barrett and Arno 1982).

Livestock ranchers and farmers settled the Calispell Valley of the lower Pend Oreille River in the 1880s and chose the fertile sites on the river where flooding frequently occurred (Bamonte 1996). Industry also began to develop in the area during this time. Mining in Metaline Falls encouraged the Idaho and Washington Railroad to construct a railroad from Spokane to Metaline Falls between 1909 and 1913 (Bamonte 1996). Local farmers on the west side of the valley agreed to have the railroad built on their land, which resulted in the construction of the embankment (ballast) for the railroad that also served as a dike during flood conditions. By 1913 the railroad was completed to Metaline Falls and three diking districts had formed in the valley. Flapper valves were located on small culverts that transected the dike; large culverts and pumps were installed in the major tributaries such as Calispell Creek that were behind the dike. In 1955 Box Canyon Dam was constructed and the Cusick Pumps were upgraded then and once again in 1977. The Pumps are operated by the Pend Oreille PUD in conjunction with operation of the dam. The combination of free flow, pumps and dikes/flapper valves reduced potential flooding in the Calispell Valley during the annual two-part spring flow of local runoff (March-April) and high flow runoff (June) coming from the upper Clark Fork and Flathead drainages in Idaho and Montana.

The Pend Oreille Subbasin was first logged from 1905 to 1930 and much of the old-growth timber was removed. Logging roads, railroad lines, and log flumes were used on the mainstem Pend Oreille River and several of its tributaries. Log flumes were common, simplified the in-stream habitat, and decreased the recruitment source for large woody debris. In more recent years, road construction and maintenance, timber harvest, and cattle grazing have degraded stream habitat conditions. Numerous forest fires occurred between 1910 and 1929 and impacted many watersheds. From 1917 to 1929, an estimated 60 to 70 percent of the LeClerc Creek watershed burned. The largest fire in the LeClerc Creek watershed occurred in 1929. Early logging removed much of the old-growth western red cedar in the Clark Fork River delta.

In the early and mid-1900s, hydroelectric facilities within the Pend Oreille Subbasin and upstream in the Clark Fork and Flathead drainages were present or under construction. Facilities in Idaho and Montana such as, Albeni Falls and Hungry Horse dams, as well as Kerr and Noxon dams were built for hydropower, flood protection, and recreation

[2] Large portions of Section 14.8 were contributed to by the Pend Oreille Subbasin Summary Report (2001) pp. 16-23, 79-83, 139-150.

(including fisheries) purposes (U.S. Senate, 1949). Recent changes in the Federal Columbia River Power System (FCRPS) flood control (FC) system, VARQ FC, and the Lake Pend Oreille kokanee experiment were initiated to assess potential benefits for fish species and resulted in higher than normal (625.1 m) winter reservoir levels (USACE 1999). The purpose of VARQ is "… to improve the multi-purpose operation [i.e., … flow objectives for the listed ESA species …] of Libby and Hungary Horse [dams] while maintaining the current level of system flood control protection in the Columbia River" (USACE 1999). The Council requested the USACE to operate Albeni Falls Dam to support the kokanee experiment by sustaining a higher winter level in Lake Pend Oreille (McGrane 1999). Residents of Pend Oreille County (Cusick Valley) remain concerned regarding management of lake levels upstream, specifically for Lake Pend Oreille and the potential flooding impacts downstream. Reducing the flood storage of one or several of the reservoirs upstream may in effect change the timing of higher spring flows and incrementally increase the potential frequency and duration of flooding downstream in places such as the lower Pend Oreille River Valley.

Large-scale habitat degradation occurred due to operation of Cabinet Gorge, Noxon Rapids, and Albeni Falls dams. Upstream dams impeded sediment transport to the Clark Fork River delta, prohibiting development of delta landforms, and the protective lakeside beach. Widely fluctuating flows associated with dam operations continue to erode delta shorelines that would naturally be protected by armored streambeds during low fall/winter flows. Compounding these impacts is an unnaturally elevated lake level during the growing season due to operations of Albeni Falls Dam. This elevated lake level removed protective vegetation due to deep inundation in areas that were formerly seasonally flooded. Elevated lake levels and lack of protective vegetation and lakeside beach exposed the delta to accelerated erosion associated with a long wind fetch across Lake Pend Oreille. Further, following growing season inundation, poorly vegetated banks slough during drawdown in late summer and early fall. The result has been the loss of roughly 50 percent of functional delta wildlife-habitat and ongoing losses estimated at 3.2 to 4.8 ha per year (Parametrix 1998).

14.8.1.1 Upper Pend Oreille Subbasin

The Pend Oreille River, prior to the construction of Albeni Falls Dam in 1952, provided free flowing riverine habitat that supported a coldwater fishery. Prior to construction of Albeni Falls and Cabinet Gorge dams, the lower Clark Fork River supported important fisheries for migrating kokanee salmon, mountain whitefish, and bull trout. Westslope cutthroat trout were also present in the river and provided a fishery for fluvial and adfluvial fish. Today, the upper Pend Oreille River supports a limited warmwater fishery and the presence of salmonids is very low (Bennett and DuPont 1993). Bennett and Dupont (1993) conducted a two-year survey (1991 to 1992) and found salmonids (native and nonnative species) only accounted for 1.9 percent of all species collected in 1991 and 0.6 percent in 1992. Management direction is to work with USACE on lake level management to improve conditions for fish species.

Fish habitat in tributary streams within the Upper Pend Oreille Subbasin has been impaired through delivery of excess bedload sediment, fine sediment delivery, loss of large woody debris and riparian forest habitat, channelization, and isolation of streams from their floodplains (PBTTAT 1998). Man-made fish migration barriers and water diversions are scattered around the Subbasin, resulting in loss of access to spawning and rearing habitat and loss of flow and migrating fish to diversions.

During the summer and fall months, the lower 5.4 km of the Clark Fork River (the headwaters of Pend Oreille Lake) are flooded by backwater from Albeni Falls Dam, creating an unproductive environment for native and introduced salmonids. Riverine habitat has been further compromised by Cabinet Gorge Dam and its operations, resulting in blocked fish passage, rapidly fluctuating river flows, and during high water years (1997), total dissolved gas (TDG) levels exceeding 150 percent saturation (Weitkamp et al. 2003).

Cabinet Gorge Dam presents a complete migration block to fish migrating upstream from the Clark Fork River. Steps are underway to restore fish passage as part of the Federal Energy Regulatory Commission (FERC) re-licensing process. Recent studies (1997 to 2000) by Weitkamp et al. (2003) found TDG levels frequently exceeded 120 percent saturation in surface waters (< 2 m) of the lower Clark Fork River and Lake Pend Oreille as a result of river flows spilling over Cabinet Gorge Dam from April to June. The biological effects, such as gas bubble disease (GBD), of TDG supersaturation varied depending on the duration and frequency of exposure (Weitkamp et al. 2003). Many of the resident fishes showed no signs of GBD, which may be related to their depth distribution (Weitkamp et al. 2003). Shallow waters (< 2 m) with higher levels of supersaturation were known to have greater biological effects on fish than deeper waters (Weitkamp et al. 2003; Mesa et al. 2000). No research has been conducted on Lake Pend Oreille concerning the effects of TDG on kokanee eggs or sac fry still in the shoreline gravels.

Avista continues to work to reduce TDG levels and understand the biological effects of supersaturation. The new FERC license for the Clark Fork River projects resulted in an increase in minimum flows released from Cabinet Gorge Dam from 3,002 cfs (85 cubic meters per second, cms) to 5,015 cfs (142 cms). The increased minimum flow results in an improvement via increase of over 4 ha (40,000 m^2) of permanently wetted riffle habitat. The effects of modified flow regimes in the lower Clark Fork River resulting from Hungry Horse Dam operations are unknown.

Lake Pend Oreille system continues to provide areas of suitable rearing habitat for coldwater fish species, but Albeni Falls Dam operations (operated by USACE) have resulted in impaired shoreline spawning habitat for kokanee salmon. Over 190,000 m^2 of high quality kokanee spawning habitat are estimated to be lost due to current operations lowering the level of Lake Pend Oreille to 625.1 m during the winter months (Fredericks et al. 1995). Lowering of the lake to 625.1 m each year has not allowed for shoreline gravel to be cleaned and resorted at a depth where it is available for kokanee spawning and may be the single largest factor contributing to kokanee declines (Maiolie and Elam 1993). Consequently, most kokanee spawning takes place at the south end of the lake where conditions are favorable with less than 35 percent sediment fines and greater wave activity (Fredericks et al. 1995). Studies are currently underway that address how dam operations may be changed to improve shoreline spawning.

Lake Pend Oreille's nutrient budget may also be affected by Albeni Falls Dam operations. Prior to impoundment, Lake Pend Oreille flooded well-vegetated shoreline areas during the spring, which likely resulted in an influx of nutrients to the lake at the onset of the summer growing season. Albeni Falls Dam operations inundated shoreline vegetation, resulting in an initial significant release of nutrients. Over time, that vegetation has been lost and higher elevation vegetation is only rarely flooded. Thus, it is possible that an important seasonal source of nutrients has been lost. Human caused eutrophication resulting in Lake Pend Oreille being included on the 303(d) list does not mitigate for the sterilization of the shoreline.

Open water nutrient levels in the lake are remaining largely unchanged over time. The deepness of the lake makes it a nutrient sink. Early summer nutrient releases would benefit plankton blooms and growth of kokanee salmon and other juvenile fish. Drawdown of Lake Pend Oreille results in an unproductive shoreline environment for production of aquatic invertebrates, potentially reducing a food source for shoreline feeding species such as cutthroat trout. Shoreline flooding would inundate emergent vegetation if the lake had good aquatic vegetation at its perimeter. Flooding and aquatic vegetation would provide productive environments for aquatic insects and rearing of small fishes. Cutthroat trout and bull trout would find a more available and abundant food source.

Raising the winter lake level by 1.2 m (4 ft) reduces the available spring storage in Lake Pend Oreille by 360,000 acre-feet (Kokanee Recovery Task Force 1999). One of the consequences of raising the lake levels in Lake Pend Oreille will be the potential increased risk of flooding around the lake and downstream below Albeni Falls Dam along the lower Pend Oreille River. Lake Pend Oreille, at lower winter elevations, may reduce the impacts of high runoff by acting as a cushion during the runoff months of May and June when residents and landowners are most affected. This risk in the lower Pend Oreille River may be further reduced if proper procedures are followed by the Pend Oreille PUD at Box Canyon Dam when certain reservoir water elevations are reached, if downstream pumping facilities are updated, and better cooperation takes place between the USACE, Pend Oreille PUD, and the downstream drainage districts (McGrane 1999).

14.8.1.2 Lower Pend Oreille Subbasin

Historically, the lower Pend Oreille River in Washington, north of Metaline Falls, and Canada supported anadromous salmon that the Kalispel Tribe relied heavily upon for subsistence as well as ceremonial, religious and other cultural uses (Kalispel Tribe of Indians 2002). The construction of dams on the Columbia River, specifically Chief Joseph and Grand Coulee Dams, extirpated upstream anadromous fish migrations from traditional Kalispel Tribal fishing sites within the Pend Oreille Subbasin.

The Pend Oreille River, located in northeastern Washington, was historically a free flowing river. The Pend Oreille River (from the outlet of Pend Oreille Lake downstream to Canada) was described in 1894 as “most places there [have] a good, strong current, becoming dangerous rapids in the narrower places” (Gilbert and Evermann 1895). Gilbert and Evermann (1895) characterized Box Canyon as a “narrow gorge about 1.5 miles long … [where] the river rushes through the narrow passage with a very strong current … [however], there is nothing here to stop the ascent of salmon.” Gilbert and Evermann (1895) also described “the river between Box Canyon and Metaline Falls [as having] a good strong current, but no falls or rapids. The total fall [Metaline Falls] is perhaps as much as 30 feet, but it is in a series of rapids, there being no vertical drop at all. The stream is here enclosed between high rocky walls and is very turbulent for some distance. Salmon could probably ascend these falls without much difficulty.”

In 1912, the USGS surveyed the Pend Oreille River from the U.S. to Canadian boundary upstream to the confluence with the Priest River. The USGS’s survey covered more than 79 miles of the river, thus the reach scale is relatively large (reach = 1 mile distance). River reach gradients (ft/mile, presented in Table 14.22) between Z Canyon and Metaline Falls, Metaline Falls and Box Canyon, and Box Canyon to Albeni Falls were relatively low (less than < 1.5 percent). However, a low gradient stream does not translate to a water body having a low velocity. In contrast, the “slope is an inverse relationship of discharge” such that “as the quantity of water in a stream increases, the down-valley slope of the water surface decreases” (Bloom 1969). Furthermore, “water flows more efficiently in larger channels, and therefore requires less slope to maintain its velocity” (Bloom 1969). This is observed in other high order streams such as Columbia River, Snake River, Missouri River, and Mississippi River.

Table 14.22 Elevation change along the Pend Oreille River downstream from the U.S.-Canadian border upstream to where Box Canyon Dam is located today based on USGS survey data from 1912. Survey data shows a 20-30 foot vertical drop at Metaline Falls between RM 10 and RM 11.

Location	River Mile	Elevation (ft)	ft/mile
U.S.-Canadian Border	0	1744	
	1	1748	4
Downstream Z Canyon	2	1760	12
	2.5	1790	60
	3	1818	56
	4	1838	20
	5	1860	22
	6	1890	30
	7	1908	18
	8	1922	14
	9	1940	18
Downstream Metaline Falls	10	1948	8
	10.5	1949	2
	10.75	1968	76
Upstream Metaline Falls	11	1970	22
Upstream of Box Canyon Dam	19	1986	4
Upstream of Albeni Falls	75	2024	1

Currently, the lower Pend Oreille River is described to be:

> no longer suitable for the production of trout as it was known for. It appears that water temperature, lack of habitat diversity and possibly food availability are the major factors that limit trout production in the Box Canyon reach of the Pend Oreille River. Only about 8 miles (15 percent) of the Box Canyon reach is even close to being considered riverine habitat preferred by trout. … The other 46 miles of the river represents mainly shallow slow moving water, numerous sloughs and backwater areas and an abundance of macrophytes (Ashe and Scholz 1992, p. 198, as cited in Andonaegui 2003).

The consensus is that habitat for native salmonids has been altered and continues to be altered from historic conditions in the Pend Oreille River. However, the cause of these changes remains in dispute. The significant decline in native salmonid populations, particularly bull trout and westslope cutthroat trout, in the Lower Pend Oreille Subbasin are believed to be correlated to: 1) habitat degradation on the mainstem and tributaries, 2) introduction and management of nonnative species, 3) man-made fish barriers into tributaries, and 4) the five hydroelectric facilities on the mainstem of the Pend Oreille River (Andonaegui 2003). These mainstem hydroelectric facilities include Waneta (Canada), Seven Mile (Canada), Boundary (U.S.), Box Canyon (U.S.), and Albeni Falls (U.S.). None of these dams were built with fish passage facilities. Other dams and diversions located in Pend Oreille tributaries include Cedar Creek Dam, Sullivan Lake Dam, Mill Pond Dam, and Calispell Creek pumping station and further fragment the connectivity of native salmonid populations.

In 1955, Box Canyon Dam was constructed, inundating resident trout habitat in the river and creating many backwater and slough areas (Ashe and Scholz 1992), changing the Pend Oreille River from a free-flowing system to a slow flowing, run-of-the-river reservoir (Bennett and Liter 1991). Comparisons of pre-Box Canyon Dam to post-Box Canyon Dam data (USGS 1951-1956, 1962-1966) have shown how hydropower construction and operations have changed historic hydrologic characteristics of the Pend Oreille River (Entz and Maroney 2001). For example, data from USGS Water Resources Division archives (1951-1956; 1962-1966) compare similar or identical discharges measured at the same location (Newport Bridge) and show the mean velocities of Pend Oreille River decreased on the average 0.19 meters per second (mps, 0.63 feet per second, fps). Mean channel width increased an average 14.3 m (47 feet) and total area increased on the average 163 m^2 (1,752 square feet) after Box Canyon Dam was operating (Table 14.23). Spring flows (May-June) were not compared since gates start to be opened at Box Canyon Dam when discharge is greater than 28,500 cfs, until all gates are removed if flows exceed 90,000 cfs. Box Canyon Dam restricts the flows in the Box Canyon reach during flows below 90,000 cfs which usually occur from July to April, although sometimes flows do not exceed 90,000 cfs during the year. Operations of Box Canyon Dam would have less to no effect during the high flow period, discharge exceeding 90,000 cfs.

Table 14.23 A comparison of pre-Box Canyon Dam to post-Box Canyon Dam measured channel widths, areas as well as mean velocity (feet per second), and total discharge (cubic feet per second). All values (width, area, mean velocity, total discharge) were taken on the Pend Oreille River at Newport, Washington.

Pre-Dam Date	Post-Dam Date	Width (ft)	Area (sq. ft.)	Mean Velocity (fps)	Total Discharge (cfs)
3/11/1953		986	4,940	2.73	13,500
	8/31/1963	1,015	7,020	1.85	13,000
3/21/1953		782	2,940	1.61	4,740
	8/26/1963	1,000	5,710	0.85	4,870
7/3/1952		1,076	8,830	3.15	27,800
	10/24/1963	1,075	11,400	2.49	28,400
12/16/1952		996	5,330	2.78	14,800
	1/13/1964	1,035	7,870	1.93	15,200
7/12/1952		1,040	6,920	2.98	20,600
	10/15/1964	1,060	9,500	2.15	20,400
	10/18/1966	814	3,000	2.13	20,800
8/14/1952				2.4	7,210
	8/8/1965	1,005	5,630	1.15	6,540
7/15/1953		1,056	7,940	2.95	23,400
	10/12/1965	1,060	9,960	2.42	24,100
4/27/1955		1,030	7,120	3.05	21,700
	3/3/1966	1,060	9,490	2.24	21,300
8/30/1954		941	3,990	2.63	10,500
	10/30/1955	1,016	5,480	1.9	10,400
7/3/1952		1,076	8,830	3.15	27,800
	12/16/1955	1,070	9,800	2.84	27,800

Pre-Dam Date	Post-Dam Date	Width (ft)	Area (sq. ft.)	Mean Velocity (fps)	Total Discharge (cfs)
7/1/1952		1,073	8,610	3.01	26,400
	1/22/1956	1,070	9,160	2.93	26,800
9/24/1953		1,014	7,120	3.1	22,100
	2/25/1956	1,055	8,340	2.67	22,300
		940	4,390		
7/30/1952				2.67	11,700
	9/1/1956	997	5,040	2.36	11,900
	10/4/1956	1,010	5,790	1.95	11,300
11/2/1953		1,059	8,150	3.24	26,400
	11/12/1956	1,075	10,000	2.69	26,900
2/23/1955		1,018	6,380	2.87	18,300
	12/9/1956	1,015	6,990	2.6	18,200
	8/3/1964	1,040	7,870	2.29	18,000

The alteration in aquatic habitat (from fast-flowing to shallow reservoirs) is also illustrated comparing historic to current aerial photos (T. Shuhda, Fisheries Biologist, USFS Colville National Forest, personal communication, 2004). Presently, the lower 0.2 to 2.0 miles of tributaries to Box Canyon Reservoir have been converted from fast flowing stream to slow moving slough habitat (T. Shuhda, Fisheries Biologist, USFS Colville National Forest, personal communication, 2003).

Currently, Box Canyon Reservoir has velocities ranging from 0.03 mps (0.01 fps) during summer low flows to upwards of 0.6 mps (2.0 fps) during high flows (Falter et al. 1991). Nonnative fish such as yellow perch, tench, and largemouth bass dominate the fish community in Box Canyon Reservoir and all of these fish species have an optimum rearing habitat preference for low velocities ranging from zero to 0.18 mps (0.59 fps) (Entz and Maroney 2001, E-3.0 Application for New License Box Canyon Project 2000). Habitat preference curves begin to reach zero for these fish when velocities are greater than 0.2 mps (0.8 fps).

The current velocities in Box Canyon Reservoir are considered unsuitable for native salmonids with the exception of mountain whitefish. Mountain whitefish were the fifth most abundant species captured in Box Canyon Reservoir from November 1988 to December 1989 (Barber et al. 1989). Gill netting, electrofishing and beach seining conducted in Box Canyon Reservoir by the University of Idaho during 1989 and 1990 captured 434 and 1,311 mountain whitefish respectively or 3 and 10 percent of the total fish captured in each year, respectively (Bennett and Liter 1991). During the1990 portion of the University of Idaho study, mountain whitefish represented 10 percent of relative abundance of all fish captured as compared to 7 and 6 percent, respectively for tench and largemouth bass (Bennett and Liter 1991).

In addition to changes in velocity and channel morphology through inundation, the construction of the mainstem hydropower dams eliminated the stream connectivity for salmonid movement and migration including the connectivity for fluvial and adfluvial bull trout migratory life forms. Based on discussions with local Indians, Gilbert and Evermann (1895) reported bull trout were historically abundant in the lower Pend Oreille River and its tributaries. At present, this is not the case and bull trout are no longer in abundance (Andonaegui 2003). The five-mainstem dams (United States and Canada) have isolated bull trout sub-populations, eliminated individuals from sub-populations, and reduced or eliminated genetic exchange (Entz and Maroney 2001).

While entrainment at hydroelectric facilities has been identified as a threat to bull trout (USFWS 2002, 2000), specific studies designed to evaluate those impacts at Box Canyon and Boundary dams have not been conducted; feasibility studies at Albeni Falls Dam are ongoing to evaluate impacts to fish and determine fish passage needs. Other dams, control structures, and diversions without fish passage facilities (for example, Calispell Creek Pumps, Cedar Creek, Sullivan Creek, and Mill Pond dams) were constructed in tributaries to the Pend Oreille River and have further fragmented native populations and reduced connectivity (Andonaegui 2003, USFWS 2002).

Construction and operation of Box Canyon and Boundary dams have also resulted in the reduction of quality and quantity of available habitat for adult and juvenile salmonids. The mainstem Pend Oreille River has been altered with transformations in flow, bedload, large woody debris transport and recruitment, thermal regime, habitat complexity, introduction of nonnative warmwater fish species, and the introduction of invasive macrophytes (Andonaegui 2003). Typical salmonid spawning and rearing habitat such as pools, glides, riffles and side habitat in the Pend Oreille River and its tributaries have been eliminated in many areas. For example, 162 acres of run/riffle and side-channel habitat have been lost in the mainstem Box Canyon Reservoir and its tributaries (USFS 2002). Downstream of Box Canyon Dam, it is unclear whether the Boundary Dam reach could ever be considered a cold flowing section of river as Boundary Dam is a peaking facility with manipulated flows (< 90,000 cfs) year round. The loss or change in cold water upwellings and effects to tributary confluences due to inundation of the Pend Oreille River is currently unknown.

Elevated river temperatures during the summer months continue to be an environmental issue for native salmonids in the Pend Oreille River. Water received annually from Lake Pend Oreille to the Pend Oreille River is of a naturally elevated temperature that occurred historically during the summer months. Pend Oreille PUD suggest these warmer summer temperatures (greater than 20 ^{o}C) may have been a natural occurrence prior to the construction of Albeni Falls Dam (P. Buckley, Pend Oreille PUD, personal communication, 2004). However, measurements of historical water temperatures prior to the construction of Albeni Falls Dam are not available. In August 1989 and 1990, river temperatures below Albeni Falls Dam were recorded at 22.8 ^{o}C (Initial Consultation

Document, Box Canyon Hydroelectric Project FERC No. 2042) and ranged from 21.7-22.0 °C in July 2003 (Geist et al. 2004). Since water in the Idaho portion of the Pend Oreille River above Albeni Falls Dam is homeothermic, the temperature of water passing through Albeni Falls Dam downstream to the lower Pend Oreille cannot be manipulated by drawing water from depth (C. Vail, Fisheries Biologist, WDFW, personal communication, 2003).

Currently, surface water releases from Albeni Falls Dam exceed 20 °C (68 °F) from early July through late September and the Pend Oreille River is on the Washington State 303(d) list for temperature (FERC 2002). Modeling efforts by Environmental Protection Agency (EPA) and the Pend Oreille PUD were unable to show any significant change in water temperatures (increase greater than 1 C degree) along the mainstem Pend Oreille River (Cope 2002; EEC 2002), although the mainstem has shown increases in temperature ranging from 0.5 to 1.5 C degrees during the summer (Pelletier and Coots 1990; Falter et al. 1991; Pend Oreille PUD Box Canyon Draft License Application 1999). In addition, sloughs and backwaters in the Box Canyon Reservoir have been documented to be as much as 6 C degrees warmer than the main channel temperatures (FERC 2002). Comparisons of mainstem river temperatures on 2 August and 24 August 1988 in Box Canyon Reservoir indicate a mean water temperature increase between 0.7 and 1.5 C degrees from Newport to Ione, Washington (Pelletier and Coots 1990). In another study on 18 August 1990, a comparison of water temperatures from the Blueside area to Box Canyon Dam revealed an increase in water temperature of 1.1 C degrees (Falter et al. 1991). Temperature monitoring data in Box Canyon Reservoir also showed an increase in river temperatures between 0.5 and 0.6 C degrees from Ione to the forebay on 26 September 1997, from the forebay to the tailrace on 29 July 1997, from Newport to Usk on 17 September 1998, and from Ione to the forebay on 3 June 1998 (Pend Oreille PUD, Box Canyon Draft License Application 1999).

In addition to elevated river temperatures, TDGs at Albeni Falls, Box Canyon, and Boundary dams also continue to be an environmental concern for native salmonids when levels of saturation exceed the 110 percent saturation standard (WAC 173-201A-030 (2)(c) (iii)) during certain times of the year. Forebay TDG measurements at Box Canyon Dam typically range from 98 percent to 112 percent saturation. Levels of 98-112 percent are generally in compliance with the standard 110 percent saturation. One mile below the Box Canyon spillway, TDG levels have exceeded 135 percent saturation (Appendix E2-2 of Final License Application 2000, as cited in Entz and Maroney 2001).

Tributaries to the lower Pend Oreille River have also exceeded water quality criteria. Water quality monitoring studies have been/are being conducted by the WDOE (Pelletier and Coots 1990; Coots and Williams 1991), the Kalispel Tribe (unpublished data for ongoing program), and, most recently, the Pend Oreille Conservation District (POCD), and the Water Resource Inventory Area (WRIA) 62 Watershed Planning. Results found total phosphorus in Calispell and Trimble creeks exceeded the EPA's (1986) recommended guideline of 50 micrograms per liter (µg/l) phosphorus. Fecal coliform densities exceeded water quality criteria during sampling in the summer of 1990 in Skookum Creek, Bracket Creek, and South Fork Lost Creek. Skookum Creek accounted for 87 percent of the fecal coliform river load (Coots and Williams 1991). The POCD is currently working with landowners along Bracket Creek to implement Best Management Practices (BMPs) aimed at reducing potential agricultural sources of elevated coliform levels in the tributaries.

In the fiscal year 2004 (FY 04) the WDOE will be examining WRIA 62 (Upper Pend Oreille Subbasin) and the Lower Pend Oreille Subbasin for Total Maximum Daily Load (TMDL). Water quality impairments have been identified on the 1998 303(d) list and include the following waters: Cedar Creek (temperature), Lost Creek (temperature), Pend Oreille River (exotic aquatic plants, pH, temperature, total dissolved gas), and Skookum Creek (fecal coliform). In FY 04 the WDOE intends to establish TMDLs for temperature and dissolved gas in the Pend Oreille River.

14.8.1.3 Priest River Subbasin[3]

There are many historical factors that have affected the mainstem of Priest River. The early log drives changed the channel morphology and removed a considerable amount of large woody debris from the edges of the channel. The installation of Outlet Dam dramatically modified the flow regime of the river. Wildfire, roads, logging, and homesteading also contributed to habitat alteration of the Priest River Subbasin.

Water quality in Upper Priest Lake and Priest Lake is currently of very high quality and both lakes are classified as oligotrophic (Rothrock and Mosier 1997; Milligan et al. 1983). Nutrient inputs come primarily in the form of sediment off land managed by the USFS and IDL. Approximately 90 percent of the Priest River Subbasin is public land. Most of the shoreline is in public ownership and development has been clustered on private lands and along state and federal lease lots. Lakeshore cabins are generally on personal septic systems, but major communities have sewage treatment facilities. Productivity of both lakes is low and they are best suited for salmonids and native non-game fish, although some warmwater species are present in low abundance.

Most of the residential development is for seasonal use and is related to the growing recreational demands from the expanding urban areas in northern Idaho and eastern Washington. Impacts are particularly acute on Upper Priest and Priest lakes and the Thorofare, although Priest Lake is the only lake with lakeshore development. Most of the drainages that enter Priest Lake have experienced growing recreational use from resident and non-resident populations. Impacts are most pronounced in the Two Mouth Creek, Granite Creek, Kalispell Creek, the lower Priest River, and East River. These impacts will be expected to increase as the popularity of this area for recreational activities continues to grow.

Land management activities and natural events in the Priest River Subbasin have resulted in the loss and degradation of stream and riparian habitat. Excess sediment and channel instability has been linked to historic large fires; historic logging practices and initial construction of a transportation network to bring timber to market; current timber

[3] Large portions of Section 14.8.1.3 were contributed to by the Pend Oreille Subbasin Summary Report (2001) pp. 139-150.

activities and the existing road network; agricultural practices such as wet meadow draining through cross ditches, channel straightening, and cattle access to streams; urbanization with clearing and excavation in riparian areas; and construction of substandard private roads. Confounding the analysis of sediment effect on the biotic community is the issue of legacy land use, fire, sediment input from current land use activities, and the effects from introduced brook trout in streams and lake trout.

Land use development has taken place in the entire Priest River Subbasin, primarily from timber management and associated roads. As typically occurs in watersheds with an extensive history of timber harvest, many of the major haul roads encroached on the riparian zone causing sedimentation to streams. Increased use of these poorly designed and located road systems by recreationists add to the problem in this Subbasin. Problems are particularly apparent along portions of the Upper Priest River, Hughes Fork, the lakeshore of Priest Lake, Lion Creek, Two Mouth Creek, Granite Creek, Indian Creek, Kalispell Creek, Soldier Creek, the lower Priest River, and the East River drainage. Culvert barriers on forest roads that may have an impact on bull trout have been identified as potential fish passage impediments on Hughes Fork, Granite Creek, South Fork Granite Creek, and Kalispell Creek.

In portions of Hughes Fork and Trapper Creek, the road densities are very high, exceeding 5.6 km/km^2 of land, with many of the roads constructed in the riparian zone. Lime Creek has 2.25 road crossings per km of stream, and several other drainages exceed 0.8 crossings per km. Logging has occurred in 5 percent of the Upper Priest River watershed, 18 percent of the Hughes Fork, and 55 percent of Trapper Creek (PBTTAT 1998a).

In tributaries draining directly into Priest Lake, the portion of the subbasin with highly erodible soils ranges from 10-30 percent, with half or more of most watersheds in the rain-on-snow sensitive zone. Road densities tend to be lower (< 3.2 km/km^2 [3.0 mi/mi^2]) in the watersheds where bull trout spawning and rearing still occur: Caribou Creek, Lion Creek, Two Mouth Creek, Indian Creek, Granite Creek, and Soldier Creek. Major portions of the watersheds have been logged, including 23 percent of Caribou Creek, 35 percent of Lion Creek, 52 percent of Two Mouth Creek, 3 percent of Indian Creek, and 75 percent of Soldier Creek (PBTTAT 1998a). In the East River, the only drainage in the lower Priest River watershed with a known bull trout population, 25 percent of the watershed has highly erodible soil types and 41 percent is in the rain-on-snow sensitive zone. Road densities are very high, averaging 8.2 km/km^2 (5.1 mi/mi^2), and there are 2.25 road crossings per kilometer of stream. The portion of the watershed that has been logged is high, but has not been quantified (PBTTAT 1998a).

The streambed of the mainstem Hughes Fork above the Hughes meadows is dominated by sands, but is hydrologically stable. A reach of the stream running through Hughes Meadows was channelized during the 1940s for construction of an airstrip, and is now extremely unstable. This instability is apparent further downstream in the excessive depositional features and the lack of sufficient large organic debris.

Approximately half the Priest River Subbasin has soil types that are classified as highly erodible, ranging from 15 percent in Lime Creek to 86 percent of the Rock Creek drainage (Fredenberg 2000, as cited in Entz and Maroney 2001). Half or more of the watersheds lie in the rain-on-snow sensitive zone, making them prone to flashy runoff patterns. These characteristics predispose the subbasin to habitat degradation with any ground disturbing activities. This is of special concern because the Upper Priest Lake watershed is the most intact habitat remaining for westslope cutthroat trout and bull trout in the Priest River Subbasin (Fredenberg 2000).

As of 1998, there are six stream segments within the Priest River Subbasin included in the Clean Water Act Section 303(d) Water Quality Limited Segments (WQLS) list (Table 14.24): Kalispell Creek, Reeder Creek, Binarch Creek, East River, Lower West Branch Priest River, and Priest River. These stream segments are not in compliance with standards for sediment, temperature, flow, and/or dissolved oxygen. The 2002 proposed 303(d) list (has not been approved by EPA) includes Kalispell, Lower West Branch Priest River, East River, Binarch, Reeder, Beaver, Goose and Granite creeks. Streams listed as WQLS are considered not fully supporting designated or existing beneficial uses. Many streams in the subbasin fail to meet temperature standards for salmonid spawning and specific temperature criteria for bull trout protection. The State of Idaho is currently in the process of determining beneficial uses and support status for water bodies throughout the subbasin (Rothrock 2000). TMDLs have been approved for Kalispell Creek, Lower West Branch Priest River, East River, Binarch, and Reeder creeks.

Table 14.24. Streams not meeting state water quality standards based on Idaho's 1998 303(d) list

Stream Name	Hydrologic Unit Code- Water Quality Limit Segment	Boundaries as Listed in 1998 303(d)	Pollutant/ Parameter*
East River	ID-17010215-3415	North Fork East River to Priest River	Sed, DO, Temp, Flow
Reeder Creek	ID-17010215-3424	Headwaters to Priest Lake	Sed, Temp
Kalispell Creek	ID-17010215-3421	WA line to Priest Lake	Sed, Temp
Binarch Creek	ID-17010215-3418	Headwater to Priest River	Sed
Lower West Branch Priest River	ID17010215-3411	WA line to Priest River	None Listed
Priest River	ID-17010215-3407	Upper West Branch Priest River to Pend Oreille River	Sed

*Sed: Sediment, Flow: Flow Alteration, Temp: Temperature, DO: Dissolved Oxygen

Water appropriations in the Priest River Subbasin equal the average annual runoff, but they are mainly non-consumptive. Water rights for recreation, aesthetics, fish and wildlife held by the State of Idaho comprise the largest appropriations. Based on Idaho Department of Water Resources (IDWR) records, approximately 24.7 million m^3 (20,000 acre-feet) of water are appropriated for consumptive uses annually within the Priest River Subbasin; this is one percent of the annual volume of the Priest River. The major consumptive uses are irrigation and domestic water supplies. Surface water is the principal water source in the basin. Less than one percent of the Subbasin's dedicated water is from ground water, but it is relied on heavily for domestic supplies (IDWR 1995).

Concern for maintaining the primitive character and aesthetic quality of the subbasin and a desire to maximize recreational opportunities lead to the implementation of several protective measures. Protection included Protected River Designations under the Columbia Basin Fish and Wildlife Program, State designation of Natural and Recreational River sections, and application for minimum stream flow appropriations on basin rivers and streams (Table 14.25 and Figure 14.12). All these measures will help to preserve and protect valuable fish and wildlife in streams and riparian corridors in the Priest River Subbasin.

Table 14.25. Protected river reaches within the Priest River Subbasin

River Reach	Length	Values	Designation	Conditions
Upper Priest River, Canadian border to Upper Priest Lake(1990)	19.6 miles	Species of concern Spawning Recreation Area	Natural River	Prohibits- Construction or expansion of dams or impoundments, hydropower projects, or water diversion works: new dredge or placer mining: new mineral or sand and gravel extraction within the stream bed; stream bed alteration
Upper Priest Lake And The Thorofare (1990)	5.9 miles	Species of concern Boating opportunity Scenic Area Geologic Features	Natural River	Same as above
Hughes Fork (1990)	14.1 miles	Species of concern Spawning Recreation Use Scenic Area	Recreational River	Same as above except: allows for alteration of the stream bed for maintenance and construction of bridges and culverts, cleaning Maintenance and replacement Of water diversion works, and Installation of fisheries Enhancement structures
Rock Creek (1990)	3.8 miles	Same as above	Recreational River	Same as above
Lime Creek (1990)	3.9 miles	Same as above	Recreational River	Same as above
Cedar Creek (1990)	4.2 miles	Same as above	Recreational River	Same as above
Trapper Creek (1990)	7.9 miles	Same as above	Recreational River	Same as above
Granite Creek (1990)	11.1 miles	Same as above	Recreational River	Same as above
Priest River, Priest Lake outlet structure To McAbee Falls (1990)	43.7 miles	Wildlife Boating Opportunity	Recreational River	Same as above
Lion Creek (1995)	11.1 miles	Species of concern Spawning Recreation Use Scenic Area	Recreational River	Same as above
Two-Mouth Creek (1995)	10.6 miles	Same as above	Recreational River	Same as above
Indian Creek (1995)	10.5 miles	Same as above	Recreational River	Same as above

(*Source*: Rothrock 2000)

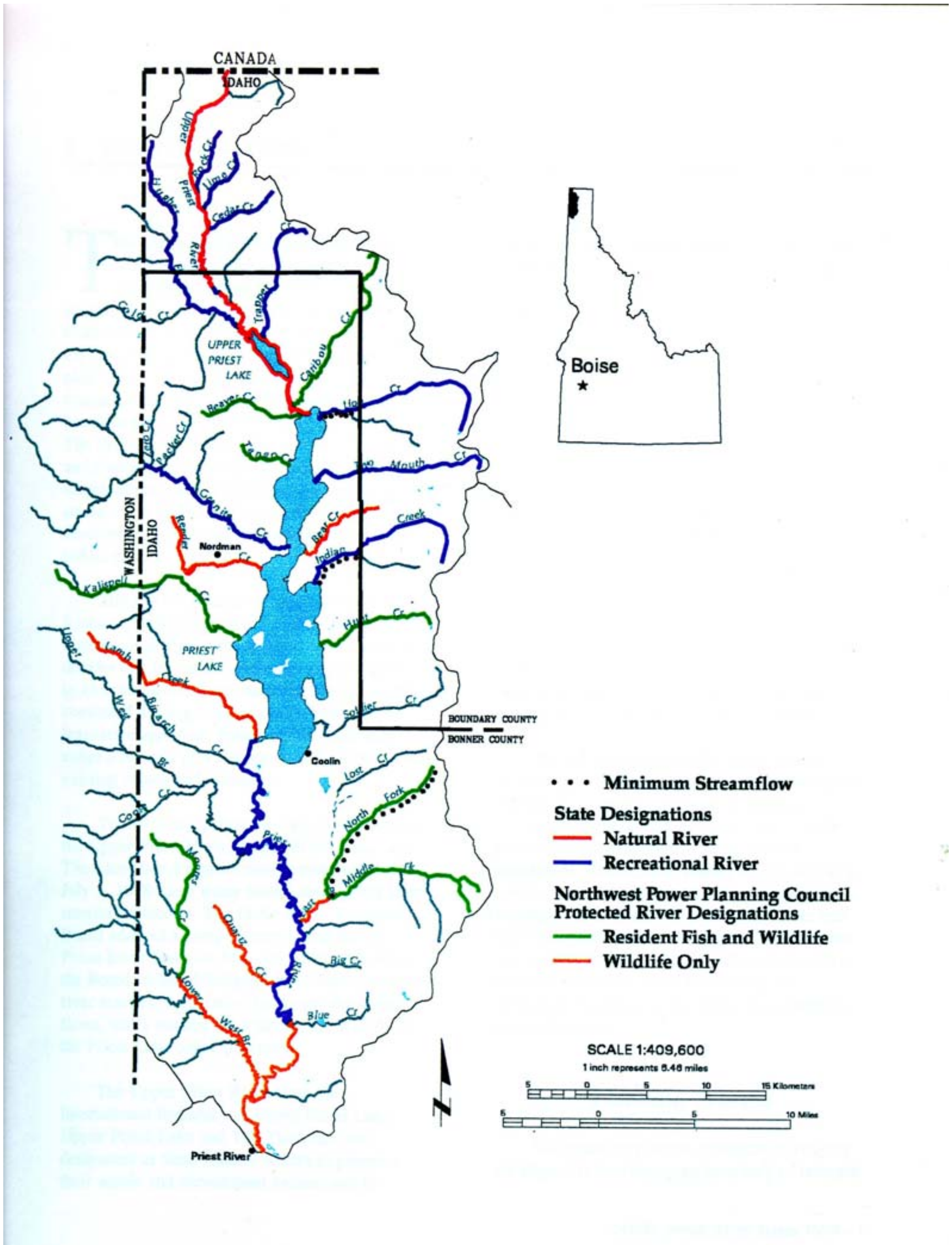


Figure 14.12. Protected river designations on streams and rivers in the Priest River Subbasin, Idaho (*Source*: IWRB 1995)

A small dam at the outlet of Priest Lake regulates the summer pool level of Upper Priest Lake and Priest Lake (Figure 14.13). This dam was constructed in 1951 by the State of Idaho for the purpose of maintaining Priest Lake at a constant summer pool level for recreational use [Idaho Code, Sec. 70-501 to 70-507]. The law requires the lake level to be maintained at 1 m (3.0 feet) on the USGS outlet gage until the end of the summer recreational season. At this level, about 8.6 million m^3 (70,000 acre-feet) of water are stored in the system until September 30. Sometime between October 1 and November 30, the stored water is released to supplement flows in the Pend Oreille and Columbia rivers for fall hydropower production (Figure 14.13). The IDWR provides oversight of the dam, and Avista operates and maintains the dam (IWRB 1995).

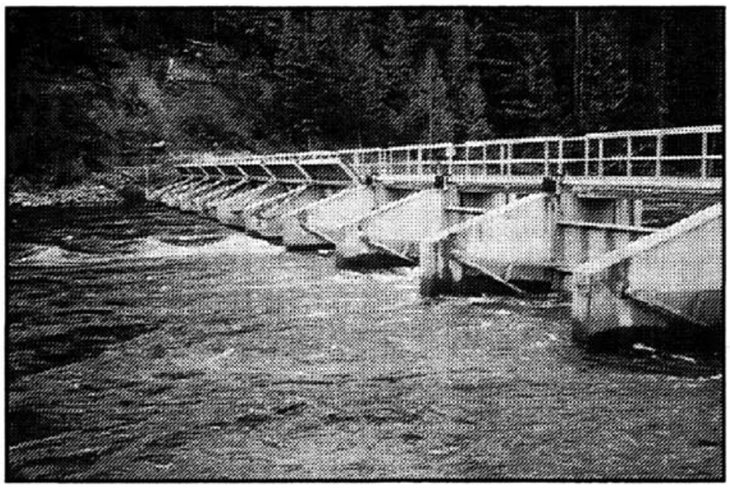


Figure 14.13. Dam on the outlet of Priest Lake, Idaho

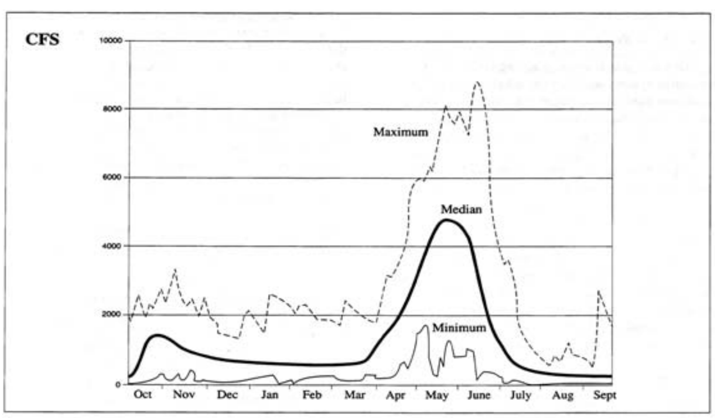


Figure 14.14. Average daily discharge for the Priest River at Dickensheet, 1951-1992 (*Source*: USGS gage station no. 12394000)

Maintenance of the summer minimum lake level elevation to benefit recreation at Priest Lake reduces flows in the Priest River during the warmest months of the year, August and September, and an unnaturally high flow period for a brief time in late October and November (Figure 14.14 and 14.15, IWRB 1995). Water temperatures exceeding 24 °C in the Priest River during the summer months can limit trout distribution to the mouths of tributary streams. Consideration was given to utilizing stored water in Priest Lake to supplement in-stream flows in the Priest River during critical times. However, it was not clear how far downstream favorable temperatures would extend. Recreation and power interests that favor current operations in Priest Lake were unwilling to consider changes in lake level management if it meant lower summer pool levels (R. Graham, Idaho Water Resource Board, 2000).

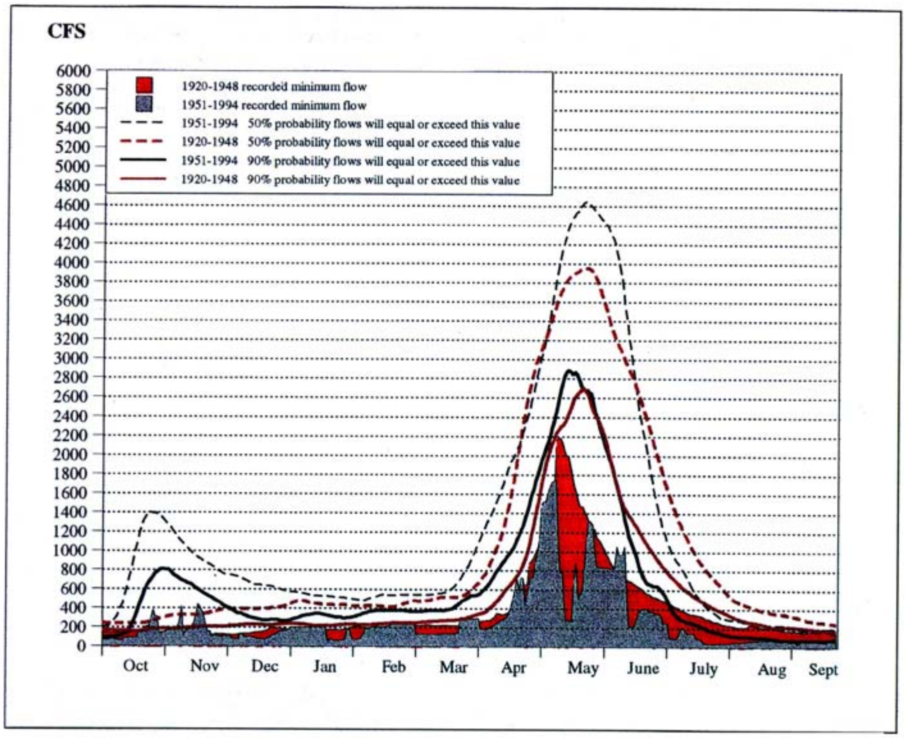


Figure 14.15. Comparison of pre-dam (1920-1948) and post-dam (1951-1994) discharge of the Priest River, Idaho, below the Outlet Dam at Priest Lake

14.8.2 Out-of-Subbasin Effects and Assumptions

Dams downstream and upstream of the Pend Oreille Subbasin have modified and currently regulate the hydrologic regime impacting the aquatic community. Dams downstream along the Columbia (for example, Chief Joseph and Grand Coulee) and on the Pend Oreille River prevent the upstream migration of anadromous fish and have isolated many native fish populations. The fragmentation of habitat has undoubtedly altered the productivity, capacity, and genetic integrity of the aquatic and terrestrial communities, especially with regard to nutrient input from the ocean (salmon).

Upstream, Hungry Horse Dam has also modified the hydrograph of the South Fork, the Flathead, and subsequently the Clark Fork and the Pend Oreille rivers. This dam was constructed over 50 years ago and provides flood management for the Columbia River basin with 2,982,000 acre-feet of capacity assigned to flood control (U.S. Bureau of Reclamation 2003). Water is released for various purposes such as flood control, power generation, and as aid to downstream juvenile salmon migration. Direct impacts to native salmonids in the subbasin from these upstream dam operations are not known or quantified.

14.9 Limiting Factors and Conditions[4]

Limiting factors vary across the Pend Oreille basin and among species. In the Upper Pend Oreille Subbasin, limiting factors for fish relate to lake and stream habitat conditions; outside influences on the species including competition, hybridization, prey availability, and predation (including human predation); and biological constraints inherent to the species (PBTTAT 1998). Illegal harvest of some species, particularly bull trout, has been cited as a limiting factor in some spawning streams (PBTTAT 1998).

The two primary limiting factors in the Lower Pend Oreille Subbasin are habitat loss and nonnative species competition. Habitat loss includes losses of connectivity, quality, quantity, and diversity of aquatic environments. The loss of connectivity for fish movement on the mainstem Pend Oreille River and its tributaries refers to man-made barriers without fish passage facilities. Quality and quantity of habitat refers to water quality conditions (temperature, dissolved oxygen, TDGs, etc.) and area of suitable/accessible habitat. Diversity of aquatic environments refers to habitat complexity and structure that can provide sources of food, shelter, and spawning habitat. Many environmental and managed factors can contribute to these limiting factors (Andonaegui 2003; Shepard et al. 2002).

Limiting factors for fish in the Priest River Subbasin are related to both natural features and anthropogenic activities. The geology of the Priest River has low nutrient value, thus creates natural aquatic communities of low productivity. The northern latitude and elevation of the watershed also limits the growing season for fish. Native fish populations were naturally limited in numbers relative to more productive areas of the state. The availability of tributary spawning and rearing habitat further limited adfluvial westslope cutthroat and bull trout below what both Upper Priest Lake and Priest Lake would support (Entz and Maroney 2001). These low productivity watersheds help explain the evolutionary history of anadromous fish in the basin and the migrating nature of resident fish (Entz and Maroney 2001).

[4] Large portions of Section 14.4 are from the Pend Oreille Subbasin Summary Report (2001) pp. 21-25, 83-89, 146-151.

14.9.1 Physical Habitat Alterations/Limiting Habitat Attributes

QHA was utilized to compare historic versus current physical stream conditions with respect to 11 habitat attributes. Details of the analysis method are provided in Section 3. QHA model does not determine which habitat attributes are most biologically limiting, but does identify which physical attributes have undergone the greatest deviation from the reference stream/reach condition. These results, coupled with knowledge of local biologists and biological status and interactions of the focal species, can assist in identifying key limiting factors. This section provides QHA results on a subbasin level for the Pend Oreille Subbasin. Results specific to each focal species are discussed within each focal species section.

In the Pend Oreille Subbasin, all areas were delineated into watersheds or river reaches (Map, PO-9, located the end of this section). Using the QHA model, habitat conditions were analyzed where bull trout, westslope cutthroat trout, mountain whitefish, and kokanee salmon were historically and are currently distributed. Reaches with habitat attributes classified as less than optimal in the reference condition are presented in Table 14.26.

Table 14.26. Reaches that were ranked as containing less than optimal habitat conditions in the reference condition

Sequence	Reach Name	Habitat Attribute < Optimal
1	Main Pend Oreille River	High Temperature, Obstructions
16	Flume Creek	Obstructions
17	Pocahontas Creek	Obstructions
27	Slate Creek	Obstructions
34	North Fork Sullivan Creek	Obstructions
47	Middle Creek	Obstructions
48	Lower Mill Creek	Obstructions
51	Upper CCA Creek	Obstructions
61	Lower North Fork Calispell Creek	Obstructions
67	Lower Small Creek	Obstructions
69	East Fork Small Creek	Obstructions
119	Kalispell Creek	Fine Sediment
131	Lion/Lucky Creek	Obstructions
132	Two Mouth Creek	Obstructions
133	Bear Creek	Obstructions
135	Upper Pack River	Obstructions
136	Hunt Creek	Obstructions
139	Soldier Creek	Obstructions
144	Sand Creek	Fine Sediment
148	Lower Pack River	Fine Sediment
150	Grouse Creek	Fine Sediment
154	Rapid Lightning Creek	Obstructions
160	North Gold Creek	Obstructions
161	(South) Gold Creek	Obstructions
162	Johnson Creek	Obstructions

Sequence	Reach Name	Habitat Attribute < Optimal
164	Lightning Creek above Rattle Creek	Obstructions
167	Clark Fork River (below Cabinet Gorge Dam)	High Temperature

The habitat parameters with the greatest deviation from reference conditions vary by species and are presented in Table 14.27. This table should be interpreted as an indication of the types of habitat parameters that are problematic for the focal species in the Subbasin as a whole. Some reaches had more than one habitat parameter ranked as being equally deviant from the reference, hence the number of reaches listed adds up to more than the total number of reaches ranked. Most reaches had more than one habitat parameter that is currently ranked less than the reference. Table 14.27 only lists those habitat parameters that had the greatest deviation from reference; not all the parameters were less than optimal.

With respect to all focal species, the most common habitat attributes rated as having the greatest deviation from the reference condition included fine sediment, riparian condition, channel stability, and habitat complexity (Table 14.27). Other habitat attributes such as flow and temperature regimes, obstructions, and presence of pollutants have also been altered impairing stream habitat, however less common throughout the Subbasin as a whole. It is possible that any one or combination of altered habitat attributes may be key factors inhibiting full biological potential of some focal species populations. QHA can only identify limiting factors regarding stream habitat conditions, however, local biologists can compare results from the QHA to other records and data documenting biological conditions and determine any potential relationships or correlations that may help better manage, protect, or restore key stream reaches and focal species using these reaches.

Table 14.27. Habitat conditions with the greatest deviation from reference conditions as presented in the QHA model output for each focal species in Pend Oreille Subbasin. In parentheses are the number of reaches or watersheds with the particular habitat attribute exhibiting the largest deviation within that area.

Whitefish (62)	Bull Trout (94)	Kokanee (17)	Cutthroat (129)
Fine Sediment (58)	Fine Sediment (53)	Channel Stability (9)	Fine Sediment (84)
High Flow (5)	Habitat Complexity (44)	Fine Sediment (8)	Riparian Condition (64)
Obstructions (5)	Riparian Condition (26)	Low Flow (5)	Habitat Diversity (64)
	Channel Stability (26)	Obstructions (4)	Channel Stability (40)
	Low Flow (16)	Pollutants (3)	Low Flow (24)
	High Temperature (8)	High Flow (3)	High Temperature (21)
	High Flow (8)		Obstructions (13)
	Obstructions (6)		High Flow (13)
	Pollutants (4)		Pollutants (7)

14.9.1 Description of Historic Factors Leading to Decline of Focal Species

Limiting factors leading to the decline of focal species have been attributed to the introduction of nonnative species, as well as habitat degradation and fragmentation in terrestrial and aquatic environments. The following section describes how habitat modifications to terrestrial and aquatic environments and the introduction of nonnative species have negatively impacted native focal species, mountain whitefish, bull trout and westslope cutthroat trout within the Pend Oreille Subbasin. There is little information available specific to mountain whitefish within the Subbasin. It is assumed that stream and lake connectivity along with water quality conditions important to bull trout and westslope cutthroat trout are similarly important to mountain whitefish as these factors are for other salmonids. The following describes the limiting factors present in tributary and mainstem habitats, as well as the non-adaptive biological factors impacting native focal species. Limiting factors impacting nonnative focal species, kokanee and largemouth bass, are discussed separately in section 14.6 and 14.7, respectively.

14.9.1.1 Tributaries

Tributary habitat in the Pend Oreille Subbasin has been degraded by the following human disturbance including timber harvest in riparian areas, riparian impacts by livestock, fish impassable culverts, splashdams and dewatering, log transport, clearing of in-stream large woody debris, roads, forest fires, small hydroelectric dams, in-stream mining, conversion of forest land to agricultural and residential areas, diking, and water diversions (Entz and Maroney 2001).

Livestock grazing has impacted public and private riparian forests and uplands in most subbasin tributaries (Entz and Maroney 2001). The USFS has an extensive grazing program in many tributaries to the Pend Oreille River. Direct impacts are evidenced by water quality problems, bank erosion, over utilization of riparian vegetation, and sediment input. The available land base on which to farm limits agriculture in the Lower Pend Oreille Subbasin, but all available agricultural land is farmed. Agricultural practices have contributed to fisheries impacts through stream channelization, sediment input and water quality problems. Inadequate stream buffers on agricultural lands are a major problem. However the continued application and acceptance of BMPs as well as increased participation by landowners in voluntary riparian fencing programs throughout the Subbasin have secured miles of streambank protection to insure future habitat improvement projects will have a lasting effect.

Culvert installation and sediment input are the major problems caused by road maintenance and construction (Entz and Maroney 2001). Improper culvert placement prevents upstream migration and extirpates native salmonid gene flow into some subbasin tributaries. Many timber hauling roads are within the riparian zone and contribute to sedimentation to streams. Road densities from forest practices are high in the majority of the Subbasin. These factors associated with road construction continue to occur and contribute to further habitat fragmentation.

Extensive and intensive timber harvests have lead to the general decline in the quality of habitat available to native salmonid species. Riparian and upland management practices aimed at extracting the maximum amount of timber have contributed to poor riparian buffer health, lack of large woody debris in the channel, poor large woody debris recruitment potential, mass wasting, and point and non-point sediment input. In 1999, the Washington State legislature endorsed the Forests and Fish Report and passed the Salmon Recovery Act. The Forests and Fish Report defines the conditions to implement the Salmon Recovery Act. This legislation is only a few years old and the problems that exist come from a century of abuse. Thus far, it has led to more restrictive harvest of riparian trees along fish-bearing streams.

In-stream habitat conditions that influence bull trout and westslope cutthroat trout distribution and abundance include flow, water temperature, cover, connectivity, geology, and habitat complexity. Living space for these species has been reduced in some streams through loss of flow; excess bedload filling in pools; widening of stream channels resulting in water too shallow to support fish; loss of large woody debris recruitment needed to create pools and cover; fine sediment covering spawning gravels; or filling in the spaces between rocks where juvenile bull fish hide. Shifting bedload in unstable streams may reduce incubation success by physically damaging eggs of fall spawning fish such as bull trout. Shifting bedload in unstable streams is believed to be a significant limiting factor in streams on the northern and eastern tributaries to Lake Pend Oreille, and is primarily associated with significant levels of timber harvest and road construction (PBTTAT 1998). Fine sediment can reduce the flow of oxygenated water into redds, reducing hatching success, and is a problem in upper Pack River tributaries (PBTTAT 1998).

Increasing development of residential and secondary home sites are expected to create further impacts to riparian areas and water quality.

14.9.1.2 Mainstem Habitat
Mainstem habitat in the Pend Oreille Subbasin can be differentiated into three sections: (1) the lower Clark Fork River, (2) upper Pend Oreille River above Albeni Falls, and (3) the lower Pend Oreille River below Albeni Falls. In general, the hydropower development and operations on the Pend Oreille River have altered much of the hydrology of the river from that of a cold fast-moving river to warm and shallow reservoirs (Karchesky 2002).

Hydroelectric facilities built 50 to 100 years ago on the Clark Fork River have eliminated bull trout passage, beginning in 1913 with construction of Thompson Falls Dam in the middle of the Clark Fork River. The dams cut off hundreds of kilometers of spawning and rearing habitat for migratory species such as bull trout, westslope cutthroat trout, and mountain whitefish. After 1913, the accessible watershed available to Lake Pend Oreille fish upstream of Albeni Falls Dam consisted of the Pend Oreille River and its tributaries, Lake Pend Oreille and its tributaries, and the Clark Fork River and its tributaries upstream to Thompson Falls Dam. After construction of Cabinet Gorge Dam blocked the Lower Clark Fork River in September 1951, the total watershed area available to bull trout in Lake Pend Oreille, excluding the Priest River Subbasin and the Lower Pend Oreille Subbasin, was thus further reduced by about 43 percent (PBTTAT 1998). Overall, it is estimated that less than 10 percent of the historic range of bull trout in the Upper Pend Oreille Subbasin is accessible to bull trout as a result of dam construction (PBTTAT 1998). Resident fracture populations still exist in these subbasins but at much lower densities and with restricted life histories. The introduction of brook trout further exacerbates the recovery of bull trout. Restoration of fish passage at Cabinet Gorge and Noxon Rapids dams is currently underway as an adaptive management program under the FERC Re-licensing Settlement Agreement of 2000. If this program is successful, it will begin to restore upstream gene flow back to conditions found between 1913 and 1952.

The lower 5 km of the Clark Fork River supports a seasonal coldwater fishery during the winter months. However, the summer pool flooding in otherwise productive riffle habitats compromises some of the most diverse and productive riverine habitat in the lower Clark Fork River. Peaking operations at Cabinet Gorge Dam lower the productivity of the Clark Fork River, but a good trout fishery is present year-round in free flowing reaches.

In the upper Pend Oreille River, upstream of Albeni Falls, over-wintering habitat was identified as the limiting factor for the development of a warmwater fishery (Karchesky 2002). Karchesky (2002) found that the population structure of largemouth bass, black crappie, and pumpkinseed had an increased abundance of larger and older fish following 3 years of higher winter water levels in the upper Pend Oreille River (above Albeni Falls). The increase in fish sizes and ages were attributed to improved winter survival during high water winter years.

The hydrological characteristics of the lower Pend Oreille River, downstream of Albeni Falls Dam, have been altered since the construction of the five mainstem dam facilities. The five mainstem dams have negatively altered habitat historically available and suitable for native salmonids. Bull trout numbers have declined in the Pend Oreille River due to factors such as habitat connectivity, habitat degradation, man-made barriers, and nonnative fish introductions (Andonaegui 2003). It is unknown which bull trout life stage is most limiting (Andonaegui 2003), but in general the mainstem Pend Oreille River is no longer suitable for trout compared to historical conditions (Ashe and Scholz 1992). Within the boundaries of the United States, native salmonids are limited by river temperatures exceeding 20 °C during the summer create unfavorable thermal conditions in Boundary and Box Canyon reservoirs, and the warmwater fishery is limited by the lack of suitable over-wintering habitat (Karchesky 2002).

14.9.1.3 Non-Adaptive Biological Factors

The introduction of nonnative species has drastically and irrevocably altered the fish community and inter-species dynamics in the Pend Oreille Subbasin. Genetic change can occur by introductions of nonnative fish into populations, shrinking population size, and fragmentation of populations through migration barriers. Behavioral changes can occur through selective breeding in a hatchery environment or introductions of new genetic stocks. Before the introduction of nonnative fish species, bull trout and northern pike minnow were the top predators in Lake Pend Oreille and its tributaries (Pratt and Huston

1993). Today, bull trout and northern pike minnow share the predator niche with a minimum of six nonnative fish species (Pratt and Huston 1993).

Brook trout out-compete bull trout for the same space and resources (Gunckel et al. 2002). Hybridization with bull trout reduces the reproductive potential of bull trout. Kanda et al. (2002) used biochemical and molecular genetic techniques to evaluate the degree of introgressive hybridization between bull and brook trout in the Flathead River drainage in Montana. They found F_1 hybrids did successfully reproduce with parental species. However, none were found. Hybridization reduces fertility of F_2 genotypes. Kanda et al. (2002) concluded that hybridization wasted more reproductive energy for bull trout since the majority of hybridization was found between female bull trout and male brook trout because eggs contain more energy than sperm.

Other nonnative interactions may also be competing with bull trout. Competition for spawning areas between bull trout and brown trout can directly reduce reproductive success if there is redd superimposition. Bull and brown trout also utilize similar microhabitats as juveniles, but the interactions and effects at this life stage are unknown (Pratt and Huston 1993).

Competition for food or habitat that is in limited supply or predation can limit populations by reducing survival to spawning age. Nonnative lake trout also pose this threat to bull trout, westslope cutthroat trout, and kokanee in Lake Pend Oreille. In Lake Pend Oreille, most of the suitable lake trout habitat is in the northern end of the lake. This is also the part of the lake where the majority of the adfluvial bull trout smolts enter the lake from the Clark Fork and other lake tributaries. Kokanee are the primary prey species for lake, bull, and rainbow trout in the lake (Videgar 2000; Fredericks et al. 1995; Maiolie and Elam 1993). IDFG is concerned that the numbers of predators exceeds the prey base ability to support them such that bull trout in Lake Pend Oreille may become depressed if the kokanee forage base is lost (Fish and Wildlife Service 2000). Kokanee comprised of 66 percent of the diet for bull trout (n = 11) greater than 408 mm in Lake Pend Oreille (Videgar 2000). The loss of kokanee would likely favor lake trout over bull trout, because of the presence of Mysis shrimp.

In the Priest River lake system, bull trout declines are attributed to lake trout out-competing bull trout for habitat. Bull trout populations are threatened in both Priest Lake and Upper Priest Lake since there is no barrier to prevent lake trout movement between the lakes (Andonaegui 2003). In the river system, brook trout are further contributing to bull trout decline through hybridization and competition (Andonaegui 2003).