Draft

Kootenai[1] River Subbasin Summary[2]

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Prepared for the Northwest Power Planning Council

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DRAFT: This document has not yet been reviewed or approved by the Northwest Power Planning Council.

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[1] Spelled Kootenai in the U.S. and Kootenay in Canada.

[2] Time constraints did not allow the for the inclusion of significant information for the Canadian portion of the subbasin. However, this information will be included in future planning efforts.

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Kootenai River Subbasin Summary

Subbasin Description

General Description

Subbasin Location

The Kootenai River Subbasin is an international watershed that encompasses parts of British Columbia (B.C.), Montana, and Idaho. The headwaters of the Kootenai River originate in Kootenay National Park, B.C. The river flows south within the Rocky Mountain Trench into the reservoir created by Libby Dam, which is located near Libby, Montana. From the reservoir, the river turns west, passes through a gap between the Purcell and Cabinet Mountains, enters Idaho, and then loops north where it flows into Kootenay Lake, B.C. The waters leave the lake's West Arm and flow south to join the Columbia River at Castlegar, B.C. In terms of runoff volume, the Kootenai is the second largest Columbia River tributary. In terms of watershed area (36,000 km^2 or 8.96 million acres), it ranks third (Knudson 1994) (Figure 1).

Drainage Area

Nearly two-thirds of the river's 485-mile-long channel, and almost three-fourths of its watershed area, is located within the province of British Columbia. Roughly twenty-one percent of the watershed lies within the state of Montana, and six percent falls within Idaho (Knudson 1994). The Continental Divide forms much of the eastern boundary, the Selkirk Mountains the western boundary, and the Cabinet Range the southern. The Purcell Mountains fill the center of the river's J-shaped course to Kootenay Lake. Throughout, the subbasin is mountainous and heavily forested. Figure 2 shows major vegetation types in the U.S. portion of the subbasin.

Climate

The subbasin has a relatively moist climate, with annual precipitation even at low elevations generally exceeding 20 inches. Warm, wet air masses from the Pacific bring abundant rain and 1,000 to 7,500 mm (40 to 300 inches) of snowfall each year. In winter, Pacific air masses dominate and produce inland mountain climates that are not extremely cold, although subzero continental-polar air occasionally settles over the mountains of northern Idaho and vicinity.

The Continental Divide Range, with crest elevations of 10,000 to 11,500 feet along nearly 250 km (155 miles) of ridgeline, is a major water source for the river. The range receives 2,000 to 3,000 mm (80 to 120 inches) of precipitation annually (Bonde 1987). Some of the high elevation country in the Purcell Range around Mt. Findlay receives 2,000 mm (80 inches) of precipitation a year; but most of the range, and most of

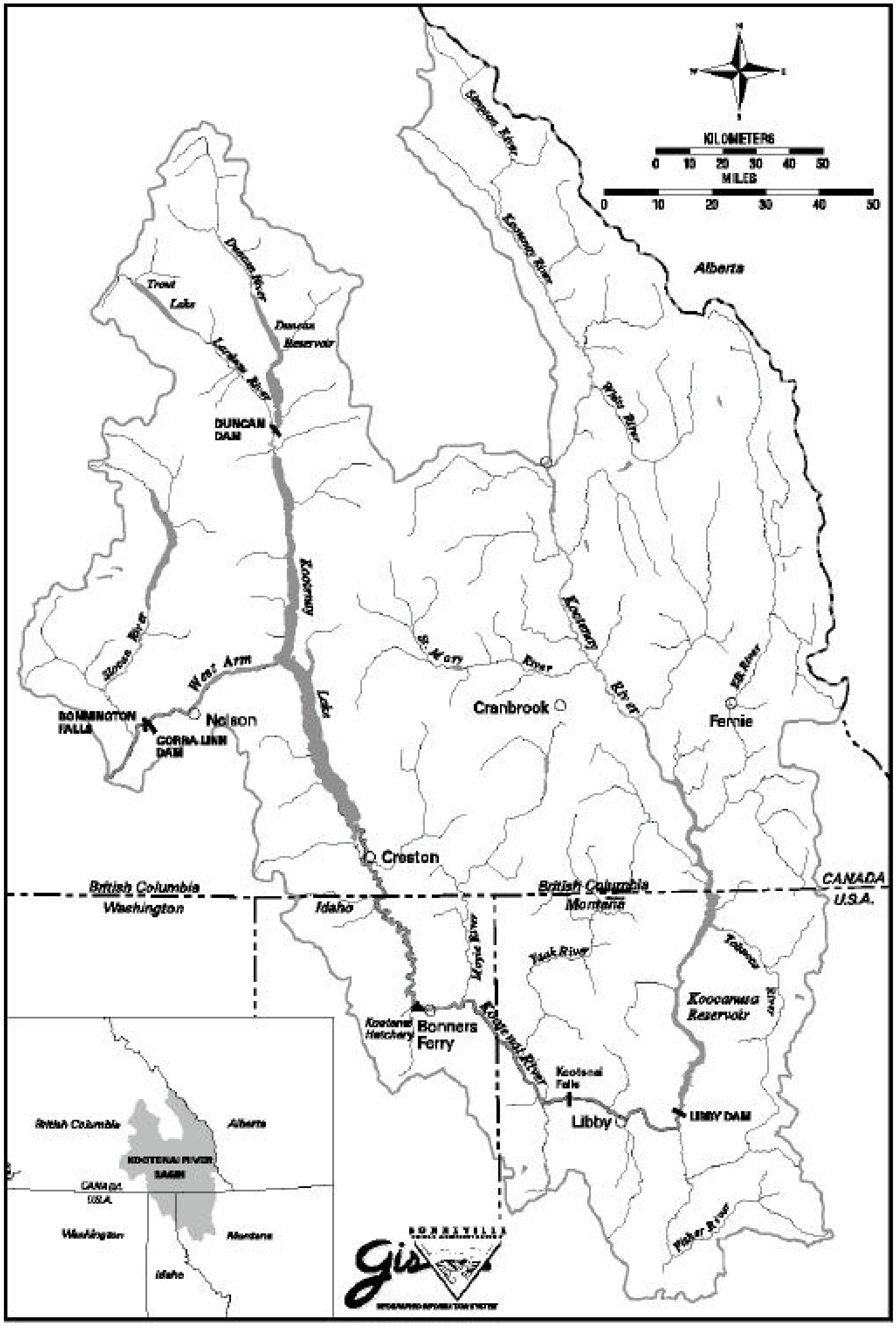

Figure 1. Kootenai River subbasin

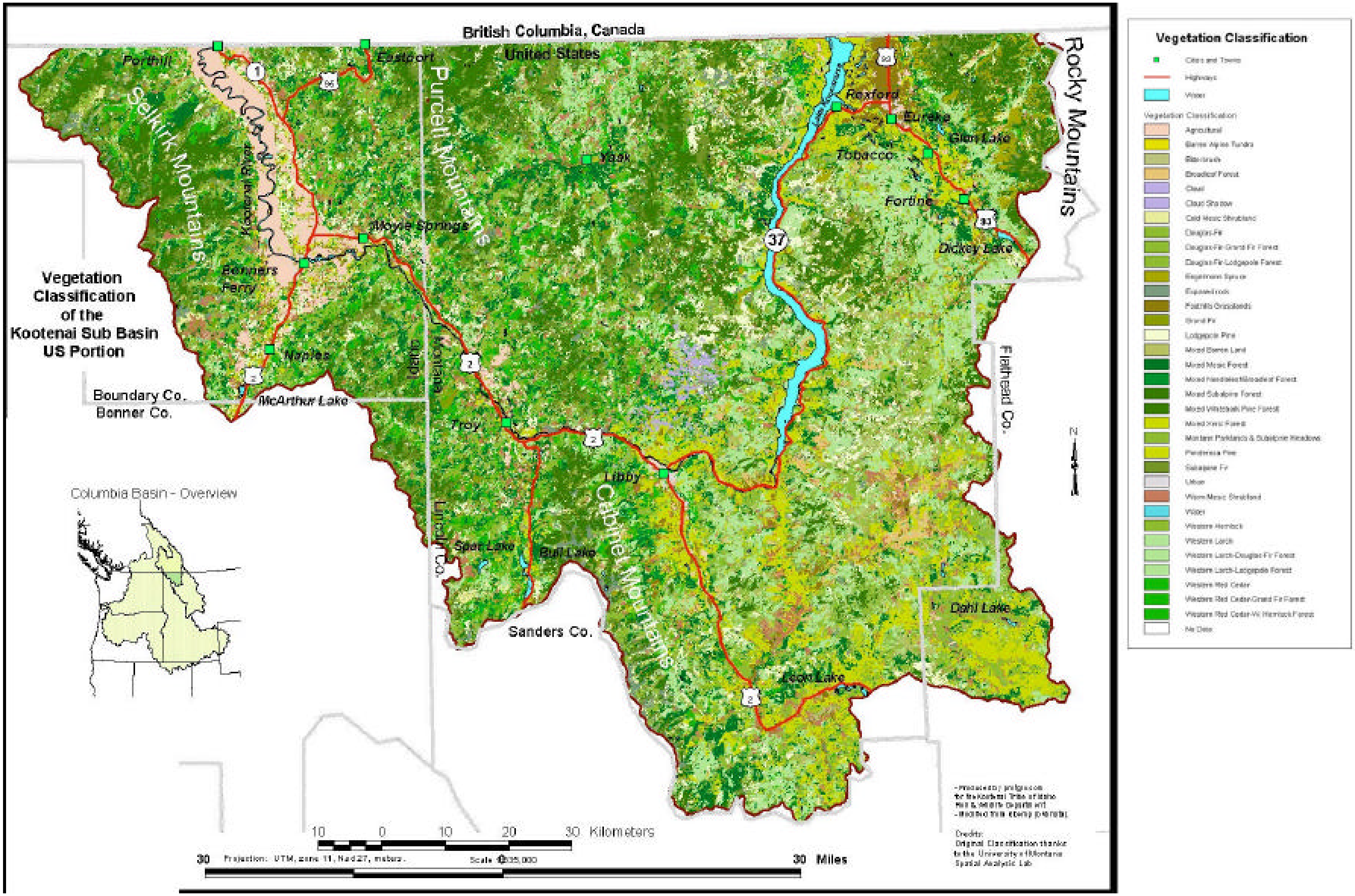

Figure 2. Vegetation classification of the U.S. portion of the Kootenai Subbasin

the Selkirk and Cabinets, get only 1,000 to 1,500 mm (40 to 60 inches) annually (Daley et al. 1981). In the inhabited valley bottoms, annual precipitation varies from just under 500 mm (20 inches) at Rexford, Montana (USACE 1974) and Creston, British Columbia (Daley et al. 1981) to just over 1,000 mm (40 inches) at Fernie, British Columbia (Oliver 1979).

Topography

The drainage basin is located within the Northern Rocky Mountain physiographic province, which is characterized by north to northwest trending mountain ranges separated by straight valleys that run parallel to the ranges.

The topography of the Kootenai River subbasin is dominated by steep, heavily forested mountain canyons and valleys. Consequently, nearly all of the major tributaries to the river, including the Elk, Bull, White, Lussier, and Vermillion Rivers have a very high channel gradient, particularly in their headwaters. In contrast, the mainstem of the Kootenai has a fairly low channel gradient after entering the Rocky Mountain Trench near Canal Flats. The river drops less than 1,000 feet (305 meters) in elevation from Canal Flats to Kootenay Lake, a distance of over 300 miles (480 km). However, even along the river's slow meandering course, valley-bottom widths are generally less than two miles and are characterized by tree-covered rolling hills with few grassland openings. The only exceptions to this topography are the slightly wider valley bottoms in the Bonners Ferry-to-Creston area and the Tobacco Plains, located between Eureka, Montana and Grasmere, British Columbia.

Synder and Minshall (l996) identified three different geomorphic reaches of the Kootenai River between Libby Dam and Kootenay Lake. The first reach (Canyon) extends from Libby Dam to the Moyie River (92 km). It flows through a canyon in places, but otherwise has a limited flood plain due to the closeness of the mountains. The substrate consists of large cobble and gravel. The second reach (Braided) extends from the Moyie River to the town of Bonners Ferry (7.5 km). It is extensively braided with depths that are typically less than 9 m, and substrates that consist mostly of gravels. The river has an average gradient of 0.6 m/km, and velocities higher than 0.8 m/s. The third reach (Meander) extends from just below the town of Bonners Ferry to the confluence of the Kootenay Lake (82.5 km). Here, the river slows to an average gradient of 0.02 m/km, deepens, and meanders through the Kootenai Valley back into British Columbia and into the southern arm of Kootenay Lake. The meandering section through the Kootenai Valley is characterized by water depths of up to 12 meters in runs and up to 30 meters in pools (Snyder and Minshall 1994). This reach has been extensively diked and channelized, which has had profound effects on ecosystem processes.

Geology

Mountains in the subbasin are composed of folded, faulted, and metamorphosed blocks of Precambrian sedimentary rocks of the Belt Series and minor basaltic intrusions (Ferreira et al. 1992). Primary rock types are meta-sedimentary argillites, sitlites, and quartzites, which are hard and resistant to erosion. Where exposed, they form steep canyon walls and confined stream reaches. The porous nature of the rock and glaciation and have profoundly influenced basin and channel morphology (Hauer and Stanford 1997).

The river character changes dramatically from a bedrock-controlled regime in Montana to a silt/clay regime near the town of Bonners Ferry, Idaho. During the Pleistocene, continental glaciation overrode most of the Purcell Range north of the river, leaving a mosaic of glacially scoured mountainsides, glacial till, and lake deposits. Late in the glacial period, an ice dam blocked the outlet at West Arm of Kootenay Lake. The dam formed glacial Kootenay Lake, the waters of which backed all the way to present-day Libby, Montana. Glacial Kootenay Lake filled the valley with lacustrine sediments, which included fine silts and glacial gravels and boulders. The Kootenai River and lower tributary reaches in Idaho are actively reworking these lacustrine sediments today. A terrace of lacustrine sediments on the east side of the valley is approximately 150 feet above the current floodplain and is a remnant of the ancestral valley floor. Tributary streams working through remnant deposits to meet the present base level of the mainstem and from the mainstem reworking existing floodplain and streambank deposits continue to be a source of fine sediments. An extensive network of marshes, tributary side channels, and sloughs were formed by lowering of the lake level, flooding, and the river reworking its floodplain. Some of these wetlands continued to be supported by groundwater recharge, springtime flooding, and channel meandering. Much of this riverine topography however, has been eliminated by diking and agricultural development, especially in the reach downstream of Bonners Ferry, Idaho.

Hydrology

The headwaters of the Kootenay River in British Columbia consist primarily of the main fork of the Kootenay River and Elk River. High channel gradients are present throughout headwater reaches and tributaries.

Libby Reservoir (Lake Koocanusa) and its tributaries receive runoff from 47 percent of the Kootenai River drainage basin. The reservoir has an annual average inflow of 10,615 cfs. Three Canadian rivers, the Kootenay, Elk, and Bull, supply 87 percent of the inflow (Chisholm et al. 1989). The Tobacco River and numerous small tributaries flow into the reservoir south of the International Border.

Major tributaries to the Kootenai River below Libby Dam include the Fisher River (838 sq. mi.; 485 average cfs), the Yaak River (766 sq. mi. and 888 average cfs) and the Moyie River (755 sq. mi.; 698 average cfs). Kootenai River tributaries are characteristically high-gradient mountain streams with bed material consisting of various mixtures of sand, gravel, rubble, boulders, and drifting amounts of clay and silt, predominantly of glacio-lacustrine origin. Fine materials, due to their instability during periods of high stream discharge, are continually abraded and redeposited as gravel bars, forming braided channels with alternating riffles and pools. Streamflow in unregulated tributaries generally peaks in May and June after the onset of snow melt, then declines to low flows from November through March. Flows also peak with rain-on-snow events. Kootenai Falls, a 200-foot-high waterfall and a natural fish-migration barrier, is located eleven miles downstream of Libby Montana.

The river drops in elevation from 3618 m at the headwaters to 532 m at the confluence of Kootenay Lake. It leaves the Kootenay Lake through the western arm to a confluence with the Columbia River at Castlegar. A natural barrier at Bonnington Falls, and now a series of four dams isolate fish from other populations in the Columbia River basin. The natural barrier has isolated sturgeon for approximately 10,000 years (Northcote 1973). At its mouth, the Kootenai River has an average annual discharge of 868 m^3/s (30,650 cfs)

Soils

Soils formed from residual and colluvial materials eroded from Belt rocks or in materials deposited by glaciers, lakes, streams, and wind. Wind deposits include volcanic ash from Cascade Range volcanoes in Washington and Oregon.

In many areas, soils formed in glacial till and are generally loamy and with moderate to high quantities of boulders, cobbles, and gravels. Although soils within the mountainous regions vary widely in character, most mountain and foothill soils are on steep slopes and well drained, with large amounts of broken rock. Rock outcrops are common.

Soils deposited by glaciers or flowing water are, for the most part, deep, well-drained, and productive soils. Most of forest soils in the subbasin are somewhat resistant to erosion by water. In most of the valleys, soils are deep, relatively productive, and gently sloping.

Ustolls, Ochrepts, and Ustalfs are the dominant soils in valleys and on lower mountain slopes. Ochrepts, Borolls, and Orthents are dominant on upper mountain slopes and crests. Orthents and areas of rock outcrop are extensive on steep mountain slopes, and Fluvents and Aquolls are in valleys (NRCS 2000).

Land Use

See Figure 3. The Kootenay Basin remains relatively remote and sparsely populated. Fewer than 100,000 people live within the basin upstream from Kootenay Lake, an area larger than the states of Maryland and Delaware combined. The largest municipal center is Cranbrook/Kimberley, which has a population of about 25,000. Only a handful of other communities have populations larger than 2,000. They include Libby, Montana, Bonners Ferry, Idaho; and Fernie, Sparwood, Elkford, and Creston, British Columbia.

The forest products industry remains the most dominant employment and most extensive development activity in the subbasin. Roughly 90 percent of the drainage is forested. Logging and associated road building has occurred in nearly all of the lower elevation valleys and on many higher elevation ridges. Roadless areas larger than 5,000 acres are uncommon. Nine roadless areas totaling 139,600 acres exist in the Idaho portion of the subbasin (IPNF 1991). In the Montana portion, nine roadless areas totaling 241,500 acres are present, including approximately 60,000 acres of upper Libby and Lake creeks within the Cabinet Mountains Wilderness Area (USDA 1987). The largest contiguous block of land without logging roads in the British Columbia portion of the Kootenay Basin is the 390,000-acre Kootenay/Mt. Assiniboine National and Provincial Parks (Rocchini 1981). Approximately 150,000 acres of the headwaters of the St. Mary River and Findlay Creek northwest of Cranbrook/Kimberley are within the Purcell Wilderness Conservancy. The total surface area of undeveloped areas amounts to about 10 percent of the Kootenai Subbasin above Kootenay Lake.

Coal and hard rock mining are prominent activities in the subbasin, particularly along the Elk and St. Mary rivers and in the northern Cabinet Mountains. Large-scale, open-pit coal mining began in the Elk River watershed in the early 1970s. Since the late 1930s, the Sullivan Mine at Kimberley, B.C. has been the largest metal producer in the basin. In 1981 it was one of the two largest lead-zinc mines in the world (Daley et al. 1981). From 1981 to the present, a large copper and silver mine and chemical floatation mill has operated in the Lake Creek watershed south of Troy, MT.

About two percent of the subbasin is agricultural land, much of it used for pasture and forage production (Bonde and Bush 1982). Agricultural development is confined primarily to narrow valley bottoms. Though it utilizes a relatively small area, it has had a large impact on habitats of the mainstem river and tributary mouths because most of the activity occurs in the floodplain. The largest contiguous block of agricultural land is within the Purcell Trench, which extends roughly from Bonners Ferry, Idaho to the river's entry into Kootenay Lake. Production of oats, wheat and barley account for 62 percent of the agricultural output in the Bonners Ferry/Creston area, with livestock production accounting for 20 percent. Hay and grass seed production and livestock grazing are the most common agricultural activities in the rest of the subbasin.

The two largest industrial operations and point-source discharges to the Kootenay River are the Crestbrook Forest Industries' pulp mill in Skookumchuck, B.C. and the Cominco mining, milling, and fertilizer plant in Kimberley, B.C. (Daley et al. 1981).

Another industrial operation in the basin was the mining and processing of vermiculite by the W.R. Grace Company northeast of Libby, MT on Rainy Creek.

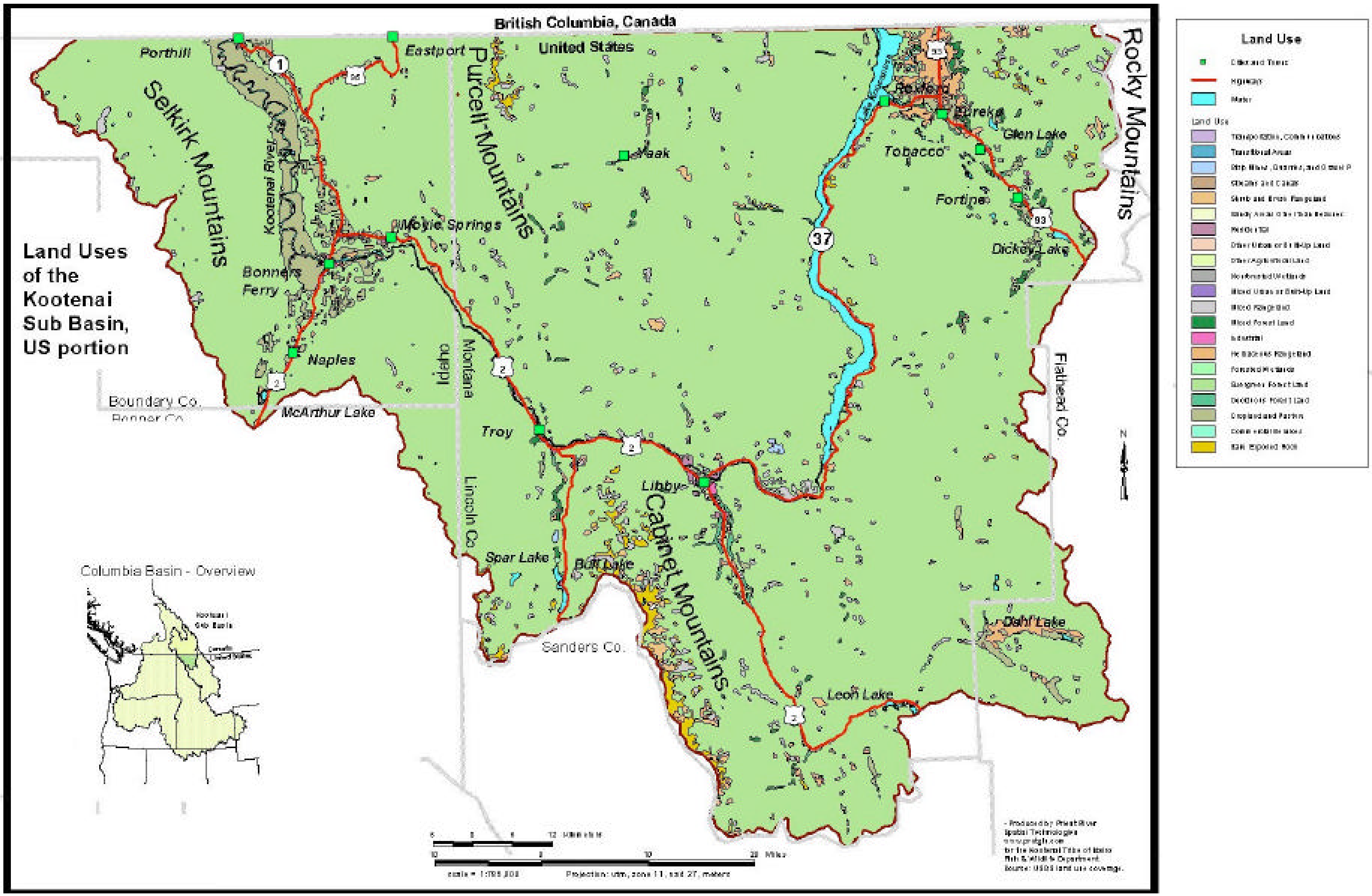

Figure 3. Land use in the U.S. portion of the Kootenai Subbasin

Natural areas and lands designated to protect wildlife and associated habitats (Figure 4) include the Dancing Prairie (TNC), Myrtle Creek Game Preserve (managed by USFS), Cabinet Mountain Wilderness Area (USFS), and several Natural Research Areas (RNA's) that are managed by the USDA Forest Service. Other wildlife management areas, not included in Figure 4, are the Kootenai National Wildlife Refuge (USFWS), Lost Trail National Wildlife Refuge (USFWS), Woods Ranch Wildlife Management Area (MFWP), West Kootenai Wildlife Management Area (MFWP), Kootenai Falls Wildlife Management Area (MFWP), Boundary Creek Wildlife Management Area (IDFG), and McArthur Lake Wildlife Management Area (IDFG). Lands specifically managed for ESA-listed or sensitive species include USFS management zones for grizzly bear, woodland caribou, wolverine, and lynx.

Impoundments

The production of hydroelectric energy is an important industry in the subbasin. Along with the Libby Dam/Libby Reservoir complex, by far the largest human-made structure in the watershed, six smaller hydroelectric dams are located in the U.S. part of the subbasin on the Elk, Bull, Moyie, and Goat Rivers and Smith and Lake Creeks (Figure 5). In addition there are five hydroelectric dams on the lower Kootenay River in British Columbia.

Libby Reservoir, formed by impoundment of the Kootenai River in 1972, is a 90-mile-long storage reservoir with a surface area of 188 km^2 (46,500 acres) at full pool. It is operated by the Army Corps of Engineers (USACOE) and located in Lincoln County, northwest Montana, approximately 27 km (17 mi.) upstream from the town of Libby. The Montana portion of the reservoir is bordered mainly by the Kootenai National Forest. The majority of the private property is located near the town of Rexford on the eastern side of the reservoir. The land along the Canadian portion of the reservoir is mostly private. Kikomun Provincial Park is located on the east bank of the reservoir, 10 miles south of the town of Wardner, B.C.

The primary benefit of the project is power production. The surface elevation ranges from 697.1 m (2,287 feet) to 749.5 m (2,459 feet, full pool). The typical operation schedule for Libby Dam and Libby Reservoir begins in July, when the reservoir fills to full pool. Drawdown begins in September and reaches minimum pool elevation in April. Historically, the USACOE operated Libby Reservoir to reach full pool in July and began drafting in September to reach a minimum pool elevation by April and frequently by March 15. Presently, operations are dictated by a combination of power production, flood control, recreation, and special operations for the recovery of ESA-listed species, including Kootenai River white sturgeon, bull trout, and Snake River salmon stocks in the lower Columbia River.

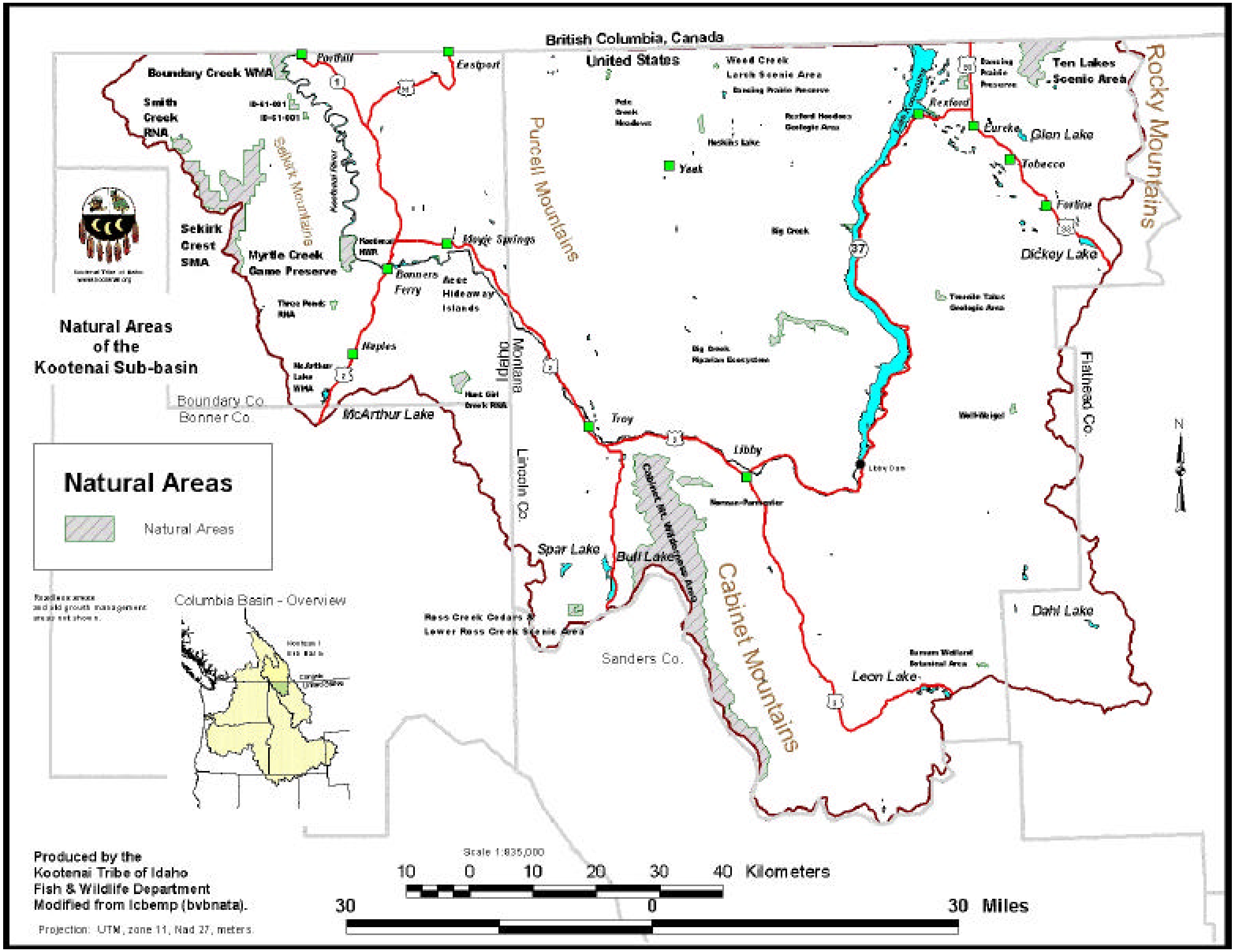

Figure 4. Natural areas in the U.S. portion of the Kootenai subbasin

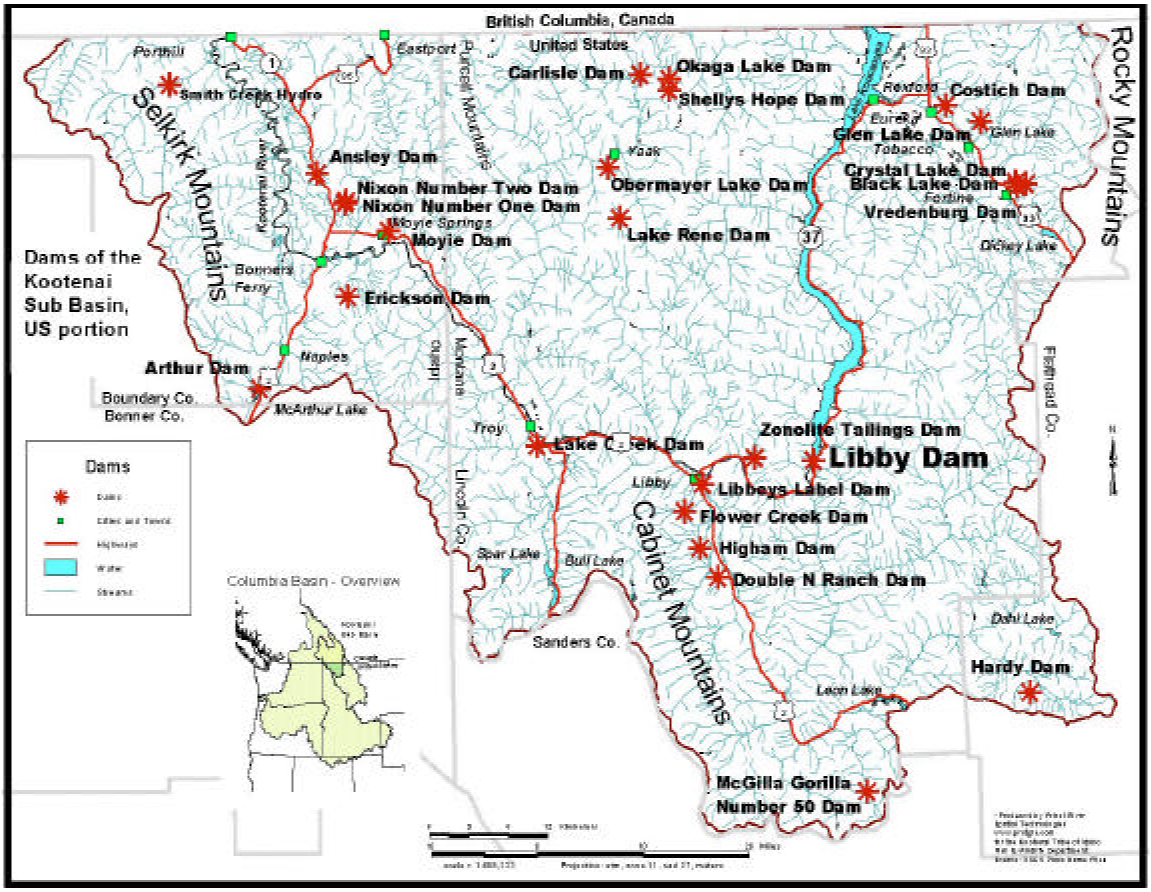

Figure 5. Major dams of the U.S. portion of the Kootenai Subbasin

Fish and Wildlife Resources

Fish and Wildlife Status

Fish

Fish species diversity in the Kootenai River Subbasin is low relative to most aquatic environments in North America. The species found with the subbasin are listed in Table 1. The relative abundance is shown in Table 2, which is followed by brief descriptions of the status of key species. Many of the streams discussed in this section are shown in Figure 6.

Table 1. Fish of the Kootenai River Subbasin

Common Name	Genus species	Location	Native
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	B	Yes
Rainbow trout	*Oncorhynchus mykiss*	B	No
Redband Rainbow trout	*Oncorhynchus mykiss subspecies*	B	Yes
Bull trout	*Salvelinus confluentus*	B	Yes
Brown Trout	*Salmo trutta*		No

Common Name	Genus species	Location	Native
Brook trout	*Salvelinus fontinalis*	R	No
Kokanee salmon	*Oncorhynchus nerka*	B	Yes
Mountain whitefish	*Prosopium williamsoni*	B	Yes
Bluegill	*Lepomis macrochirus*		No
Pumpkinseed	*Lepomis gibbosus*		No
Smallmouth Bass	*Micropterus dolomieu*		No
Largemouth Bass	*Micropterus salmonides*		No
Burbot	*Lota lota*	B	Yes
White sturgeon	*Acipenser transmontanus*	Ri	Yes
Northern Pike	*Esox lucius*		No
Yellow perch	*Perca flavescens*	R	No
Redside shiner	*Richardsonius balteatus*	B	Yes
Peamouth chub	*Mylocheilus caurinus*	B	Yes
Northern pikeminnow	*Ptychocheilus oregonensis*	B	Yes
Largescale sucker	*Catostomus macrocheilus*	B	Yes
Longnose sucker	*Catostomus catostomus*	B	Yes
Torrent sculpin	*Cottus rhotheus*	Ri	Yes
Slimy sculpin	*Cottus cognatus*	Ri	Yes
Longnose dace	*Rhinichthys cataractae*	Ri	Yes

R - Reservoir, **Ri** - River, **B** - Both

Table 2. Relative abundance of fishes collected by nighttime electrofishing at Kootenai River four lower Kootenai River sites between Bonners Ferry and Porthill, Idaho

Catch per Unit	**Species[1]**					
Effort	**MWF**	**LSS**	**LNS**	**PMC**	**NPM**	**RBT**
N/HR[2]	42	119	13	102	46	3
B/HR[3]	3	61	6	14	3	--

1 Species abbreviations are: MWF = mountain whitefish, LSS = largescale suckers, LNS = longnose sucker, PMC = peamouth chub, NPM = northern pikeminnow, and RBT = rainbow trout.

2 Numbers per hour

3 Biomass per hour

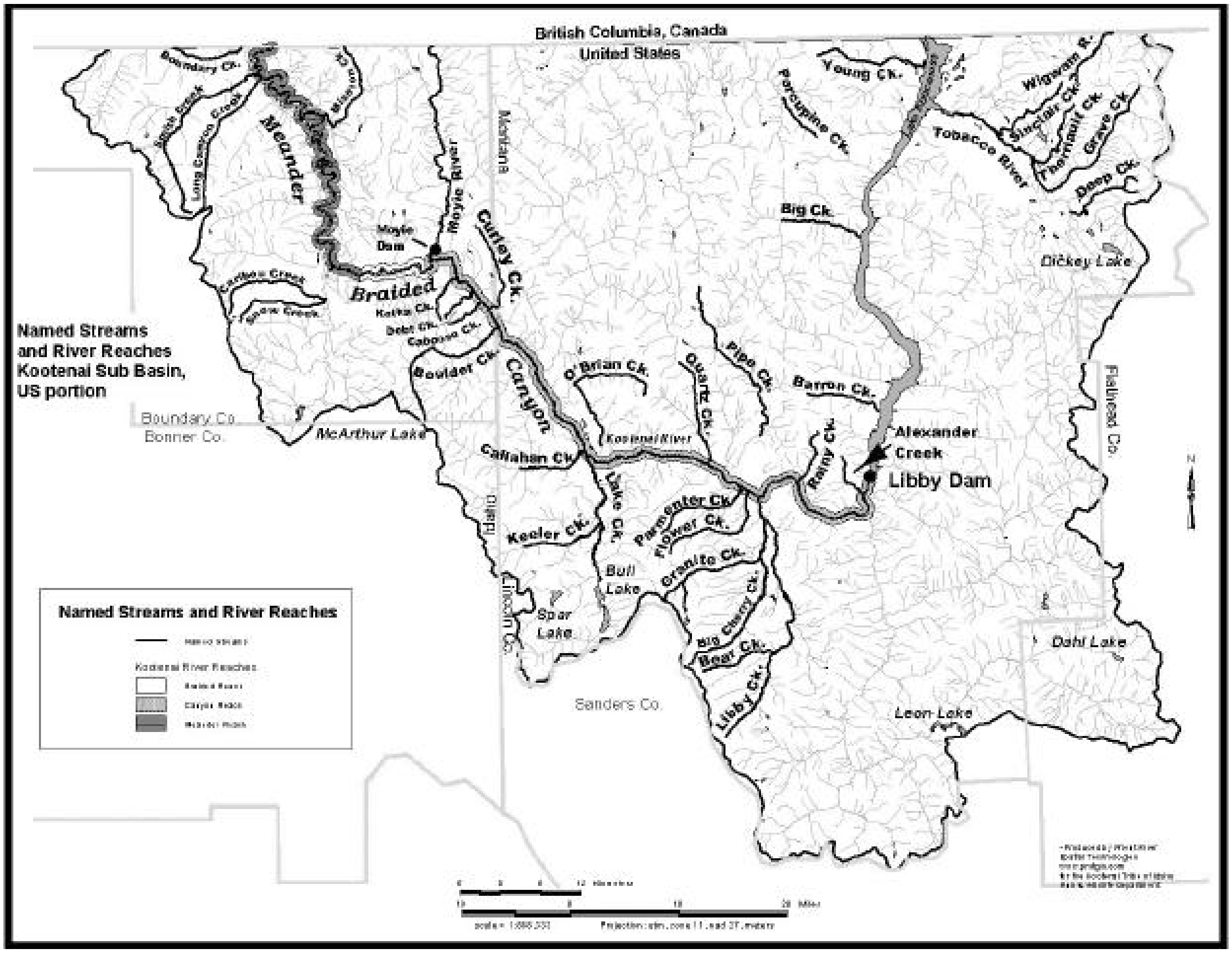

Figure 6. Streams and waterbodies discussed in this section

White sturgeon

The Kootenai River white sturgeon is a landlocked, genetically distinct stock (Setter and Brannon 1990) with unique behavioral characteristics. It is active at 6°C, several degrees cooler than the activity threshold for Columbia and Snake river sturgeon (Paragamian and Kruse, in progress). It also has a unique, two-step spawning pattern, migrating to staging reaches from the lower river and Kootenay Lake during Autumn. Then in spring, it migrates to the spawning reach near Bonners Ferry, Idaho (Paragamian and Kruse in progress).

The white sturgeon population in the Kootenai River was listed as endangered in 1994. A lack of recruitment has been identified as the most critical limitation for Kootenai River white Sturgeon (Anders et al. 2000; USFWS 1999; Duke 1999; Anders et al. 1996; USFWS 1994; Giorgi 1993; and Partridge 1983). Persistent natural recruitment failure in this endangered population appears to be due to intermittent female stock limitation (pre-spawning recruitment limitation) and/or one or more early life mortality factors (post-spawning recruitment limitation.

There has been very little juvenile recruitment since 1974. The most recent population estimate of adult Kootenai River white sturgeon (sturgeon $\geq$ 120 cm) indicated about 1,469

(95% C.I = 740 – 2,197) adult fish are present in the river and Kootenay Lake (Paragamian et al. 1996). The adult segment of the population was comprised primarily of fish of the 1972 year-class and older. The estimated number of wild, juvenile white sturgeon was substantially lower, about 87 individuals. The lower number of juveniles is evidence of the diminutive or lost year-classes of fish. Adults have spawned each year during flow augmentation experiments (initiated in 1991) as evidenced by the capture of fertilized eggs by the Idaho Department of Fish and Game (IDFG). Unfortunately, even with improved flow conditions, since the ESA listing, few naturally produced juvenile sturgeon have been found.

The Kootenai Tribe of Idaho's White Sturgeon Conservation Culture Program began in 1990 as an experimental approach to answer questions concerning water quality, white sturgeon gamete viability, and feasibility of aquaculture as a component of recovery. Culture efforts documented successful egg fertilization, incubation, egg viability, and juvenile white sturgeon survival (Apperson and Anders 1991). In 1995, conservation aquaculture was identified by the White Sturgeon Recovery Team as a Priority 1 Action to preserve genetic variability, begin rebuilding age-class structure, and prevent extinction of white sturgeon in the Kootenai River while measures were identified and implemented to rehabilitate natural recruitment and production (USFWS 1999). Juvenile sturgeon (ages 1 and 2) have been released into the Kootenai River. Subsequent monitoring results indicate that their survival is high and growth is normal.

Recovery actions are outlined in the recovery plan for the white sturgeon (USFWS 1999). Actions are coordinated and implemented by fisheries managers from federal, state, Tribal, and Canadian agencies. The recovery plan can be downloaded at: http://endangered.fws.gov/RECOVERY/RECPLANS/Index.htm

Bull trout

Bull trout are listed as threatened under the ESA. The population in the Canadian headwaters of Libby Reservoir is believed to be the strongest metapopulation in existence (Marotz , B. MFWP, pers. com. 2000). The primary spawning stream for that population is in British Columbia in a drainage now undergoing road building and soon to be logged. Libby Dam isolated bull trout populations above and below the dam. The strongest metapopulation in the U.S. spawns and rears in Grave Creek. Populations in the reservoir have stabilized at low numbers. However, the bull trout population below Libby Dam, which is now mainly supported by three tributaries upstream of Kootenai Falls, has too few subpopulations to be considered a stable metapopulation. Below the falls, only O'Brien Creek in Montana produces significant numbers of juvenile bull trout. In Idaho, juvenile bull trout are occasionally found in Boundary, Mission, Long Canyon, Boulder, Caribou, and Snow Creeks, while adults are occasionally captured in the lower mainstem section of the Kootenai River in Idaho during routine monitoring and evaluation of hatchery released white sturgeon juveniles (KTOI and IDFG, unpublished data). Recovery actions in the United States are coordinated with the British Columbia Ministry of Environment (B.C. Environment). Population trends are based on redd counts in spawning tributaries (Table 3). Occurrences of bull trout in Idaho tributaries of the Kootenai River are shown in Table 4. Bull trout occurrence in the subbasin is shown in Figure 7.

Table 3. Annual bull trout redd counts in the Lower , Middle, and Upper Kootenai River in Montana

Core Areas[1]	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**
Lower Kootenai Drainage (Kootenai Falls to Kootenay Lake)									
O'Brien Creek Drainage			24	34	22	23	12	36	
Keeler Creek (disjunct)							73	59	
Middle Kootenai Drainage (Libby Dam to Kootenai Falls)									
Quartz Creek Drainage	76	76	17	89	64	66	47	69	
Pipe Creek Drainage		5	11	6	7	5	17	26	
Libby Creek Drainage							10	13	
Upper Kootenai River Drainage (above Libby Dam)									
Grave Creek Drainage				36	71	15	35	49	
Wigwam River (Canada)					105	247	524	615	

[1]Core areas are drainages that currently contain the strongest remaining populations of bull trout.

Table 4. Occurrences of bull trout in Idaho tributaries of the Kootenai River

Tributary	**Year Observed**	**Method of Observation**	**Reference**
Boulder Creek	2000	Snorkeling	IDFG unpubl. data
Caboose Creek	1998	Electrofishing	Downs 2000
Caboose Creek	1999	Electrofishing	IDFG unpubl. data
Curly Creek	1998	Electrofishing	Downs 2000
Curly Creek	2000	Electrofishing	IDFG unpubl. data
Debt Creek	1999	Electrofishing	Downs unpubl. data

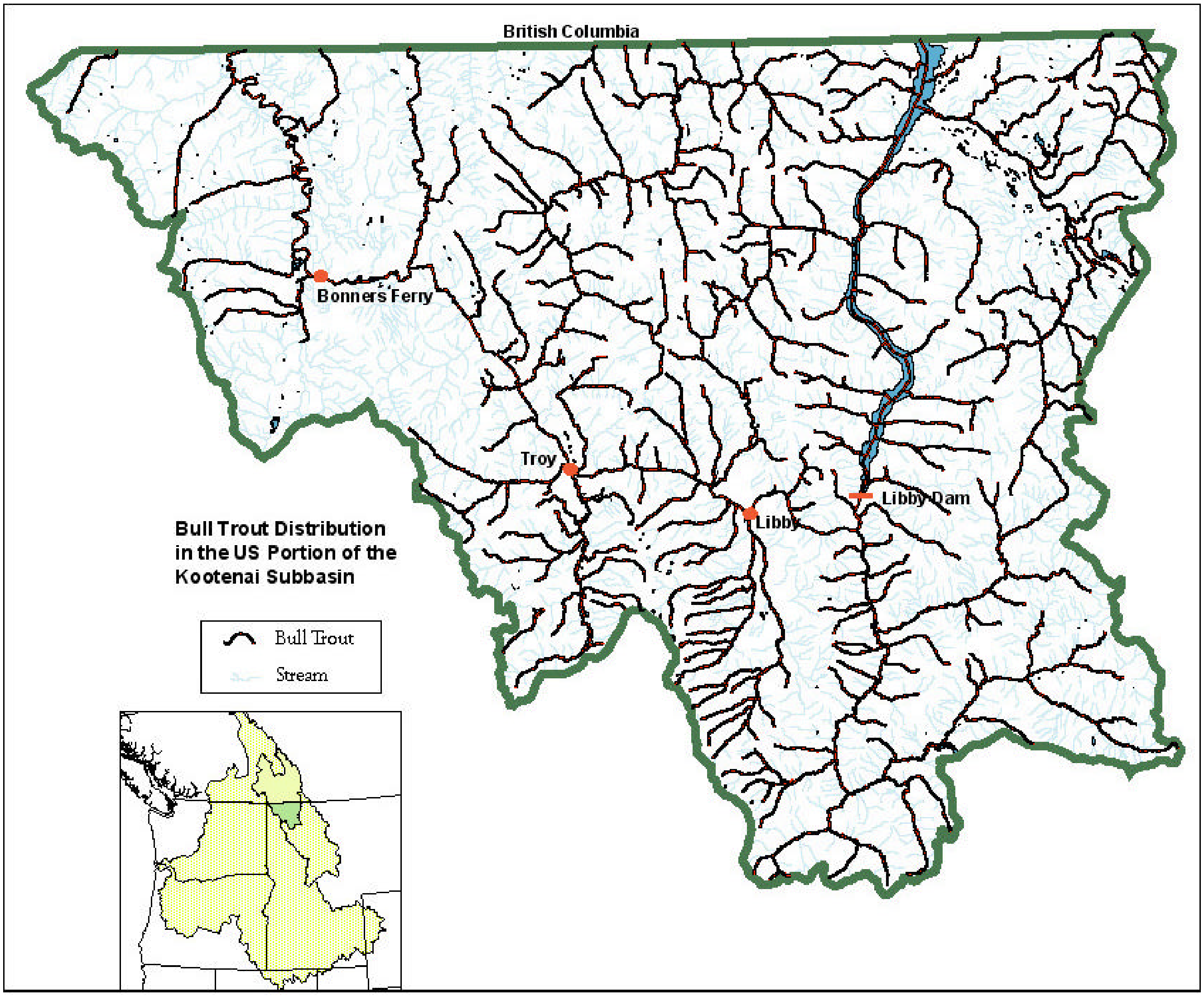

Figure 7. Bull trout occurrence in the U.S. portion of the Kootenai Subbasin

Burbot

Burbot in the Kootenai River in Idaho has been petitioned for ESA listing and is Red Listed in B. C. It is a designated species of Special Concern in Idaho. In Montana, however, burbot are still common, although they are listed as a species of special concern. It is believed that at one time, the burbot fishery in Idaho produced many thousands of fish each winter. It provided a valuable social, sport, and commercial fishery but collapsed soon after the completion of Libby Dam. Burbot were once very important to the anglers of Kootenay Lake, as well. Creel data from the West Arm of Kootenay lake revealed that during some years, the harvest of burbot exceeded 26,000 fish (Paragamian et al. 2000). Just as in Idaho, the fishery collapsed soon after Libby Dam began operations. Genetic analyses have indicated burbot in Idaho and B.C. are of the same genetic stock, while burbot in Montana are of a different stock.

An investigation initiated in 1993 was designed to assess burbot abundance, distribution, size, reproductive success, and movement and to identify factors limiting burbot in the Kootenai River in Idaho and British Columbia. A total of only 17 burbot were caught in 1993 (CPUE one burbot/33 net days) and 8 in 1994 (CPUE of one burbot/111 net days). However, numerous age groups of fish were apparent in the net catch, indicating some burbot recruitment was occurring. Only one burbot was sampled between Bonners Ferry and the Montana border, and there was no evidence of reproduction in Idaho. Unspawned females have been caught (post spawn) that were reabsorbing eggs, as have males (one month post spawn) that were in various stages of gonadal maturity. This information suggests that a large segment of the adult burbot are reproductively dysfunctional. Sampling for burbot during the winter of 1993 through 1994 at the mouths of Idaho tributaries was carried out in anticipation of intercepting a spawning run of fish from Kootenay Lake or lower river, but no burbot were caught. Cooperative sampling in the British Columbia reach suggests that burbot are only slightly more abundant in the lower river. Telemetry studies have shown the population is transboundary.

Kokanee salmon

Native kokanee salmon (*Oncorhynchus nerka*) runs in lower Kootenai River tributaries in Idaho have experienced dramatic population declines during the past several decades (Ashley and Thompson 1993; Partridge 1983). The kokanee that historically spawned in these tributaries inhabited the South Arm of Kootenay Lake in British Columbia. Native kokanee are considered an important prey item for white sturgeon and also provided an important fishery in the tributaries of the lower Kootenai River (Partridge 1983; Hammond, J., B.C. Min. Env. Lks and Prks, per. com. 2000). Kokanee runs into North Idaho tributaries of the Kootenai River that numbered into the thousands of fish as recently as the early 1980s have now become “functionally extinct” (Anders 1994; KTOI, unpublished data). Since 1996, visual observations and redd counts in five tributaries found no spawners returning to Trout, Smith, and Parker Creeks, while Long Canyon and Boundary Creeks had very few kokanee returns (Table 5 [Partridge 1983; KTOI unpublished data], Figure 8 [adapted from Partridge 1983]). No Kokanee redds or adults were observed in lower Kootenai River tributary surveys in Idaho in fall 1999 (Walters, IDFG, pers. com. 2000). Kokanee are not considered native to Libby Reservoir.

Table 5. Estimated peak number of kokanee spawners for stream reaches in six tributaries to the Kootenai River in Idaho

Year	Boundary Creek (610 m)	Smith Creek (380 m)	Long Canyon Creek (700 m)	Parker Creek (790 m)	Trout Creek	Myrtle Creek
1981	1,100	600	1,600	350	N/S	N/S
1993	0	N/S	12	64	0	0
1996	0	0	0	0	0	0
1997	0	0	3	0	0	N/S
1998	8	0	0	0	0	N/S

1999	38	0	0	0	0	N/S

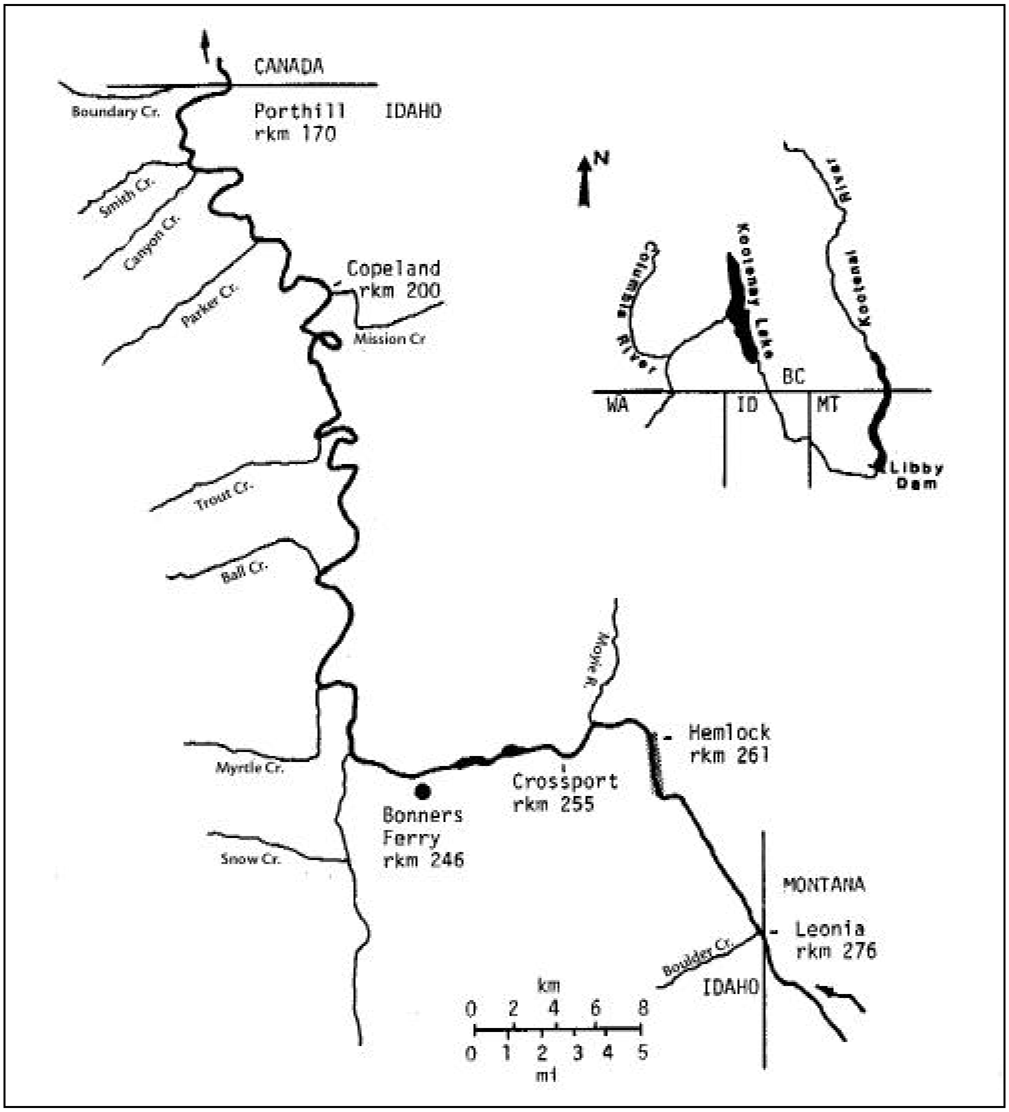

Figure 8. Location of Idaho Kootenai River tributaries where visual observations and redd counts of kokanee were conducted

Westslope cutthroat trout

The headwaters of Libby Reservoir contain important, genetically pure stocks of fluvial and adfluvial westslope cutthroat trout. However, in the U.S., the species has been petitioned for ESA listing and has been designated a Species of Special Concern in Montana. Twenty-four years of population estimates show a population decline. In 1973, 44 percent of trout captured in the Kootenai River were westslope cutthroat with angler catch rates recorded at 0.5 fish/hour, ranking the river among other Montana blue ribbon trout streams. Estimates in 1994 document significant population reductions, less than five percent of the trout captured were westslope cutthroat trout. Figure 8 shows the species distribution in the U.S. portion of the subbasin.

Severe declines in westslope cutthroat trout in reservoir tributaries have been measured since the early 1980s in population index streams (Table 6 and Table 7) (Ostrowski et al. 1998). Severe reductions have also been measured in adults migrating into reservoir tributaries to spawn. Spawning adults in Young Creek have declined from an estimated 700+ in the late 1970s to 4 in 1998 (Ostrowski et al. 1998). Annual gillnet sets show a similar decline (Dalbey et al. 1998). Figure 9 shows the distribution of westslope cutthroat trout in the U.S. portion of the subbasin.

In the Idaho reach of the Kootenai River, westslope cutthroat trout are not common and provide only a small portion of the salmonid harvest (Paragamian 1994).

Table 6. Estimated population of westslope cutthroat trout in section 1 of Young Creek compared to discharge and water temperature

Year	1986	1987	1996	1997
Onchorynchus clarki > 75 mm/1000 meters	1,975 (CI =1,975-2447)	904 (CI = 904 -1,052)	27 (CI=27-35)	12 (CI=12-18)
Discharge (cfs)	6.37	1.72	9.5	----
Water Temp. (°F)	48.0	46.5	42	40

Table 7. Potential spawners of Oncorhynchus spp (> 175 mm) captured in box traps

Location	Rbt	Wct	Wct x Rbt	Dates of operation
Big Creek, North Fork[1]	1(133)	0(12)	(35)	4/13/95-5/4/95[2] 5/30/95-6/21/95
Big Creek, South Fork[1]	5(164)	1(10)	(74)	5/30/95-6/21/95

1 Number in parenthesis is number of spawners trapped in 1980.

2 Trap not operated 5/5/95-5/30/95 due to high water

Rbt = rainbow trout; Wct = Westslope cutthroat trout; Wct x Rbt = Hybrid

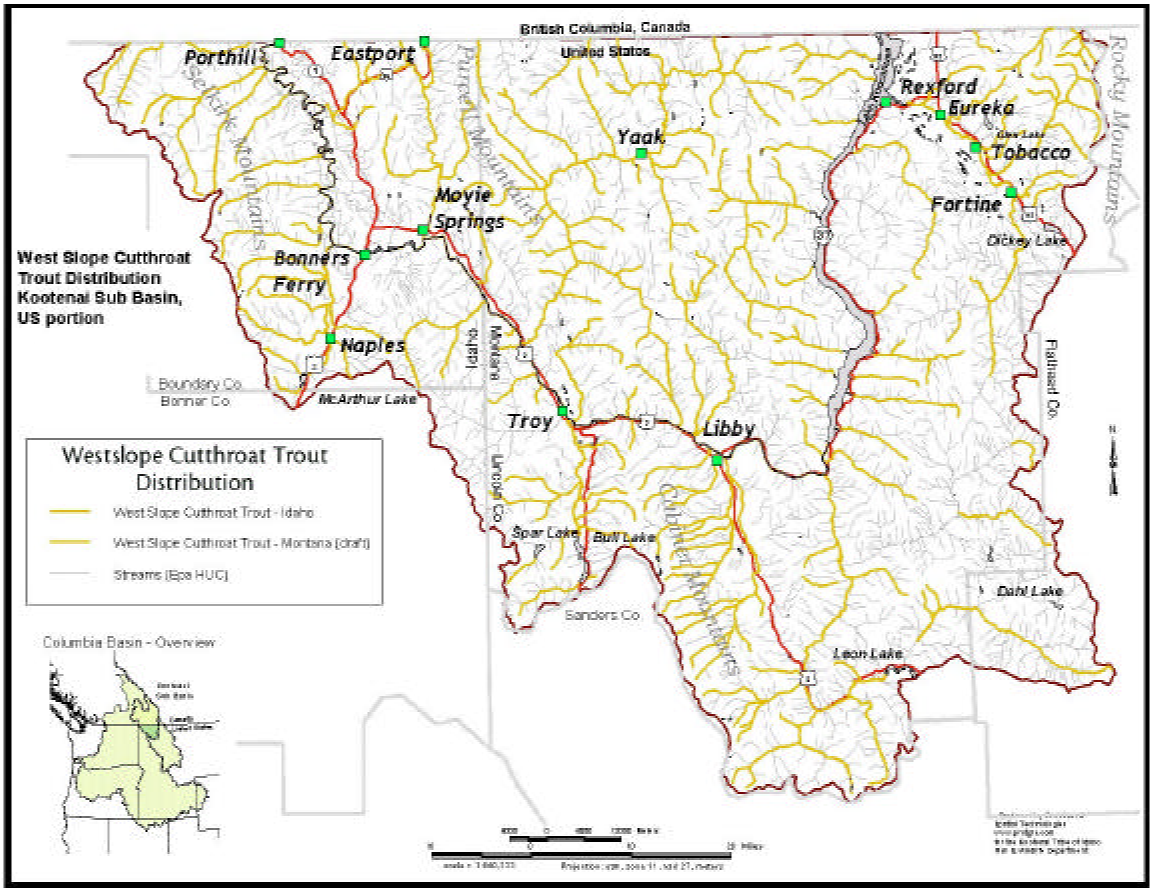

Figure 9. The distribution of westslope cutthroat trout in the U.S. portion of the subbasin

Interior redband trout

Native interior redband, a subspecies of rainbow trout and designated a Species of Special Concern in Montana, exist in only a few isolated Kootenai River tributaries. Callahan Creek in Montana is the only stream believed to provide spawning habitat for Kootenai River redband, although adult redband have been observed in the mouth of the Yaak River. The redband rainbow trout provides the most important fishery in the Kootenai River in Idaho. Although anglers were estimated to have caught over 1,000 trout in 1994, the total population numbers are thought to be down from pre-Libby Dam years. Research studies have shown that the recruitment of rainbow trout in the Idaho reach has come from two sources. Trout below Bonners Ferry rear in the Deep Creek drainage and mature in Kootenay Lake, B.C., while fish above Bonners Ferry are thought to recruit from a few tributaries in Idaho and Montana. Electro-fishing surveys have shown a shift in the mainstem Kootenai River fish community from a pre-Libby Dam community composed primarily of whitefish and trout to a post-dam community consisting primarily of suckers, Columbia River chub, and northern pikeminnow. The post-dam community also has a lower total fish biomass.

Mountain whitefish

Mountain whitefish abundance has declined in the Idaho reach of the Kootenai River since the early 1980s, despite what is considered to be ideal physical habitat for spawning (Partridge 1983; May and Huston 1983; Paragamian 1994; Downs 1998; Downs 1999). The 1980 and 1981 mountain whitefish estimates (Partridge 1983) in the Idaho reach of the Kootenai River upstream of Bonners Ferry were likely two-fold higher than pre-Libby Dam conditions. Partridge estimated 1,533 and 1,331 mountain whitefish per 305 m of river upstream of Bonners Ferry in 1980 and 1981, respectively. By 1994, mountain whitefish abundance had declined to an estimated 326 mountain whitefish per 305 m of river (Paragamian 1994).

Other species

Slimy and torrent sculpins are designated Species of Special Concern in Montana. May and Huston (1975) reported declines in sculpins, but more recent sampling suggests these species may have recovered.

Wildlife

The Kootenai River Subbasin encompasses a wide diversity of habitats from its source to its mouth. These habitats, in turn, provide niches for a diverse array of birds, mammals, amphibians, and reptiles. Approximately 308 species of birds, 69 species of mammals, 8 species of amphibians, 9 species of reptiles, and 23 species of fish occur in the watershed (Wood, MFWP, pers. com. 2000)

Time constraints did not allow the inclusion of wildlife population estimates and trends for the Canadian portion of the subbasin, although this information will be included in future planning efforts.

Mammals

Table 8 lists some of the key mammal species in the subbasin of interest to managers. The status of threatened and endangered species follows.

Table 8. Key mammal species in the subbasin of interest to managers

Species	Abundance	Description of Status
Mule deer	Abundant	Mule deer population trends are variable throughout the subbasin. Populations are increasing below Libby Dam and along the Fisher River and are declining on the west slope of the Galton Range near Eureka and along the east side of Koocanusa Reservoir. Harvest data for the Idaho portion of the subbasin show an increase from 1974-1989, and a decline through 1999 (Hayden J. IDFG, pers. com. 2000).
Moose	Common	In Montana, moose populations increased from the mid-1980’s through 1995 and have subsequently experienced sharp declines. In the Idaho portion of the subbasin, their populations do not appear to be declining as documented by incidental reports. In 1994, the area north and east of the Kootenai River was estimated to have 0.8 moose per km^2, a relatively high

Species	Abundance	Description of Status
		density.
Black bear	Common	Populations have remained relatively stable, although they fluctuate depending on natural food production.
Fisher	Uncommon	Fisher populations were supplemented with transplants during the 1960's and 1989-91 in parts of the subbasin. The British Columbia Ministry of Environment transplanted fisher in the Canadian portion of the subbasin 1996-98. They continue to persist in the subbasin at low-densities as they have historically.
Wolverine	Rare	Wolverine populations exist at very low densities in the higher elevations of the subbasin. Populations have probably increased since poison baits were banned in the early 1970's.
River otter	Common	River otter numbers and trend are currently unknown. Populations are assumed to respond directly to aquatic and riparian habitat quality and fish abundance.
Northern flying squirrel	Common	Population trends and estimates were not available prior to publication.
Townsend's big-eared bat	Uncommon	Population trends and estimates were not available prior to publication.
Rocky mountain elk	Common	Population trends remained relatively stable, but localized fluctuations are common.
Mountain lion	Common	Over the entire Kootenai subbasin, upward population trends continue, although fluctuations are associated with prey availability.
Northern bog lemming	Uncommon	Population trends and estimates were not available prior to publication.
Mink	Common	Population trends were not available prior to publication.
American beaver	Abundant	Upward population trends are reported in Idaho, Montana, and British Columbia.
Snowshoe hare	Abundant	Population estimates were not available prior to publication.
American Marten	Common	Population trends and estimates were not available prior to publication.
Golden-mantled ground squirrel	Common	Population trends and estimates were not available prior to publication.
Deer mouse	Abundant	Population trends for subbasin are not currently known
Red-backed vole	Common	Population trends for subbasin are not currently known

Avian Species

Montana and Idaho Partners-In-Flight (PIF) Bird Conservation Plans (Casey 2000; Idaho Partners in Flight 2000) classified breeding bird species in Montana and Idaho based on their priority for conservation action within the two states. Table 9 lists high priority breeding bird species in the Kootenai River Subbasin along with their habitats and abundance. All neotropical migrant birds are also considered potential target species, as are wood ducks, northern pintails, common goldeneye, western grebe, American redstart, double-crested cormorant and sandhill cranes.

Table 9. High priority breeding bird species1 found in the Kootenai River Subbasin

Species	Montana Priority[2]	Idaho Priority	Habitat	Abundance
Common Loon	I		Wetland	Uncommon
Horned Grebe	II		Wetland	Rare
Cinnamon Teal		I	Wetland	Common
Harlequin Duck	I		Riparian	Uncommon
Barrow's Goldeneye	II	I	Wetland; Riparian	Uncommon
Hooded Merganser	II	I	Wetland; Riparian	Common
Bald Eagle	II		Wetland; Riparian	Common
Sharp-shinned Hawk	III	I	Forest	Uncommon
Northern Goshawk	II	I	Forest	Uncommon
Golden Eagle		I	Forest; Grassland; Shrubland	Uncommon
Peregrine Falcon	II		Wetland; Riparian; Unique	NA
Blue Grouse	III	I	Forest	Common
Ruffed Grouse	II		Riparian	Common
Columbian Sharp-tailed Grouse	II		Grassland; Riparian	Rare
Sandhill Crane		I	Wetland	Rare
Killdeer		I	Wetland	Common
Long-billed Curlew	I	I	Grassland	Uncommon
Flammulated Owl	I	I	Forest	Uncommon
Short-eared Owl	III	I	Wetland; Grassland; Shrubland	Uncommon
Black Swift	II	I	Riparian; Unique	Rare
Vaux's Swift	II	I	Riparian; Forest	Common
Black-chinned Hummingbird		I	Riparian; Shrubland	Uncommon
Calliope Hummingbird	II	I	Riparian; Forest; Shrubland	Common
Rufous Hummingbird	III	I	Forest; Riparian; Shrubland	Common
Lewis's Woodpecker	II	I	Riparian; Forest	Uncommon
Red-naped Sapsucker	II		Riparian; Forest	Abundant
Williamson's Sapsucker	II	I	Forest	Uncommon
Three-toed Woodpecker	II		Forest	Common
Black-backed Woodpecker	I	I	Forest	Uncommon
Pileated Woodpecker	II		Forest	Common
Olive-sided Flycatcher	II	I	Forest	Common
Willow Flycatcher	II	I	Riparian	Common
Hammond's Flycatcher	II	I	Riparian; Forest	Abundant
Dusky Flycatcher	IV	I	Forest; Riparian	Abundant
Cordilleran Flycatcher	II		Riparian	Uncommon
Black-billed Magpie	IV	I	Shrubland; Riparian; Forest	Abundant
Brown Creeper	I	I	Forest	Uncommon
Rock Wren	IV	I	Unique	Uncommon
Winter Wren	II		Forest	Common
American Dipper	III	I	Riparian	Common
Veery	II		Riparian	Uncommon
Varied Thrush	III	I	Forest	Common
Red-eyed Vireo	II		Riparian	Common
Yellow Warbler		I	Riparian	Abundant
Townsend's Warbler	III	I	Forest	Common
MacGillivray's Warbler	III	I	Riparian; Shrubland	Common
Western Tanager	IV	I	Forest	Common

Species	Montana Priority[2]	Idaho Priority	Habitat	Abundance
Lazuli Bunting	II		Riparian; Shrubland	Common
Brewer's Sparrow	II	I	Shrubland	Rare
Grasshopper Sparrow	II	I	Grassland	Rare

1.The Conservation Bird Plans utilizes a system that prioritizes each species of North American breeding birds based upon seven measures of "vulnerability". Factors include relative abundance, size of breeding and non-breeding ranges, threats to the species in breeding and non-breeding areas, population trend, and relative density.

2. Priority Levels from Montana Bird Conservation Plan: Level I species exhibit declining populations and require conservation plans; Level II species are under fewer threats; may be declining or stable but still must be monitored.

Amphibians and Reptiles

Amphibians are present in many of the wetter parts of the subbasin, especially wetland and riparian habitats. Species include the Coeur d'Alene salamander, long-toed salamander, Pacific chorus frog, Columbia spotted frog, northern leopard frog, tailed frog, and boreal toad. Populations of the boreal toad and Columbia spotted frog appear diminished. The tailed frog occurs in high-gradient streams and is more restricted in its distribution. The northern leopard frog was historically common in the subbasin. Two species of garter snakes (the common and western terrestrial) and painted turtle are common in valley and foothill habitats, as are western skinks and northern alligator lizards. The bull or gopher snake, ringneck snake, racer, and rubber boa also occur.

Threatened and Endangered Species

The woodland caribou (the only population in the lower 48 states), gray wolf, and bald eagle in Idaho are classified as endangered species. The Canada lynx and grizzly bear are both listed as threatened in Idaho and Montana. The peregrine falcon was recently removed from the ESA List due to recovery, and the bald eagle is proposed for removal from the list.

Grizzly Bear

Grizzly bears in the Kootenai Subbasin are considered part of the combined grizzly population of the Selkirk/Cabinet-Yaak Ecosystem. Based on ongoing study estimates, the Selkirk Range population is approximately 45 to 50 bears, and the total Cabinet-Yaak population is 30 to 40 bears (Selkirk/Cabinet-Yaak Grizzly Bear Ecosystem Status Report 1999). Recent data indicates this population is increasing at 1.3 percent annually (Wakkinen and Johnson 2000). Despite this, the population is far from meeting delisting criteria (Table 10).

Table 10. Grizzly bear delisting criteria

Delisting Criterion	Target	1999 Condition
Females with cubs	At least 6.0	0.83
Mortality Limit	Less than 0.50	1.33
Female Mortality Limit	Less than 0.15	0.17
Distribution of females with young	At least 7 of 10 Bear	4 of 10 bear Management Units

	Management Units	

Based on 3-year running average of observations. See Grizzly Bear Recovery Plan for calculation details.

Gray Wolf

The gray wolf has been extirpated throughout the majority of its historic range in the lower 48 states, and by 1940 was eradicated in the Rocky Mountains. The wolf was listed as endangered in 1973 and was later re-designated as an experimental population south of Interstate 90. USFWS reports that northwestern Montana has five breeding pairs of wolves, down from approximately six to eight pairs in 1995. The highest estimated total number of wolves was 88 in 1993. At present, four wolf packs may inhabit and utilize the Kootenai Subbasin (USDA 2000).

Canada Lynx

The Canada lynx is listed as a threatened species. The status of the lynx population in the subbasin is unknown at this time, although it is known lynx habitat exists within the subbasin, and persistent populations exist.

Woodland Caribou

Early population estimates of woodland caribou in the Selkirk Range varied from 70 to 400 animals (Evans 1960). In the early 1970s the population was estimated to include only 20 to 25 animals (Freddy 1974). Despite the translocation of 103 caribou from British Columbia between 1987 and 1999, this population has not rebounded to its former levels. Adult mortality during late summer is very high, with predation by mountain lions the primary proximate cause (Wakkinen pers. com. 2000). During the winter of 1999-2000, only three caribou were located in the subbasin.

Other Important Species

Many species of terrestrial, vertebrate wildlife species in the subbasin are classified as Species of Special Concern, Federal Candidate Species, BLM and Forest Service Sensitive Species, and Management Indicator Species. Due to the differences in these classifications, the wildlife managers in the Kootenai Subbasin have elected to list wildlife species of a known importance. Wildlife managers also acknowledge that with changes in habitat and human disturbances, ecosystem indicator and sensitive species will change, and no one species should be eliminated from a potential target-species list (Tables 6, 7, and 9). All species with low populations, threats to their habitats, or highly restricted distributions are of concern to managers. Some of these species, which were not listed in Tables 8 and 9, are listed in Table 11. These species do not necessarily have legal protection but are considered sensitive to human activities, and attention to their habitat and population needs may be warranted during the planning of resource management activities. The status of many of these species is not known because there have been few population or habitat studies.

Table 11. Sensitive species in the Kootenai Subbasin

Birds
American white pelican
Tundra swan
Trumpeter swan
Columbian sharp-tailed grouse
American redstart
Forster's tern
Black tern
Great gray owl
Boreal owl
White-headed woodpecker
Double-crested cormorant
Mammals
Bighorn sheep
Mountain goat

The Ural-Tweed bighorn sheep are a genetically distinct, isolated, native population with a distribution restricted to the shore above Libby Reservoir. The population is decreasing. In the most recent survey, only eight animals were counted. The population is protected by the state of Montana.

Portions of two mountain goat populations, the Selkirk population and the West Cabinet Mountain population, inhabit the Kootenai Subbasin. The majority of goats in the Selkirks reside in the Priest Lake Subbasin, while the majority in the West Cabinet population live in the Pend Oreille Subbasin. Neither population is hunted in Idaho, although the West Cabinet population is hunted in Montana. The Selkirk population has declined dramatically. In 1955 an estimated 195 goats lived in the range, sixty-five of them in drainages to the Kootenai River (Brandborg 1955). But by 1981, only three goats were observed during an aerial survey and none were in the Kootenai River drainage. From 1981 to 1994, 31 mountain goats were trapped in other areas of Idaho and released in the Selkirk Range. Twelve of these were released in the Kootenai drainage. During the most recent survey of 1995, 33 mountain goats were observed in the entire subbasin, with only three in the Kootenai portion of the range.

The Columbian subspecies of the sharp-tailed grouse is rare throughout its range and is protected in Montana. The only known occupied site is in the Tobacco River Valley. The population is known to have declined dramatically in the last 25 years. Currently there is one known active lek remaining in the valley. In a spring, 2000 survey only two males were counted.

Habitat Areas and Quality

Although fish and wildlife are separated in the discussion that follows, the quality of habitat in riparian and wetland areas as well as in upland areas affects both fish and wildlife. Upland areas that have been heavily roaded or overgrazed affect big game populations, but they also can contribute sediment to waterways impacting fish and other aquatic organisms. Similarly, when wetlands and riparian areas are lost or degraded, both fish and terrestrial wildlife species suffer. Conversely, habitat improvements in upland areas that are designed to benefit wildlife usually have beneficial effects on fish, just as measures designed to rehabilitate riparian and wetland areas for fish almost certainly benefit wildlife.

Fish

Completion of Libby Dam in 1972 created the 109-mile Libby Reservoir. Filling Libby Reservoir inundated and eliminated 109 miles of the mainstem Kootenai River and 40 miles of critical, low-gradient tributary habitat. This conversion of a large segment of the Kootenai River from a lotic to lentic environment changed the aquatic community (Paragamian 1994). Replacement of the inundated habitat and the community of life it supported are not possible. However, mitigation efforts are underway to protect, reopen, or reconstruct the remaining tributary habitat to offset the loss. Fortunately, in the highlands of the Kootenai Basin, tributary habitat quality is high. The headwaters are relatively undeveloped and retain a high percentage of their original wild attributes and native species complexes. Protection of these remaining pristine areas and reconnection of fragmented habitats are high priorities.

Between 1974 and 1996, reservoir drawdowns averaged 112 feet, but were as extreme as 152 feet. Drawdown effects all biological trophic levels and influences the probability of subsequent refill during spring runoff. Refill failures are especially harmful to biological production during warm months. Annual drawdowns impede revegetation of the reservoir varial zone and result in a littoral zone of nondescript cobble/mud/sand bottom with limited habitat structure.

Similar impacts have been observed in the tailwater below Libby Dam. A barren varial zone has been created by the daily changes in water-flow elevation. Power operations cause rapid fluctuations in dam discharges (as great as 400 percent change in daily discharge), which are inconsistent with the normative river concept. Flow fluctuations widen the riverine varial zone, which becomes biologically unproductive. Daily and weekly differences in discharge from Libby Dam have an enormous impact on the stability of the river banks. Water logged banks are heavy and unstable; when the flow drops in magnitude, banks calve off, causing serious erosional impacts and destabilizing the riparian zone. These impacts are common during winter but go unnoticed until spring. In addition, widely fluctuating flows can give false migration cues to burbot and white sturgeon spawners (Paragamian 2000 and Paragamian and Kruse, in press).

Also, barriers have been deposited in critical spawning tributaries to the Kootenai River through the annual deposition of bedload materials (sand, gravel, and boulders) at their confluence with the river. During critical times of the year, when redband and cutthroat trout are out-migrating from nursery streams, the streams go subterranean because of the deltas (Paragamian V., IDFG, pers. com. 2000). As a result, many potential recruits are stranded. Prior to impoundment, the Kootenai River contained sufficient hydraulic energy to annually remove these deltas, but since the dam was installed, peak flows have been limited to maximum turbine capacity (roughly 27 kcfs). Hydraulic energy is now insufficient to remove deltaic deposits. During periods of low streamflow, the enlarged deltas and excessive deposition of bedload substrate in the low gradient reaches of tributaries impedes or blocks fall-spawning migrations. Changing and regulating the Kootenai River annual hydrograph for power and flood control and altering the annual temperature regime have caused impacts typical of dam tailwaters.

Bull Trout Habitat

Forestry practices rank as the highest risk to bull trout in the middle Kootenai (Libby Dam to Kootenai Falls; Table 3), largely because it is the dominant land use in all core areas. This risk to the bull trout population is elevated due to the low number of spawning streams (Quartz, Pipe, O'Brien and Libby Creek drainages) available because of the fragmentation caused by Libby Dam. The Fisher River drainage is also being considered for addition as a core area. The middle Kootenai is designated a nodal habitat because it contains critical over-wintering areas, migratory corridors, and other critical habitat.

The threat from dam operations is considered high to bull trout in the middle Kootenai because of the biological affects associated with unnatural flow fluctuations and gas supersaturation problems arising from spilling water. The dam is a fish barrier, restricting this migratory population to 29 miles of river, which increases the likelihood of localized effects becoming a higher risk. Dam operations are considered a very high risk to the continued existence of the Kootenai drainage population of bull trout (Montana Bull Trout Scientific Group 1996).

In the upper Kootenai (above Libby Dam; Table 3), the threats to bull trout habitat include illegal fish introduction, introduced fish species, rural residential development, and forestry. Additional risks come from mining, agriculture, water diversions, and illegal harvest (Montana Bull Trout Scientific Group 1996c). Critical spawning streams include the Grave Creek drainage in the U.S. and the Wigwam drainage in British Columbia. Transboundary research is ongoing in Canadian tributaries known to be used by spawning bull trout, Elk River, St. Mary River, Skookumchuck Creek, White River, Palliser River, and the Kootenay River upstream (Baxter and Oliver 1997). Nodal habitats for this population are provided by Libby Reservoir, Tobacco River, and the Kootenay River in Canada.

Bull trout are found below Kootenai Falls in O'Brien Creek and in Bull Lake, the latter a disjunct population. Montana Fish, Wildlife and Parks's personnel, in cooperation with personnel from Idaho Department of Fish and Game, are monitoring movement patterns of fish tagged after spawning in O'Brien Creek. These fish inhabit areas in the lower Kootenai River and Kootenay Lake during most of the year.

White Sturgeon Habitat

The substantially unnatural change to the flows in the Kootenai River caused by at Libby Dam is considered to be a primary reason for the Kootenai River white sturgeon's continuing lack of recruitment and declining numbers. As a result of original Libby Dam operations (until the initiation of experimental flows in 1992), the natural, high, spring flows thought to be required by white sturgeon for reproduction rarely occurred during the May-to-July spawning season when suitable temperature, water velocity, and photoperiod conditions would normally exist. In addition, cessation of periodic flushing flows has allowed fine sediments to build up in Kootenai River bottom substrates. This sediment fills the spaces between riverbed cobbles, reducing fish egg survival, larval and juvenile fish security cover, and insect production. Acoustic doppler profiles of the Kootenai River bottom have revealed large sand dunes located in the spawning reaches used by the white sturgeon (IDFG/USGS unpublished data). The effects of moving dunes is unknown but may contribute to egg suffocation and/or prolonged contact with contaminated sediments, further contributing to recruitment failure.

Kootenai River white sturgeon spawn within an 18 km reach of river downstream of Bonners Ferry, Idaho (river kilometers (rkm) 228-246). This spawning reach is comprised of sand substrate, which is thought to be poor habitat for survival of eggs and larva when compared to white sturgeon spawning habitat in the Columbia River (Parsley and Beckman 1994; Paragamian et al., in press). More suitable substrates of cobble and gravel are upstream of Bonners Ferry (Apperson 1991, Paragamian et al., in press). Improved flows for spawning in recent years appears to have resulted in increased spawning as evidenced by the collection of more sturgeon eggs (Paragamian et al., in press). Despite improved spawning, the success for recovery of Kootenai River white sturgeon remains a serious concern. Few wild juvenile white sturgeon have been captured that were produced during flow test years.

Lake spring maximum elevations also appear to be contributing to the decline of white sturgeon. Concomitant to Libby Dam construction, the elevation of Kootenay Lake was lowered 2 m. Although Kootenay Lake is 108 km downstream of the spawning reach, higher lake elevations have a backwater effect on the sturgeon spawning reach. As the lake elevation rose during any given spawning season, sturgeon spawned progressively further upstream (Paragamian et al., in progress). Fifty-nine percent of the variation in spawning location was attributable to Kootenay Lake elevation. A linear regression model indicated higher lake elevations might promote spawning further upstream over cobble substrate.

As a consequence of altered flow patterns, average water temperatures in the Kootenai River are typically warmer (by 3 degrees Celsius) during the winter and colder (by 1 - 2 degrees Celsius) during the summer than prior to impoundment at Libby Dam (Partridge 1983). However, during large water releases and spills at Libby Dam in the spring, water temperatures in the Kootenai River may be colder than under normal, non-spill, spring flow conditions.

Much of the Kootenai River has been channelized and stabilized from Bonners Ferry downstream to Kootenay Lake, resulting in reduced aquatic habitat diversity, altered flow conditions at potential spawning and nursery areas, and altered substrates in incubation and rearing habitats necessary for survival (Partridge 1983, Apperson and Anders 1991). Side-channel slough habitats in the Kootenai River flood plain were eliminated by diking and bank stabilization in the Creston Valley Wildlife Management Area in British Columbia and Kootenai National Wildlife Refuge in Idaho.

The overall biological productivity of the Kootenai River downstream of Libby Dam has also been altered. Libby Dam blocks the open exchange of water, organisms, nutrients, and coarser organic matter between the upper and lower Kootenai River. Snyder and Minshall (1996) stated that a significant decrease in concentration of all nutrients examined was apparent in the downstream reaches of the Kootenai River after Libby Dam became operational in 1972.

Libby Dam and the impounded Lake Koocanusa reduced downstream transport of phosphorus and nitrogen by up to 63 and 25 percent respectively (Woods 1982), with sediment-trapping efficiencies exceeding 95 percent (Snyder and Minshall 1996). The Kootenai River, like other large river-floodplain ecosystems, was historically characterized by seasonal flooding that promoted the exchange of nutrients and organisms among a mosaic of habitats (Junk et al. 1989; Bayley 1995). As a result of channel alterations, the Kootenai River has a lowered nutrient and carbon-retention capacity. Wetland drainage, diking and subsequent flood control has eliminated the "flood pulse" of the river and retention and inflow of nutrients. Removal of riparian and floodplain forests has eliminated sources of wood to the channel and potential retention structures.

In relation to reduced productivity, potential threats to Kootenai River white sturgeon include decreased prey availability for some life stages of sturgeon, and a possible reduction in the overall carrying capacity for the Kootenai River and Kootenay Lake to sustain populations of white sturgeon and other native fishes. A limited food supply for young of the year could contribute to increased mortality rates, either through starvation or through increased predation mortality, because young of the year would spend more time feeding, thereby exposing themselves to higher predation risk. The reduction in native kokanee in the South Arm of Kootenay Lake may have also reduced nutrient contributions (deteriorating carcasses from spawners) from tributaries in Northern Idaho and British Columbia flowing into the Kootenai River. Kokanee were also considered an important food source for adult sturgeon to build reserves for the winter and help in final gonad maturation. Growth rates of sturgeon have declined and relative weights in the Kootenai River/Lake population are the lowest in reported sturgeon populations in the Northwest.

In the Adaptive Environmental Assessment modeling exercise performed for the Kootenai River system in 1997, predation on eggs and larvae was identified as a potential threat to successful white sturgeon recruitment. For broadcast spawners like white sturgeon, the mortality rate on eggs and larvae will increase with: 1) an increase in the number of predators; 2) an increase in the vulnerability of eggs or larvae to predation associated with changes in habitat or foraging behavior; and 3) a decrease in the volume or area of water that the eggs/larvae are dispersing into or over (as volume or area decreases, prey concentration to predators in increases). In post-impoundment years, Kootenai River springtime flows have been reduced substantially and vulnerability has increased due to an increase in water clarity and reduced food supply, as well as loss of habitat in the spawning reach.

Georgi (1993) noted that the chronic effects on wild sturgeon spawning in "chemically polluted" water and rearing over contaminated sediments, in combination with bioaccumulation of contaminants in the food chain, is possibly reducing the successful reproduction and early-age recruitment to the Kootenai River white sturgeon population. Results from a contaminant study performed in 1998 and 1999 showed that water concentrations of total iron, zinc, and manganese, and the PCB Arochlor 1260 exceeded suggested environmental background levels (Kruse 2000). Zinc and PCB levels exceeded EPA freshwater quality criteria. Several metals, organochlorine pesticides, and the PCB Arochlor 1260 were found above laboratory detection limits in ova from adult female white sturgeon in the Kootenai River. Plasma steroid levels in adult female sturgeon showed a significant positive correlation with ovarian tissue concentrations of the PCB Arochlor 1260, zinc, DDT, and all organochlorine compounds combined, suggesting potential disruption of reproductive processes. In an experiment designed to assess the effects of aquatic contaminants on sturgeon embryos, results suggest that contact with river-bottom sediment increases the exposure of incubating embryos to metal and organochlorine compounds (Kruse 2000). Increased exposure to copper and Arochlor 1260 significantly decreased survival and incubation time of white sturgeon embryos and could be a potentially significant additional stressor to the white sturgeon population.

Burbot Habitat

Winter hydropower operations and associated flow fluctuations make higher than pre-Libby Dam flows and may inhibit migrations of fluvial and adfluvial burbot in the Kootenai River to spawning areas. Burbot can move extensive distances during the winter to spawn. In the Kootenai River, traditional spawning tributaries in Idaho are 50 to 120 km from Kootenay Lake. Current velocities in the lower Kootenai River are subject to change with daily winter operations at Libby Dam, and velocity increases are directly proportional to flow increases and the elevation of Kootenay Lake. Burbot are weak swimmers and have a low endurance for extended periods of increased flow (critical velocity of about 24 cm/s) (Jones et al. 1974). Flows in the Kootenai River at Copeland, Idaho above 255 m^3/s produced average current velocities higher (>24cm/s) than the critical velocity for burbot (Paragamian 2000). Flow near the Idaho/B.C. border can often be as high as 510 m^3/s during normal winter dam operations. Tagging and telemetry studies in the river have shown that burbot move freely between the lake and the river in Idaho, providing flow conditions are low. Paragamian (2000) provided telemetry data that indicated high flows during the winter inhibit spawning migrations of burbot in the Kootenai River. In addition, biopsies of post-spawn female and male burbot indicated that some burbot do not spawn and are reabsorbing gonadal products (Paragamian 1994; Paragamian and Whitman 1996).

Velocity data and the timing of the collapse of the burbot fisheries in Idaho and British Columbia coincident with the operation of Libby Dam implicate winter hydropower and flood control operations as important factors responsible for the collapse of the burbot populations. McPhail (1995) stated “although burbot populations often increase after impoundment, the downstream effects of impoundment can be detrimental. .” Burbot are winter spawners and are know to spawn at temperatures at or near 0 ^{o}C (Beckeer 1983), the Kootenai River is now 4^{o}C warmer than pre Libby Dam during winter. Burbot are plentiful in Lake Koocanusa, Montana (Skaar, D. MFWP, pers. com. 2000) and make up a portion of the fish entrained through Libby Dam (Skaar et al. 1996). High flows very well could have altered their behavior, disrupted the spawning synchrony of burbot [they are considered highly ordered in their spawning (Becker 1983)], and effected their physiological fitness or spawning readiness.

Westslope Cutthroat Trout and Interior Redband Trout Habitat

Libby Dam has impacted westslope cutthroat trout and interior redband trout in many of the same ways as it has affected bull trout. Alterations of the hydrograph have resulted in a loss of mainstem salmonid spawning and rearing habitat. Fluctuating discharges from Libby Dam force juvenile salmonids to frequently seek new habitat, increasing the risk of predation. In addition, the widely fluctuating flows prevent colonization of the varial zone by periphyton and macroinvertebrates, reducing the efficiency with which energy is transferred from one trophic level to another. Abundance and diversity of important aquatic invertebrates has declined since construction of Libby Dam (Hauer and Stanford 1997), further reducing food abundance for trout. All of these factors combined have likely resulted in reduced trout abundance in the Kootenai River.

Kokanee Habitat

Because the Kootenai River kokanee are spawning populations from Kootenay Lake, changed habitat conditions for that lake have altered the numbers of spawners in the river within Idaho and Montana. The construction of Duncan Dam on the Duncan River in 1967 and Libby Dam on the Kootenai River in 1972 resulted in reduced nutrient loading (primarily nitrogen and phosphorus) to Kootenay Lake followed by a decline in phytoplankton, zooplankton, and ultimately kokanee abundance (Ashley and Thompson 1993). Kokanee populations continued to decline throughout the 1980s, and by 1990 the South Arm stocks of kokanee had become virtually extinct (Richards 1996). The presence of *Mysis relicta* in Kootenay Lake and their potential to compete with juvenile kokanee for zooplankton makes it difficult to quantify the magnitude of the affect of the reduced phosphorus loading on kokanee numbers. In addition diking, channelization, and grazing activity in the riparian area of key spawning tributaries in Idaho may have played an additional role in their population decline.

Wildlife

The most important wildlife habitat within the subbasin consists of two major types: riparian and floodplain bottoms and forest uplands. The upland habitat range from open and drier ponderosa/larch areas to moist cedar/hemlock dominated stands. The lowland habitats are equally diverse containing wetland and riparian habitats associated with the wide floodplain of the Kootenai River. Remnant gallery cottonwood forests are present as well, but remain as decadent, fragmented, and limited in distribution. Grassland habitats are scattered along the Kootenai River system where they support big horn sheep populations. One of the largest blocks of bighorn sheep habitat in the subbasin is located along the eastern portion of Lake Koocanusa (Libby Dam inundated 4,350 acres of low elevation, big horn sheep winter range). Alpine, cirque, and high-meadow habitats are found in the Selkirk and Cabinet Mountains.

Semi-permanent to permanent emergent wetlands, poor to rich fens, paludified forests, and ombotrophic bogs in the subbasin include some of Idaho and Montana's rarest wetland-associated plants and animals. National Wetland Inventory (NWI) maps show 1,373 acres of palustrine and 2,500 acres of riverine wetlands remain along the lower 51 miles of the Kootenai River in Idaho. This includes 800 acres of wetland that have been rehabilitated on the 2,774 acres Kootenai Refuge. In the lower Kootenai River system, most of the 50,000 acres of lowland floodplain and 5,000 acres of perennial wetlands have been converted into agricultural row crop and pastureland. Additional smaller wetland communities can be found in Idaho and Montana along the canyon and braided reaches of the Kootenai River system and on geologic features such as cirques, kettles, scours, and outwash channels. Since the 1860s, when mining and farming boomed, wetlands in Idaho have decreased 56 percent, from 879,000 acres to approximately 386,000 acres (Dahl 1990). Losses of perennial wetlands along the Lower Kootenai River are shown in Figure 10. Wetland losses are attributed to a combination of factors that include the operations of Libby Dam, river diking, draining associated with development, and tributary channelization.

Prior to the construction of Libby Dam, diking alone could not contain frequent high spring flows along the Kootenai River. The river often topped dikes and flooded agricultural grounds. These overland flows supplied a natural source of river nutrient inputs and created low velocity, backwater and side-channel habitat. Additionally, flood events increased the diversity of the riparian community by creating shallow-water areas with high concentrations of hydrophilic plants, both emergent and submerged. The events also created areas of fluvial deposition for cottonwood and willow recruitment. The 1992 National Resource Inventory indicates that nearly 60 percent of non-federal wetlands in the Kootenai-Pend Oreille-Spokane subbasins are used for cropland and pastureland (Jankovsky-Jones 1997). Today, the Kootenai Tribe of Idaho and the Idaho Department of Fish and Game are forming partnerships with local communities and state and federal agencies to design projects which mitigate hydropower losses in the Kootenai Subbasin, in addition to protecting and enhancing critical wildlife habitat for species dependent on wetland and riparian habitats.

Other activities in the Kootenai Subbasin have altered habitat community functions and affected both aquatic and terrestrial wildlife. For example, fire exclusion and selective logging practices have shifted forest composition from a heterogeneous to a more homogeneous state. The introduction white pine blister rust in 1909 has devastated white pine forests and changed forest composition across large landscapes. Furthermore, introductions of noxious weeds (Table 12) have invaded native plant communities and reduced plant diversity and richness. Noxious weeds have invaded riparian areas where power peaking has exposed riverbanks and made them uniquely susceptible to weed establishment.

Table 12. Noxious weed species in the Kootenai Subbasin

Noxious Weeds
common tansy (*Tanacetum vulgare*)
spotted knapweed (*Centaurea biebersteinii*)
diffuse knapweed (*Centaurea diffusa*)
meadow hawkweed (*Hieraceum pratense*)
orange hawkweed (*Hieraceum aurantiacum*)
dalmatian toadfax (*Linaria genistifolia*)
Canada thistle (*Cirsium arvense*)
tansy ragwort (*Senecio jacobaea*)
sulfur cinquefoil (*Potentilla recta*)
oxeye daisy (*Chrysanthemum leucanthemum*)
goatweed (*Hypericum perforatum*)
leafy spurge (*Euphorbia esula*)

rush skeletonweed (*Chondrilla juncea*) purple loosestrife (*Lythrum salicaria*) Eurasian watermilfoil (*Myriophyllum spicatum*)

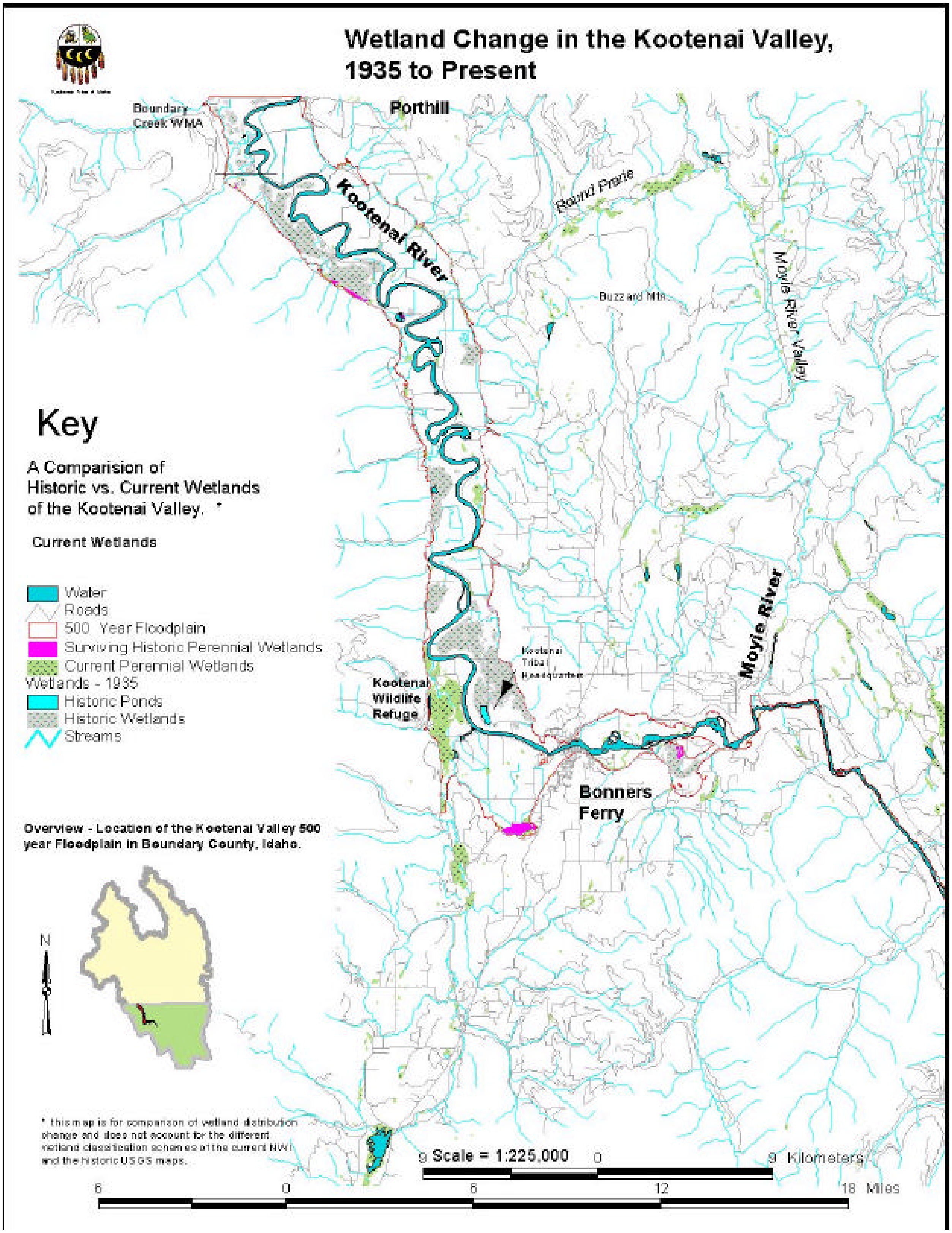

Figure 10. Losses of perennial wetlands along the Lower Kootenai River

Priority Plant Guilds

Numerous studies and publications exist to evaluate, model, and apply wildlife-habitat relationships (Brown, E.R. 1985, Thomas, J.W. 1979, USDA 1991, USDA 2000, Johnson and Thomas Unpubl., Verner et al. 1986). Wildlife-habitat relationships hold enormous promise on managed lands, but due to time constraints, wildlife habitats of importance were placed in artificial assemblages that are categorized by similar plant guilds for analysis purposes. The plant guilds that are considered management priorities within Kootenai River Subbasin include the following:

<u>Subalpine Guild</u>

This plant guild is found at high elevation sites, approximately 4,500 feet and above, where plant communities are associated with ridges, krummholtz, alpine meadows (sedge and grass communities), and exposed rock outcroppings. Associated tree species include subalpine fir (*Abies lasiocarpa*), subalpine larch (*Larix lyallii*) and whitebark pine (*Pinus albicaulis*).

Whitebark Pine

Whitebark pine is associated with the federally listed grizzly bear, which utilizes the tree's seeds or pine nuts. An assessment of the interior Columbia River basin found that the amount of area in the whitebark pine cover type has declined by 45 percent since the turn of the century. The decline, which has had strong negative consequences for grizzly bears, has been due to a combination of factors, the most prominent of which are mountain pine beetle and whitepine blister rust. Most of the loss occurred in the more productive, seral whitebark pine types, of which 98 percent has been lost.

<u>Wet and Moist Forest Guilds</u>

These plant guilds include wetter plant communities that are generally associated with riparian areas and mesic sites below 4,500 feet that are characterized by mid-to-late seral stages of western redcedar/western hemlock (*Tsuga heterophylla/ Thuja plicata*) forests. The USDA Forest Service associates the Wet Forest Guild with the “ancient cedar groves” (USDA 1999), which are fragmented across the subbasin.

Riparian Coniferous Forest

Many upper elevation reaches are in good to excellent condition due to inaccessibility. Fire suppression may be altering species composition in some areas by eliminating seral species such as western larch, subalpine fir, and lodgepole pine, and favoring western redcedar, western hemlock, and grand fir. Lower and mid-elevation reaches are more susceptible to the pressures of overgrazing, flood and erosion control efforts, irrigation withdrawals, road-building, logging, and firewood cutting. Long-term grazing impacts in low-elevation stands have reduced shrub, forb, and grass cover and created open-understory conditions. Grazing can also de-stabilize stream banks and increase erosion.

Moist Douglas-Fir/Grand Fir

The combination of logging and fire-suppression has produced a more homogeneous landscape dominated by mid-seral forests, as opposed to historical conditions where more young and old-growth forest existed.

Dry Forest Guild

This plant guild is found predominately in xeric sites and associated with open understory areas and dry plant communities like ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). This plant guild is generally found below 4,500 ft in elevation.

Ponderosa pine

The major change common to most dry forest types (especially ponderosa pine) in the subbasin and elsewhere in the American west is a profound alteration in age-class structure, physical structure, tree density, and tree species composition as a result of logging and fire suppression. Stands that were largely dominated by mature and old-growth ponderosa pine trees in an open-parkland setting have been changed to abnormally dense stands dominated by younger Douglas-fir trees.

Deciduous Riparian Guild

This plant guild encompasses broad-leaved deciduous forests in low elevational sites, riparian areas, and valley bottoms where species like black cottonwood (*Populus trichocarpa*), quaking aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*) and red alder (*Alnus rubra*) can be found. The habitat integrity and availability of riparian deciduous forest habitats have been compromised in many parts of the subbasin, and there are continued threats to this habitat. Generally, degradation has resulted either through interruption or alteration of natural flood processes, or through direct removal of vegetation through grazing, clearing, or logging. Nearly complete elimination of this habitat type has been accomplished in the lower reaches of the Kootenai River below Bonners Ferry through diking and conversion for agriculture. Changes in flow regimes can have profound effects on the mix of seral stages present along river reaches, because cottonwoods require flooding and silt deposition for germination. In many cases where the seasonal pattern of high flows has been removed or stabilized, there is a threat of inadequate recruitment to replace older trees as they die. In the most extreme examples of flow alteration, dewatering on the one hand, and inundation through damming on the other, all riparian habitat values can be lost. Specific activities that have the most direct effects on riparian deciduous forest habitats include:

- Diking, flood control and channelization;
- Dam construction and operation;
- Logging, particularly of older cottonwoods for lumber or pulp;
- Water diversion for irrigation;

- Clearing for agriculture;
- Grazing;
- Residential development;
- Recreational use.

Quaking Aspen

Aspen stand clones are in poor condition in many areas of the subbasin. Most of the aspen remaining are in the older age classes and are in critical need of regeneration. Older stands are usually less vigorous and the least likely to regenerate successfully. Many of these stands are currently being crowded out by competing conifers, and aspen will eventually be lost from the site. In addition, pure and mixed stands in the older age classes are of low vigor and are often heavily infested with pathogens. Effective fire suppression over the past 50 years has permitted competition and disease to reduce clone vigor to levels lower than would be expected under natural conditions. Compounding the situation, fire suppression has drastically reduced fire-induced regeneration in recent years, resulting in few younger-aged stands.

Wetland and Peatland Guilds

This plant guild includes species that are associated with hydric soil conditions and have various levels of decomposed organic materials in the soil substrate. Depending on elevation, temperature, substrate materials, pH and abiotic process, different species communities will persist. Important peatland rare plant guilds identified by US Forest Service, USFS (INPF 1999) include poor fen, intermediate/rich fen, ombrotrophic bog, paludified forest, and shrub carr.

Intermountain Valley and Floodplain Wetlands

Substantial wetland losses in the subbasin have resulted mostly from the operations of Libby Dam, river diking, draining associated with agricultural and human development, and tributary channelization. Intermountain wetlands have also been impacted by development of surrounding uplands (especially cabins and rural subdivisions along shorelines), contaminants, invasion of nonnative and noxious plants, introduction of nonnative fish, livestock grazing, and disturbance from increasing recreational use.

Grassland and Shrubland Guilds

This plant guild is found in xeric sites, generally low elevation and south facing slopes, with deep to shallow soil substrates. Early seral stage plant communities are associated with both guilds. Grass and shrub species can include wheatgrasses (*Agropyron spp.*), bromes (*Bromus spp.*), fescues (*Festuca spp.*) bluegrasses (*Poa spp.*), sagebrush (Artemisia spp.), rabbitbrush (*Chrysothamnus spp.*), ninebark (*Physocarpus malvaceus*) and bitterbrush (*Purshia tridentate*).

Intermountain Grasslands

The most immediate threat comes from conversion of existing native grasslands to other types. Conversion primarily occurs in three ways: urban sprawl, establishing tame pastures, and conversion to cropland. Major concerns in intermountain grassland areas are the introduction and spread of noxious weeds. Other management issues include: 1) grazing regimes; 2) replacement of fire regimes; 3) fragmentation of existing grasslands; and 4) shrub and tree encroachment.

Watershed Assessment

Watershed assessments are an important tool for identifying limiting factors and projects. Past studies and habitat surveys provide extensive assessment-type data. These are described below. The findings are summarized in the preceding section on fish and wildlife habitat and the limiting factors section that follows this section.

In the 1980s and 1990s, Bonnieville Power Administration (BPA) funded a series of fish and wildlife studies in the basin as part of the agency's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. Under this funding, the Montana Fish, Wildlife, & Parks (MFWP) conducted studies of instream flows needed for successful migration, spawning, and rearing of rainbow and westslope cutthroat trout in selected tributaries of the Kootenai River (Marotz et al. 1988 and Marotz and Fraley 1986). The IDFG conducted various white sturgeon investigations (Apperson and Anders 1991; Apperson 1992; Marcusen 1994; Marcusen et al. 1995; Paragamian et al. 1996; Paragamian et al. 1997; Setter and Brannon 1990) and burbot studies (Paragmaian 1994). Also funded were reports on the quantification of Libby Reservoir levels needed to maintain or enhance reservoir fisheries (Chisholm et al. 1989 and Skaar et al. 1996). Wildlife studies included a wildlife impact assessment and mitigation summary for Libby Dam (Yde and Olsen 1984).

Dam operations were assessed during the Columbia Basin System Operation Review (SOR EIS 1994) and subsequent system-wide analyses (Wright et al. 1996).

MFWP, Confederated Salish and Kootenai Tribes (CSKT), and the Kootenai Tribe of Idaho (KTOI) completed a fisheries mitigation and implementation plan for losses attributable to the construction and operation of Libby Dam (MFWP 1998) that includes a loss statement with assessment-type information. The same is true of the IDFG's fisheries losses and mitigation proposal for the Kootenai River (IDFG 2000).

Idaho Panhandle and Kootenai National Forest Land and Resource Management Plans contain broad assessment information for those portions of the subbasin managed by the US Forest Service. Specific Environmental Assessments for timber sales and a variety of other projects on National Forest lands in the subbasin also include assessment information.

Two inventories of “westside” tributaries have been conducted in Idaho (EcoAnalysts I998a and 1998b). The purposes of one of these inventories was to: 1) characterize invertebrate community abundance and diversity in west side tributaries in Idaho; 2) determine if tributary macroinvertebrate communities are impaired and if so what are the potential sources of impairment; compare condition between agriculturally influenced reaches and upstream reaches;

and 4) determine if limitation of macroinvertebrate community may contribute to fish population declines. The purpose of the other survey was to: 1) determine spawning habitat availability and condition for kokanee salmon; 2) determine enhancement or restoration opportunities; 3)characterize possible sources of perturbation; and 4) establish baseline monitoring for habitat and fisheries presence in these tributaries.

Huston (1995) conducted a native species search for the Kootenai River drainage in 1994. Hensler and Huston (1996) conducted a genetic survey of lakes in the Cabinet Wilderness Area. Muhlfeld (1999) reported on the seasonal habitat use by redband trout in the Kootenai River Drainage.

Bull trout assessments and recovery actions are coordinated with the Montana Bull Trout Scientific Team, the U.S. Fish and Wildlife Service (USFWS) and B.C. Environment. In the mid-1990s, the Montana Bull Trout Study Group compiled a series of bull trout status reports. Status reports that include waters within the Kootenai Subbasin are 1) Upper Kootenai River Drainage Bull Trout Status Report (including Lake Koocanusa, upstream of Libby Dam); 2) Middle Kootenai River Drainage Bull Trout Status Report (between Kootenai Falls and Libby Dam); 3) Lower Kootenai River Drainage Bull Trout Status Report (below Kootenai Falls). These status reports are intended to provide the most current and accurate information available to the Bull Trout Restoration Team and local bull trout watershed groups.

The White Sturgeon Recovery Plan (USFWS 1999) is the most comprehensive compendium of conditions that affect the white sturgeon. The Plan serves as a guidance document listing various conservation actions for the recovery of the white sturgeon population within the Kootenai River basin. The Plan takes a holistic approach to white sturgeon recovery by recommending measures that should also benefit other native aquatic species and possibly aid in the restoration of declining species in Kootenai River habitats before their status becomes critical. Actions that will directly benefit white sturgeon are given highest priority.

A water column and sediment chemical analysis was conducted for the Kootenai Tribe of Idaho by SVL (1995). The purpose of this report was to document results from water column and sediment sampling from eight sampling locations from Eureka, MT to Porthill, ID. The sampling project’s objective was to provide information on current and or potential pollutants within the river. Results were compared with standard toxicity levels.

Two water quality reports summarize water quality in the subbasin. Knudson (1994) discusses water quality issues and problems and makes recommendations. Bauer (1999) evaluates the quality of inlet hatchery water for reproduction of white sturgeon, evaluates trace metal contamination in water as a potential limiting factor in fish populations, and evaluates nutrient concentrations in the Kootenai River.

In 1999, a group of consulting firms prepared a Comprehensive Water Quality Monitoring Plan for the Kootenai River Basin, British Columbia, Montana, and Idaho that includes an assessment of the sources of pollutants and habitat reduction (Century West et al. 1999).

A nutrient availability and nutrient cycling analysis was conducted by the Stream Ecology Center at Idaho State University (Snyder and MinshaIl 1996). The purpose of this study was to estimate the effect of Libby Dam on the Kootenai River in relation to nutrient loading and ecosystem metabolism. The study included an examination of the fate of nutrients in

Lake Koocanusa, nutrient concentrations in several tributaries, primary production, carbon-cycling rates, and the standing crop of macroinvertebrates among other objectives. Several recommendations are made.

A literature review on changes in land use and aquatic life was conducted by Richards (1996). This baseline assessment report summarizes previous studies, provides a review of existing literature, and integrates observed conditions in the Kootenai River Basin. The report provides a good introduction or "snapshot" of issues concerning aquatic conditions.

Macroinvertebrate Study of the Kootenai River was conducted by Richards (1998). The purpose of the study was to "strengthen the inventory of Kootenai River invertebrate populations, and provide a comprehensive ecosystem assessment so that future enhancement measures can be evaluated". The study was also designed to evaluate the availability of macroinvertebrate forage for juvenile sturgeon. Hauer and Stanford (1997) of the Flathead Lake Biological Station reported on a study of the long-term influence of Libby Dam operation on the ecology of macrozoobenthos of the Kootenai River.

The Kootenai River Watershed Assessment Report (Pacific Watershed Institute and Resources 1999) was prepared for the Kootenai Tribe of Idaho to provide an assessment of watershed health of the Kootenai River system. Findings from several studies are summarized, interpreted, and integrated to assess aspects important to the ecological integrity of the system. Scholz et al. (1985) compiled information the Kootenai Tribe of Idaho's anadromous and resident fish resources.

Riparian habitats have been mapped by the University of Montana for the Kootenai Subbasin. The present map, which has a coarse level of detail (30 meter pixels), limits quantification of small-scale characteristics. With coarse-level maps, broad-scale classifications of community types (i.e., needleleaf-broadleaf riparian forest) can be utilized at a landscape level, but fine-scale structural and functional elements of the communities are difficult to assess.

Most of the data that has been collected in various assessments conducted within the subbasin have been digitized and are stored in various GIS data bases kept by the Kootenai Tribe's Fish and Wildlife Department, the Montana State Library (the Montana Natural Resource Information System, NRIS and the Montana Rivers Information System, MRIS), and Montana Fish, Wildlife and Parks.

Wildlife Impact Assessment and Mitigation Summary along with the Wildlife and Wildlife Habitat Mitigation Plan were compiled by MFWP personnel for Libby Dam dated 1984.

The Idaho Department of Environmental Quality (DEQ) is responsible for assessing waters of the state. The Clean Water Act and EPA regulations direct that the state monitor and assess the physical, chemical, and biological integrity of water bodies. To accomplish this, DEQ has developed the Beneficial Use Reconnaissance Project (BURP), and the Water Body Assessment Guidance (WBAG) program. Waters identified as potentially impaired also undergo a more rigorous water quality Subbasin Assessment that incorporates all available information and focuses on the cause and extent of impairments for development of a Total Maximum Daily Load (TMDL) if necessary.

The purpose of the BURP program is to consistently provide the physical, chemical, and biological data necessary to assess the integrity and quality of waters. It relies heavily on macroinvertebrate sampling, habitat evaluation and measurement, bacterial sampling, and fish sampling. The BURP protocol closely follows EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Plafkin et al. 1989). BURP data also documents existing uses, which must then be designated and protected under Idaho's water quality standards. It is the goal of the state to re-monitor water bodies on a rolling five year schedule.

The WBAG was designed to use BURP data to answer questions about stream integrity, water quality, and beneficial use support status. It originally consisted of multi-metric indexes for macroinvertibrates and habitat, qualitative and quantitative fisheries assessments, and evaluation of criteria exceedances. Assessments of BURP data collected from 1993 through 1996 were conducted to generate the 1998 list of impaired waters required under section 303(d) of the CWA. Revisions to the assessment methodology are currently underway that would allow the use of more types of data, revise the macroinvertebrate and habitat indexes, add a multi-metric fish index, revise the salmonid spawning beneficial use assessment, and add an interpretation of criteria exceedances in the assessments. The revised water body assessment methodology is expected to be completed in 2001 for use in the next 303(d) and 305(b) reporting cycles, and in ongoing TMDL sub-basin assessments.

Limiting Factors

Habitats and landuses vary across the Kootenai Subbasin, consequently the limiting factors also differ. The following list groups the subbasin into six zones based upon major types of waterbodies and landuses and lists the primary limiting factors for each. The list is followed by a brief description of each of the limiting factors. At present there is not enough information available to identify the primary limiting factors in the Canadian portion of the subbasin, however, these will be identified in future planning efforts. Other, non-biological factors also have a major effect on fish and wildlife productivity in the subbasin. They can be addressed in part by improving natural resource education programs, better dissemination and exchange of information, and increasing enforcement of state and federal environmental laws.

Headwaters and Associated Uplands (includes all mountain tributaries)

Primary Limiting Factors:

- Fragmentation/Connectivity (fish and wildlife)
- Stream Morphology Changes (includes sedimentation) (fish)
- Nonnative Species Interactions (fish and wildlife)
- Vegetation Change (wildlife)

Additional Limiting Factors

- Water Pollution (fish and wildlife)
- Human-Wildlife Interactions (fish and wildlife)

Impoundments (includes Kootenay Lake, Libby Reservoir, and Duncan Reservoir)

Primary Limiting Factors:

- Inundation and Water Fluctuations (fish)
- Nutrient Sink , Kootenay Lake only (fish)

Additional Limiting Factors:

- Fragmentation/Connectivity (fish and wildlife)

- Nonnative Species Interactions (fish)
- Vegetation Change (wildlife)

Unregulated Mainstem

Primary Limiting Factors:

- Nonnative Species Interactions (wildlife)
- Fragmentation/Connectivity (fish and wildlife)
- Water Pollution (fish)
- Human Wildlife Conflicts (wildlife)

Regulated Mainstem

Primary Limiting Factors:

- Altered Hydrograph (fish and wildlife)
- Altered Thermal Regime (fish)
- Lower Spring Elevation of Kootenay Lake (fish)
- Lack of Recruitment (fish)
- Floodplain Alterations and Stream Morphology Changes (fish and wildlife)
- Nonnative Species Interactions (wildlife)
- Water Pollution (fish)
- Nutrient Stripping (fish)
- Predation (fish)
- Fragmentation/Connectivity (fish and wildlife)
- Vegetation Change (wildlife)

Lower Valley Tributaries & Wetlands (includes all valley tributaries)

Primary Limiting Factors:

- Floodplain Alterations and Stream Morphology Changes (fish and wildlife)
- Nonnative Species Interactions (fish and wildlife)
- Water Pollution (fish and wildlife)
- Fragmentation/Connectivity (fish and wildlife)
- Human-Wildlife Conflicts (fish and wildlife)

Lakes (includes connected and closed-basin lakes)

Primary Limiting Factors:

- Nonnative Species Interactions (fish and wildlife)
- Human-Wildlife Conflicts (fish and wildlife)
- Alteration of the Littoral Zone (fish and wildlife)

Altered Hydrograph

Mean monthly Kootenai River flows at Bonners Ferry, for 1928-72 (pre-Libby Dam) and 1973-1995 (post-Libby Dam) are shown in Figure 11 (USFWS 1999). The altered hydrograph is a primary limiting factor in the Regulated Mainstems zone. Hydropower-related discharge fluctuations in the Kootenai River have resulted in a wider zone of water fluctuation, or *varial zone*, which has become biologically unproductive. Research has shown that normal vegetated varial zones are significantly impacted where abnormal fluctuating water levels and flows produce a highly altered riparian zone (Mack et al. 1990, Mackey et al. 1987, Suchomel 1994). Reduction in natural spring freshets due to flood control has eliminated much of the hydraulic energy needed to maintain the river channel and periodically re-sort river gravels. Lack of flushing flows have resulted in sediment buildup in the river cobbles, which are important for insect production, fish food availability, and security cover. In addition, large daily fluctuations in river discharge and stage (4-6 feet per day) strand large numbers of sessile aquatic insects in the varial zone. The reduction in magnitude of spring flows has caused increased embeddedness of substrates, resulting in a loss of interstitial spaces in cobble and gravel substrates, and in turn, a loss of habitat for algal colonization and an overall reduction in species diversity and standing crop. Benthic macroinvertebrate densities are one of the most important factors influencing growth and density of trout in the Kootenai River (May and Huston 1983). Caving of river banks has increased silt loads, which in turn further reduces productivity by reducing transparency and covering invertebrates. Large gravel deltas have formed at the mouths of several tributaries of the Kootenai River (Quartz, O'Brien, Pipe, Boulder, Caboose, and Curly Creeks) due to the loss of high spring flows. At low river levels, these deltas have become barriers to migrating fish such as bull trout, westslope cutthroat trout, burbot, and mountain whitefish (Marotz et al. 1988). The deltas also prevent the out-migration of juvenile redband from some streams (V. Paragamian, IDFG, personal communication).

Velocities during winter that are higher than pre-Libby Dam conditions have been shown to impede upstream spawning migration of burbot (Paragamian 2000). These high velocities are also thought to be a stress factor rendering a substantial portion of the burbot population reproductively dysfunctional (Paragamian 2000).

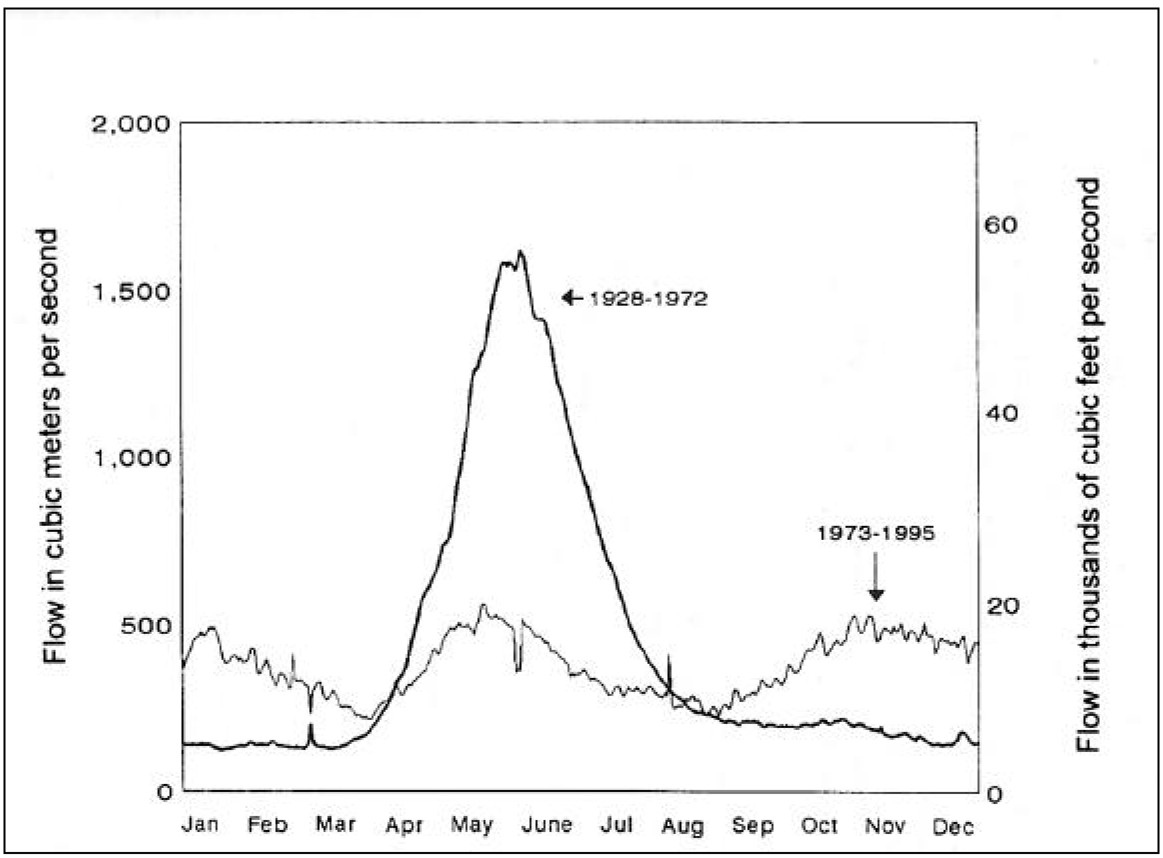

Figure 11. Mean monthly Kootenai River flows at Bonners Ferry, for 1928-72 (pre-Libby Dam) and 1973-1995 (post-Libby Dam)

Altered Thermal Regime

The thermal regime of the Kootenai River has been changed from pre-Libby Dam. Kootenai River water is now 4°C warmer during the winter and 2°C cooler during the summer (Partridge 1983) because of Lake Koocanusa. Temperature changes caused by Libby Dam may affect white sturgeon spawning migration and spawning behavior. Paragamian and Kruse (in press) found female Kootenai River white sturgeon spawning migration was primarily attributable to water temperature. Changes in water temperature could disrupt spawning migration of females, as it has male sturgeon held in the KTOI hatchery for spawning (Ireland, S., KTOI, pers. com.). Burbot spawn at temperatures usually below 4°C (Becker 1983). It is not known if the now warmer winter temperature of the Kootenai River is responsible for much of the burbot population becoming reproductively dysfunctional. However, recent studies indicate the higher winter flows have a backwater effect on the tributary streams in which burbot once spawned. This may mask their cool water inputs by mixing the warmer river water with that of the tributary. It is well documented that wildlife has been impacted by declines in aquatic productivity.

Alteration of Lake Littoral Zones

This is a primary limiting factor in the Lakes zone. Much of the growth that has occurred in the Kootenai Subbasin over the past twenty years has occurred near or adjacent to lakes. The result has been the loss of important lakeside riparian and wetland areas. These areas, whether they occur along lakes or streams, are important because so many species depend on them. It is estimated that wetland and riparian areas in general contain 75 percent of plant and animal diversity. Over half of the resident and migratory bird species that occur in the subbasin depend directly on wetlands and riparian areas for one or more of their habitat requirements. In addition, many of the subbasin's threatened, endangered, and species of concern; for example, trumpeter swans, bald eagles, grizzly bears, boreal toads, northern leopard frogs, use these areas. Wetlands and riparian areas also provide much of the food consumed by a number of fish species, and they serve as nurseries and spawning areas for fish.

Floodplain Alterations and Stream Morphology Changes

This is a primary limiting factor in the Headwater Tributaries, Regulated Mainstems, and Lower Valley Tributaries & Wetland zones. In headwater tributaries, the impacts include stream morphology changes such as loss of pools, stream widening, head cuts, and high peak-to-low basal flow ratios.

In the mainstem and valley tributaries, wetlands and other floodplain habitats have been lost to agricultural row crop and pastureland. The substantial wetland losses that have occurred in the subbasin are attributed to a combination of factors that include the operations of Libby Dam, river diking, draining associated with development, and tributary channelization (Richards 1997). Similar losses elsewhere and the alteration of low-elevation habitats such as riparian and wetland areas have been shown to decrease plant and wildlife diversity (Gresswell et al. 1989, Ebert and Balko 1987, Hodorff et al. 1988, Naiman et al. 1993, Wiggins et al. 1980). As an example, woodland caribou historically used the lowland floodplains for early winter habitat in the Lower Kootenai River portion of the subbasin. Additionally, significant grizzly bear use of the floodplain in the lower Kootenai River drainage has been detected during the spring. Bears move to low-elevation areas immediately upon exiting the den to feed on the relatively high-protein succulents and to search for winter-killed ungulates (Wakkinen pers. com. 2000).

Prior to the construction of Libby Dam, the river often topped dikes and flooded agricultural grounds. Those overland flows supplied a natural source of river nutrient inputs, created low velocity, backwater, and side-channel habitats and introduced pioneering riparian species (Johnson et al. 1976, Miller et al. 1995). The overland flows ended when the dam was built.

Diking, channelization, road fill, bank armoring, and other encroachments along valley stream segments have narrowed channels, altered riparian zones and limited meanders inside floodplains. This has created shorter channels, steeper gradients, higher velocities, loss of storage and recharge capacity, bed armoring, and entrenchment.

In both headwater and valley tributaries logging activities, road building, residential development, and agricultural practices have increased the amount of fine sediments entering streams. Fine sediments accumulating in spawning substrates reduce egg-to-fry survival. In some areas sedementation has reduced natural reproduction to the point that it is insufficeint to fully seed available rearing habitat with juevenile fish. Pools and rearing habitat have become clogged with sediment as well, further reducing the productive capacity of the stream. Sediment has also killed aquatic insects and algae. All of these changes have affected the food base for the many wildlife species that feed on aquatic organisms.

Fragmentation/Connectivity

This is a primary limiting factor in the Headwaters and Associated Uplands, Impoundments, Unregulated Mainstems, and Valley Tributaries & Wetlands zones. Fish migrations have been blocked from man-caused barriers that include dams, road culverts, dewatered stream reaches, irrigation diversions, etc. Construction of Libby Dam blocked spawning migrations of westslope cutthroat trout, bull trout, and burbot residing above Kootenai Falls to spawning tributaries in the U.S. and Canada. The lack of fish-passage facilities at Libby Dam assures that fish do not migrate upstream from below the dam. Downstream passage is possible through the dam turbines and outlet works (Skaar et al. 1996).

For wildlife, fragmentation has been caused by a combination of human and natural factors. Ninety percent of private landowners in the subbasin are located along low-elevation riverine systems. Development of these riparian areas has fragmented some of the most important wildlife habitats and severed habitat linkages. Relatively large losses of low-elevation habitats have resulted in the Kootenai Subbasin being recognized by many conservation organizations as a high priority restoration area. For example, portions of the Kootenai Subbasin have been listed in the North American Waterfowl Management Plan as one of 34 original “Areas of Major Concern”. The Nature Conservancy has listed the Kootenai River Valley as a *Priority 1 Five Year Action Site*. The Kootenai Subbasin is also included in the Idaho Panhandle “Focus Area” for the Intermountain West Joint Venture group, and the Subbasin has been designated as an important linkage zone for critical habitats in the

Yellowstone-to-Yukon Conservation Initiative Focus Area. In addition, connectivity of wildlife habitats and populations in the Kootenai subbasin has been severed, primarily between Selkirk and Cabinet/Yaak ecosystems, where artificial barriers such as highways, railroads, power lines, and other human developments have reduced natural linkages and decreased movement permeability (Jacobson, pers. com. 1999).

Human-Wildlife Interactions

This is a primary limiting factor in the Unregulated Mainstems, Lower Valley Tributaries & Wetlands, and Lakes zones. Increasing numbers of humans in sensitive wildlife habitats (especially low elevation habitats) has led to an increasing number of human-wildlife conflicts. For example, an increase in human developments, transportation corridors, and recreational activities has contributed to an increase in human-caused grizzly bear mortality; displacement of wintering elk, transportation-related wildlife mortality, and illegal harvest of bull trout and other fish and wildlife species. Animal populations that utilized low elevation wetlands, alluvial, and riparian communities include woodland caribou, moose, and grizzly bear, all of which are easily displaced by human activities (Franzman and Schwartz 1998, Johnson pers. com. 2000, Wakkinen 1999).

Inundation and Reservoir Water Fluctuations

This is a primary limiting factor for the Impoundments zone. When Libby Reservoir filled, 149 miles of high-quality stream habitat was lost. Extremely deep reservoir drawdowns now expose vast expanses of reservoir bottom to drying, killing the primary spring food supply, aquatic insects. The reduced reservoir pool volume impacts all aquatic trophic levels due to the diminished size of the aquatic environment. During summer, reservoir drawdown reduces the availability terrestrial insects for fish prey because fewer insects are trapped on the diminished surface area. Problems occur for resident fish when Libby Reservoir is drawn down during late summer and fall, the most productive time of year. The reduced volume and surface area reduces the potential for providing thermally optimal water volume during the high growth period, and limits the abundance of fall-hatching aquatic insects. Surface elevations continue to decline during winter, arriving at the lowest point in the annual cycle during April. Deep drafts reduce food production and concentrate young trout with predators like northern pikeminnow. Of greatest concern is the dewatering and desiccation of aquatic dipteran larvae in the bottom sediments. These insects are the primary spring food supply for westslope cutthroat trout (a species of special concern in Montana) and other important game and forage species. Deep drawdowns also increase the probability that the reservoirs will fail to refill. Refill failure negatively affects recreation and reduces biological production, which decreases fish survival and growth in the reservoir (Marotz et al. 1996, Chisholm et al. 1989). Furthermore, brief retention times flush nutrients out of the reservoir and downstream, thus making these nutrients unavailable to the reservoir biota. The continued nutrient loss to reservoir sediments has further contributed to declining nutrient loads throughout the Kootenai ecosystem. Reservoir-created barriers and degradation of existing habitat in reservoir tributaries have also contributed to declining westslope cutthroat trout populations.

Lack of Recruitment

This is an important limiting factor for the Regulated Mainstem zone. A lack of recruitment has been identified as the most critical limitation for Kootenai River white sturgeon (Anders et al. 2000; USFWS 1999; Duke 1999; Anders et al. 1996; USFWS 1994; Giorgi 1993; and Partridge 1983). Persistent natural recruitment failure in this endangered population appears to be due to intermittent female stock limitation (pre-spawning recruitment limitation) and/or one or more early life mortality factors (post-spawning recruitment limitation. Potential post-spawning, recruitment-limiting factors may include: embryo suffocation, predation, and potential food limitation. Anders et al. (2000) provided theoretical and empirical support for intermittent female stock limitation and the roles of post-spawning mortality factors in recruitment limitation. Stock limitation is also an important limiting factor for kokanee and burbot.

Nonnative Species Interactions

Nonnative species are a limiting factor throughout the subbasin. Illegal and unintentional introductions of non-native fish species have set up negative inter-species competition with native fish. Brown trout, brook trout, kamloops and coastal rainbow, northern pike, largemouth bass, smallmouth bass, bluegill, and yellow perch have been introduced into the subbasin. Conversely, impoundment greatly benefited the native pikeminnow and peamouth chub, which now compete with species of special concern for food and space, and predation (MBTSG 1996).

The introduction of diseases such as the Eurasian white pine blister rust in 1909 has devastated whitebark pine forests and changed forest composition across large landscapes (IPNF 1999). Additionally, the introduction and spread of noxious weeds into native plant communities has reduced native plant diversity and richness. Noxious weeds have also invaded riparian areas where power peaking has exposed riverbanks and make them uniquely susceptible to weed establishment (Suchomel 1994). White-tailed deer and turkeys have also been introduced; the full range of impacts of these and other nonnative species on native populations and their habitats have yet to be determined. Additionally, nonnative wildlife species (i.e., turkeys, pheasant, etc.) have a broad range of potential impacts on native populations and associated habitats that have yet to be determined.

Nutrient Sink

This is a limiting factor in Kootenay Lake. Productivity in Kootenay Lake has been negatively impacted by Duncan and Libby Dams. The reservoirs formed by these impoundments trap nutrients, phosphorus and nitrogen, and thereby reduce productivity in downstream waters. Serious concerns over this issue were first raised in late 1980, when Kootenay Lake kokanee, bull trout, and rainbow trout experienced patterns of declining growth and numbers. Intensive study, modeling, and a review of options to address this problem were begun in 1990. A large scale, experimental lake fertilization project was subsequently implemented in 1992. B.C. Hydro and the B.C. Ministry of Environment have provided funding for the experiment. Results to date suggest current methods show great promise as a long-term mitigation measure, and it is reasonable to expect the fertilization will need to continue annually as long as flows are required for downstream salmon migration.

Nutrient Stripping

This is a limiting factor in the Regulated Mainstem zone. The Kootenai River downstream of Libby Dam is nutrient poor because Lake Koocanusa acts as a nutrient trap. Libby Dam blocks the open exchange of water, organisms, nutrients, and coarser organic matter between the upper and lower Kootenai River. Snyder and Minshall (1996) stated that a significant decrease in concentration of all nutrients examined was apparent in the downstream reaches of the Kootenai River after Libby Dam became operational in 1972. Libby Dam and the impounded Lake Koocanusa reduced downstream transport of phosphorus and nitrogen by up to 63 and 25 percent respectively (Woods 1982), with sediment trapping efficiencies exceeding 95 percent (Snyder and Minshall 1996) The Kootenai River, like other large river-floodplain ecosystems, was historically characterized by seasonal flooding that promoted the exchange of nutrients and organisms among a mosaic of habitats (Junk et al. 1989; Bayley 1995). As a result of channel alterations, the Kootenai River has less nutrient and carbon retention capacity. Wetland drainage, diking and subsequent flood control has eliminated the "flood pulse" of the river and retention and inflow of nutrients. Removal of riparian and floodplain forests has eliminated sources of wood to the channel and potential retention structures. The limited productivity is a limiting factor for white sturgeon because it results in decreased prey availability for some life stages of sturgeon, and a possible reduction in the overall carrying capacity for the Kootenai River and Kootenay Lake to sustain populations of white sturgeon and other native fishes. It appears that experimental releases of nutrients will be be neccessarry to rehabilitate primary and secondary productivity, which in turn will serve to provide more food to insectivores (primarily mountain whitefish and trout).

Predation

Predation on sturgeon eggs and larvae was identified as a potential threat to successful white sturgeon recruitment. For broadcast spawners like white sturgeon, the mortality rate on eggs and larvae will increase with: 1) an increase in the number of predators; 2) an increase in the vulnerability of eggs or larvae to predation associated with changes in habitat or foraging behavior; and 3) a decrease in the volume or area of water that the eggs/larvae are dispersing into or over (as volume or area decreases, prey concentration to predators in increases). In post-impoundment years, Kootenai River springtime flows have been reduced substantially and vulnerability has increased due to an increase in water clarity and reduced food supply, as well as loss of habitat in the spawning reach.

Water Pollution

This is a limiting factor in the Unregulated Mainstem, Regulated Mainstem, and Lower Valley Tributaries zones. The two largest point source discharges to the Kootenai River are the Crestbrook Forest industries' pulp mill in Skookumchuck, B.C. and the Cominco mining, milling, and fertilizer plant in Kimberley, B.C. The pulp mill has caused discoloration of the river, toxicity, and fish tainting problems in the Unregulated Mainstem zone. Also, point source pollution containing toxic levels of heavy metals is well documented in the St. Mary's River and the Kootenai River (KRN 2000). Other mines that have contributed to water quality degradation include: Snowshoe Mine in Libby Creek, Great Northern Mountain area in the Fisher Creek drainage, operations in lower Boulder Creek, ASARCO mine on Lake Creek, and the Continental Mine in the headwaters of Boundary Creek (Knudson 1994). Major municipalities discharging secondary treated waste to the Kootenai River include: Cranbrook, Kimberly, Fernie, Creston, Sparwood, and Elkford, B.C.; Libby, Troy, and Eureka, MT; and Bonners Ferry, ID. The waste treatment plant at Bonners Ferry has added chlorine gas since 1984 to kill bacteria. Chlorine and ammonia have been associated elsewhere with toxicity and migration barriers for aquatic life. Rural residential development has impaired water quality, as have past and present forestry practices (road construction, log skidding, riparian harvest, and clearcutting), which have increased sediments and modified thermal regimes in headwater streams. In the regulated mainstem, temperature changes may have had an adverse impact on the winter spawning of burbot; winter temperatures are now 3 to 4^{o}C warmer than they were pre Libby Dam. High winter flows have also affected burbot spawning migration by reducing synchrony and stamina. The temperature changes caused by Libby Dam also effect white sturgeon. Wildlife has been impacted by declines in aquatic productivity.

Vegetation Change

Historically, wildfire in the Kootenai Subbasin was responsible for maintaining expansive early-seral stage forests of western larch, lodgepole pine, ponderosa pine, and western white pine. Fire frequencies kept shade-tolerant species from encroaching (Zack 1995). But after ninety years of a fire exclusion policy, shade-tolerant species dominate forest understories. This change in forest structure and composition is a potential limiting factor for wildlife species that depend on early-seral forest communities. In addition, because of fuel accumulations, there is now a danger that extremely hot, stand-replacing fires will occur and result in critical reductions of stored nutrients and an accompanying loss in potential productivity (USDA 1999). It is likely these changes in forest habitat components have altered ungulate and associated predator habitat availability, utilization, and other factors that affect local populations. These changes have also altered runoff patterns, which has adversely affected fish and other aquatic organisms.

Floodplain vegetation and associated wetland and riparian habitats have also changed. Approximately 50,000 acres of lowland floodplain and 5,000 acres of perennial wetlands have been converted into agricultural row crop and pastureland (Richards 1997). In addition, preliminary investigations of deciduous riparian vegetation along the Kootenai river system have shown impacts of hydroelectric operations on pioneering riparian species, and the associated establishment of more xeric tolerant species, similar to that found on the lower Flathead River. Suchomel (1994) concluded that with regulated flows on the lower Flathead River pioneer species (black cottonwood and sandbar willow) were being replaced by later successional riparian community types, and the majority of the cottonwood galleries were mature to decadent. Suchomel's studies can be related to the few remaining lower Kootenai River black cottonwood stands, but dike building and dike maintenance has significantly reduced the historic black cottonwood galleries and other riparian vegetation components. Vegetation change can potentially be linked to most of the other limiting factor listed in this section. By understanding vegetation changes in the Kootenai River Subbasin we may increase our ability to apply ecological principles to its management.

Artificial Production

The Hatchery and Genetics Management plan for the Kootenai Tribe of Idaho's conservation aquaculture facility for white sturgeon is attached as Appendix A.

Montana Fish, Wildlife and Parks Libby Area Office personnel are preparing facilities for eventual introduction of redband rainbow trout. The facility was used as a hatchery by the department into the 1970s and consisted of a spring-fed stream (e channel) and a very shallow pond, which drained into a stream and was a tributary to Libby Creek. Since 1998, upgrades have been made to prepare for the conversion of the hatchery into a genetic reserve area for redband rainbow trout.

As part of the conversion, a fish-passage barrier screen (to prevent upstream recolonization by nondesirable species) and pond draining system was installed during the fall of 1998. The pond was also enlarged and made deeper, and littoral areas were maintained for secondary production and wildlife and rearing habitat. During the fall of 1999, the existing over-widened channel was re-contoured to the proper profile to provide potential spawning and rearing habitat for redband rainbow trout. Following this work, the spring and pond were chemically treated with antimyicin to remove existing populations of coastal rainbow trout and brook trout.

The regional fisheries manager has secured the necessary permits for moving redband trout into the facility during 2000. The permits were secured after genetics and disease testing of donor stocks. We will be able to move fish into the habitat this fall 2000.

The facility is an effort on the part of Montana Fish, Wildlife and Parks to prevent listing of redband rainbow trout; part of a pro-active program that utilizes existing stocks to re-colonize eliminated stream stocks. It is expected the effort will integrate well with Montana's current study of Remote Site Incubators to bolster suppressed westslope cutthroat trout in Koocanusa Reservoir tributaries. There are also indications that redband rainbow trout may be less susceptible to whirling disease than other *Onchorhynchus* species due to earlier and colder spawning preferences, so there is interest in using this species throughout the hatchery system if research indicates that it is appropriate.

Existing and Past Efforts

Summary of Past Efforts

Initially, subbasin managers identified the historic and current status of fish stocks, population levels, and habitat conditions. In some portions of the Kootenai subbasin, baseline work remains to be completed.

From 1982 through 1985, Montana Fish Wildlife and Parks compiled biological data needed to construct the quantitative reservoir model LRMOD (Marotz et al. 1996, updated

1999). With aid from Montana State University (MSU), the U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (USACOE), B.C. Hydro, and scientific reviews, Montana completed the model and developed Biological Rule Curves (BRCs) for Libby Dam, first published in Fraley et al. (1989). The BRCs were integrated with power and flood control during the Columbia Basin System Operation Review, and by 1995 the Integrated Rule Curves (IRC) were completed and adopted by the Northwest Power Planning Council (NWPPC). The IRCs were subsequently superseded by operations dictated by the National Marine Fisheries Service (NMFS) and have not been fully implemented to date. In 1999, an in-stream flow incremental methodology (IFIM) project on the Kootenai River below Libby Dam developed a river model. This model quantifies fish habitat (juvenile and adult life stages of rainbow trout and mountain whitefish) under a variety of Libby Dam discharge scenarios. Further research is being conducted to include bull trout and white sturgeon habitat requirements in the completed model. Ultimately, the IFIM, IRCs, and the entrainment model from Libby Dam will be coupled to evaluate the biological tradeoffs under a variety of operational schemes between Libby Reservoir and the Kootenai River. This effort extends the utility of LRMOD by refining biological relationships in the river as a result of Libby Dam operation.

Montana completed a basin-wide in-stream flow investigation of 56 important spawning and rearing streams in 1988 (Marotz and Fraley 1986; Marotz et al. 1988). The two volume report located impacted areas and fish barriers and provided population estimates in Montana tributaries. This information was used to prioritize stream habitat projects. The Libby Mitigation Plan expanded on this information with a watershed framework to implement conservation aquaculture, imprint planting, native species reintroductions, and population enhancement where appropriate. On-the-ground mitigation began in 1997.

MFWP initiated a study to quantify fish entrainment through Libby Dam in 1990. The completion of this investigation in 1996 revealed that an estimated 1.15 to 4.5 million kokanee salmon are entrained annually. A variety of other fish species were also entrained (including bull trout and burbot), although kokanee comprised 97.5 percent of total entrainment. No entrainment deterrent system currently exists on Libby Dam. MFWP suspects that many entrained fish are eaten by bull trout and rainbow trout below Libby Dam. Another portion of fish probably survive and are carried downstream. With the commencement of “sturgeon enhancement” flows in June (when the greatest densities of kokanee are found in the forebay), many kokanee are probably washed down the Kootenai River and into Kootenay Lake. We believe that most kokanee that are entrained and do not survive are eaten by fish, ospreys, and eagles before passing the Highway 37 bridge; therefore it may be said that sturgeon do not benefit from fish entrainment and the resulting kokanee carcasses.

The Idaho Department of Fish and Game entered the Kootenai River fisheries investigations in 1978 with a three year study funded by the U S Army Corps of Engineers. Post impoundment studies focused on white sturgeon, burbot, and trout population dynamics and distribution. A creel survey was implemented to document angler recreational fishing, harvest, and catch rates. The white sturgeon and burbot populations were found to be recruitment limited, while rainbow and cutthroat trout abundance were found to be in lower abundance in Idaho compared to Montana. In 1989 IDFG reentered the Kootenai River with white sturgeon study #8806400 (funded by BPA) which directed recovery efforts at restoring the spring hydrograph to stimulate sturgeon spawning and improve rearing conditions. In 1993 burbot and trout studies were initiated and focused on spawning and recruitment and the sport fishery. Several graduate studies were also carried out. Nutrient spiraling was investigated, and it was reconfirmed that the river was nitrogen and phosphorous limited. Additional studies were contracted to the USGS to document substrate composition and current profiles in the white sturgeon spawning reach. Hypothesis testing has been conducted for burbot from 1995 through 1998. However, minimal cooperation from the USACOE has resulted in only one year of clear evidence linking flows to failed burbot migrations. To aid in recovery of burbot an international multi agency Recovery Committee was formed to formulate a recovery strategy.

The Kootenai River White Sturgeon Study and Conservation Aquaculture Program (8806400) began in 1991 in response to questions concerning water quality, white sturgeon gamete viability, and the feasibility of aquaculture as a component to population recovery. In 1991, 1992, 1993, 1995, and 1998, 1999, and 2000 progeny from wild broodstock were successfully produced and reared in the Kootenai Tribal Hatchery. Two experimental releases of juvenile white sturgeon occurred in 1992 and 1994, providing the first habitat use, movement, survival, and growth information for juvenile white sturgeon in the Kootenai River. Since then, the program has become fully implemented and approximately 2,700 juvenile white sturgeon juveniles representing 25 family groups have been released into the Kootenai River. Subsequent monitoring results indicate that survival of these fish is high and growth is considered normal. Since 1996, the Kootenai Tribe has also directed study efforts to obtain baseline information on the biological status of the Kootenai River ecosystem to ultimately identify management options for enhancement. Actions have included river modeling, water quality monitoring, as well as assessing macroinvertebrate and fish populations in the Kootenai River and it’s tributaries in North Idaho. In 1997, because of the decline in kokanee spawners returning to Kootenai River tributaries from Kootenay Lake, the Kootenai Tribe initiated a native kokanee reintroduction program using instream incubation techniques. Initial monitoring indicates hatch rates are high and kokanee returns are expected in 2001.

In the late 1980s, a pattern of declining growth and numbers emerged for Kootenay Lake kokanee, bull trout, and rainbow trout. After intensive study, modeling, and a review of options, B.C. Ministry of Environment initiated a large scale, experimental lake-fertilization project in Kootenay Lake in 1992 to address the reduction in productivity caused by the trapping of nutrients by Libby and Duncan Dam and additional impacts caused by increased summer flows for downstream salmon recovery. A significant increase in phytoplankton, zooplankton, and kokanee abundance has been noted to date.

Stansberry (1996) documented increased forage production and increased use of habitat enhancement areas by mule deer and bighorn sheep along Koocanusa Reservoir. Wood (1991) completed the Columbian sharp-tailed grouse mitigation implementation plan for western Montana, which compiles historic and recent information on the status of Columbian sharp-tailed grouse and includes management goals and objectives for western Montana. Bissell completed the Hungry Horse and Libby Riparian/Wetland Habitat Conservation Implementation Plan in 1996. The purpose of the document was to describe the means by which FWP will implement this program from 1996 through 2006 (Bissell 1996).

All wildlife inundation mitigation efforts associated with Libby Dam for the Idaho/Montana Kootenai Subbasin have been situated in Montana. Initial mitigation projects funded included enhancement and maintenance of 8,745 acres of white-tail deer winter range, 10,586 acres of mule deer winter range, 3,190 acres of bighorn sheep spring/winter range, 2,462 acres of sharp-tailed grouse habitat, and 3,418 acres of prime waterfowl habitat.

In all, mitigation projects since the 1970's have resulted in over 27,000 acres of wildlife habitat that have been enhanced or conserved. This work has resulted in 9,451 acres of mitigation credit for wildlife habitat losses associated with Libby Dam. MFWP has completed hydropower mitigation for Palouse prairie losses, 65 percent of upland forest losses, and 4 percent of riparian/wetland losses. Table 13 summarizes acres of wildlife habitat lost to hydroelectric development, mitigation accomplished through July 2000, and mitigation remaining for each component of the program within the Kootenai River subbasin.

Table 13. Acres of wildlife habitat lost to hydroelectric development, mitigation accomplished through July 2000, and construction and inundation mitigation remaining for each component of the program within the Kootenai River subbasin

Habitat Category	Libby Dam	Hydropower Losses	Mitigated thru 7/00	Mitigation Remaining
Riparian/Wetland	11,724	9,262	400	8,862
Palouse Prairie	1,583	1,251	1,481	0
Upland Forest	15,118	11,943	7,800	4,143
TOTAL	28,425	22,456	9,681	13,005

No mitigation has been accomplished in Idaho for hydroelectric development in the Kootenai Subbasin. However, off-site mitigation in the Kootenai Subbasin associated with hydroelectric development in the adjacent Upper Pend Oreille Subbasin has been accomplished. In 1988, the Idaho Department of Fish and Game (IDFG), in coordination with the Albeni Falls Interagency Work Group (Pend Oreille Subbasin), identified Boundary Creek (Kootenai River Subbasin) to mitigate wetland losses associated with construction of Albeni Falls Dam.

In 1998, the IDFG identified a 1,400-acre parcel adjacent to the Kootenai River and Boundary Creek that contained significantly altered historic riparian and wetland habitats in addition to important grizzly bear spring habitat. The Natural Resources Conservation Service protected an estimated 1,200 acres using funds from the Wetlands Reserve Program to purchase a permanent conservation easement. In 1999, the fee-title was purchased by IDFG, with 30 percent of the purchase price coming from BPA Albeni Falls wildlife mitigation funds. Moreover, Albeni Falls Interagency Work Group mitigates inkind wildlife habitats (HU's) within adjacent, previously identified areas that includes several subbasins (Kootenai River, Priest River, and Coeur d' Alene). This mitigation policy will be incorporated into planning and implementation efforts in the Kootenai River Subbasin.

Accomplishments by Year (Funded by BPA, unless otherwise noted)

1989

The LRMOD and preliminary IRCs (called Biological Rule Curves) were first published in 1989 (Fraley et al. 1989), then refined in 1996 (Marotz et al. 1996 and 1999).

A long-term database was established for monitoring populations of kokanee, bull trout, westslope cutthroat trout, rainbow trout, burbot, and other native fish species, as well as zooplankton and trophic relations.

1991

The Kootenai Tribe of Idaho (KTOI) built an experimental hatchery and contributed monitoring information to IDFG for wild white sturgeon adults and hatchery produced juveniles released into the Kootenai River. This has continued to present. KTOI successfully captured and spawned wild white sturgeon broodstock for use in the conservation aquaculture program in 1991, 1992, 1993, 1995, 1997, 1998, 1999, and 2000.

1992

KTOI released white sturgeon juveniles into the Kootenai River in 1992, 1994, 1997, 1998, and 1999.

1993

KTOI conducted kokanee spawning surveys in lower Kootenai River tributaries in Idaho. This has continued to present. The IDFG initiated a burbot investigation to determine if they were extirpated and to conduct population status studies.

1994

IDFG Fish Community Study indicated that a substantial change in the trophic structure of the community occurred post-Libby Dam. The community is now comprised primarily of omnivores, whereas previously it was made up of an equal mix of insectivores and omnivores. The whitefish population has declined 300 percent. Trout are also less common.

IDFG Burbot Study concludes that burbot are present but in very low numbers.

1995

MFWP developed a tiered (variable volume) approach for white sturgeon spawning flows balanced with reservoir IRCs and Snake River salmon biological opinion.

IDFG developed the hypothesis inferring that river flows impair burbot spawning migrations and fitness.

IDFG began experimenting with a variety of gear to determine the best means of monitoring wild white sturgeon and hatchery sturgeon abundance. The study demonstrated small-mesh gillnets were very effective in sampling juvenile sturgeon.

Burbot cooperative sampling in B.C. indicated the Goat River is likely the only location of spawning, but some burbot appear to be reproductively dysfunctional.

KTOI completed the "Kootenai River Biological Baseline Status Report." KTOI collected fisheries, water quality, and limnological field data and subsequent baseline data sets for Kootenai River and its tributaries.

1996

MFWP calibrated a model to estimate the entrainment of fish and zooplankton through Libby Dam as related to hydropower operations and the use of the selective withdrawal structure.

KTOI developed and implemented a disease-testing protocol for juvenile white sturgeon. IDFG and KTOI recaptured hatchery-released white sturgeon juveniles from the Kootenai River. Recapture data has provided the first habitat use, movement, survival, and growth information for juveniles in the Kootenai system. Monitoring and evaluation of hatchery released juveniles continues.

KTOI used the Adaptive Environmental Assessment process to identify and prioritize ecosystem restoration and management strategies. The Tribe, along with federal, state, and Canadian agencies also developed and used Adaptive Environmental Assessment model, resulting in identification of factors limiting ecosystem productivity and biodiversity.

KTOI completed a one-year macroinvertebrate investigation. The International Kootenai River Ecosystem Restoration Team (IKRERT), an international, inter-agency research and management team, was formed to develop and guide ecosystem restoration research and management.

An IDFG-contracted nutrient-spiraling study was completed. It found that the Kootenai River in Idaho, Montana, and B.C. is nutrient deprived.

1997

Burbot in the Kootenai River and Kootenay Lake were determined genetically distinct from burbot above Kootenai Falls in Montana. Kootenai River white sturgeon spawning migration behavior and environmental variables were modeled. The effects of dam operation on benthic macroinvertebrates were assessed (Hauer and Stanford 1997) for comparison with conditions measured in the past (Perry and Huston 1983). MFWP chemically rehabilitated Bootjack, Topless, and Cibid Lakes (closed-basin lakes) in eastern Lincoln County to remove illegally introduced pumpkinseeds and yellow perch and reestablish rainbow trout and westslope cutthroat trout.

KTOI began reintroducing Kootenay Lake kokanee into lower Kootenai River tributaries in Idaho. This has continued to present. Sampling of Kootenai River white sturgeon eggs indicated spawning can be enhanced with mitigated flows but spawning habitat (over sand) was unusual for white sturgeon. KTOI developed and implemented non-lethal sampling method for detection of white sturgeon iridovirus (WSIV).

KTOI determined DNA haplotype frequency of 23 wild white sturgeon broodstock spawned in the Kootenai Hatchery. All five mtDNA haplotypes found in the wild population were represented at least once by spawned broodstock. This continued through 1999.

KTOI completed a water quality monitoring program on the Kootenai River

1998

It was determined by IDFG that rainbow trout spawners in Deep Creek (a major tributary to Kootenai River in Idaho) are adfluvial stock, and juveniles seed lower river in Idaho and Kootenay Lake, B.C. Seismic studies of the Kootenai River subbottom indicated five m of coarse sand, no evidence of gravels or cobbles.

Hypothesis testing concluded winter operation of Libby Dam impairs burbot spawning migration and may also be responsible for reproductive dysfunction. Analysis of Kootenai River white sturgeon spawning habitat indicated spawning over sand substrate may be limiting survival of eggs and larva. IDFG telemetry data for white sturgeon indicated spawning reach abandonment will occur if mitigated flows are not coordinated with sturgeon behavior. IDFG studies of wild and hatchery abundance indicated better than expected survival of hatchery fish and few wild fish from flow test years.

MFWP formed or revitalized five citizen-based watershed planning organizations for five key sub-drainages in the basin, completing one implementable watershed plan for Grave Creek and made important progress on four other plans. The agency secured FEMA funding ($400,000) for an effort by county, city, homeowners, USFS, NRCS, MFWP, USFWS, Montana DOT, local schools, and several private organizations to reconstruct a major portion of Parmenter Creek to a stable form.

MFWP coordinated FEMA remapping of Libby, Big Cherry, Granite, Parmenter, Flower Creeks with the Libby Area Conservancy District, North Cabinet Conservancy District, USACOE, and USFS. MFWP coordinated a Rosgen level III and IV geomorphic survey of Libby Creek and collection of cross sectional data needed to run HEC II modeling, which is necessary to develop a channel design that will return much of Libby Creek to its proper functioning condition.

MFWP coordinated the development and design of implementable plans to screen bull trout from the Glen Lake Irrigation Ditch on Grave Creek, the most important bull trout spawning tributary in the U.S. portion of the Upper Kootenai.

MFWP instituted and coordinated an international effort with B.C. Environment to monitor bull trout populations in the Wigwam River/Lake Koocanusa complex.

MFWP directed a morphological survey of the unstable, lowest three miles of Grave Creek necessary to design a naturally functioning channel. The survey and design will give the local watershed group a critical tool to garner funding to implement the design. MFWP participated in initial planning for the rehabilitation of the tributaries to the Pleasant Valley Fisher River on the Lost Trail and Monk properties by the USFWS and NRSC.

MFWP negotiated a 1.25-mile riparian corridor and channel reconstruction of Therriault Creek where the creek is currently deeply incised, and unstable (part of Tobacco River Drainage which also includes the important Grave and Sinclair Creeks).

MFWP negotiated for the fencing and riparian planting of several miles of overgrazed westslope cutthroat trout habitat on Young Creek (important recovery tributary to reservoir) and won approval to reconstruct a one mile segment of channelized stream.

MFWP initiated the halt of tributary stocking of fingerling westslope cutthroat trout into Young Creek and replaced this with remote site incubator (RSI) seeding of the creek.

MFWP rehabilitated 200 feet of Pipe Creek frontage to prevent further loss of habitat for bull trout and westslope cutthroat trout. Pipe Creek is a primary spawning tributary to the Kootenai River.

MFWP developed an isolation facility for the conservation of redband rainbow trout at the Libby Field Station. Existing ponds were rehabilitated and the inlet stream was enhanced for natural outdoor rearing (1998 through 1999).

KTOI completed the macroinvertebrate investigation report "Kootenai River Macroinvertebrate Investigation" and the first year of a multi-year project to survey all the tributaries of the Kootenai River in Idaho. KTOI completed the first season of evaluating biological and population-parameter data for all fish species in the Kootenai River using electrofishing techniques. KTOI analyzed age-class-structure, growth, movements, and fish community dynamics in the lower Kootenai River and its tributaries and analyzed seasonal dietary preferences of non-game fishes in the lower Kootenai River in Idaho.

KTOI joined the Albeni Falls Interagency Work Group to assist in the coordination and implementation of the Albeni Falls Wildlife Mitigation project (BPA # 9206100). KTOI activities included identifying habitat mitigation opportunities, participation in habitat surveys using HEP, evaluation and enhancement activities, and providing assistance in the annual mitigation reporting requirements.

1999

IDFG found over 60 percent of the variation in spawning location of white sturgeon was due to Kootenay Lake elevation. Further study indicated that since Libby Dam became operational, a Canadian utility lowers Kootenay Lake over 2 m each spring.

IDFG trout tagging and telemetry studies indicate redband trout in Kootenai River above Bonners Ferry are fluvial, and some spawn in Montana.

MFWP chemically rehabilitated Carpenter Lake to remove illegally introduced pike, largemouth bass, and bluegills and reestablish westslope cutthroat trout and rainbow trout. Natural reproduction is not expected in this closed-basin lake.

MFWP rehabilitated about 400 feet of Sinclair Creek to reduce erosion, stabilize highway crossing, and install fisheries habitat for westslope cutthroat trout. Sinclair Creek is a tributary to Libby Reservoir.

MFWP formalized a cooperative agreement with stake holders on Grave Creek, and Therriault Creek. KTOI identified maternal lineage of each wild white sturgeon that spawned at Kootenai Hatchery.

KTOI conducted a preliminary assessment of inheritance of mtDNA markers (D-loop length variants) completed (n=60). Results to date support the use of this marker as an informative and legitimate population marker.

A redband trout genetic-reserve-development facility was developed on the grounds of MFWP, including an isolated and secure pond and a recreated spawning and rearing stream.

KTOI participated in the Albeni Falls Interagency Work Group and assisted in the coordination and implementation of the Albeni Falls Wildlife Mitigation project (BPA # 9206100). KTOI activities included participation in the development of the annual project funding proposals, identifying habitat mitigation opportunities, participation in habitat surveys using HEP, evaluation and enhancement activities, and providing assistance in the annual mitigation reporting requirements. KTOI proposed several habitat mitigation projects that were reviewed and ranked, and preliminary habitat mitigation activities were implemented.

2000

MFWP completed a fish screening (bull trout) project on Grave Creek diversion channel in cooperation with USFS, USFWS and MFWP's Future Fisheries Program. Grave Creek is a primary native trout spawning tributary to Libby Reservoir.

MFWP stabilized about 1,000 feet (100-foot-tall cut bank) of Libby Creek (a tributary to Kootenai River) to eliminate a major sediment point source and to improve the migration corridor for bull trout and instream habitat for westslope cutthroat trout and juvenile bull trout.

MFWP completed additional work on Sinclair Creek to stabilize a bank slough for westslope cutthroat habitat improvement. Sinclair Creek is now accessible to adfluvial spawners from Libby Reservoir.

MFWP was a major contributor toward completion of Parmenter Creek rechannelization/ rehabilitation work in Libby (Project Impact). Parmenter Creek has the potential to provide additional spawning and rearing habitat for Kootenai River fish.

MFWP was a major contributor toward the completion of anew ditch diversion/fish-screen/channel-stabilization project on Porcupine Creek. The project will benefit redband trout in this Yaak River tributary.

MFWP completed the Instream Flow Incremental Methodology report and model for use in guiding operational strategies for Libby Dam to better suit fisheries habitat needs. The agency also provided evidence and recommendations for improved river operations.

MFWP formalized an Memorandum of Understanding (MOU) with Lincoln County for the restoration of Parmenter Creek and an MOU with the Kootenai River Network for site planning in Libby Creek, Big Cherry Creek, and Pleasant Valley Fisher River. KTOI completed "Ecologically-based long-term systematic monitoring and research plan."

MFWP completed stream rehabilitation on an 800-foot section of Libby Creek.

USGS, in cooperation with KTOI and IDFG, completed sediment coring and seismic profiling in the lower Kootenai River.

IDFG and KTOI initiated a study to determine early life stage survival “bottle neck" by releasing hatchery white sturgeon sac fry.

IDFG trout recruitment studies above Bonners Ferry indicated some small tributaries have up to a 100 age-0 trout out-migrating an evening.

IDFG studies also demonstrated tributary streams above Bonners Ferry can go subterranean during low flows and may be major source of mortality to age-0 out-migrants.

Ongoing Projects

MFWP, in collaboration with the Tribes of Montana and Idaho, IDFG, and British Columbia. Canada is implementing watershed-based habitat enhancement and fish recovery actions to mitigate the losses caused by hydropower in the Kootenai Subbasin (BPA #199101903).

The Focus Watershed Coordination Project for the Kootenai River Watershed fosters "grass-roots" public involvement and interagency cooperation for habitat restoration to offset deleterious effects to the Kootenai River watershed fisheries and establishes cost-share arrangements with government agencies and private groups. Partners include the USFWS "Partners for Wildlife Program", the USFS, Glenn Lake Irrigation District, Plum Creek Timber Company, Lincoln County, the City of Troy, Lincoln County Fair Board, and the Libby Area Conservancy District, among others.

IDFG is determining the status of Kootenai River white sturgeon (ESA), burbot (a genetically distinct stock), whitefish, and bull and redband trout stocks in the Kootenai River and effects of water fluctuations and ecosystem changes on these stocks (BPA project #8806500).

Currently in the Kootenai River Subbasin, there are three ongoing habitat enhancement projects being conducted in cooperation with the Kootenai National Forest. These projects are designed to enhance over 50,000 acres of important wildlife habitat adjacent to Koocanusa Reservoir. The Kootenai River project (16,321 acres) is nearing completion. The West Kootenai/Pinkham project (4,688 acres) will begin in fiscal year 2001. The Forest Fuels/Wildlife winter range enhancement project (33,545 acres) is also scheduled for fiscal year 2001. In addition to habitat enhancement activities, there is an ongoing habitat conservation project whose goal is to conserve or enhance 8,862 acres of riparian and wetland habitats in the Kootenai River Subbasin over the next 45 years.

KTOI is implementing the conservation aquaculture program to prevent extinction, preserve the existing gene pool, and begin rebuilding age class structure of the endangered white sturgeon in the Kootenai River (BPA # 8806400). The implementation of the program also includes a monitoring and evaluation component to evaluate the success of the program, as well as a research component to test hypotheses concerning factors limiting the recruitment of wild white sturgeon. Funding for this project is provided by BPA and Upper Columbia United Tribes (UCUT). Direct in-kind services have been provided by B.C. Ministry of Environment and Fisheries, U.S Fish and Wildlife Service, U.S. Geological Survey, and Clear Springs Foods. Technical support is provided by IDFG, MFWP, U of I, UC Davis, College of S. Idaho and many others. The Tribe is also performing assessments, data analysis, and research in order to identify best management strategies to enhance aquatic biota in the Kootenai River ecosystem to recover native species assemblages across multiple trophic levels (BPA # 9404900). An important aspect of the ecosystem project is the formation of a multi-agency team to develop and guide ecosystem restoration research and management. Funding for this project has been provided by BPA, BOR, EPA, Upper Columbia United Tribes, and in-kind contributions (data exchange and technical support) from IDFG, MFWP, B.C. Ministry of Environment, Free-Run Aquatic Research, and Kootenai River Network.

Another ongoing project performed by KTOI is kokanee reintroductions in the Westside tributaries to the Kootenai River. This work includes a monitoring and evaluation component and is supported by contributions of eyed-kokanee eggs from the B.C. Ministry of Environment and Fisheries.

KTOI participates in the Albeni Falls Interagency Work Group and assists in the coordination and implementation of the Albeni Falls Wildlife Mitigation project (BPA #

9206100). KTOI activities include participation in the development of the annual project funding proposals, identifying habitat mitigation opportunities, participation in habitat surveys using HEP, evaluation and enhancement activities, and providing assistance in the annual mitigation reporting requirements. KTOI is continuing with proposed mitigation projects and anticipates implementation of several of these habitat projects by FY 2001.

MFWP has been conducting a twelve-year study of white-tailed deer in coniferous forests of northwestern Montana to develop techniques to determine basic biological and ecological parameters for white-tailed deer and relate those parameters to characteristics of individual habitats and potentially limiting factors. Final reports for this project are scheduled for 2002.

USFWS has been conducting a eleven-year study of grizzly bears in the Cabinet-Yaak grizzly bear recovery area. The purpose is to evaluate basic biological and ecological parameters pertinent to the recovery of this population. The Forest Service also captured and transplanted four female grizzlies from B.C. to the Cabinet Mountains for the purpose of bolstering the resident population and enhancing genetic diversity within this population.

IDFG initiated grizzly bear research in the Selkirk ecosystem in 1983. Since that time, 62 different grizzly bears have been captured in Idaho, Washington, and British Columbia. Recent grizzly bear movement data indicates the Selkirk and Yaak ecosystems are connected in British Columbia via the Purcell Mountains. Cooperative analysis of the data collected in the Selkirks and Yaak investigated the relationship between road densities and grizzly bear distribution. Currently, an analysis investigating survival rates, causes of mortalities, movements, and population trends for these two ecosystems is underway.

IDFG initiated woodland caribou research in the early 1980s and augmented the existing caribou population with 60 caribou between 1987 and 1990. Research focused on survival rates, causes of mortalities, population trend, annual censuses, and seasonal habitat use. Mountain lion research has been initiated because of the observed predation rates on woodland caribou.

MFWP has two full-time positions to handle wildlife/human conflicts in Northwestern Montana. With this focus, the Department has developed innovative techniques using aversive conditioning to teach grizzly bears to avoid potential conflict situations. The individuals in these positions are also involved in an information and education program to provide public information on how to coexist with wildlife. They, along with regular wardens and biologists, respond to hundreds of calls resulting from situations where wildlife presence is either undesirable or poses a public safety issue. The workload continues to increase as more people move into previously undeveloped wildlife habitats.

IDFG has a full-time enforcement/education position that is focused on grizzly bear and woodland caribou recovery efforts. The Conservation Officer is responsible for field patrols and public education during the active bear year. During the time bears are denned, the focus switches to education efforts, primarily in the school systems around the Selkirk ecosystem, as well as field contacts related to woodland caribou.

MFWP is expanding its efforts to educate all hunters. These efforts are intended to decrease game-law violations and cases of mistaken identity, foster increased public acceptance of hunters and hunting, and improve relationships between hunters and landowners. This is being accomplished through development of advanced hunter education classes and other information and education efforts.

Wildlife surveys and inventories are conducted annually on a variety of game, furbearer, and nongame species in the basin by state, Tribal, and federal agencies. Also, the states and Tribes conduct annual hunter harvest surveys to monitor population trends and demographic patterns in harvested wildlife populations.

Tribal, local, state, and federal agencies spend significant sums of money annually for the control of various noxious weeds in the Kootenai River Subbasin.

Kootenai Tribe of Idaho began development of a Water Resources Management Plan for the Kootenai River watershed. The plan contains a "management principles" document and "technical overview" document. Present and future water resources activities are identified through technical and community outreach. They are guided by the Tribe's four fundamental principles of water resource management: stewardship, leadership, harmony, and guardianship.

Present Subbasin Management

Existing Management

The following is a list of federal, state, county, and tribal government entities having regulatory/management authority in the subbasin and a short description of their responsibility areas. Canadian government entities are not listed but will be in future planning documents.

Federal Government

Bonneville Power Administration

The Bonneville Power Administration operates the federal Columbia River hydropower system as if it were a single-owner enterprise to maximize power efficiency. BPA schedules Hungry Horse Dam operations for power production and coordinates the power transmission system. BPA also serves as the funding source for projects mitigating the construction and operation of federal dams.

U.S. Army Corp of Engineers

The Army Corp of Engineers operates Libby Dam. The Corps is the regulatory entity that controls water levels within federal Columbia River storage projects for flood control. Since the 1960s, the agency's regulatory program's aim has been expanded to consider the full public interest in protecting and using water resources. Section 404 of the Clean Water Act prohibits discharging dredged or fill material into U.S. waters without a permit from the Corps. Because the definition of "discharge of dredged material" was modified in August 1993, activities that impact waters, including wetlands, will most likely require a Corps permit.

U.S. Forest Service

The U.S. Forest Service (USFS) manages approximately 72 percent (2.2 million acres) of the U.S. portion of the subbasin. Management of these lands is guided by USFS policies and federal legislation. Management guidelines are contained in the Idaho Panhandle and Kootenai National Forest Land and Resource Management Plans.

U.S. Fish and Wildlife Service

In addition to administering the national wildlife refuges and wildlife lands, the U.S. Fish and Wildlife Service (USFWS) administers the Endangered Species Act as it pertains to resident fish and wildlife. USFWS reviews and comments on land use activities that affect fish and wildlife resources such as timber harvest, stream alteration, dredging and filling in wetlands and hydroelectric projects.

U.S. Environmental Protection Agency

The United States Environmental Protection Agency (EPA) implements Federal laws designed to promote public health by protecting the nation's air, water, and soil from harmful pollution. EPA also coordinates and supports research and anti-pollution activities of State and local and tribal governments, private and public groups, individuals, and educational institutions. EPA also monitors the operations of other Federal agencies for their impact on the environment. The agency is responsible for implementing the Clean Water Act, including approving Total Maximum Daily Load plans.

Natural Resource Conservation Service

The Natural Resource Conservation Service provides technical support to the Soil and Water Conservation District (SWCD) with distribution of federal cost-share monies associated with reducing soil erosion and increasing agricultural production on privately owned land. They provide engineering and technical support for land and water resource development, protection and restoration projects.

Tribes

Kootenai Tribe of Idaho

The Kootenai Tribe of Idaho aboriginal territories (ICC, 1957) encompass portions of Montana and Idaho in the subbasin. In addition to the administration of their aboriginal lands, they review proposed management on public lands within the subbasin and provide comments relative to protection of fish and wildlife resources. Management of Tribal lands is guided by several documents including the Fish and Wildlife Management Plan (KTOI 1999). Additional policies that are incorporated into natural resource management activities include, but are not limited to, USFWS recovery plans, Albeni Falls Interagency Work Group policies, EPA, BPA and BIA policies, regulations and procedures.

Confederated Salish and Kootenai Tribes

The Confederated Salish and Kootenai Tribes of the Flathead Nation have a strong management interest in the area because it is encompassed within the aboriginal territory of the Tribes and consists largely of lands ceded to the United States government under the provisions of the Hellgate Treaty of 1855. Tribal members of the Kootenai Tribe lived in northwestern Montana. Under the provisions of the Treaty, the Tribes maintained the right to continued use of resources in the area. Today, Tribal members continue to utilize those resources for subsistence, cultural, and spiritual needs. As a result, the Confederated Salish and Kootenai Tribes value this area and take an active role in ongoing management activities that affect fish, wildlife, and habitat resources.

State

Montana Fish, Wildlife and Parks and Idaho Department of Fish and Game

These two state agencies are responsible for protecting and enhancing their respective state's fish and wildlife populations and habitats. Management is guided by MFWP and IDFG policies and federal and state legislation. Both conduct BPA-funded mitigation activities and are involved in research and monitoring. State game wardens from both agencies regularly patrol the Kootenai subbasin to enforce laws and regulations designed to protect fish and wildlife.

Montana Department of Natural Resources and Conservation

The Montana Department of Natural Resources and Conservation (DNRC) provides leadership in managing the state of Montana’s natural resources. Specifically, it is responsible for promoting the stewardship of Montana’s water, soil, forest, and rangeland resources and for regulating forest practices and oil and gas exploration and production. The department includes four divisions involved in land management in the subbasin. The Conservation and Resource Development Division coordinates, supervises, and provides financial and technical assistance to Montana’s 58 conservation districts, and it provides technical, financial, and administrative assistance to public and private entities to complete projects that put renewable resources to work, increase the efficiency with which natural resources are used, or solve recognized environmental problems. The Forestry Division protects the state’s forested and non-forested watershed lands from wildfire; provides aviation services; operates a nursery and provides shelterbelt, windbreak, wildlife habitat improvement, reclamation, and reforestation plantings on state and private lands; and regulates forest practices and wildfire hazards created by logging or other forest management operations on private lands. The Trust Land Management Division is responsible for managing the surface and mineral resources of forested, grazing, agricultural, and other classified state trust lands to produce revenue for the benefit of Montana’s public schools and other endowed institutions. The Water Resources Division is responsible for many programs associated with the uses, development, and protection of Montana’s water.

Idaho Department of State Lands

The Idaho Department of State Lands manages the state's endowment lands for the beneficiaries and to protect natural resources for the people of Idaho. Endowment lands currently total nearly 2.5 million acres statewide, including 780,000 acres of commercial timberland and about 3 million acres of minerals.

The Idaho Department of Water Resources

The Idaho Department of Water Resources role is to ensure that water and energy are conserved and available for the sustainability of Idaho's economy, ecosystems, and resulting quality of life. The agency accomplishes this through controlled development, wise management, and protection of Idaho's surface and ground water resources, stream channels, and watersheds; and promotion of cost-effective energy conservation and use of renewable energy sources.

Idaho Department of Environmental Quality

The Idaho DEQ administers several programs designed to monitor, protect, and restore water quality and aquatic life uses. These include BURP monitoring; 305(b) water quality assessments; 303(d) reports of impaired waters and pollutants; TMDL assessments, pollutant reduction allocations, and implementation plans; Bull trout recovery planning; 319 nonpoint source pollution management; Antidegradation policy; Water quality certifications; Municipal wastewater grants and loans; NPDES inspections; Water quality standards promulgation and enforcement; General ground water monitoring and protection; Source water assessments; and specific watershed management plans identified by the legislature. The Idaho Board of Environmental Quality oversees direction of the agency to meet responsibilities mandated through Idaho Code, Executive Orders, court orders, and agreements with other parties.

Local Government

County Governments

County governments in the subbasin are responsible for planning and land use. They also issue building permits.

County Conservation Districts

Conservation districts administer The Natural Streambed and Land Preservation Act, also known as the "310 Law." Any private individual or corporation proposing to undertake a project or construction activity in a perennial stream must first apply for a permit from the local conservation district. Conservation districts are the local contact for the control of nonpoint source (NPS) pollution. Districts conduct projects which demonstrate NPS pollution control practices, preferring voluntary, educational, and incentive-based approaches over regulatory approaches. Additionally, district boards work with state and federal regulatory agencies (for the most part, the Montana Department of Environmental Quality and the U.S. Environmental Protection Agency) to identify problem areas and prioritize treatment. Recently, the manner in which these problems are addressed has become the development of Total Maximum Daily Loads for impaired streams in Montana. Conservation districts often draw people and resources together to catalyze or assist in the development of watershed planning efforts. Conservation districts sponsor many stream restoration projects, conduct landowner workshops, produce and distribute informational and educational materials, and hold demonstrations and tours of innovative riparian management techniques and projects.

Existing Goals, Objectives, and Strategies

The overall goal for the Kootenai River subbasin is to rehabilitate and protect the abundance, productivity, and diversity of biological communities and habitats within the subbasin. The fish and wildlife populations of the subbasin are of economical and cultural significance to the people of the states of Idaho and Montana, the Northwest, and the Nation and to members of the Kootenai Tribe of Idaho and the Confederated Salish and Kootenai Tribes of the Flathead Indian Reservation.

Our objectives are intended to address the primary limiting factors in the subbasin, and so they follow the same grouping used for limiting factors.

Headwaters and Associated Uplands (includes all mountain tributaries)

Objective 1 Reconnect five blocked tributaries by 2004.

Limiting Factors

Fragmentation/Connectivity

Strategies

- Provide passage to migratory fish by removing potential man-caused barriers, i.e. impassable culverts, hydraulic headcuts, water diversion blockages, landslides, and impassable deltas.

Objective 2 Significantly reduces the level of sedimentation in five impacted spawning areas by 2004.

Limiting Factors

Stream Morphology Changes

Strategies

- Maintain and protect habitat by achieving compliance with existing habitat protection laws, policies, and guidelines.
- Work with the U.S. Forest Service to lower forest road densities.
- Implement stream bank stabilization measures where necessary.
- Implement riparian revegetation/rehabilitation projects.
- Agitate embedded gravels to remove silts and fine sands.
- Install artificial spawning structures where necessary.
- Participate with the Idaho and Montana Department of Environmental Quality in the Total Maximum Daily Load planning, implementation, and monitoring process.

Objective 3 Rehabilitate pools, riffle, and run frequencies in five streams so they equal that of undisturbed referenced reaches by 2004.

Limiting Factors

Stream Morphology Changes

Strategies

- Place large rocks and woody debris in streams to restore the appropriate channel morphometry using Rosgen-type rehabilitation techniques.

Objective 4 Eliminate or reduce negative nonnative species interactions in three streams by 2004.

Limiting Factors

Nonnative Species Interactions

Strategies

- Rehabilitate habitat to favor native species assemblages.
- Use RSI's to increase native species densities in areas where natural colonization is not possible.
- Protect native populations in headwater areas by installing barriers to upstream invasion by nonnative species. Remove barriers where the threat of invasion is corrected.
- Selectively remove nonnatives using available management tools.

Objective 5 Rehabilitate, protect, and maintain five percent or more of suitable and potential whitebark pine habitats by 2005.

Limiting Factors

Vegetation Change, Nonnative Species Interactions, and Fragmentation/Connectivity

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated whitebark pine and subalpine larch forest habitats map for the Kootenai subbasin.
- Investigate and analyze historic losses of whitebark pine and subalpine larch forest habitats in the Kootenai subbasin.
- Identify whitebark pine forest habitat losses and associated losses in biological functions and performance (i.e., grizzly bears, subalpine larch etc.).
- Coordinate efforts to develop comprehensive whitebark pine forest protection, rehabilitation, and enhancement plan for the Kootenai subbasin ecosystem.

- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., fires) in whitebark pine forest habitats.
- Identify and address human impacts in whitebark pine forest habitats utilizing adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance, and rehabilitate whitebark pine forest habitats.

Objective 6 Rehabilitate, protect, and maintain five percent or more of suitable and potential mid-elevation riparian coniferous forest habitats by 2005.

Limiting Factors

Vegetation Change, Nonnative Species Interactions, and Fragmentation/Connectivity

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated riparian coniferous forest habitat map for the Kootenai subbasin.
- Investigate and analyze historic losses of riparian coniferous forest habitats in the Kootenai subbasin.
- Identify riparian coniferous forest habitat losses and associated losses in biological functions and performance (i.e., grizzly bears, etc.).
- Coordinate efforts to develop comprehensive riparian coniferous forest protection, rehabilitation, and enhancement plan for the Kootenai subbasin ecosystem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., fires) in riparian coniferous forest habitats.
- Identify and address human impacts in riparian coniferous forest habitats utilizing adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate riparian coniferous forest habitats.

Objective 7 Restore Idaho's Beneficial Uses for Cold Water Biota and Salmonid Spawning to Full Support.

Limiting Factors

- Fragmentation/Connectivity
- Stream Morphology Changes
- Water Pollution
- Foodplain Alterations

Strategies

- Complete approvable TMDL Sub-basin Assessments, pollutant reduction allocations, and Implementation Plans for impaired water bodies.
- Maintain current schedule for TMDL development.
- Complete development of TMDL implementation plans within 18 months of TMDL approvals through coordination with appropriate agencies, advisory groups, and interested parties.
- Seek funding for projects identified in TMDL Implementation Plan.

Impoundments (includes Kootenay Lake, Libby Reservoir, and Duncan Reservoir)

Objective 1 Reduce reservoir drawdown and reduce the frequency of Libby Reservoir refill failure (to within five feet of full pool) as compared to historic operation.

Limiting Factors

Inundation and Water Fluctuations

Strategies

- Operate dams to provide reservoir operations that are consistent with VARQ and IRC concepts by 2002 (USACOE 1997a).
- Reduce runoff forecasting error by increasing the number of monitoring sites and improved remote sensing technology.
- Balance the releases of stored water for flow augmentation with reservoir refill. Specifically, calculate tiered flows for sturgeon using a conservative inflow forecast, assuming the lowest 25^{th} percentile precipitation (rather than average).
- Assess cost effective means for revegetating the reservoir varial zone.

Objective 2 Initiate a study by 2002 of the spawning locations of Kootenai River sturgeon with Kootenay Lake held at the pre-Libby Dam spring elevation. Identify spawning locations by 2007.

Limiting Factors

Inundation and Water Fluctuations

Strategies

- Hypothesis test Kootenay Lake elevation as a contributing factor to white sturgeon spawning location by maintaining the lake at historic spring levels for three consecutive years and monitoring white sturgeon spawning.
- Hypothesis test movement of the point of contact between backwater Kootenai River and free-flowing Kootenai River as a contributing factor to white sturgeon spawning locations by developing a flow model to track the contact in real time.

Objective 3 Improve nutrient levels in Kootenay Lake to produce 2.1 million kokanee in the Meadow Creek spawning channel and the Lardeau River in British Columbia.

Limiting Factors

Altered Hydrograph, Floodplain Alterations and Stream Morphology Changes, Water Pollution, Nutrient Sink and Nutrient Stripping

Strategies

- Continue the addition of artificial nutrients to Kootenay Lake to mitigate for impacts of providing flow augmentation for downstream U.S. salmon recovery.

Regulated Mainstem

Objective 1 Move Libby Dam operations 50 percent closer to normative[3] compared to current operations by 2004.

Limiting Factors

Altered Hydrograph

Strategies

- Implement seasonal flow windows and flow ramping rates.

Objective 2 Evaluate biological effects of temperature and water quality related to selective reservoir withdrawal for sturgeon flows annually.

Limiting Factors

Altered Hydrograph, Nutrient Stripping, Water Pollution (altered thermograph)

Strategies

- Monitor temperatures within the reservoir and downstream sites during flow augmentation.
- Monitor white sturgeon behavior during spawning in relation to flow and temperature.
- Evaluate reservoir discharges and spawning-zone stream water for selected microorganisms and water quality that may affect egg survival.

Objective 3 Determine the spawning migration rate of Burbot during January under pre-Libby Dam conditions by 2004.

Limiting Factors

Altered Hydrograph

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3 Normative conditions are defined as those pre-Libby Dam years for which there are records (1911-1972).

Strategies

- Hypothesis test travel-migration distance and rate by maintaining the Libby pre-Libby Dam flow condition of 6,000 cfs for five weeks and monitoring burbot movement with sonic telemetry.

Objective 4 Assess the condition of Kootenai River fish spawning, incubation, and juvenile rearing habitat quality, and evaluate potential substrate improvement measures by 2005.

Limiting Factors

Altered Hydrograph, Floodplain Alterations and Stream Morphology Changes, Water Pollution, Altered Thermal Regime, and Nutrient Stripping,

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations for cooperative management of transboundary populations and habitats needed by different life stages.
- Conduct flume studies to simulate the active sand dunes in the Kootenai River where white sturgeon currently spawn to access the extent that sturgeon eggs may be buried by shifting sands.
- Monitor suspended sediment transport and bedload transport in white sturgeon habitat and develop conceptual and computer models of transport to aid in assessing the potential for substrate habitat creation or enhancement.
- Conduct a pilot test in the white sturgeon spawning area to determine the rate of sediment accumulation using sedimentation rods (Phase I) and installation of suitable substrate (Phase II) to evaluate the potential for habitat enhancement to increase survival of eggs and larval sturgeon.
- Monitor river-bottom sand dunes and gravel substrate in white sturgeon spawning reaches using side-scan sonar and/or multi-beam acoustic survey to identify how river bottom features move and evolve on a seasonal basis and under a range of flow regimes (deals with potential egg suffocation).
- Monitor behavior and response of adult Kootenai River white sturgeon to experimental temperatures and flows during the spawning migration and spawning seasons, with sonic and radio telemetry.
- Monitor and evaluate white sturgeon spawning, timing, and habitat with artificial substrate mats.
- Measure success of experimental temperatures and flows for white sturgeon spawning by sampling for larval and juvenile sturgeon with various net gears in the Kootenai River and Kootenay Lake.
- Monitor adult burbot with sonic telemetry to determine spawning timing and location.

- Monitor behavior and response of adult redband and bull trout during the spawning migration and spawning seasons with radio telemetry and reward tags.
- Deploy substrate crates to determine if in-river spawning habitat is a limiting factor to redband spawning.
- Monitor and evaluate white burbot spawning, timing, and habitat with half-meter and meter nets in the Kootenai River and Kootenay Lake.
- Determine the affect of warmer water temperature of the Kootenai River and masking of cold water tributaries by monitoring water temperatures of tributaries at their mouth and 100 m upstream.

Objective 5 Determine the potential of revegetating the varial zone by 2005.

Limiting Factors

Floodplain Alterations, Altered Hydrograph, Vegetation Change, Nonnative Species Interactions and Fragmentation/Connectivity

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated riparian and wetland habitat map for the Kootenai River mainstem of the Kootenai subbasin.
- Investigate and analyze historic losses of riparian and wetland habitats in the Kootenai River mainstem of the Kootenai subbasin.
- Identify associated losses in biological functions and performance (i.e., riparian dependent birds, etc.).
- Coordinate efforts with all natural resource managers to develop comprehensive riparian and wetland habitat protection, rehabilitation, and enhancement plan for the Kootenai River mainstem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., natural vegetation, etc.) in the Kootenai River mainstem.
- Identify and address human impacts in the Kootenai River mainstem utilizing adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate riparian and wetland habitats in the Kootenai River mainstem.

Objective 6 By 2004, remove delta blockages from 50 percent of the tributaries where the blockages are problematic.

Limiting Factors

Altered Hydrograph, Fragmentation/Connectivity

Strategies

- Coordinate removal of cobble and gravel deltas with the U.S. Army Corps of Engineers and Burlington Northern and Santa Fe Railroad.

Objective 7 Rehabilitate five percent of historic floodplain habitat by 2005.

Limiting Factors

Floodplain Alterations, Altered Hydrograph, Vegetation Change, Nonnative Species Interactions and Fragmentation/Connectivity

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated floodplain habitat map for the Kootenai River mainstem of the Kootenai subbasin.
- Investigate and analyze historic losses of floodplain habitats in the Kootenai River mainstem of the Kootenai subbasin.
- Identify associated losses in biological functions and performance (i.e., riparian vegetation communities, etc.).
- Coordinate efforts with all natural resource managers to develop comprehensive floodplain habitat protection, rehabilitation and enhancement plan for the Kootenai River mainstem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., natural vegetation, etc.) in the Kootenai River mainstem.
- Identify and address human impacts in the Kootenai River mainstem utilizing adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance, and rehabilitate floodplain habitats in the Kootenai River mainstem.

Objective 8 Determine the rehabilitation potential of floodplain and river connectivity by 2005.

Limiting Factors

Floodplain Alterations, Altered Hydrograph, Vegetation Change, Nonnative Species Interactions and Fragmentation/Connectivity

Strategies

- Coordinate subbasin research activities with appropriate agencies and organizations.
- Initiate and develop research strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop and analyze hydrology and potential floodplain habitat model for the Kootenai River mainstem of the Kootenai subbasin.
- Identify associated losses in biological functions and performance (i.e., overland flows, groundwater, riparian vegetation, etc.).
- Coordinate efforts with all natural resource managers to develop comprehensive river/floodplain rehabilitation and enhancement plan for the Kootenai River mainstem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., natural vegetation, etc.) in the Kootenai River mainstem.
- Research, design and implement floodplain/river reconnectivity experiments and environmental engineering techniques (i.e., re-engineered two way fish ladders, etc.).
- Investigate historic and current potential of floodplain/river nutrient exchange.
- Cooperate and coordinate efforts to restore natural stream flows and associated river connections (i.e., channelized tributaries, etc.) in the Kootenai River mainstem.
- Research, design and implement tributary reconnectivity and restoration.
- Identify and address human impacts in the Kootenai River mainstem utilizing adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance, and rehabilitate floodplain habitats in the Kootenai River mainstem.

Objective 9 Reduce noxious weeds within the varial zone by 10 percent by 2005.

Limiting Factors

Altered Hydrograph, Vegetation Change and Nonnative Species Interactions

Strategies

- Coordinate subbasin noxious weed activities with appropriate agencies and organizations.
- Initiate and develop noxious weed management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Coordinate efforts with all natural resource managers to develop comprehensive noxious weed management plan for the Kootenai River mainstem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., natural vegetation, etc.) in the Kootenai River mainstem.
- Identify and address direct and indirect human introduction and spread of noxious weeds in the Kootenai River mainstem utilizing adaptive management techniques.
- Cooperate and coordinate with weed spraying, biological control, and other management technique in an efforts to reduce noxious weeds in the Kootenai River mainstem.

Objective 10 Lower the existing rate of spread of noxious weeds by 2002.

Limiting Factors

Altered Hydrograph, Vegetation Change and Nonnative Species Interactions

Strategies

- Coordinate subbasin noxious weed activities with appropriate agencies and organizations.
- Initiate and develop noxious weed management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Coordinate efforts with all natural resource managers to develop comprehensive noxious weed management plan for the Kootenai River mainstem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., natural vegetation, etc.) in the Kootenai River mainstem.
- Identify and address direct and indirect human introduction and spread of noxious weeds in the Kootenai River mainstem utilizing adaptive management techniques.
- Cooperate and coordinate with weed spraying, biological control, and other management technique in an efforts to reduce noxious weeds in the Kootenai River mainstem.

Objective 11 Evaluate the affects of contaminants on Kootenai River biota by 2005.

Limiting Factors

Water Pollution

Strategies

- Develop a historic timeline for the type, rate, and source of organic and inorganic contamination for the Kootenai River watershed by collecting, studying and analyzing cores of Kootenay Lake bottom sediments near the Kootenai River delta
- Install contaminant collection devices in the Kootenai River bed to evaluate pore water contaminants that could effect sensitive habitat.
- Perform sediment-pore water analysis to determine the bioavailable portion of sediment-related contaminants.
- Address biomarkers and tissue accumulation of contaminants in aquatic biota to determine the potential effect on the food chain.
- Test eggs and sperm from wild white sturgeon used as broodstock fish for contaminant burdens.
- Monitor motility of sperm from wild white sturgeon in relation to contaminant burden.
- Determine hatching success and survival of white sturgeon families in the hatchery in relation to parental contaminant burden of sperm and eggs.
- Determine survival, growth, development, and deformity rates of larval and juvenile sturgeon reared in simulated river conditions in relation to contaminant uptake and tissue burden.
- Monitor sediment particles and water chemistry for contaminants.

- Participate with the Idaho and Montana Department of Environmental Quality in the Total Maximum Daily Load planning, implementation, and monitoring process.

Objective 12 Continue monitoring key water quality parameters.

Limiting Factors
Water Pollution

Strategies

- Coordinate with affected agencies and develop a comprehensive strategy to ensure consistent and cost effective monitoring strategies that take into account ecosystem, biological, and water quality measurements.

Objective 13 By 2004, determine if warmer water temperatures and high flows during winter effect the reproductive fitness of burbot.

Limiting Factors
Water Pollution

Strategies

- Capture and biopsy burbot in the Kootenai River to determine reproductive stages.
- Determine if reproductive dysfunction of burbot is due to high Kootenai River winter flows by sampling burbot and measuring blood testosterone, chloride, and estradiol-2B and compare to levels from a control group (Columbia Lake).
- Deploy continuous-recording thermographs in various locations of the Kootenai River and tributaries to monitor water temperatures in relation to burbot reproductive fitness.
- Under controlled laboratory conditions measure stress and reproductive fitness of burbot under varying temperature and velocity conditions and apply to water management and recovery needs for Kootenai River burbot.

Objective 14 Complete large-scale monitoring of primary, secondary, and tertiary trophic levels by 2003.

Limiting Factors
Nutrient Stripping

Strategies

- Monitor fish community dynamics annually at index sites on the mainstem Kootenai River.
- Monitor macroinvertebrate community dynamics annually at index sites on the mainstem Kootenai River.
- Monitor key water quality parameters annually within key reaches of the Kootenai River to assess primary productivity.

- Evaluate aquatic biota community dynamics and productivity of backwater slough habitats adjacent to the lower Kootenai River.
- Evaluate terrestrial biota community dynamics and productivity of wetland and riparian habitats adjacent to the lower Kootenai River.
- Collect algae and plankton monthly for ID and chlorophyll analysis and apply IBI to algae production to determine the available food base for larval fish.
- Assess pre and post dam trophic and water quality changes using fossil diatoms obtained from river coring done in 2000.
- Sample fish populations at a minimum of four index sites and determine trophic structure, species composition, CPUE, and species biomass.
- Conduct a creel survey on the Kootenai River one year prior to nutrient additions and compare harvest and catch rates to post treatment creel.

Objective 15 Assess the feasibility of a large-scale, controlled, nutrient-addition experiment downstream of Montana by 2004.

Limiting Factors

Nutrient Stripping

Strategies

- Assess primary productivity and algal community composition and test nutrient addition effects using mesocosm analysis within key reaches of the Kootenai River in Montana and Idaho.
- Perform analysis of assessment program results and mesocosm results.
- Reconvene the International Kootenai River Ecosystem Restoration Team to develop recommendations for implementation of nutrient-addition experiment (depending upon results of strategies listed above).
- Implement, monitor, and evaluate large-scale, controlled, nutrient addition experiment downstream of Montana.

Objective 16 Determine the effect of nutrient additions on sport fish populations in Kootenai River downstream of Montana.

Limiting Factors

Nutrient Stripping

Strategies

- Conduct a creel survey on the Kootenai River after three years of nutrient additions and compare harvest and catch rates to pre-treatment creel.
- Estimate population changes, size, condition and age structure changes in burbot, white sturgeon, redband and bull trout, and mountain whitefish post nutrient treatment.

- Sample fish populations at minimum of four index sites and determine trophic structure, species composition, CPUE, and species biomass and compare to pre nutrient treatment data.

Lower Valley Tributaries & Wetlands (includes all valley tributaries)

Objective 1 Rehabilitate five channelized reaches on lower valley tributaries by 2005.

Limiting Factors

Floodplain Alterations and Stream Morphology Changes

Strategies

- Incorporate Rosgen-based rehabilitation techniques into stream stabilization designs.
- Restore proper pattern, profile, and form.

Objective 2 Assess the condition of Kootenai River tributary fish spawning, incubation, and juvenile rearing habitat quality and evaluate potential substrate improvement measures by 2005.

Limiting Factors

Floodplain Alterations and Stream Morphology Changes, Fragmentation/Connectivity

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations to develop cooperative adaptive management strategies due to transboundary population issues and habitat needs for different life stages.
- Perform kokanee spawner and redd counts annually in tributaries to the Kootenai River in Idaho to monitor success of reintroductions.
    1. Measure out-migration from key nursery tributaries of juvenile redband, cutthroat trout, and bull trout with screw traps and drift nets.
    2. Deploy substrate crates to determine if tributary spawning habitat is a limiting factor to redband spawning.

Objective 3 Maintain water temperatures within the tolerance range of native fish species.

Limiting Factors

Water Pollution

Strategies

- Deploy continuous recording thermographs in important tributaries to monitor water temperatures in relation to tolerance range of native fish species.
- Protect or revegetate riparian areas to maintain shading and cool water temperatures.

- Collect adequate data to ensure that significant water temperature issues can be addressed during the Total Maximum Daily Load planning, implementation, and monitoring process or through other legal mechanisms.

Objective 4 Evaluate the effects of contaminants on Kootenai River tributary biota by 2005.

Limiting Factors

Water Pollution

Strategies

- Coordinate with affected agencies and develop a comprehensive strategy to ensure consistent and cost effective monitoring strategies that take into account ecosystem, biological, and water quality measurements
- Perform sediment pore water analysis to determine the bioavailable portion of sediment-related contaminants.
- Address biomarkers and tissue accumulation of contaminants in aquatic biota to determine the potential effect on the food chain.
- Monitor sediment particles and water chemistry for contaminants.
- Collect adequate data to ensure that significant water temperature issues can be addressed during the Total Maximum Daily Load planning, implementation, and monitoring process or through other legal mechanisms.

Lakes (includes connected and closed-basin lakes)

Objective 1 Remove the sources of nonnative or hybridized trout from two to three connected lakes each year over the next three years.

Limiting Factors

Nonnative Species Interactions

Strategies

- Selectively remove non-desirable fish and restock with native desirable fish.
- Establish barriers to nonnative fish escapement or spawning.

Objective 2 Increase the angler opportunities in three closed-basin lakes over the next three years.

Limiting Factors

Human-Wildlife Conflicts (relieving pressure on sensitive populations of native species)

Strategies

- Utilize hatchery production to stock offsite, closed-basin lakes.

- Where appropriate, rehabilitate three closed-basin lakes per year to provide maximum angler opportunity and system productivity.
- Form partnerships with the public through the Focus Watershed Program and other avenues to increase awareness of the role of mitigation in achieving native species and habitat restoration.

Subbasin-wide Objectives

Objective 1 Continue the assessment of existing and potential water quality impairments.

Objective 2 Rehabilitate to a self-sustaining condition populations of threatened, endangered, and other declining native species by 2020.

Limiting Factors

Floodplain Alterations, Vegetation Change, Nonnative Species Interactions, Alteration of the Littoral Zone, Human-Wildlife Conflicts and Fragmentation/Connectivity

Strategies

- Coordinate with appropriate agencies and organizations to develop cooperative adaptive management strategies for transboundary populations and habitats needed by different life stages.
- Protect critical habitats through acquisition, conservation easements, or agreements.
- Develop public information/outreach program to increase public understanding of the need to protect and rehabilitate native species.
- Facilitate consensus building processes within the subbasin to address public issues and concerns.
- Continue implementation of conservation aquaculture and preservation stocking program for endangered white sturgeon in the Kootenai River (USFWS 1999, Appendix)
- Refine elements of the conservation aquaculture program for white sturgeon using research with direct management implications (e.g. refine disease testing protocol, investigate cryopreservation techniques, and develop and evaluate permanent tagging or marking technologies to identify larval, fingerling, and YOY white sturgeon to allow for earlier release).
- Monitor and evaluate genetic variability and diversity of hatchery-produced white sturgeon juveniles and wild broodstock to compare with that of the wild population.
- Monitor and evaluate survival, condition, growth, movement and habitat use of white sturgeon released into the Kootenai River.
- Monitor juvenile and adult sturgeon and burbot in Kootenay Lake and coordinate database for use in evaluation of transboundary population dynamics and habitat use.
- Monitor and evaluate biological condition and related population dynamics of white sturgeon as it relates to carrying capacity.

- Evaluate the feasibility of establishing an experimental non-essential white sturgeon population outside the current occupied range.
- Increase enforcement effort to deter illegal take/harvest of declining native fish and wildlife.

Objective 2a. By 2005, restore and maintain a population of 50 woodland caribou in the Selkirk Mountain Ecosystem. Meet delisting criteria by 2020.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille), International Mountain Caribou Technical Committee, Caribou Recovery Team, and Selkirk Priest Basin Association.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated habitat map for the Selkirk Mountains caribou.
- Investigate and analyze caribou habitat availability, capability and suitability.
- Identify priority zones for caribou habitat protection, rehabilitation and enhancement activities.
- Expand efforts to monitor and assess population trends, productivity, distribution and movement of caribou.
- Coordinate efforts to develop comprehensive fire regime maps in the Selkirk Mountain Ecosystem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., fire) in caribou habitats.
- Identify and address human harassment and mortality of caribou in the Selkirk Mountains.
- Investigate, analyze and minimize predator mortality of the Selkirk Mountain caribou population.
- Investigate and analyze road densities and associated impacts to caribou.
- Expand the caribou information and education program.
- Investigate and coordinate caribou transplant options.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate low elevation habitats (i.e., early winter) for caribou.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate subalpine habitats for caribou.

Objective 2b. By 2005, meet or exceed the 50-percent mark of all targeted delisting criterion and maintain population viability for grizzly bears in the Selkirk/Cabinet-Yaak Ecosystem. Meet delisting criteria by 2020 (USFWS).

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille), Interagency Grizzly Bear Committee.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Identify priority zones for grizzly bear habitat protection, rehabilitation and enhancement activities.
- Expand the grizzly bear information, education and enforcement programs while providing funds for brochures, signs, information materials, hunter education and enforcement activities.
- Expand efforts to monitor and assess population trends, productivity, distribution and movement of grizzly bears.
- Investigate and analyze grizzly spring range habitat availability, capability and suitability.
- Investigate and analyze grizzly bear low elevation habitat availability, capability and suitability.
- Cooperate and coordinate efforts to protect, rehabilitate, enhance and maintain grizzly spring range and low elevation habitats.
- Assist existing efforts and research regarding the influence of road densities on habitat, topography, etc.
- Assist in the development of international cooperative research, monitoring and adaptive management strategies for grizzly bears.
- Research and develop strategies to restore, enhance, and maintain connectivity of wildlife movement corridors.
- Research, develop and implement genetic viability conservation plan for grizzly bears populations.
- Develop a proactive management program to prevent human-grizzly interactions and nuisance situations (i.e., bear proof garbage containers, etc.).
- Expand the grizzly bear information and education program.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate whitebark pine habitats for grizzly bear.

Objective 2c. By 2005, survey and monitor lynx in at least 50 percent of the lynx analysis units and identify all capable and suitable habitats in Lynx Management Zones for the Kootenai subbasin.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations in adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead) and internationally (i.e., British Columbia Ministry of the Environment, etc.).
- Conduct surveys of Lynx Analysis Units (LAU's) to determine presence and persistence of lynx.

- Develop regional guidelines for the classification and mapping of capable and suitable lynx habitat.
- Research and assess fragmentation and connectivity of capable and suitable lynx habitats.
- Research and develop strategies to restore, enhance and maintain connectivity of movement corridors for carnivores.
- Conduct telemetry studies, hair snag surveys and genetic analysis on lynx populations.
- Investigate and assess human harassment of lynx populations.
- Investigate intra and inter-specific competition related to lynx populations.

Objective 2d. By 2005, meet or exceed the existing harvests levels of big game, upland birds, and waterfowl in the Kootenai River Subbasin. Manage self-sustaining populations and habitats by 2020.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations in adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead) and internationally (i.e., British Columbia Ministry of the Environment, etc.).
- Identify priority zones for big game, upland birds and waterfowl habitat protection, rehabilitation and enhancement activities.
- Protect, enhance and maintain big game, upland birds and waterfowl critical habitats.
- Enhance an average of 500 acres in each specific zone for each individual big game, upland birds and waterfowl species annually through habitat manipulation, adaptive management techniques and forest management practices.
- Protect, enhance and maintain big game, upland birds and waterfowl habitat with an emphasis on critical, littoral zone, riparian and highly productive habitats in specific zones.
- Cooperate and coordinate efforts to protect, rehabilitate, enhance, and maintain specific zones for individual species with an emphasis on low elevation habitats (i.e., closed canopy winter ranges, etc.).
- Protect, enhance and maintain big game, upland birds and waterfowl habitat with an emphasis on livestock watering facilities, fencing, and livestock management techniques in specific zones.

Objective 2d. Protect, maintain or enhance neo-tropical migrant birds, native birds, and amphibian and reptile populations at current levels within present use areas, and identify critical habitats within the Kootenai River subbasin by 2020.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations in adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead) and internationally (i.e., British Columbia Ministry of the Environment, etc.).

- Identify priority zones and species for neo-tropical migrant birds, native birds, amphibian and reptile habitat protection, rehabilitation and enhancement activities.
- Identify, protect, enhance and maintain neo-tropical migrant birds, native birds, amphibian and reptile critical habitats.
- Enhance an average of 200 acres in each specific zone for identified priority neo-tropical migrant birds, native birds, amphibian and reptile species annually through habitat manipulation, adaptive management techniques and forest management practices.
- Protect, enhance and maintain neo-tropical migrant birds, native birds, amphibian and reptile habitat with an emphasis on critical, riparian, wetland and low elevation habitats in specific zones.
- Protect, enhance and maintain neo-tropical migrant birds, native birds, amphibian and reptile habitat with an emphasis on livestock management techniques in specific zones.

Objective 3 Replace locally extirpated species with genetically and behaviorally compatible populations at three locations within the species' historic range by 2010.

Limiting Factors

Floodplain Alterations, Vegetation Change, Nonnative Species Interactions, Alteration of the Littoral Zone, Human-Wildlife Conflicts and Fragmentation/Connectivity

Strategies

- Coordinate with appropriate agencies and organizations to develop cooperative adaptive management strategies for transboundary populations and habitats needed by different life stages.
- Reintroduce native kokanee from the North Arm of Kootenay Lake into Westside tributaries in Idaho using instream incubation techniques.
- Evaluate the feasibility of developing burbot donor stocks from Kootenay/Duncan Lake for recovery of declining native burbot stocks in the lower Kootenai River.
- Develop culture techniques for burbot to determine the potential use of conservation culture for recovery of native burbot stocks in the Kootenai River.
- Complete the planning process (NWPPC 3 step process for artificial production) to establish a second facility in the subbasin in Idaho for mitigation/restoration/preservation of declining native fish populations.
- Experimentally release Duncan Lake burbot (genetically and behaviorally similar stock), under controlled conditions, into three historic spawning tributaries to determine feasibility of re -establishing a spawning run for recovery.
- Initiate wild runs of westslope cutthroat, bull trout, and redband where natural recolonization is not possible using available management techniques.

Objective 3a. By 2005, rehabilitate 15 percent or more of the riparian habitat lost in the Kootenai subbasin with the no new net losses of riparian habitat.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated riparian habitat map for the Kootenai subbasin.
- Investigate and analyze historic losses of riparian habitats in the Kootenai subbasin.
- Identify riparian habitat losses and associated losses in biological functions and performance.
- Coordinate efforts to develop comprehensive riparian protection, rehabilitation and enhancement plan for the Kootenai subbasin ecosystem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., floods) in riparian habitats.
- Identify and address human impacts in riparian zones with adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate low elevation riparian habitats.
- Protect, enhance and maintain riparian habitat with an emphasis on livestock watering facilities, fencing, and livestock management techniques in specific zones.

Objective 3b. By 2005, rehabilitate 15 percent or more of the wetland habitat lost in the Kootenai subbasin with no new net losses of wetland habitat.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated hydrology (overland flows, groundwater, etc.) and wetland habitat map for the Kootenai subbasin.
- Investigate and analyze historic hydrologic losses and wetland habitats in the Kootenai subbasin.
- Identify wetland habitat losses and associated losses in biological functions and performance.
- Coordinate efforts to develop comprehensive wetland protection, rehabilitation and enhancement plan for the Kootenai subbasin ecosystem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., floods) in wetland habitats.

- Identify and address human impacts in wetland areas with adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate wetland habitats with an emphasis in low elevation and intact wetland habitats.
- Protect, enhance and maintain wetland habitats with an emphasis on livestock watering facilities, fencing, and livestock management techniques in specific zones.

Objective 3c. By 2005, rehabilitate 10 percent or more of ponderosa pine forest habitat lost in the Kootenai subbasin with no new net losses of ponderosa pine habitats.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated ponderosa pine habitat map for the Kootenai subbasin.
- Investigate and analyze historic losses of ponderosa pine habitats in the Kootenai subbasin.
- Identify ponderosa pine forest habitat losses and associated losses in biological functions and performance.
- Coordinate efforts to develop comprehensive ponderosa pine forest protection, rehabilitation and enhancement plan for the Kootenai subbasin ecosystem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., fires) in dry forest habitats.
- Identify and address human impacts in ponderosa pine forest habitats with adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate ponderosa pine forest habitats with an emphasis in dense Douglas-fir understory and intact ponderosa pine forest habitats.

Objective 3d. By 2005, rehabilitate 15 percent or more of grassland habitats lost in the Kootenai subbasin with no new net losses of grassland habitats.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).

- Develop a consolidated grassland habitat map for the Kootenai subbasin.
- Investigate and analyze historic losses of grassland habitats in the Kootenai subbasin.
- Identify grassland habitat losses and associated losses in biological functions and performance.
- Coordinate efforts to develop comprehensive grassland protection, restoration and enhancement plan for the Kootenai subbasin ecosystem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., fires) in grassland habitats.
- Identify and address human impacts in grassland habitats with adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance and rehabilitate grassland habitats with an emphasis in intermountain areas and intact grassland habitats.
- Protect, enhance and maintain grassland habitats with an emphasis on livestock watering facilities, fencing, and livestock management techniques in specific zones.

Objective 3e. By 2005, rehabilitate 20 percent or more of the aspen forest habitat lost in the Kootenai subbasin with no new net losses of aspen forest habitats.

Strategies

- Coordinate subbasin activities with appropriate agencies and organizations such as adjacent subbasins (i.e., Priest River, Pend Oreille, Flathead), soil and water conservation districts, United States Department of Agriculture, and Canadian agencies.
- Initiate and develop cooperative adaptive management strategies with International entities (i.e., British Columbia Ministry of the Environment, environmental organizations, etc.).
- Develop a consolidated aspen forest habitat map for the Kootenai subbasin.
- Investigate and analyze historic conditions of aspen forest habitats in the Kootenai subbasin.
- Identify aspen forest habitat declines and associated declines in biological functions and performance.
- Coordinate efforts to develop comprehensive aspen forest protection, rehabilitation, and enhancement plan for the Kootenai subbasin ecosystem.
- Cooperate and coordinate efforts to restore natural disturbance regimes (i.e., fires) in aspen forest habitats.
- Identify and address human impacts in aspen forest habitats with adaptive management techniques.
- Cooperate and coordinate efforts to protect, enhance, and rehabilitate aspen forest habitats, with an emphasis on over mature forest clones and intact aspen forest habitats.

Research, Monitoring, and Evaluation Activities

The on-the-ground BPA-funded projects described in the section titled *Existing and Past Efforts* include a number of monitoring, evaluation, and research activities. Specific monitoring strategies, including pre- and post-treatment sampling, have been designed for each completed and ongoing project. Monitoring includes project-specific and watershed level parameters. These activities are combined with watershed level, long-term, time-series indices for habitat and populations in order to evaluate direct and indirect effects of projects. Specific on-going monitoring activities include:

Fisheries

For MFWP, on-going BPA-funded monitoring includes:

- Monitor permanent stream form and maintain sediment monitoring stations in the Wigwam River (B.C.) and in Grave Creek (MT).

- Evaluate the effectiveness of remote site incubators (RSI) and artificial redd construction as a means of increasing recruitment of age-2 or greater westslope cutthroat trout into tributary populations. The agency will monitor the spawning population and strength of emigration through the operation of the permanent weir on Young Creek to capture upstream migrant adult trout and downstream migrant juvenile trout. It will monitor the effects of RSI's and artificial redds by conducting electrofishing population estimates in historically sampled reaches, and it will monitor the effectiveness of westslope cutthroat trout at displacing non-native eastern brook trout by deploying RSI's in Barron Creek in conjunction with physical habitat inventory, beginning in 2001.

- Monitor and assess trout populations pre- and post-project implementation in stream reaches where enhancement activities will/have been implemented. Either population estimates (for purely habitat-based projects) or CPUE (for primarily hydrologically-based projects) will be monitored. Aquatic insect response, temperature response, and in some cases, vegetative response, will also be monitored. The biological and hydrological effects of lake rehabilitation will be evaluated by monitoring zooplankton recolonization and fisheries growth in chemically treated lakes.

- Monitor spawning and rearing of fluvial burbot and cutthroat and bull trout in the mainstem Kootenai River and principal tributaries. The agency will monitor burbot spawning activity in the stilling basin below Libby Dam by continuing hoopnetting operations during December and February. It will monitor tributary use of fluvial bull trout in the Montana portion of the Kootenai River. Conduct bull trout redd counts in core-area tributaries in the U.S. and Canada. Redd counts have been the principal bull trout monitoring tool since 1983.

- Continue counting rainbow trout redds below Libby Dam between Alexander Creek and the Fisher River.

- Monitor bull trout movement and habitat use of main stem Kootenai River and tributaries. The agency will collect adult bull trout in the Kootenai River via electrofishing and from Bear Creek via migrant trapping and surgically implant radio tags. It will track fish from boats and planes on a bi-weekly basis annually, and weekly during spawning season.

- Document entrainment of fish through Libby Dam during flow events greater than 20,000 cfs. The agency will monitor entrainment of fish through Libby Dam; measure draft tube velocities and determine relationships to discharge and reservoir elevation; incorporate >20 kcfs entrainment data into the existing entrainment model (Skaar et al. 1996). It will estimate forebay kokanee densities using hydroacoustic technology and equipment.

- Monitor zooplankton and gamefish populations in Koocanusa Reservoir and monitor zooplankton and gamefish populations in Libby Reservoir. MFWP will monitor seasonal and annual changes in fish abundance in near-shore zones with seasonal gillnetting, conduct annual estimates of population numbers of each age class of kokanee (hydroacoustics) with MFWP Regional Fisheries Program, and monitor zooplankton populations in the reservoir.

- Assess bull trout food habits in Koocanusa Reservoir and the Kootenai River.

For KTOI, on-going BPA-funded monitoring includes:

- Monitor fish community dynamics at index sites on the mainstem Kootenai River. In cooperation with IDFG, the Tribe will conduct late summer, night-time electrofishing of near-shore feeding-zone habitats, gillnetting of deepwater habitats, and beach seining of shallow water habitats.

- Monitor fish community dynamics at index sites on selected tributaries of the Kootenai River. The tribe will derive fish community composition and relative abundance by snorkeling techniques and backpack electrofishing techniques.

- Monitor macroinvertebrate community dynamics within the mainstem Kootenai River as part of a pre-nutrient enhancement decision. The Tribe will deploy macroinvertebrate samplers during the biologically productive months at sites within representative reaches of the Kootenai River from Libby Dam to Porthill, Idaho, conduct monthly field collections of macroinvertebrate samplers, clean and sort macroinvertebrate samples in the laboratory and prepare for identification, and conduct a macroinvertebrate taxonomy and community dynamics analysis.

- Monitor primary productivity, algal community composition, and test nutrient addition effects on these parameters. The Tribe will perform detailed mesocom analysis within key reaches of the Kootenai River in Montana and Idaho.

- Monitor key water-quality parameters at mainstem Kootenai River sites as part of pre-nutrient enhancement decision. The Tribe will take monthly water quality samples during the biologically productive months within key reaches of the Kootenai River in Montana and Idaho, and British Columbia, and ship water-quality samples to certified lab for nutrient and chemical analysis

- Monitor and evaluate genetic variability and diversity of hatchery white sturgeon juveniles produced and wild broodstock spawned in the Kootenai Hatchery. In cooperation with the University of Idaho, the Tribe will optimize and use nuclear and mitochondrial DNA marker analyses (sequencing, RFLP's, and microsatellites) to document existing variability and diversity of wild broodstock and hatchery progeny. It will compare genetic variability and diversity of hatchery progeny and wild broodstock with that of the wild population to assess genetic representation in hatchery progeny and refine breeding matrix if necessary.

- Monitor and evaluate survival, condition, growth, movement, and habitat use of hatchery-reared juvenile white sturgeon released into the Kootenai River. In cooperation with IDFG and B.C. Ministry of Fisheries, the Tribe will sample juvenile white sturgeon to collect information pertaining to life history characteristics using gillnets, hoopnets, and angling. It will conduct sonic tracking studies to determine movement and habitat use of juvenile white sturgeon. It will evaluate habitat characteristics in areas used by white sturgeon and identify habitat improvements opportunities and monitor and evaluate juvenile and adult sturgeon and burbot in Kootenay Lake, B.C.

- Monitor and evaluate biological condition and related population dynamics of white sturgeon in the Kootenai River. The Tribe and IDFG will determine existing empirical range and variation of growth and condition values of white sturgeon in the Columbia and Kootenai Basin; identify, develop, and rank techniques to determine biological condition as it relates to carrying capacity and associated population dynamics; and evaluate cumulative effects of incremental annual stocking of white sturgeon on growth, condition, and behavioral responses of the hatchery origin and wild population components in the Kootenai River.

- Monitor and evaluate flora and fauna biological condition on habitat mitigation projects. The Tribe will determine baseline Habitat Evaluation Procedures (HEP), using Habitat Suitability Indices (HIS’s), to measure enhancements, variation of flora growth and condition values on habitat mitigation projects in the Columbia and Kootenai Basin; identify and develop appropriate HSI models to determine changing biological conditions as they relate to management activities, carrying capacity and associated ecological functions; and evaluate cumulative effects of management activities on vegetative growth, condition, and wildlife responses in the Kootenai River.

For IDFG, on-going BPA-funded monitoring includes:

- Evaluate burbot movement, spawning, and recruitment through the use of hypothesis tests using scientific designs approved by the Kootenai River Burbot Recovery Committee. It will also evaluate the effect of winter hydro operations on the rate and timing of burbot spawning migration. IDFG will continue with a cooperative program with B.C. Ministry of Environment sampling the Kootenai River and portions of Kootenay Lake in evaluation of the status of burbot.

- The IDFG will monitor and evaluate the size structure of the burbot population in the Kootenai River and Kootenay Lake. Including periodic estimates of population size of adult and juvenile burbot in the Kootenai River and Kootenay Lake.

- The IDFG will monitor and evaluate the blood level of testosterone, plasma chloride, and Estradiol-17B with respect to reproductive failure of burbot and compare their levels to a control population from Columbia Lake, B.C.

- Monitor and evaluate the size structure of the population of Kootenai River white sturgeon in the Kootenai River and Kootenay Lake. The effort will include periodic estimates of population size of adult and juvenile white sturgeon in the Kootenai River and Kootenay Lake.

- With radio and sonic telemetry, monitor the timing of movement of adult Kootenai River white sturgeon each spring and measure response to flow augmentation and temperature. This effort will also collect information pertaining to life history characteristics. The IDFG will continue subcontracting to the B.C. Ministry of Environment for telemetry and juvenile white sturgeon studies in Kootenay Lake.

- Deploy artificial substrate mats and monitor white sturgeon spawning events, locations, habitat (substrate, mid-column velocity, depth, and temperature), and intensity in response to experimental flows.

- Monitor and evaluate larval white sturgeon abundance/year class strength in response to experimental flows.

- Use small-mesh gillnets to monitor and evaluate wild and hatchery white sturgeon year class abundance, growth, relative weight, and survival in the Kootenai River.

- Conduct a creel survey on the Kootenai River in 2001 to determine species composition of the angler catch, harvest, and trout exploitation.

- Use radio telemetry to monitor the timing of movement and habitat preferences of adult redband and bull trout and document spawning locations in the main-stem Kootenai river and tributaries.

- Monitor and evaluate sources (tributary and main-stem) of redband, cutthroat, mountain whitefish, and bull trout recruitment with screw traps, drift nets, and by snorkeling.

- Using hypothesis testing, the IDFG will evaluate the availability of redband and bull trout spawning habitat and test the use of spawning habitat cribs to determine if habitat is a limiting factor to recruitment.

- The IDFG will monitor the fish community, species composition, relative abundance, biomass, and trophic structure by electrofishing two, key large-scale index sites between rkm 246 and 276 and develop a data base for future ecosystem rehabilitation studies.

Wildlife

Monitoring has provided, and continues to provide, important information to insure that mitigation is being carried out in the most biologically sound and economically efficient way possible.

Nongame Monitoring

This ongoing MFWP wildlife mitigation project evaluates the effects of habitat enhancements at Hungry Horse and Libby on breeding bird communities to determine if enhancement prescriptions for big game species effectively rehabilitate habitat for bird species as well. Nongame birds, which are widely recognized as one of the best indicators of habitat quality, inhabited all the habitats lost in both project areas. There is growing international concern over the status and trend in many western bird populations and their relationships with habitat management practices. In order to optimize benefits to all wildlife, we need to determine whether activities done to benefit big game animals also benefit other species groups that depend on those habitats. A final summary report of this eight-year effort will be prepared by June 2001. The results will be used to review and develop new habitat enhancement proposals and methods for measuring wildlife benefits.

Population Monitoring

Big game, furbearer, and nongame populations in the subbasin are monitored annually through a variety of surveys and inventories. States and Tribes conduct annual surveys of subbasin species such as elk, mule deer, white-tailed deer, moose, mountain goats, and grizzly bears. MFWP also conducts breeding-bird surveys on each of its wildlife management areas as well as furbearer-track surveys during winter. Local organizations like the Montana Bald Eagle Working Group, Montana Loon Society, sportsman groups and other entities coordinate annual mammal counts, transportation-related mortality surveys, and bald eagle and common loon occupancy and productivity surveys. The IDFG coordinates bald eagle occupancy and nest surveys as well as surveys for wintering eagles. The National Audubon Society sponsors annual Christmas bird counts. There are annual breeding bird surveys conducted in the Kootenai Subbasin as part of the national surveys coordinated by the USFWS.

Research

MFWP has been conducting a 12-year study of white-tailed deer in coniferous forests of northwestern Montana to develop techniques to determine basic biological and ecological parameters for white-tailed deer and relate those parameters to characteristics of individual habitats and potentially limiting factors. Final reports for this project is scheduled for 2002.

USFWS has been conducting an eleven-year study of grizzly bears in the Cabinet-Yaak grizzly bear recovery area. The purpose is to evaluate basic biological and ecological parameters pertinent to the recovery of this population. They also captured and transplanted four female grizzlies from British Columbia to the Cabinet Mountains for the purpose of bolstering the resident population and enhancing genetic diversity within this population.

Statement of Fish and Wildlife Needs

The following near-term priority fish and wildlife needs have been identified for the Kootenai River Subbasin:

- **Protect habitat of native fish and wildlife populations.**
  There is a need to use land acquisitions, conservation easements, and agreements to protect significant intact habitats that support rare, unique, or highly productive populations of fish and wildlife and to protect habitats that are important for sustaining annual public harvests. More active management of existing fish and wildlife management areas is also needed to provide increased benefits.

- **Reduce or eliminate hybridization and competition with nonnative species.**
  Hybridized fish populations in headwater lakes and connected streams pose a threat to genetically pure westslope cutthroat populations. Illegal and legal introductions of nonnative fish species have similarly effected progress toward fisheries mitigation and native species recovery. Rehabilitation of selected lakes is needed to create genetic reserves for native fish, prevent genetic introgression, improve fisheries, and eliminate source populations for further illegal introductions. Public awareness of damages caused by illegal fish introductions must be a priority. Existing laws regulating the transport of live fish must be enforced.

  There is a need to reduce or eliminate nonnative plant species that pose a threat to wildlife populations and aquatic organisms.

- **Rehabilitate locally extirpated fish and wildlife species to a self-sustaining condition.**
  Self-supporting fish populations need to be reestablished in areas where their habitat can be rehabilitated. Natural colonization of rehabilitated habitats would be encouraged where possible. Where wild stocks have been extirpated, an appropriate source population could be replicated through imprint planting of genetically compatible eyed eggs or fry. Various techniques for reestablishing wild runs using adult fish of similar genetic and behavioral traits need to be evaluated through rigorous comparisons of effectiveness and risk.

Wherever habitat is available or where there is a potential for habitat restoration, there is a need to rehabilitate populations (and habitats) of native wildlife species whose populations have been extirpated or drastically reduced.

- **Reconnect fragmented habitats and isolated populations.**
  There is a need to reconnect access to spawning and rearing habitat that has been blocked by man-caused barriers or stream hydrology. Improving fish passage into existing habitat is a cost-effective tool to replace habitat lost during the construction and operation of the hydropower system. These efforts will be consistent with the maintenance of genetic integrity in fish species and protection of threatened, endangered, and senstive plant and animal species.

  For wildlife there is a need to reconnect fragmented habitats and protect existing migration corridors and existing connected habitats from additional fragmentation. This can be accomplished by working with local communities to modify activities such as timber harvesting, housing developments, and road construction and by acquiring key parcels of land and establishing conservation easements with landowners.

- **Rehabilitate in-channel habitat structure, function, and complexity.**
  Fish require suitable habitats for natural production and survival through all life stages.

  Sediment sources need to be reduced or eliminated. Fine sediments accumulating in spawning substrate reduce egg-to-fry survival such that natural reproduction may be of insufficeint quanity to fully seed available rearing habitat with juevenile fish. Pools and rearing habitat clogged with sediment need to be rehabilitated to improve the productive capacity of the stream. Land management needs be consistent with natural stream function. Possible treatments include stream bank stabilization, riparian revegetation, and agitation of embedded gravels to remove silts and fine sands. In some locations the installation of artificial spawning structures may be beneficial. Stream habitats on channelized or impacted streams need to be rehabilitated to natural form and function. This can be accomplished passively or by placing large rocks and woody debris in the stream to restore the appropriate channel morphometry. Similarly, lake or reservoir habitat needs be improved by revegeetating areas subject to water fluctuations or by adding wooden cribs, slash structures, or artifical substrates.

- **Devise inovative means of replacing lost or irretrievable spawning or rearing habitat.**
  In some circumstances habitat that once provided spawning or rearing conditions to sustain a population or populations of native fish may be irretrivable or socially or economically impractical to reestablish. Under such circumstances, it may be neccessarry to develop innovative ways to replace the lost spawning or rearing habitat.

- **Rehabilitate riparian and wetland habitats and floodplain function.**
  Riparian and wetland areas have the greatest influence over the biological health of the watershed. They provide security cover for fish and terrestrial wildlife, habitat and food for

insect production, and woody debris that creates channel diversity and pocket water for spawning-gravel deposition. The canopy of the riparian zone helps maintain cool water temperatures and traps sediments produced from adjacent land areas. There is a need to identify and protect the best available remaining riparian and wetland habitats through the use of conservation agreements and land acquisitions and a need to modify the activities that are causing the degradation of impacted areas or that are preventing the ecosystem from recovering. Riparian and wetland vegetation needs to be rehabilitated and protected through fencing and revegetation projects.

Channelization, road fill, bank armoring, and other encroachments along stream segments have narrowed channels and limited meeanders inside floodplains. This has created shorter channels, steeper gradients, higher velocities, a loss of stroage and recharge capacity, bed armoring, and entrenchment. Restoration of highly altered stream reaches and protection of intact systems is needed to rehabilitate and maintain stream diversity. A long-term conservation easement program is needed to assist with protecting channel and riparian enhancement and rehabilitation investments.

- **Rehabilitate primary and secondary productivity.**
  The Kootenai River downstream of Libby Dam is nutrient poor because Lake Koocanusa acts as a nutrient trap. Nutrients escaping Lake Koocanusa are rapidlly utilized below the dam and are not available to downstream biota. It appears that experimental releases of nutrients will be be neccessarry to rehabilitate primary and secondary productivity, which in turn will serve to provide more food to insectivores (primarily mountain whitefish and trout).

- **Rehabilitate watershed function and condition.**
  In terrestrial habitats, fire exclusion, logging practices, and agriculture have created many changes since pre-European times. Forests have expanded onto grasslands, overall diversity has declined, and the species composition has shifted. Forest structures have changed, and there have been increases in the density of vegetation. Changes in patch size and edge, shifts in the ages and sizes of trees, and increases in road densities have also occurred. All these trends have resulted in less resilient and less diverse habitats for fish and wildlife. There is a need to reverse these trends by changing forest and agricultural practices so vegetation communities become more sustainable. There is a need to use mechanical treatments in combination with prescribed fire to rehabilitate and maintain forest and grassland communities and to enhance fish and wildlife habitats. There is also a need to identify and protect the best available remaining habitats through the use of conservation agreements and land acquisitions.

- **Reduce point and non-point sources of pollution.**
  There is a need to address all significant point and nonpoint sources of water pollution in the system. Reductions in water quality can lower the overall resilience of aquatic environment and keep fish and wildlife populations from recovering. Standards for total maximum loading of nutrients (TMDL), thermal pollution, and gas saturation need to be enforced.

- **Restore the quantity, seasonal pattern, and stability of streamflows and reservoir conditions.**
  There is a need to operate dams and reservoirs to restore and maintain normative hydrologic conditions, conditions that mimic natural processes and minimize impacts on fish and wildlife. Dams need to be operated to provide reservoir operations consistent with VARQ and IRC concepts (USACOE 1997a). Specifically, there is a need for a gradual ramp-down approach to Kootenai River flows after the spring runoff and a need to maintain stable discharges during the biologically productive summer months in order to benefit native species. Restoration of stream flows to river and reservoir tributaries is important to provide spawning and rearing habitat stability. This is especially important in streams used by adfluvial bull trout, as well as in streams supporting resident populations of westslope cutthroat trout and redband trout. There is also a need to address downstream operational impacts of Libby Dam upon riparian habitat on the Kootenai River.

- **Replace lost Tribal hunting, fishing, and gathering areas and cultural and spiritual sites.**
  In the Kootenai subbasin, construction, inundation, and operation of Libby Dam has impacted significant acreage of wildlife habitat along the Kootenai River. Portions of lost habitats were located on Federal lands administered by the U. S. Forest Service. These habitats were very important to members of the Kootenai Tribe of Idaho and the Salish and Kootenai Tribes of the Flathead Reservation as a source of resources for subsistence under the language of the Hellgate Treaty of 1855. With considerable direct and indirect hydropower-facilities impacts from construction, inundation and operations, the use of additional lands and the resources that they produced were forever lost to the tribes. In two cases, the State of Montana and BPA signed settlement agreements to mitigate for construction and inundation losses related to BPA hydrofacilities (i.e., Libby Dam and Hungry Horse Dam). The tribes were not a signatory to these agreements and were not included in the negotiations that led to its development. As a result, the tribes currently have no ability to achieve meaningful mitigation for their losses. This situation needs to be rectified as soon as possible.

  Because of this history, substantial deficit in mitigation of construction and inundation losses continues. There is a need to acquire both on-site and off-site and in-kind habitats to the greatest extent possible that were degraded or destroyed by the hydroelectric facilities and a need to enhance or rehabilitate acquired habitat to maximize wildlife productivity. Specifically, there is a need to: 1) secure critical wildlife habitats from further habitat fragmentation and high disturbance levels; 2) secure and enhance big game winter ranges at key areas; 3) mitigate for ongoing impacts of Libby Dam on the habitat quality and quantity of the Kootenai River; 4) preserve, protect, and rehabilitate remaining acres of unprotected wetland habitat, riparian areas and associated grasslands; 5) rehabilitate native grassland and woody draw habitats; and 6) protect, maintain and rehabilitate low elevation habitats that have been heavily impacted and that no longer support the wildlife species that they did historically.

Given the political realities and difficulties involved with land acquisition and management for wildlife in the Kootenai River subbasin, the Confederated Salish and Kootenai Tribes may choose to seek mitigation funding to acquire mitigation habitat on the Flathead Indian Reservation.

The Kootenai Tribe of Idaho encourages and promotes stewardship of the Kootenai River subbasin natural resources and recognizes the connection of its resources to all peoples. The Tribe also recognizes that to mitigate for on-site hydroelectric construction, inundation, and operational impacts, emphasis of those mitigation efforts should be directed towards habitat restoration and rehabilitation in the Kootenai River subbasin.

- **Reduce human-wildlife conflicts.**
  There is a need for increased public outreach and education and law enforcement to reduce human-wildlife conflicts resulting from high rates of rural residential growth. Effective educational strategies must be developed to educate homeowners about how to coexist with wildlife. The need for continued law enforcement is integral to fish and wildlife species and habitat protection in the subbasin, as are forest road closures, obliteration, and other road treatments in order to minimize poaching and harassment (and to reclaim habitat). There is a need to limit new development of forest habitats to avoid increasing and intensifying human-wildlife conflicts.

- **Increase research, evaluation and monitoring.**
  A systematic program for monitoring game and nongame wildlife needs to be established within the subbasin. Wherever possible, efforts such as breeding bird surveys to determine whether activities done to benefit a single wildlife species also benefit other species groups and should be consistent with existing efforts nationwide to allow wide-scale trend monitoring. Monitor and evaluate biological condition and function of vegetation in the Kootenai River subbasin. Determine baseline habitat functions and conditions to measure enhancements, variation of flora growth and condition values on wildlife habitat in the Columbia and Kootenai Basin. Identify and develop appropriate models (i.e., source habitats, etc.) to determine changing biological conditions and disturbance regimes as they relate to management activities, wildlife carrying capacity, and associated ecological functions. Evaluate subbasin cumulative effects of various management activities on vegetative growth, habitat condition, and wildlife responses.

- **Increase community understanding and respect.**
  See previous comments regarding the need for community consensus building.

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