Chapter: 22

State(s): Washington

Recovery Unit Name: Upper Columbia

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be necessary to recover and protect listed species. Recovery plans are prepared by the U.S. Fish and Wildlife Service, and in this case with the assistance of recovery unit teams, State and Tribal agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views, the official positions or approval of any individuals or agencies involved in plan formulation, other than the U.S. Fish and Wildlife Service. Recovery plans represent the official position of the U.S. Fish and Wildlife Service *only* after they have been signed by the Director or Regional Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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Members of the Upper Columbia Recovery Unit that contributed to the development of this chapter include:

Ken MacDonald, U.S. Forest Service, Okanogan-Wenatchee National Forest
Heather Bartlett, Washington Department of Fish and Wildlife
Barbara Kelly-Ringel, U.S. Fish and Wildlife Service
Judy De La Vergne, U.S. Fish and Wildlife Service
Bill Baer U.S. Forest Service, Okanogan-Wenatchee National Forest
Tim Cummings, U.S. Fish and Wildlife Service

Additional review and comments were provided by:

Nancy Wells, U.S. Forest Service, Okanogan-Wenatchee National Forest
Jim Uehara, Washington Department of Fish and Wildlife
Terry Jackson, Washington Department of Fish and Wildlife
Bao Le, U.S. Fish and Wildlife Service

UPPER COLUMBIA RECOVERY UNIT
CHAPTER OF THE BULL TROUT RECOVERY PLAN

EXECUTIVE SUMMARY

CURRENT SPECIES STATUS

The Fish and Wildlife Service issued a final rule listing the Columbia River and Klamath River populations of bull trout (*Salvelinus confluentus*) as threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). The Columbia River Distinct Population Segment is threatened by habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, and past fisheries management practices such as the introduction of nonnative species.

As required by the Endangered Species Act, the U.S. Fish and Wildlife Service has developed a plan which when implemented will lead to the recovery and ultimate delisting of the Columbia River Distinct Population Segment. An overall recovery team with membership from the States of Washington, Oregon, Idaho, Montana, and Native American Tribes was established to develop a framework for the recovery plan, provide guidance on technical issues, and ensure consistency through the recovery planning process. Within the Columbia River Distinct Population Segment, the recovery team has identified 22 recovery units. Recovery unit teams were established to develop specific reasons for decline and actions necessary to recover bull trout.

Recovery units were identified based on three factors: 1) recognition of jurisdictional boundaries, 2) biological and genetic factors common to bull trout within a specific geographic area, and 3) logistical concerns for coordination, development, and implementation of the recovery plan. In Washington, to facilitate the recovery planning process and avoid duplication of effort, the recovery team has adopted the logistical framework proposed in the 1999 draft Statewide strategy to recover salmon, "Extinction Is Not An Option." Based on this draft strategy, bull trout recovery units overlap the State's salmon recovery regions. The identification of Lower Columbia, Middle Columbia, Upper Columbia, Snake, and Northeast Washington recovery units will allow for better

coordination during both salmon and bull trout recovery planning and implementation.

The U.S. Fish and Wildlife Service, in cooperation with the Washington Department of Fish and Wildlife, solicited participation with the Upper Columbia Recovery Unit Team from individuals having bull trout expertise or other technical expertise applicable to bull trout recovery planning. The team had representation from the U.S. Forest Service, Washington Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service. The Upper Columbia Recovery Unit Team believes that coordination with the National Marine Fisheries Service salmon recovery efforts is essential for the recovery of bull trout in the Upper Columbia Recovery Unit.

The Upper Columbia Recovery Unit Team identified three core areas including the mainstem and tributaries of the Wenatchee, Entiat, and Methow Rivers. Based on survey data and professional judgement, the Upper Columbia Recovery Unit Team also identified local populations of bull trout within each core area. Currently there are six local populations in the Wenatchee Core Area, two in the Entiat Core Area, and eight in the Methow Core Area. Additional local populations may be added to this total as additional information is gathered in areas outside the currently designated core areas for this recovery unit.

Recent information on migration and use of the mainstem Columbia River by bull trout has been verified. Tagging studies conducted by the Chelan County Public Utilities District have monitored movements of bull trout tagged and released at Rock Island, Rocky Reach, and Wells dams. In addition, studies conducted by the U.S. Fish and Wildlife Service have verified the movement of adult bull trout into the lower Wenatchee River. Most likely, these tagged fish entered the mainstem Columbia River to overwinter and feed. The mainstem Columbia River contains core habitat elements for bull trout that are important for migration, feeding, overwintering, and eventual recovery. The Upper Columbia Recovery Team believes that further research on migrational patterns and genetic similarities is needed to better understand the role that the mainstem Columbia River will play in recovery.

The Lake Chelan basin is historic bull trout habitat, but their presence has not been documented since the late 1950's, and they may have been extirpated from the basin. However, complete surveys in remote tributary reaches of the Lake Chelan basin have not been conducted and further investigation is needed. While there are anecdotal reports on bull trout occurrence in the Okanogan River, the current distribution within the Okanogan basin is unknown. The Upper Columbia Recovery Unit Team recommends that expanded surveys be conducted in each basin to verify status and distribution.

HABITAT REQUIREMENTS AND LIMITING FACTORS

A detailed discussion of bull trout biology and habitat requirements is provided in Chapter 1 of this recovery plan. The limiting factors discussed here are specific to the Upper Columbia Recovery Unit Chapter.

Within the Upper Columbia Recovery Unit, historic and current land use activities have impacted bull trout local populations. Some of the historic activities, especially water diversions, hydropower development, forestry, and agriculture within the core areas, may have significantly reduced important fluvial populations. Lasting effects from some, but not all, of these early land and water developments still act to limit bull trout production in core areas. Threats from current activities are also present in all core areas of the Upper Columbia Recovery Unit.

RECOVERY GOALS AND OBJECTIVES

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the species' native range, so that the species can be delisted.** To achieve this goal the following objectives have been identified for bull trout in the Upper Columbia Recovery Unit:

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Upper Columbia Recovery Unit.

- Maintain stable or increasing trends in abundance of bull trout.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunity for genetic exchange.

RECOVERY CRITERIA

Recovery criteria for the Upper Columbia Recovery Unit are established to assess whether actions are resulting in the recovery of bull trout in the basin. The criteria developed for bull trout recovery address quantitative measurements of bull trout distribution and population characteristics on a recovery unit basis.

1. **Distribution criteria will be met when bull trout are distributed among at least 16 local populations in the Upper Columbia Recovery Unit.** The 16 identified local populations are currently distributed within the Wenatchee (6), Entiat (2) and Methow (8) core areas and are comprised of the migratory life-history form. For recovery to occur, the distribution of these migratory local populations should be maintained, while abundance is increased. Designation of local populations is based on survey data and the professional judgement of Upper Columbia Recovery Unit Team members. Further genetic studies are needed in order to more accurately delineate local populations, quantify spawning site fidelity, and determine straying rates. The complete distribution of resident local populations in the recovery unit is unknown. The Upper Columbia Recovery Unit Team recommends that further studies be conducted in the Wenatchee, Entiat, and Methow core areas to elucidate the current and recovered distribution of resident bull trout in the recovery unit. Geographic distribution of resident local populations should be identified within 3 years and actions needed to implement re-introduction efforts will be incorporated into review of the Upper Columbia Recovery Unit plan. Additional local populations may be added to this total as additional information is gathered in areas outside the currently designated core areas for this recovery unit.

2. **Abundance criteria will be met when the estimated abundance of bull trout among all local populations in the Upper Columbia Recovery Unit (Wenatchee, Entiat, and Methow core areas) is between 6,322 and 10,426 migratory fish.** Recovered abundance ranges for the Wenatchee (1,876 to 3,176), Entiat (836 to 1,364), and Methow (3,610 to 5,886) core areas were derived using the professional judgement of the Team and estimation of productive capacity of identified local populations. Resident life history forms are not included in this estimate, but are considered a research need. As more data is collected, recovered population estimates will be revised to more accurately reflect both the migratory and resident life history components.

3. **Trend criteria will be met when adult bull trout exhibit a stable or increasing trend for at least two generations at or above the recovered abundance level within the Wenatchee, Entiat, and Methow core areas.** The development of a standardized monitoring and evaluation program that would accurately describe trends in bull trout abundance is identified as a priority research need. As part of the overall recovery effort, the U.S. Fish and Wildlife Service will take the lead in addressing this research need by forming a multi-agency technical team to develop protocols necessary to evaluate trends in bull trout populations.

4. **Connectivity criteria will be met when specific barriers to bull trout migration in the Upper Columbia Recovery Unit have been addressed.** The Upper Columbia Recovery Unit Team recommends that to adequately address habitat problems in the Methow core area (*e.g.,* low instream flows, grazing, culverts, and diversion dam barriers), and to recover bull trout, basin-wide conservation efforts (*e.g.,* Habitat Conservation Plans) must be developed and implemented. The U.S. Fish and Wildlife Service working with Federal, State, and private entities, and in coordination with local governments, needs to secure quality habitat conditions for bull trout. These efforts should be coordinated with ongoing National Marine Fisheries Service salmon recovery actions to avoid duplication in planning and implementation.

The Upper Columbia Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. Future adaptive management will play a major role in recovery implementation and refinement of recovery criteria. While removal of bull trout as a species under the Act (*i.e.,* delisting) can only occur for the entity that was listed (Columbia River Distinct Population Segment), the recovery unit criteria listed above will be used to determine when the Upper Columbia Recovery Unit is fully contributing to recovery of the population segment.

ACTIONS NEEDED

Recovery for bull trout will entail reducing threats to the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms. The seven categories of actions needed are discussed in Chapter 1; tasks specific to this recovery unit are provided in this chapter.

ESTIMATED COST OF RECOVERY

Total estimated cost of bull trout recovery in the Upper Columbia Recovery Unit is $15 million. Total costs include estimates of expenditures by local, Tribal, State, and Federal governments and private business and individuals. The estimate includes recovery actions associated with the Wenatchee, Entiat, and Methow core areas as well as identified research needs (*e.g.,* Columbia River). These costs are attributed to bull trout conservation, but other aquatic species will also benefit. Cost estimates are not provided for tasks which are normal agency responsibilities under existing authorities.

ESTIMATED DATE OF RECOVERY

The time required to achieve recovery depends on bull trout status, factors affecting bull trout, implementation and effectiveness of recovery tasks, and responses to recovery tasks. A tremendous amount of work will be required to restore impaired habitat, reconnect habitat, and eliminate threats from nonnative

species. Three to five bull trout generations (15 to 25 years), or possibly longer, may be necessary before identified threats to the species can be significantly reduced and bull trout can be considered eligible for delisting.

Degradation and fragmentation of bull trout habitat in the Upper Columbia Recovery Unit have resulted in populations that are at high risk. Ultimately, these threats must be addressed in the near future if recovery is to be achieved. If identified actions are implemented, the Upper Columbia Recovery Unit Team anticipates that recovery could occur within 25 to 50 years.

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INTRODUCTION

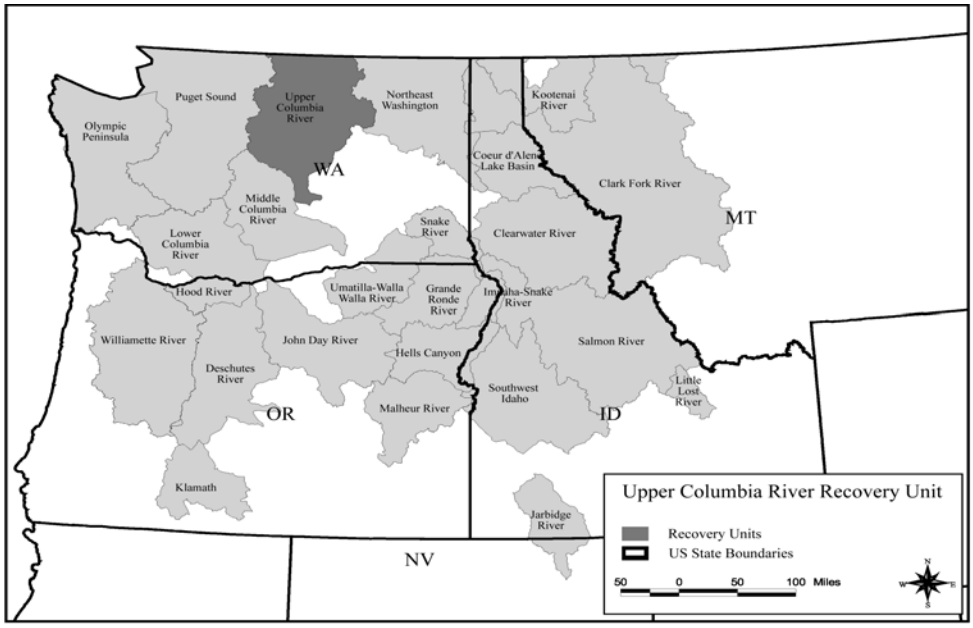
Recovery Unit Designation

The Fish and Wildlife Service issued a final rule listing the Columbia River and Klamath River populations of bull trout (*Salvelinus confluentus*) as a threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). The Jarbidge River population was listed as threatened on April 8, 1999 (64 FR 17110). The Coastal-Puget Sound and St. Mary-Belly River populations were listed as threatened on November 1, 1999 (64 FR 58910), which resulted in all bull trout in the coterminous United States being listed as threatened (Figure 1). The five populations discussed above are listed as distinct population segments, *i.e.,* the U.S. Fish and Wildlife Service has concluded that they meet the joint policy with the National Marine Fisheries Service regarding the recognition of distinct vertebrate populations (61 FR 4722).

An overall recovery team with membership from the states of Washington, Oregon, Idaho, Montana, and Native American Tribes was established to develop a framework for the recovery plan, provide guidance on technical issues, and ensure consistency in the recovery planning process. Within the Columbia River Distinct Population Segment, the recovery team has identified 22 recovery units. Recovery unit teams were established to develop specific reasons for decline and actions necessary to recover bull trout.

Recovery units were identified based on three factors: 1) recognition of jurisdictional boundaries, 2) biological and genetic factors common to bull trout within a specific geographic area, and 3) logistical concerns for coordination, development, and implementation of the recovery plan. In Washington, to facilitate the recovery planning process and avoid duplication of effort, the recovery team has adopted the logistical framework proposed in the 1999 draft Statewide strategy to recover salmon entitled “Extinction Is Not An Option” (WGSRO 1999). Based on this draft strategy, bull trout recovery units overlap the State’s salmon recovery regions. The identification of Lower Columbia,

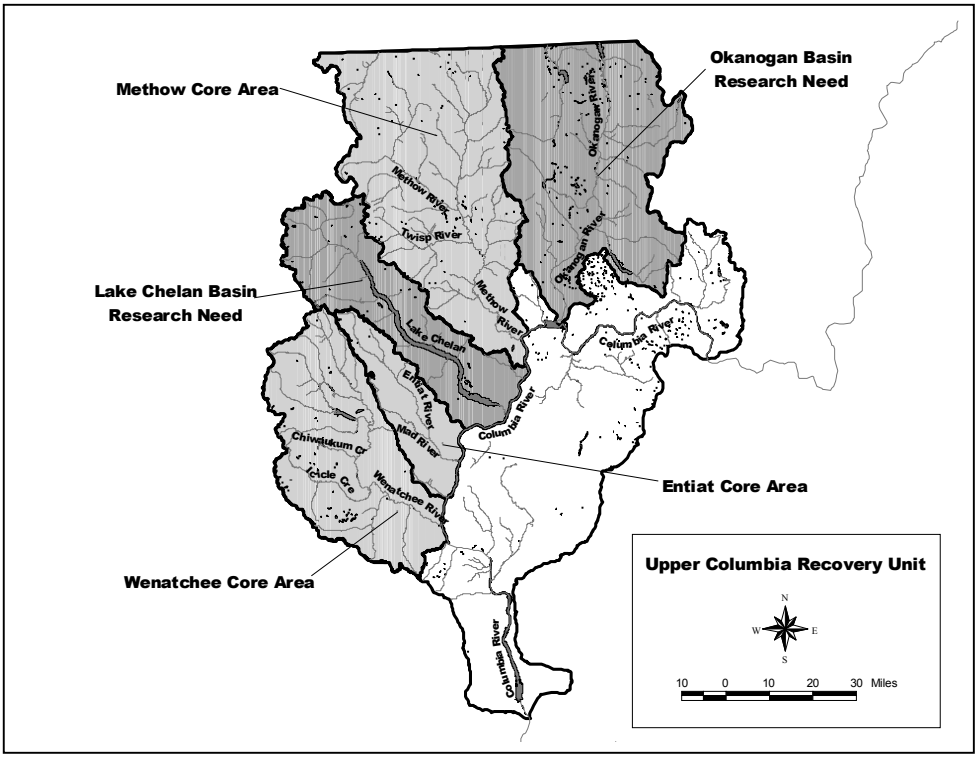
Figure 1. Bull trout recovery units in the United States. The Upper Columbia Recovery Unit is highlighted.



Middle Columbia, Upper Columbia, Snake, and Northeast Washington recovery units will allow for better coordination during both salmon and bull trout recovery planning and implementation.

The Upper Columbia Recovery Unit encompasses the geographic area from the Yakima River upstream to Chief Joseph Dam. The recovery unit includes the Entiat, Wenatchee, Methow, Chelan, and Okanogan basins and the mainstem Columbia River (Figure 2). Historically, these basins have been an important area for anadromous salmon, steelhead (*Oncorhynchus mykiss*), and bull trout production. Based on survey data and professional judgement**,** the Upper Columbia Recovery Unit Team identified three core areas (Wenatchee, Entiat, and Methow Rivers) in the recovery unit. The Upper Columbia Recovery Unit Team has identified the mainstem Columbia River as containing core habitat elements (*e.g.,* foraging and overwintering habitat) considered important for bull trout recovery.

Figure 2. Upper Columbia Recovery Unit.



Within the Wenatchee, Entiat, and Methow core areas 16 local populations supporting migratory bull trout were identified. The Upper Columbia Recovery Unit borders reservations lands of the Colville Tribe and geographically overlaps ceded lands established by Executive Order along portions of the Okanogan River. In addition, the Upper Columbia Recovery Unit overlaps ceded lands (Wenatchee, Entiat, and Methow Rivers) of the Yakama Nation. When the Upper Columbia Recovery Unit has achieved its goal, the Washington Department of Fish and Wildlife, Colville Tribe, and Yakama Nation will determine the location and level of bull trout harvest that can be sustained while maintaining healthy populations.

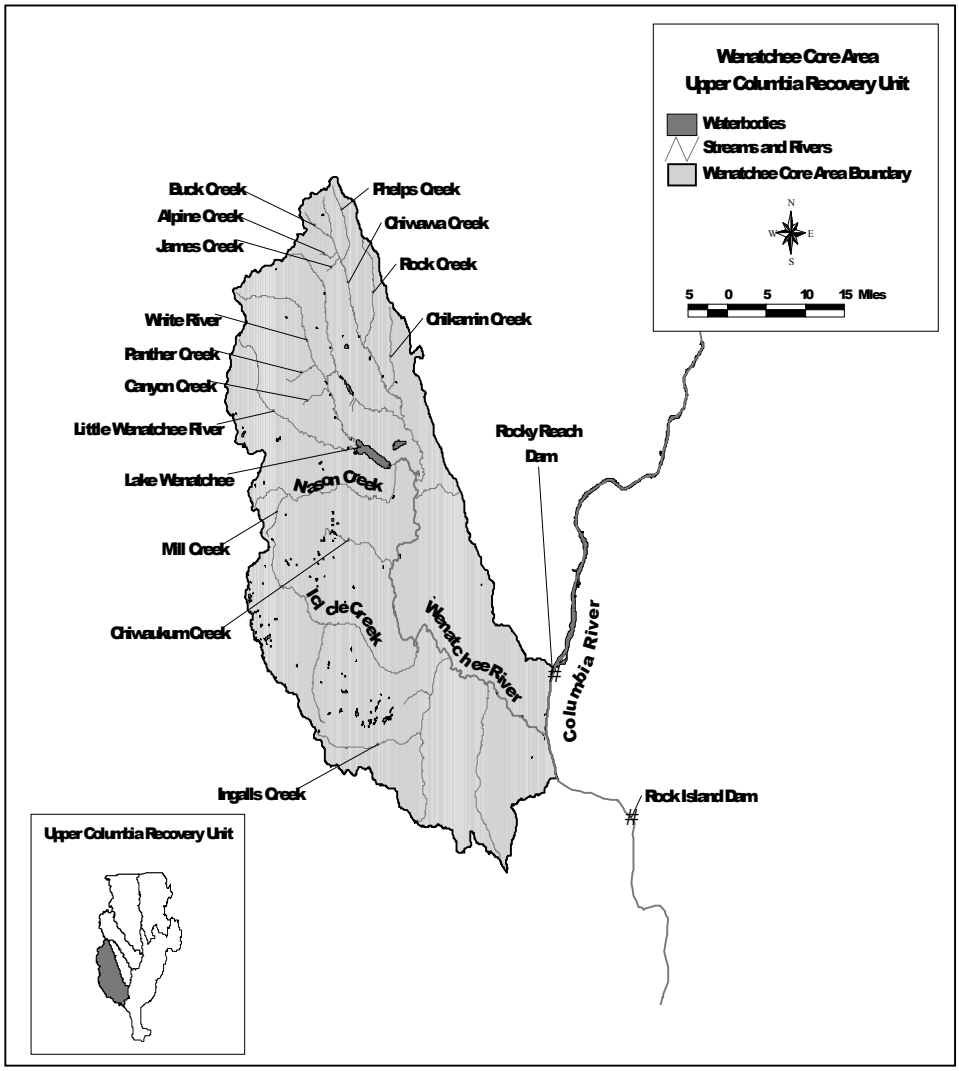
Geographic Description

Wenatchee Core Area. The Wenatchee basin encompasses approximately 3,551 square kilometers (1,371 square miles) in central Washington (NPPC 2001a; USFS 1999a; 1999b; WSCC 2001). The watershed heads at the Cascade crest and flows east towards the Columbia Plateau (Figure 3). The Wenatchee River drains into the Columbia River at the town of Wenatchee. Major tributaries are the White and Little Wenatchee Rivers, which drain into Lake Wenatchee (source of the Wenatchee River), Chiwawa River, and Nason Creek. Additional tributaries to the Wenatchee River include Icicle Creek, Peshastin Creek, and Mission Creek.

Higher elevations within the Wenatchee River basin are characterized by heavy precipitation with accumulations close to 385 centimeters (150 inches) annually (WSCC 2001). Lower portions of the basin receive less than 22 centimeters (8.5 inches) of precipitation annually. Average monthly discharge in the basin varies from a low of 24 cubic meters per second (836 cubic feet per second) in September to 258 cubic meters per second (9,043 cubic feet per second) in June (Parametrix, Inc. 2000). Mean annual discharge is approximately 96 cubic meters per second (3,390 cubic feet per second).

As described by the U.S. Forest Service, two major subsections, the Wenatchee Highlands and Swauk Sandstone Hills, dominate the basin geology (USFS 1999a). Prevalent land types include glacial cirque headwaters, glacial trough, and floodplains. Water rapidly runs off the cirques, due to the shallow soils and near surface rock, and into the till material where it moves slowly downslope into stream channels. The regulating capacity of the troughs provides relatively well-regulated summer flows with relatively low summer stream temperatures, especially in tributaries. In contrast, stream temperatures during low summer flows in the mainstem rivers can approach the upper limits of the preferred temperature range for salmonids. However, these high temperatures are usually short in duration.

Figure 3. Wenatchee Core Area and selected tributaries.



The Peshastin, Mission and Chumstick watersheds lie within the Wenatchee Swauk Sandstone Hills Subsection (USFS 1999a). The Swauk Sandstone and Chumstick Sandstone geologic formations dominate this subsection. The geomorphology is characterized by confined "v-shaped" valleys. Surface erosion is the predominant erosion process with occasional mass wasting of weaker slopes. These land forms lie within the rain shadow of the crest of the Cascade Mountains, and with the exception of some headwaters areas, are relatively dry landscapes.

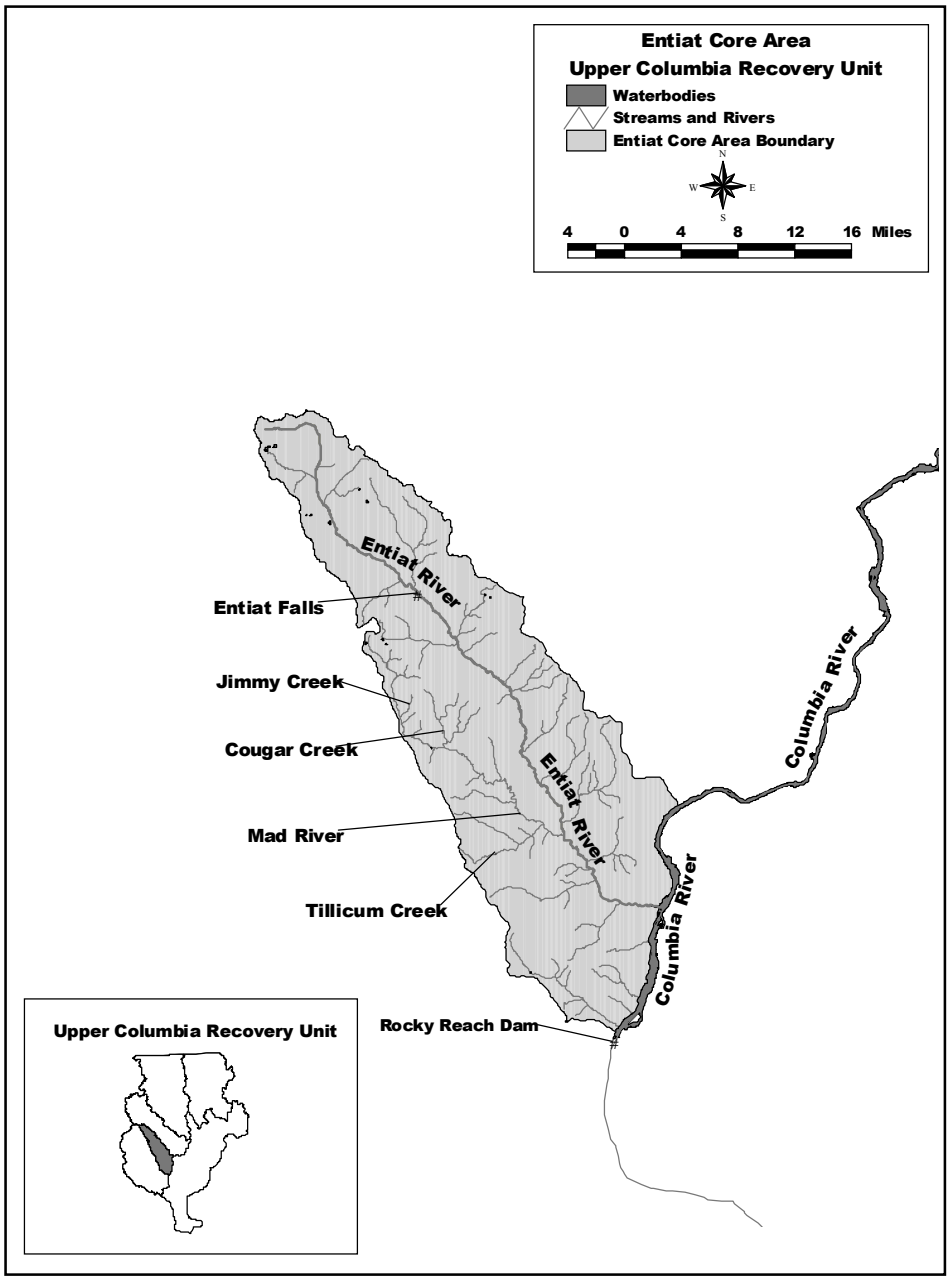
Historically, much of the lower Wenatchee Swauk Sandstone Hills experienced a natural high frequency of low-intensity fires (USFS 1999a). Management actions such as fire suppression and selective timber harvesting have changed much of the area to an unnatural high-intensity fire regime. Now when fires occur, followed by high-intensity precipitation, an accelerated rate of erosion may occur.

Entiat Core Area. The Entiat River drains an area of approximately 1,085 square kilometers (419 square miles) (NPPC 2001b; WSCC 1999). The headwaters of the Entiat River are in glaciated basins near the Cascade Crest. Flowing southeasterly the Entiat River enters the Columbia River near the town of Entiat, approximately 32 kilometers (20 miles) upstream from Wenatchee (Figure 4). Approximately 90,720 hectares (224,000 acres) of the 108,540-hectare (268,000 acre) drainage area are in public ownership, primarily U.S. Forest Service lands, with lesser amounts of land administered by the Bureau of Land Management and Washington Department of Fish and Wildlife (USFS 1996a). Agriculture is an important land use in the lower portion of the valley that includes 527 hectares (1,300 acres) of orchards. About one-half of the Entiat River flows through the Wenatchee National Forest. The two major tributaries are the North Fork Entiat River and the Mad River.

Precipitation ranges from about 25.4 centimeters (10 inches) at the mouth of the Columbia River to 228 centimeters (90 inches) in the headwaters (WSCC 1999).

Summer thunderstorms can produce flash floods in narrow tributary channels. The steep topography, pinnate drainage pattern, relatively low drainage density

Figure 4. Entiat Core Area and selected tributaries.



and short drainage length is conducive to rapid mainstem flow response time and can result in a "flashy" flow regime. Mean annual peak flow is approximately 99 cubic meters per second (3,500 cubic feet per second) and mean annual base flow is around 2.3 cubic meters per second (80 cubic feet per second).

As described by the U.S. Forest Service, the Entiat River watershed can be divided into three broad geomorphic settings, the Transportation, Transition, and Deposition Zones (USFS 1996a). The Transportation Zone extends from the headwaters of the Entiat River down to Entiat Falls, and lies within the Wenatchee Highlands Subsection (USFS 1996a). It consists of strongly-glaciated land types, and has high subsurface water storage capacity. Woody debris and sediment are recruited from stream banks and a naturally high occurrence of debris flows. The Transition Zone extends from Entiat Falls downstream to near the National Forest boundary. The Transition Zone is an area of glacially-influenced mountain slopes without the strong expression of glacial troughs (USFS 1996a). The primary bull trout spawning and rearing in the Mad and Entiat Rivers occurs in the Transition Zone. The lower Entiat is in the Deposition Zone where sediment deposition is the dominant process. Flooding and debris flows are significant transport processes for both sediment and organic input (USFS 1996a). Alluvial fans are present at the mouths of most tributary drainages.

The U.S. Forest Service indicates that fire is an important natural disturbance in the Entiat basin (USFS 1996a). High-intensity, stand replacing fires with 50 to 100 year recurrence intervals are a dominant process in the upper elevations. In the lower elevations, the historic fire regime is characterized by low-intensity fires with a recurrence interval of 5 to 10 years.

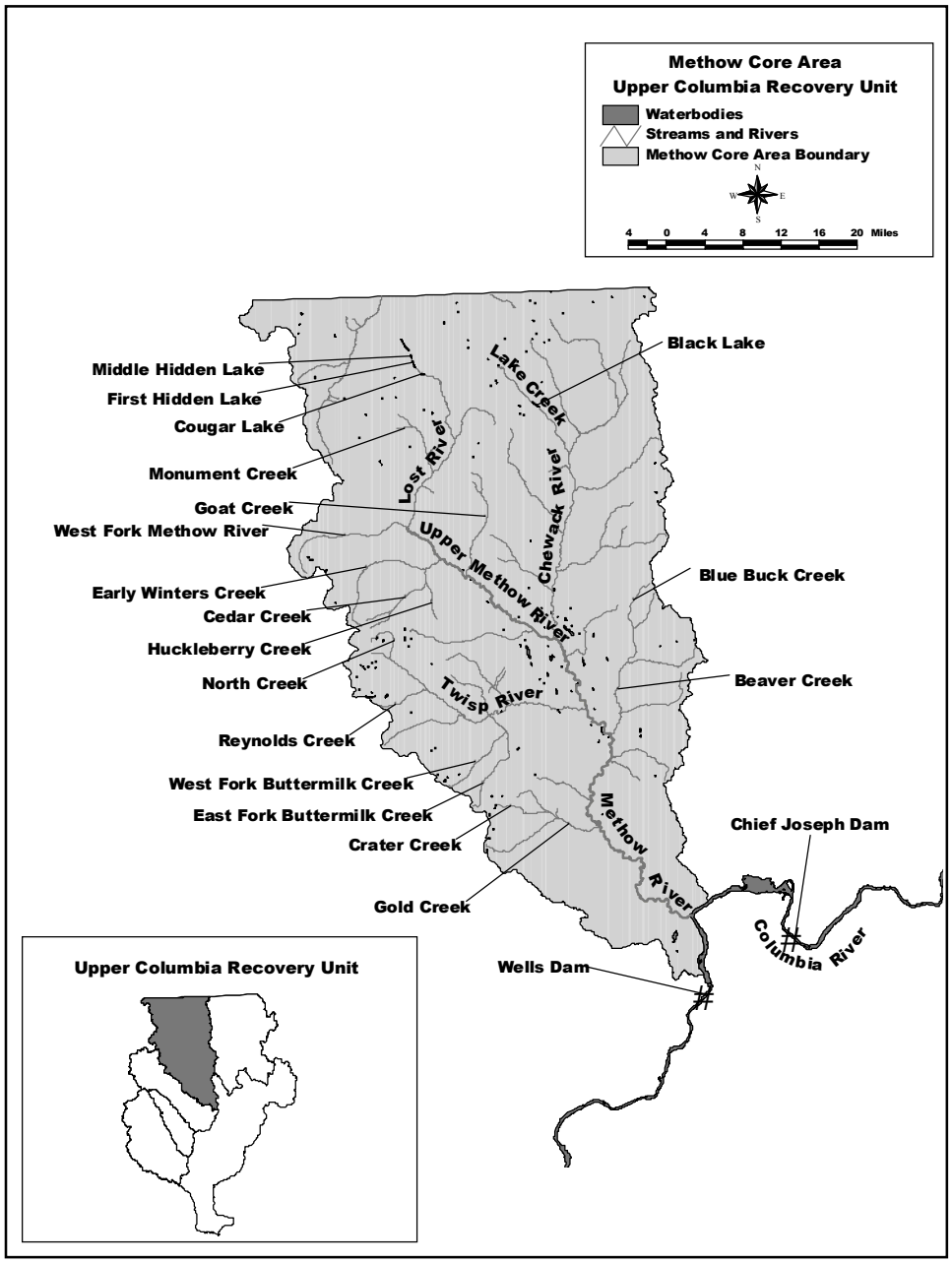
Methow Core Area. The Methow Core Area drains an area of approximately 4,895 square kilometers (1,890 square miles) (NPPC 2001c). The Middle Methow watershed contains approximately 86,670 hectares (214,000 acres), of which about 52,893 hectares (130,600 acres) are U.S. Forest Service lands, 33,615 hectares (83,000 acres) are privately owned, and the remaining 162 hectares (400 acres) are managed by the Washington State Department of

Wildlife. The watershed drains in a northwest to southeast direction and major tributaries include Early Winters Creek, Twisp River, Chewuch River, and the Lost River (Figure 5).

Over 60 percent of the annual precipitation within the Methow River basin occurs between October and March (NPPC 2001c; Parametrix, Inc. 2000). Precipitation is primarily in the form of snow with summer thunderstorms contributing minor amounts. The upper reaches of the basin along the Cascade Crest receive as much as 203.2 centimeters (80 inches) of precipitation annually. The amount of precipitation drops with elevation, with only about 25.4 centimeters (10 inches) occurring in the lower elevations each year. Average monthly flows within the lower Methow River range from 12 cubic meters per second (424 cubic feet per second) in January and February, to 170 cubic meters per second (5,963 cubic feet per second) in June (Parametrix, Inc. 2000).

Most of the land in the lower watershed has been heavily modified by a combination of farming, irrigation, or residential and recreational development (WSCC 2001). Upslope of the private lands are U.S. Forest Service lands, and a majority of these are used for timber management. There is a small section of the Lake Chelan-Sawtooth Wilderness located in the western portion of the watershed. There is also a small section of the Pasayten Wilderness located in the northern portion of the watershed.

Figure 5. Methow Core Area and selected tributaries.



DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final listing rule (63 FR 31647), the U.S. Fish and Wildlife Service identified eight bull trout subpopulations in the Entiat, Wenatchee, and Methow River basins (USFWS 1998). The U.S. Fish Wildlife Service identified eight subpopulations within this recovery unit: Lake Wenatchee, Ingalls Creek, Icicle Creek, Entiat system, Methow River, Goat Creek, Early Winters Creek, and Lost River. The Service considered half of these to be "at risk of stochastic extirpation" due to: a) their inability to be refounded, b) presence of a single life-history form, c) limited spawning areas, and c) relatively low abundance. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology to better reflect the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter.

Current Distribution and Abundance

The Wenatchee River has bull trout dispersed throughout the basin, with the strongest populations centered around Lake Wenatchee and the Chiwawa River (WDFW 1998). Bull trout are found in the Entiat River up to Entiat Falls, with the primary known spawning areas occurring in the middle reaches of the Mad River. Migratory bull trout persist in the Methow River; the largest populations occurr in the Twisp River, Wolf Creek, West Fork Methow River, and the Lost River. The overall status and distribution of resident bull trout within the Methow River basin is unknown. Bull trout have recently been found using the mainstem Columbia River, most likely for feeding, overwintering, and migration.

The Lake Chelan basin is historic bull trout habitat, but their presence has not been documented since the late 1950's, and they may have been extirpated from the basin (WDFW 1992; WDG 1984). Complete surveys in remote tributary reaches of the Lake Chelan basin have not been conducted, however, and further

investigation is needed. Bull trout are known to occur in the Okanogan River in British Columbia (McPhail and Carveth 1992). While there are anecdotal reports on bull trout occurrence in the Okanogan River (United States portion), the current distribution within the Okanogan basin is unknown (Wells, N. pers. comm., 2000). The Upper Columbia Recovery Unit Team recommends that expanded surveys be conducted in each basin to verify status and distribution.

Based on survey data and professional judgement**,** the Upper Columbia Recovery Unit Team identified three core areas (Wenatchee, Entiat, and Methow Rivers) within the recovery unit. Genetic information for distinguishing local populations was lacking for the Upper Columbia Recovery Unit. Tributaries that comprise migratory local populations were grouped based on professional judgement and geographic proximity. Future genetic studies may revise the current classification. Currently there are six local populations in the Wenatchee Core Area, two in the Entiat Core Area, and eight in the Methow Core Area.

Wenatchee Core Area. The Upper Columbia Recovery Unit Team has identified six migratory local populations within the Wenatchee River including the Chiwawa River (including Chikamin, Phelps, Rock, Alpine, Buck and James creeks), White River (including Canyon and Panther creeks), Little Wenatchee River (below the falls), Nason Creek (including Mill Creek), Chiwaukum Creek, and Peshastin Creek (including Ingalls Creek). Adfluvial, fluvial, and resident forms of bull trout currently exist in the Wenatchee River Core Area (WDFW 1998). The majority of the spawning and fry rearing habitat are within U.S. Forest Service lands, including the Glacier Peak and Alpine Lake Wilderness areas. Resident bull trout occur in Icicle Creek above the barrier falls, and migratory bull trout are known to frequent the area below the falls, most likely while foraging. It is unclear whether migratory bull trout can pass the falls, and more information is needed in order to determine if Icicle Creek could support a local population of migratory bull trout. The distribution and status of resident bull trout in Icicle Creek is unknown and the role of Icicle Creek in bull trout recovery is considered a research need.

Chiwawa River

The Chiwawa River local population complex is the strong-hold for bull trout in the upper Wenatchee (WDFW 1998). Spawning has been documented in Rock Creek, Chikamin Creek, and Phelps Creek (Table 1). Spawning has also been documented in the mainstem Chiwawa River and in Buck Creek (J. DeLaVergne, U.S. Fish and Wildlife Service, pers. comm., 2001). A minor amount of spawning has been documented in Alpine and James Creeks (WDFW 1992). Spawning surveys have been conducted by the U.S. Forest Service in cooperation with Washington Department of Fish and Wildlife and the U.S. Fish and Wildlife Service in Rock, Chikamin, and Phelps Creeks since 1989. A change in fishing regulations in 1992 has apparently helped stabilize the Chiwawa local population of bull trout. Rock Creek represents the strongest population in the basin, and since 1995, annual surveys have documented between 151 and 355 redds. Habitat in Phelps Creek is in good condition and bull trout surveys have documented between 22 and 33 redds since 1995. While both Rock and Phelps Creeks contain similar high quality habitat features, production in Phelps Creek is limited by an impassable barrier falls located approximately 1 mile upstream from the confluence with the Chiwawa River (K. MacDonald, U.S. Forest Service, pers. comm., 2001).

Juvenile bull trout and redds have been observed in the upper reaches of the Chiwawa River (Hillman and Miller 1993; 1994; 1995). The majority of the juveniles have been found between Rock Creek and the old mining site at Trinity, which corresponds with where spawning has been observed in the mainstem. Adult bull trout 46 to 61 centimeters (18 to 24 inches) in length have been found throughout the river. While these are definitely migratory fish, whether they are fluvial (from the mainstem Chiwawa River, Wenatchee River, or possibly the Columbia River), or adfluvial fish from Lake Wenatchee, or a combination is not known. Smaller, possibly resident bull trout have also been observed during the surveys.

Table 1. Bull trout redd survey data in the Wenatchee River 1989 to 2001. (Incomplete survey indicated by asterisks. Data provided by the U.S. Forest Service, Wenatchee, WA.)

Local Population	Stream	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Chiwawa River	Rock Creek	114	64	239	205	179	169	313	258	271	220	355	298	151
	Chikamin Creek	39	22	71	16	19	19	66	67	52	99	59	29	24
	Phelps Creek	23	7	22	34	32	19	26	33	1*	28	22	22	33
	Chiwawa River											26	48	38
	Buck Creek												3	---
White River	Panther Creek	33	7*	37	26	45	48	26	29	18	35	11	19	11
	White River											30*	43	10
Nason Creek	Nason Creek									0	6	5	10	1
	Mill Creek								3	1	3	10	5	2
Little Wenatchee River	Below Falls											3	3	1

White River

The White River local population is a major tributary to Lake Wenatchee and is an important spawning stream for sockeye salmon (*O. nerka*), spring chinook salmon (*O. tshawytcha*), steelhead, and bull trout (WDFW 1998). Bull trout have access to the system up to an impassable barrier at White River Falls. Recently, bull trout spawning in the mainstem White River has been documented at least down to the Napeequa River (WDFW 1992; MacDonald, pers. comm., 2001)(Table 1). Bull trout have been observed in the smaller tributaries of Canyon and Sears creeks. Canyon Creek is a very flashy system moving large amounts of bedload, which may make it marginally suitable. Presently the mouth of Canyon Creek flows subsurface in late summer and fall due to deposition of coarse substrate at the mouth.

The Napeequa River is a major tributary to the White River and approximately 2 miles of this glacier-fed stream is potentially available before a potential barrier falls. In 1999, 5 to10 large migratory bull trout were observed in the Napeequa River (DeLaVergne, pers. comm., 2001). Whether or not these bull trout spawned in the Napeequa River is unknown. Rough terrain and glacial flour limit the ability to effectively conduct spawning ground surveys in this tributary.

Panther Creek is a known spawning stream for bull trout and consistent redd surveys have been conducted since 1989 (Table 1). Bull trout spawn in the lower reach, approximately 1 mile before a barrier falls. While spawning counts have fluctuated, Panther Creek represents an important spawning tributary in the White River system (USFWS 1999a; MacDonald, pers. comm., 2001).

Little Wenatchee River

The Little Wenatchee River local population is the other major tributary to Lake Wenatchee. Like the White River, the Little Wenatchee is used by sockeye salmon, spring chinook salmon, and steelhead. In the past, redd surveys for bull trout have been very difficult due to the combination of spring chinook redds and

sockeye redds. Migratory bull trout have access to the Little Wenatchee up to Little Wenatchee Falls at river kilometer 11 (river mile 6.8). A few redds were identified during recent surveys in the mainstem Little Wenatchee and further survey work is needed (Table 1). There are anecdotal accounts of migratory spawners below the falls but no adults have been observed recently. Resident bull and brook trout (*S. fontinalis*) have been observed below the falls and some hybridization may have occurred (WDFW 1992; Hillman and Miller 1995). Limited snorkel survey data indicates that resident bull trout may exist above the falls in Rainy Creek (MacDonald, pers. comm., 2001). More intensive survey work is needed above the falls in order to characterize the status and distribution of bull trout.

Nason Creek

Nason Creek originates at Steven's Pass and flows into the Wenatchee River just below the outlet of Lake Wenatchee. Limited redd surveys indicated that spawning for this local population of bull trout occurs in Nason Creek and Mill Creek (Table 1). Large migratory fish have been observed in lower Nason Creek. Nason Creek is sparsely populated by adult and juvenile bull trout throughout but are primarily found in the upstream reaches (WDFW 1992; USFS 1996c). Resident bull trout exist in Mill Creek up to a barrier falls about a mile from the confluence with Nason Creek. Bull trout redd counts are low in Mill and Nason Creeks and both resident and migratory bull trout are believed to spawn in the system (USFWS 1999a). Bull trout redds were identified during spot surveys near the Whitepine campground in 2000, by the U.S. Fish and Wildlife Service, and adult bull trout were observed in the vicinity of Nason Creek campground (De La Vergne, pers. comm., 2001).

Chiwaukum Creek

Chiwaukum Creek joins the Wenatchee River at the head of Tumwater Canyon. There is a potential barrier falls approximately 4 miles upstream from the mouth. Brown (1992) reports anecdotal accounts of a localized fishery for adult bull trout in the late summer and fall. There have been no recent intense surveys of potential bull trout habitat in Chiwaukum Creek. Two approximately

25 to 30 centimeter (10 to 12 inch) bull trout were identified during U.S. Forest Service snorkel surveys in 1997 (MacDonald, pers. comm., 2001). A subsequent foot survey was conducted for approximately 1 mile upstream, but no redds were observed. In 2001, intensive snorkel surveys were conducted and 27 juvenile, 12 migratory-size fish, and 29 redds were observed (USFWS, *in litt.* 2002). The status and distribution of bull trout in Chiwaukum Creek is unknown and expanded surveys are needed.

Peshastin Creek

Peshastin Creek serves as a bull trout migrational corridor to Ingalls Creek. Ingalls Creek is the only tributary within the Peshastin Creek watershed known to support bull trout. Brown (1992) indicated that in the 1950's, Peshastin Creek had a large run of bull trout in the late summer. Bull trout migration into Ingalls Creek was documented through angler interviews. Bull trout were still present during recent surveys by the U.S. Fish and Wildlife Service in Ingalls Creek (USFWS 1997). However, bull trout were not found during the same surveys in Peshastin Creek (USFWS 1997). More recently, three bull trout were observed in lower Peshastin Creek, and one radio-tagged bull trout was located in Peshastin Creek during the winter of 2001-2002 (USFWS *in litt.* 1998a; Kreiter 2002).

Icicle Creek

Large migratory fish have been observed in Icicle Creek below the dam at Leavenworth National Fish Hatchery, however, it is unclear whether successful spawning has occurred (WDFW 1992; USFWS 1999b). Resident bull trout are known to occur upstream of the dam in low densities (USFWS 1997). Bull trout have also been observed in French Creek (USFWS 1999c). The status and distribution of these resident bull trout is unknown.

Snorkel surveys conducted below the spillway dam resulted in documentation of 8 bull trout in 1996; 6 in 1997; 40 in 1998; 7 in 1999; and 40 in 2000 (USFWS 2002). Four dead bull trout were removed from the hatchery's

water diversion at river mile 4.5 (B. Kelly-Ringel, U.S. Fish and Wildlife, pers. comm., 2001). Bull trout radio-tagged in the spillway pool have been documented moving downstream past Dryden Dam. One bull trout radio-tagged in the Columbia River moved into Icicle Creek in 2001. Potential use of Icicle Creek by migratory bull trout, and the status and interaction with the upstream resident component, is considered a research need.

Entiat Core Area. Currently two local populations of bull trout are found in the Entiat Core Area (mainstem Entiat River, and Mad River). The two local populations are thought to be isolated from each other due to a natural thermal barrier (USFS 1996a). Bull trout in the Entiat River are believed to be primarily fluvial. The Washington Department of Fish and Wildlife has classified the status of bull trout in the mainstem Entiat River as "Unknown," while bull trout in the Mad River have been classified as "Healthy," based on the trends in available abundance data (WDFW 1998). However, the U.S. Forest Service expressed concern for the long-term persistence of bull trout in the Entiat Core Area due to the low number of spawning fish, restricted spawning distribution, and limited opportunities for refounding (USFS 1996a).

Mainstem Entiat

Bull trout have been found in small numbers throughout the mainstem Entiat River up to Entiat Falls (WDFW 1992). Bull trout in the mainstem Entiat are considered to be fluvial, rearing there, or possibly the Columbia River. A very small amount of spawning has been observed below the falls, but no spawning aggregations have been found (USFS 1996a). Habitat may be a potentially limiting factor for bull trout in tributaries to the Entiat (USFS 1996a). The tributaries are either low in the drainage where thermal regimes are not believed to be suitable for bull trout, or the streams are blocked by natural falls. Incomplete spawning ground surveys have been conducted in the Entiat since 1995. These surveys indicate that the local population abundance is very low (Table 2). Additional tributary surveys are needed to identify potential spawning areas.

Table 2. Bull trout redd counts in the Mad River Index Reach 1989 to 2001, and Entiat River 1994 to 2001. Surveys in the Entiat River are incomplete. (Data provided by the U.S. Forest Service, Wenatchee, WA)

Local Population	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Mad River	15	17	21	16	10	17	16	23	23	43	30	45	34
Entiat River						3	3	0	0	0	6	0	3

Mad River

The majority of the known bull trout spawning and rearing in the Entiat River occurs in its 40 kilometer (25 mile) tributary, the Mad River (WDFW 1998). The Mad River flows into the mainstem Entiat at the town of Ardenvoir. Most bull trout spawning occurs over a 12.4 kilometer (7.7 mile) reach between Young Creek and Jimmy Creek (USFS 1996a**)**. A barrier falls upstream of Jimmy Creek prevents further access. Bull trout spawning surveys have been conducted annually on the Young Creek to Jimmy Creek index reach since 1989 (Table 2). Redd counts have varied from a high of 45 in 2000, to a low of 10 in 1993. Bull trout in the Mad River may be a combination of fluvial and resident fish (WDFW 1992). Bull trout may also spawn in Tillicum Creek (a tributary to the lower Mad River) **(**WDFW 1998). Additional survey information is needed to characterize the current use and potential importance of Tillicum Creek within the Mad River.

Methow Core Area. Bull trout are known to occur in Gold Creek, Twisp River, Chewuch River, Wolf Creek, Early Winters Creek, Upper Methow River, Lost River, and Goat Creek. The Washington Department of Fish and Wildlife classifies the status of bull trout in the Lost River as "Healthy," but the remaining bull trout in the Methow River are classified as "Unknown" (WDFW 1998). Within the Methow River, adfluvial, fluvial and resident life history forms are present. The resident form is usually found in portions above passage barriers and the distribution and abundance of the resident form is a research need. Sporadic and incomplete redd surveys have been conducted in selected areas of the Methow River basin since 1992.

Gold Creek

The lower Methow River (below the town of Carlton) is an important spawning area for summer chinook and steelhead as well as for bull trout (WSCC 2000). Bull trout most likely use the lower Methow River as a migratory corridor, moving in and out of the Columbia River (DeLaVergne, pers. comm., 2001). Crater Creek, a tributary to Gold Creek, has the only documented fluvial spawning population within the Gold Creek watershed (Table 3) (USFS 1996b). During a 1998 spawning survey, a 15 centimeter (6 inch) dead bull trout was found in Gold Creek (DeLaVergne, pers.comm., 2001). A radio-tagged bull trout was tracked into Libby Creek in 2001, but limited snorkel surveys by the U.S. Forest Service did not result in any bull trout. Additional survey work in the lower Methow River is needed to accurately understand current and potential bull trout distribution.

Beaver Creek

Bull trout in the South Fork Beaver Creek and Eightmile Creek in the Methow system may have been extirpated due to brook trout introgression (WDFW 1998; USFS 1993). However, there may be a few bull trout remaining in Bluebuck Creek and the mainstem of Beaver Creek (USFS *in litt.* 1992; USFS 1993; Proebstel *et al.* 1998).

Twisp River

Bull trout in the Twisp River local population are comprised of migratory and resident forms in mainstem Twisp River, Buttermilk Creek, Bridge Creek, Reynolds Creek, and North Creek. Redd count surveys for migratory adults have been conducted in the mainstem Twisp River since 1992 (Table 3). While older surveys are incomplete, more recent sampling indicates that the mainstem is an important spawning area. Bull trout are known to spawn and rear in the upper reaches of the Twisp River (USFS 1995a). The Twisp River is also an important spring chinook spawning and steelhead spawning and rearing stream. There is considerable spatial and temporal overlap of bull trout, salmon, and steelhead spawning areas in the Twisp River, and consequently some observational error may occur.

Table 3. Bull trout redd survey data in the Methow River 1992 to 2001. Incomplete surveys indicated by asterisk.. (Data provided by the U.S. Forest Service, Wenatchee, WA.)

Local Population	Stream	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Gold Creek	Crater Creek					2*	1	1	0		
Twisp River	Mainstem	3*	5*	4*	18	10*	3	67	38	72	53
	E.F. Buttermilk				4*	0*	0	0	0	0	3
	Reynolds	1*				0*					
	North							19	63	33	0
Chewuch River	Lake Creek				22	13*	9	9	0	12	23
Wolf Creek	Mainstem					7	3	27	29	15	20
Early Winters	Mainstem					9*	0*	2	0	3	5
	Cedar Creek					1	2*		0		
Upper Methow River	West Fork				27	10	13*	11*	1	2	19
Goat Creek	Mainstem				0					11	
Lost River	Mainstem	5*		0				0			
	Monument Creek	2*	0								

Buttermilk Creek may be an important spawning and rearing stream for bull trout. Bull trout are found throughout the mainstem to at least river kilometer 8 (river mile 5). Bull trout also inhabit the first 11 kilometers (6.8 miles) of the East Fork and 7.9 kilometers (4.9 miles) of the West Fork (DeLaVergne, pers. comm., 2001). Both fluvial and resident bull trout have been located in the Buttermilk Creek drainage (WDFW 1998). Four redds were found during surveys on the West Fork in 1995 (DeLaVergne, pers. comm., 2001). Additional survey information is needed to delineate bull trout distribution within Buttermilk Creek.

Reynolds Creek is used by both resident and fluvial fish, with the distribution of fluvial fish limited below a barrier falls at river kilometer 1.1 (river mile 0.7) (WDFW 1998). Spawning occurs between the falls and U.S. Forest Service Road number 4430, with a single redd observed in 1990 and 1992 (DeLaVergne, pers. comm., 2001; WDFW 1998). Resident-sized bull trout have also been located in North Creek, but their distribution and status is unknown (WDFW 1998).

Wolf Creek

The Wolf Creek local population is an important spawning and rearing stream for migratory bull trout. Distribution within the watershed extends up to approximately river kilometer 18 (river mile 11 mile) where a natural rock and log barrier blocks upstream passage. Only westslope cutthroat (*O. Clarki lewisi*) have been found above the rock barrier (USFS 1995b). Redd counts have been conducted in the mainstem since 1996 and the population appears to be highly variable (Table 3). From 1999 to 2001, adfluvial sized bull trout were seen at the base of these falls and within the surveyed spawning reach (DeLaVergne, pers. comm., 2001). Resident bull trout have also been located in Wolf Creek (WDFW 1998).

Chewuck River

The Chewuck River local population currently consists of bull trout in Lake Creek. Bull trout in Lake Creek (Upper Chewuck River) are thought to be

an adfluvial population inhabiting Black Lake (DeLaVergne, pers. comm., 2001). Redd surveys conducted since 1995 are low and highly variable (Table 3). Above Black Lake, bull trout have been observed in Lake Creek up to Three Prong Creek (USFS 1995c). Additional surveys are needed to determine distribution upstream of Three Prong Creek. Bull trout have also been observed in Black Lake during a survey conducted by the U.S. Forest Service (USFS 1994). A few bull trout (possibly of fluvial origin) have been caught in the lower and middle reaches of the Chewuck River, and occasionally show up in the Methow Salmon Hatchery fish trap (WDFW 1998; DeLaVergne, pers. comm., 2001). In 2001, bull trout redds were seen in the Chewuch River near Thirty Mile Creek (De La Vergne, pers. comm., 2002). Historically, Eightmile and Boulder Creeks may have supported bull trout (USFS 1994).

Upper Methow River

The Upper Methow River local population includes the West Fork of the Methow River, Trout Creek, Robinson Creek, and Rattlesnake Creek. There are resident and fluvial life-history forms present in the Upper Methow River local population. Redd surveys in the West Fork Methow have been conducted since 1995 (Table 3). The redd counts are highly variable ranging from 1 redd in 1999 to 27 redds in 1995. Surveys have been inconsistent and the available information indicates that the West Fork Methow is not in a secure condition (USFS 1998a). A few bull trout have been observed spawning in the lower portions of Trout Creek (WDFW 1998). While bull trout have not been documented in Robinson or Rattlesnake Creeks, the lower portions of these systems are accessible to bull trout and may provide additional spawning habitat (DeLaVergne, pers. comm., 2001).

Goat Creek

Little survey work has been conducted in the Goat Creek local population, however, 11 migratory bull trout redds were found during surveys in 2000, and this may be an important spawning area (DeLaVergne, pers. comm., 2001). The watershed contains both resident and fluvial fish, but the status of each life-

history form is unknown (USFS 1995d). The resident bull trout component was determined through size at maturity of females (WDFW 1998).

Early Winters Creek

Bull trout in the Early Winters Creek local population apparently continue to exist in very low numbers (Table 3). The Early Winters Creek local population includes the mainstem, Cedar Creek, and Huckleberry Creek. Incomplete redd surveys in the mainstem have been conducted since 1995, with a high redd count of nine occurring in the same year. Redd surveys are conducted from Klipchuck Campground up to the falls at river kilometer 13 (river mile 8.0) near the crossing of Highway 20. The falls are thought to be a barrier to chinook salmon and steelhead. Migratory-sized bull trout were found above the falls during recent electrofishing surveys by the U.S. Fish and Wildlife Service (DeLaVergne, pers. comm., 2001). Resident bull trout are known to be above these falls and are thought to spawn in the upper reaches (WDFW 1998).

Cedar and Huckleberry creeks are tributaries to Early Winters in the lower reaches of stream. Two and one bull trout redds were found during incomplete redd surveys in Cedar Creek during 1996 and 1997, respectively (USFS 1998a). In 1988, the Washington Department of Fish and Wildlife estimated the population to be 4 fish per 100 square meters (WDFW 1998). The location of spawning is thought to occur below a falls on Cedar Creek at about river kilometer 4 (river mile 2.4) (WDFW 1998). While bull trout have access to Huckleberry Creek, it is unknown if bull trout use this area for spawning, and additional survey information is needed.

Lost River

The Lost River local population may be represented by resident, fluvial, and adfluvial forms (USFS 1999c). In 1993, the Washington Department of Fish and Wildlife estimated the bull trout population size in the Lost River to be 1,092 fish (WDFW 1998). This estimate did not distinguish between resident and migratory life-history forms and was based on a catch per unit effort of 210 fish

per mile. Timing and distribution of bull trout migration in the Lost River is unknown. Many holding areas in the upper Lost River and near the outlet of Cougar Lake were identified during snorkel surveys conducted by U.S. Fish and Wildlife Service and U.S. Forest Service (DeLaVergne, pers. comm., 2001). Other information indicates that the current population of bull trout in the Lost River is most likely greater than 500 adults (DeLaVergne, pers. comm., 2001). This number includes the populations in Cougar Lake, First Hidden Lake, and Middle Hidden Lake, as well as fish downstream of the gorge. Migratory bull trout redd surveys in the Lost River are incomplete and surveys are complicated due to the inaccessibility of stream reaches and rough terrain (Table 3).

Intermittent connectivity exists between headwater lakes during spring runoff and early summer. Downstream connectivity is also intermittent between the lakes and the mainstem Lost River. The Lost River periodically goes subsurface near the downstream end of the gorge above Monument Creek. Currently in the Lost River, spawning seems to be occurring upstream of the gorge and in Monument Creek (WDFW 1998; DeLaVergne, pers. comm., 2001).

Mainstem Columbia River. In 2001, Chelan County Public Utility District began a radio telemetry study of 39 bull trout captured at Rock Island (7 fish), Rocky Reach (22 fish), and Wells (10 fish) Dams (Kreiter 2001). Fish were released upstream and downstream at each facility. All bull trout released downstream moved back upstream, and those released upstream continued moving upstream. Tagged bull trout have been located in the Wenatchee River mainstem (4), Icicle Creek (1), Peshastin Creek (1), Chiwawa River (1), Entiat River mainstem (6), Mad River (7), Methow River mainstem (3), and Methow River tributaries Libby Creek (1), Twisp River (10) , and Twisp River tributary Buttermilk Creek (1). Some bull trout were tracked moving up more than one of the mainstem dams. One of the tagged bull trout ventured into the Okanogan River, but left shortly after detection, and immigrated into the Methow River. In 2002, one bull trout was detected near the I-90 Highway bridge near Vantage, Washington (DeLaVergne, pers. comm., 2002)

In 2000, during a U.S. Fish and Wildlife Service bull trout radio telemetry study in the Wenatchee River, movements of two bull trout were monitored in the Chiwawa River and Rock Creek during the spawning migration (USFWS 2000a; 2001). After spawning, the tagged fish moved downstream and overwintered most likely in the mainstem Columbia River. In 2001, these bull trout migrated back to the Chiwawa River and Rock Creek. Further mainstem and tributary studies are needed to elucidate movements and habitat requirements of adult and subadult bull trout in the recovery unit.

REASONS FOR DECLINE

Within the Upper Columbia Recovery Unit, historic and current land use activities have impacted bull trout local populations. Some of the historic activities, especially water diversions, hydropower development, forestry, and agriculture within the core areas, may have significantly reduced important fluvial populations. Lasting effects from some, but not all, of these early land and water developments still act to limit bull trout production in core areas. Threats from current activities are also present in all core areas of the Upper Columbia Recovery Unit. Below, we discuss the historic and current human-induced limiting factors to bull trout.

Dams

Mainstem Columbia River dams (Rock Island, Rocky Reach, and Wells) have significantly altered historic habitat conditions within the recovery unit. Dams on the Columbia River can effect salmonids by delaying or impeding migration of adults and by injuring or killing juveniles that pass downstream. In 2000, the U.S. Fish and Wildlife Service issued a Biological Opinion on the Effects to Listed Species from Operations of the Federal Columbia River Power System (USFWS 2000b). Effects of the Federal Columbia River Power System included: 1) fish passage barriers and entrainment, 2) inundation of fish spawning and rearing habitat, 3) modification of the streamflow and water temperature regime, 4) dewatering of shallow water zones during power operations, 5) reduced productivity in reservoirs, 6) gas supersaturation of waters downstream of dams, 7) loss of native riparian habitats, 8) water level fluctuations interfering with establishment of riparian vegetation along reaches affected by power peaking operations, and 9) establishment of non-native riparian vegetation along affected reaches. Similar effects most likely occur with the operation of Rock Island, Rocky Reach, and Wells Dams within the Upper Columbia Recovery Unit. Recent information indicates that adult bull trout do use the mainstem Columbia River for foraging, overwintering, and as a migrational corridor. The operation of each facility, and potential impacts to bull trout, need additional investigation.

Historically, dams on the major tributaries in the Upper Columbia Recovery Unit probably contributed to the decline in bull trout by blocking migratory corridors, and restricting connectivity to upstream spawning areas and downstream overwintering areas. Large dams for generating power and dams for irrigation water were located on the mainstem Wenatchee, Entiat, and Methow Rivers (Bryant and Parkhurst 1950). Fish movements were blocked for several years in the late 1800's and early 1900's in each of these major tributaries. Migrations to and from the Columbia River would have been blocked, and long-term effects to life-history patterns is unknown.

Within the Wenatchee River system, Dryden Dam at river kilometer 28.3 (river mile 17.6) was constructed in 1908. Originally designed for power production, the facility is currently used as a water diversion structure to provide water to the Wenatchee Reclamation District Canal and to the Washington Department of Fish and Wildlife for fish rearing. Tumwater Dam at river kilometer 51.5 (river mile 32) was constructed in 1909. Both Dryden and Tumwater dams were reladdered with vertical slot fishways in 1986 and 1987. Two radio-tagged bull in the Chiwawa River have been tracked moving downstream past the dams in 2000 and 2001, and returning upstream in 2001 (USFWS 2000a; 2001). Some concern exists regarding the operation of each facility and the possible delaying of bull trout migration.

The Leavenworth National Fish Hatchery has blocked upstream fish passage in Icicle Creek at river kilometer 4.5 (river mile 2.8) since 1941. As part of the "Icicle Creek Restoration Project" the U.S. Fish and Wildlife Service has proposed to improve fish passage through Icicle Creek, and to improve habitat conditions adjacent to the hatchery (USFWS 2002). A natural boulder barrier exists upstream of the hatchery at river kilometer 8.9 (river mile 5.5) and it is unknown whether fish can negotiate upstream passage.

In 2001, the Washington Legislature approved a $250,000 grant to undertake a water storage feasibility study on Lake Wenatchee in the Wenatchee River basin (Partridge, *in litt*., 2001). The Legislature acted upon

recommendations of the State's Water Storage Task Force to study the issue of water storage across the State. If a project is implemented, it would involve construction of a dam on the Wenatchee River downstream of Lake Wenatchee. The project would flood the lower parts of the Little Wenatchee and White Rivers, and possibly Nason Creek, depending on the location of the dam. Project effects to the lake ecosystem, including lake productivity, predator and prey population dynamics, and habitat suitability are unknown. The majority of the bull trout in the Wenatchee basin migrate between Lake Wenatchee and the Chiwawa River for spawning. Juveniles moving into the lake for rearing, and spawning adults, would need to migrate over the dam and up its ladder. Construction of a new dam in important bull trout spawning, rearing, and migratory habitat is a significant concern. Evaluation of the proposed dam, and potential negative impacts to bull trout, will be reviewed by the U.S. Fish and Wildlife Service under section 7 of the Endangered Species Act.

Summary of Dam Effects

Continued research into the operation of mainstem Columbia River dams and their effect on bull trout is needed in the Upper Columbia Recovery Unit. Studies should address concerns and potential limiting factors similar to those identified by the U.S. Fish and Wildlife Service in the "Biological Opinion on the Effects to Listed Species from Operations of the Federal Columbia River Power System." Passage and habitat improvement measures recommended in the Final Environmental Impact Statement on the "Icicle Creek Restoration Project" need to be implemented to address concerns at Leavenworth National Fish Hatchery. In addition, the potential use of Icicle Creek by migratory bull trout is considered a research need. Research on the continued operation of Tumwater and Dryden Dams is needed to ensure that these facilities do not inhibit bull trout passage. The proposed construction of a water storage facility on Lake Wenatchee should be scrutinized through section 7 consultation to ensure consistency with goals, objectives, and recovery criteria identified in the Upper Columbia Recovery Unit Plan.

Forest Management Practices

Both direct and indirect impacts from timber harvest have altered habitat conditions in portions of the Upper Columbia Recovery Unit. Impacts from timber harvest management included the removal of large woody debris, reduction in riparian areas, increases in water temperatures, increased erosion, and simplification of stream channels (Quigley and Arbelbide 1997). Past timber harvest practices include the use of heavy equipment in channels, skidding logs across hillslopes, splash damming to transport logs downstream to mills, and road construction. Today the legacy of these activities still persists where roads, channel changes, and compaction of hill slopes remain.

The aquatic assessment portion of the Interior Columbia Basin Ecosystem Management Project provided a detailed analysis of the relationship between road densities and bull trout status and distribution (Quigley and Arbelbide 1997). The assessment found that bull trout are less likely to use streams for spawning and rearing in highly roaded areas, and were typically absent at mean road densities above 1.1 kilometer per square kilometer (1.7 miles per square mile). Road construction and maintenance can effect bull trout habitat when sedimentation, channel connectivity, high erosion and slope hazards, culvert sizes, and access are not addressed concurrently with land management proposals. Roads can promote simplification and channelization, which reduce the connectivity of surface and ground waters.

Wenatchee Core Area. In the Wenatchee River, natural channel complexity and riparian conditions have been altered over time by past timber-related activities (WSCC 2001). These activities have resulted in reduced riparian and wetland connectivity, reduced high flow refuge habitat, reduced sinuosity and side channel development, increased bank erosion, reduced large woody debris, and reduced pool frequency. Road construction associated with timber harvest adjacent to streams or rivers has resulted in the straightening of stream channels, alteration of stream gradients, decreased gradients, and an overall change in habitat type (USFS 1999a).

High road densities within certain portions of U.S. Forest Service lands in the Wenatchee River basin may contribute to habitat degradation (USFS *in litt.* 2002). Areas of special concern, where road densities need to be reduced, include: Lower Chiwawa River, Middle Chiwawa River, Lake Wenatchee, Lower White River, Lower Little Wenatchee, Upper Little Wenatchee, Lower Nason Creek, Upper Nason Creek, the headwaters of Nason Creek, Wenatchee River (Upper, Middle, and Lower portions), Lower Icicle Creek drainage, and Peshastin Creek.

Entiat Core Area. Fish habitat in the lower Entiat River (Deposition Zone) has been impacted by human activity. Channelization, bank stabilization, and wood removal has resulted in a wider than natural, simplified channel with a loss of pool habitat, large pools, cover, and off-channel habitat (WSCC 1999). Large pool habitat has declined by 88 percent between surveys in 1935 - 1937, and in 1990, 1994, and 1995 (USFS 1998b). Agricultural development precludes future wood recruitment and development of off-channel habitat. Juvenile bull trout are often positively associated with cover; lack of suitable rearing habitat negatively impacts bull trout (Hillman and Miller 1993; 1994; 1995; Reiman and McIntyre 1993). Water temperatures in the Deposition Zone are higher than generally accepted for bull trout rearing habitat. The degree to which artificial widening and channelization have contributed to elevated temperatures is not known. Much of the Deposition Zone of the Entiat River may never have had temperatures conducive to juvenile rearing. The habitat simplification may have had a greater effect on adult bull trout given the preference of adult fish for pool habitat.

The Transition Zone of the Entiat River has not been impacted to the degree as the Deposition Zone. Bull trout spawning has been documented in the Transition Zone. The river has not been channelized, but salvage logging and stream clean-out after the 1970 fires has removed in-channel wood and diminished the potential for future wood recruitment. A comparison of 1935 to 1937 surveys with 1990 to 1994 surveys in the Entiat River shows large pool habitat has decreased by 31 to 60 percent (USFS 1996a).

Loss of pools in the lower Mad River and mainstem Entiat River may have had an adverse effect on adult bull trout. Habitat diversity is provided by plunge pools and pocket pools in riffles that are formed by boulders and wood (USFS 1996a). There has been a history of wood removal in the 1970's in the Mad River, and during the 1994 Tyee Fire, wood in the channel was "bucked" during suppression. Bucking the in-channel wood destabilized some known spawning gravel. Most management activity (*e.g.,* timber harvest) in the Mad River has occurred in the headwaters of tributary streams.

High road densities within portions of U.S. Forest Service lands in the Entiat River basin may contribute to habitat degradation (USFS *in litt.* 2002). Areas of special concern, where road densities need to be reduced, include: Lower Entiat River, Middle Entiat River, Lower Mad River, Middle Mad River, and the Upper Mad River.

Methow Core Area. In the Methow River area, roads that accessed timbered lands are located in the narrow floodplains, with extensive networks in the Twisp watershed including sensitive bull trout tributaries (*e.g.,* Little Bridge and Buttermilk Creeks). A similar situation exists in Lake Creek in the Chewuch watershed (WSCC 2000). This road location practice can result in multiple impacts. Ground-based skidding is still a common practice on the private lands in these watersheds and can be a significant source of sediment.

High road densities within portions of U.S. Forest Service lands in the Methow River Core Area may contribute to habitat degradation (USFS 2002; 2001a; 2001b). Areas of special concern, where road densities need to be reduced, include: Lower Methow River, Chewuch River, and Goat Creek.

Summary of Forest Management Practices Effects

A detailed analysis of road impacts, including elevated sediment delivery and instream habitat alteration, needs to be developed for the Upper Columbia Recovery Unit. Recommendations for road repair or decommissioning should be prioritized based on the location of sensitive bull trout local populations. Areas within the Upper Columbia Recovery Unit that support strong bull trout

populations and are currently in a low road density or "unroaded" condition should be maintained. Road densities in bull trout watersheds that exceed 1.1 kilometer per square kilometer (1.7 miles per square mile) should be reduced. Restoration activities should be initiated to increase the quality of spawning and rearing habitat in bull trout local populations.

The Upper Columbia Recovery Unit Team recommends the development and implementation of guidelines for bull trout that would provide for high quality habitat conditions. These guidelines would also provide for consistency in identifying areas for restoration throughout the recovery unit. Current forest practice regulations should be evaluated to determine effectiveness in key habitat areas. Establishment of new forest practices rules should include detailed monitoring and enforcement components.

Road management on non-Federal forested lands falls under State forest and fish regulations when associated with timber management. Efforts should be made to encourage Habitat Conservation Plan development in areas where effects to bull trout may occur from land management activities. In the Upper Columbia Recovery Unit, areas in the Wenatchee River (*e.g.,* White River, Nason Creek, and Peshastin Creek), Entiat (lower Mad and Entiat rivers), and in the Methow River (*e.g.,* lower portions of Gold Creek, Wolf Creek, Early Winters Creek, lower Chewuch River, and lower Twisp River) should be considered the highest priority areas for Habitat Conservation Plan development, conservation agreements, and land exchanges.

Livestock Grazing

Historically, grazing of cattle, horses, and sheep has occurred throughout the Upper Columbia Recovery Unit (USFS 1999a; 1998c; 1996a; and WSCC 1999; 2000; 2001). Annual operating plans are usually drawn up for each allotment, and continued monitoring of these allotments is necessary to ensure compliance with the Endangered Species Act and Forest Plan Standards and Guidelines. Concerns associated with grazing include water withdrawals, loss of riparian vegetation, and redd trampling.

Methow Core Area. Over 60 percent of the private bottom lands in the Methow River area have erosion problems related to grazing (USFWS 1992). Cattle have access to the main channels and eroded stream banks (and associated sediment inputs) are an existing problem. Of specific concern are riparian areas adjacent to the Twisp River, lower Wolf Creek, Upper Methow River, Chewuch River, Buttermilk Creek, Gold Creek, and Goat Creek (USFWS *in litt.* 1998b). Impacts from grazing need to be evaluated in these and other areas, and where appropriate, corrective measures should be instituted. Future livestock grazing plans should include actions to reduce impacts (*e.g.,* riparian fencing) and should adaptively manage allotments to ensure quality habitat conditions. The development of these plans should be coordinated with conservation districts, counties, and private landowners.

Agricultural Practices

Irrigation Diversions

Irrigation diversions can result in passage barriers by creating structural blockages, reducing or dewatering stream flows, and increasing water temperatures. Decreased stream flow and high temperatures can create barriers to upstream habitat and poor habitat conditions. High temperatures can result in negative effects to foraging and migrational patterns. Historically, there were many irrigation diversions in the Upper Columbia Recovery Unit that may have totally or partially blocked migrating fish (USFWS 1992). Other irrigation diversions, although not located in bull trout spawning streams, remove instream flow and may impact important foraging and high water refuge habitat. Future watershed studies should address potential impacts to bull trout from reduced instream flows and changes in downstream habitats.

Wenatchee Core Area. The Peshastin Irrigation District operates an irrigation diversion dam that presents a barrier to summer and fall migration, partially blocking migrating spring chinook salmon and migrating bull trout. In low water years, the stream directly downstream of the diversion is dewatered for 100 feet during late summer, completely blocking all fish passage (USFS 1998d). In October 2001, several large salmonids, including a large adult bull trout and a

large rainbow/steelhead, were found dead at the screening structure by a Washington Department of Fish and Wildlife biologist (DeLaVergne, pers. comm., 2001). An assessment of the structure needs to occur to determine how effective it is at reducing impacts to bull trout.

The Tandy irrigation ditch is located upstream of the Peshastin Irrigation Ditch diversion about one-half mile. The ditch is screened; however, the effects to bull trout from water diversion and instream flow manipulation of the ditch channel are unknown. Similarly, Mill Creek (tributary to Peshastin Creek) has multiple irrigation diversions and the impact to bull trout is also unknown. Numerous unnamed intermittent tributaries exist in Lower Peshastin Creek that have irrigation diversions, and effects of these on bull trout are unknown. Diversion dams can limit the potential to transport wood, sediment, water, and nutrients during spring run-off and winter and summer storm events (USFS 1999d). Diversion dams may also limit high flow refuge habitat for rearing subadult or adult bull trout during certain times of the year.

In Icicle Creek, the water diversion dam for the Leavenworth National Fish Hatchery and the Cascade Orchards Irrigation District intake, blocks fish passage at low flows and is improperly screened (USFWS 2002). During drought years, the stream is dewatered from the diversion downstream to the fish hatchery. Upstream, the Icicle/Peshastin Irrigation District water diversion also has an instream structure that may impact bull trout migration. The screens at the Icicle/Peshastin Irrigation District diversion do not currently meet National Marine Fisheries Service and U.S. Fish and Wildlife Service criteria, and need to be updated. Within Icicle Creek, diversions for irrigation, hatchery operations, and municipal use remove significant portions of water during August, September, and October (USFWS 1992). Low flows in the lower reach are the result of natural conditions compounded by public water supply needs, irrigation diversions, and the fish hatchery diversions (Hindes 1994).

Within the upper Wenatchee River, there are several water diversions and a diversion dam located on Chiwaukum Creek (USFS 1999b). It unknown whether these diversions meet National Marine Fisheries Service and U.S. Fish

and Wildlife Service screening criteria. The Chiwawa Irrigation District water diversion is located at river kilometer 5.8 (river mile 3.6) on the Chiwawa River and can divert up to 0.94 cubic meters per second (33.3 cubic feet per second), but more commonly diverts 0.3 to 0.4 cubic meters per second (12 to 16 cubic feet per second) (USFS 1999b). The diversion is screened (updated in the mid 1990's), but it is unclear if the screen meets the National Marine Fisheries Service and U.S. Fish and Wildlife Service fish screen criteria, or how the altered flow regime may effect rearing or subadult fish. The U.S. Forest Service and the Chiwawa Irrigation District currently monitor flows and temperatures above and below the diversion to determine impacts to aquatic habitat.

A diversion in the upper Chiwawa River in Phelps Creek is located within spawning and rearing habitat (USFS 1999b). The Trinity water diversion is located approximately 1.2 kilometers (0.75 miles) upstream of the 2.4 meter (8 foot) natural falls at river kilometer 0.6 (river mile 1.0), which blocks upstream fish passage. Bull trout have not been found in the area of the diversion headgate structure, but have been located spawning within the return channel from the settling ponds and in Phelps Creek below the falls. The Trinity diversion is currently being relicensed under Federal Energy Regulatory Commission. It is unknown how the changes in instream flows affect rearing and spawning bull trout downstream in Phelps Creek.

Entiat Core Area. Currently, there are no identified passage barriers for bull trout in the Entiat Core Area. The McKenzie Irrigation Diversion was modified in 1994 to be fully passable at all flows. However, the Entiat River has been listed on the 303d list for instream flow deficiencies, high stream temperatures, and exceeding pH standards (USFS 1996a). Natural low summer flows in the Entiat River may be exacerbated by irrigation withdrawals, and plans should be developed to minimize potential impacts to the migratory corridor.

Methow Core Area. In the Twisp watershed, the mainstem Methow River, Little Bridge Creek, and East Fork Buttermilk Creek have full or partial barriers. There is a diversion dam across the Twisp River on non-Federal land at approximately river kilometer 8 (river mile 5) and is used by the Twisp Power

Irrigation Ditch and the Washington Department of Fish and Wildlife for adult chinook brood stock collection (WSCC 2000). It is assumed that this dam does not impede passage, but further investigation of the diversions operation is needed to verify suitable passage conditions.

Prior to 1999, two irrigation dams on Little Bridge Creek were partial passage barriers to bull trout. Both structures have been improved in an attempt to pass fish, but current effects of the diversion dams need to be evaluated. Bull trout have been observed in the lower 2 miles of Little Bridge Creek between the lower and upper diversions (WSCC 2000). No bull trout have been seen above the upper irrigation dam barrier which may still impede adult bull trout migration during the spawning season. Other irrigation withdrawal points that may impact bull trout as passage barriers or by contributing to low instream flow problems include:

1. The Eightmile Ranch Ditch is owned by the U.S. Forest Service and irrigates pasture for horse and mule stock (WSCC 2000).

2. The Lucille Mason Ditch located on the opposite bank from the Eightmile Ranch Ditch is adequately screened but contributes to low flow conditions in the Lower Chewuch River (WSCC 2000).

3. Irrigation withdrawal by three diversions (Wolf Creek Reclamation District Irrigation Ditch) operated in the Wolf Creek watershed (including use of Patterson Lake for irrigation storage) may be adversely impacting bull trout (WSCC 2000). The Wolf Creek diversion is one of the largest irrigation ditches in the Methow Valley and has been in operation since 1921.

Dewatering of channels as a result from irrigation or water withdrawals may act as a barrier to bull trout passage. In the Methow basin, the Lost River and the mainstem upper Methow River typically go subsurface. Ground water and irrigation withdrawals may have a compounding effect on maintaining perennial flows. Where subsurface flows are natural, the condition may be

exasperated by instream and aquifer withdrawals. Specific areas of concern include: Lower Early Winters Creek, Methow River from Robinson Creek to Weeman Bride, Lost River, Wolf Creek, Twisp River, and Gold Creek.

Summary of Agricultural Practices Effects

Irrigation withdrawal in the Wenatchee River may have localized effects on local populations within the core area. A basin-wide study in the Wenatchee Core Area is needed to determine impacts to bull trout migration, spawning, rearing, and foraging habitat. The Upper Columbia Recovery Unit Team also recommends that instream flow assessments be conducted in areas where irrigation withdrawals could potentially impact bull trout. As part of the final Environmental Impact Statement for the "Icicle Creek Restoration Project," the preferred alternative for correcting passage problems should be implemented (USFWS 2002).

The current pattern of irrigation withdrawal within the Methow Core Area represents an impediment to bull trout recovery, and the development of a coordinated basin-wide approach to water management is needed. A specific limiting-factors analysis is needed to identify barriers that prevent passage or entrain bull trout. Overall, the Upper Columbia Recovery Unit Team recommends that Habitat Conservation Plans be developed in the Methow Core Area to address bull trout instream flow, passage, and entrainment issues. This effort should be coordinated with salmon and steelhead planning processes to limit overlap and development costs.

Mining

Mining can degrade aquatic habitats used by bull trout by altering water chemistry (*e.g.,* pH); altering stream morphology and flow; and causing sediment, fuel, and heavy metals to enter streams (Martin and Platts 1981; Spence *et al.* 1996; Harvey *et al.* 1995). Mining activities within Washington State are guided by published rules entitled "Rules and Regulations for Mineral Prospecting and Placer Mining in Washington State" (also known as the "Gold and Fish" pamphlet) (WDFW 1999b). The pamphlet describes streams, timeframes, and

equipment that are permitted for small scale prospecting and mining. Currently, small scale recreation gold mining occurs within the Wenatchee River (*e.g.,* Peshastin Creek and Chiwawa River) (USFS 1999a). Cumulative impacts from these operations on water quality should be monitored and evaluated.

The U.S. Forest Service has issued a special use permit in the upper Chikamin Creek drainage for an exploratory mining operation. Bull trout spawn just downstream in Chikamin Creek and hold within the Chiwawa River for most of the year. Given the importance of bull trout in this system, rigorous monitoring of this operation should occur, and potential impacts to this high quality habitat should be evaluated. In addition, the potential for establishing a gold mine in the Twisp River (North Creek) is being considered (DeLaVergne, pers. comm., 2001). The Twisp River is an important local population of bull trout in the Methow River. Future development of this, and other mining operations, should be evaluated relative to possible effects on bull trout populations.

Residential Development and Urbanization

Residential Development

Numerous areas within the Upper Columbia Recovery Unit are experiencing a socio-economic shift from a natural resource based economy reliant on agriculture, forestry, and mining to an economy more dependent on industries associated with tourism, recreation, and general goods and services. Population growth in Chelan and Okanogan Counties have been 27.5 percent and 18.6 percent in the 1990's, respectively (WSOFM 2000). Concern over impacts to bull trout center around the degradation of water quality, instream habitat, and riparian habitat in migratory corridors within the Wenatchee and Methow Rivers (WSCC 2000; 2001; Parametrix, Inc 2000).

Areas of concern in the Wenatchee Core Area include:

1. The Wenatchee River downstream of Leavenworth (loss of side channels, bank revetment, and floodplain development).

2. Wenatchee River through communities of Plain and Ponderosa (degraded water quality due to improperly functioning septic systems).

3. Peshastin Creek (below Ingalls Creek confluence, the natural channel and floodplain function has been disturbed due to channel constriction and confinement).

4. Icicle Creek (lower portion of the river has been impacted from loss of riparian vegetation, bank hardening, and residential development).

5. Nason Creek (lower Nason Creek impacts include channel confinement, removal of riparian vegetation, and reduction in large woody debris recruitment).

6. White River (below Panther Creek impacts due to loss of riparian and large woody debris recruitment).

7. Lake Wenatchee (shoreline development and associated loss of riparian vegetation, increased nutrient loading, and inadequate sewage treatment).

Areas of concern in the Methow Core Area basin include:

1. Early Winters Creek (riprap and diking of the lower 0.5 miles).

2. Mainstem Methow River (bank erosion and loss of vegetation from the Early Winters Creek confluence downstream to Mazama).

3. Mainstem Methow River (Wolf Creek confluence bank erosion and loss of vegetation).

Cumulative effects from development within the basin are the greatest concern. Areas identified within this chapter as important habitat (*e.g.,* spawning sites and migrational corridors) for bull trout in the Wenatchee and Methow rivers should be incorporated in Chelan and Okanogan County planning efforts to minimize impacts to bull trout.

Recreational Development

Campgrounds, trails, and other recreational development in the Upper Columbia Recovery Unit frequently overlap areas of bull trout spawning, juvenile rearing, and adult migration (USFS 1999a; 1999b; 1996a). Impacts of these recreational developments can include reduction in large woody debris and its recruitment, loss of riparian vegetation, and diking or bank hardening to protect campgrounds. These developments can also increase stream access, which can lead to poaching of bull trout. In many cases, the U.S. Forest Service is beginning to take action to move campgrounds away from streams. Studies to evaluate impacts and recommend corrective actions where necessary need to be initiated, and should focus on sensitive bull trout areas including: Tumwater Campground at the confluence of Chiwaukum Creek and the Wenatchee River, Nason Creek Campground, Riverside Campground on the Little Wenatchee River, dispersed sites on the Little Wenatchee River, Pine Flat Campground on the Mad River, Roads End Campground on the Twisp River, and dispersed camping sites on the Chiwawa River.

Fisheries Management

Nonnative species

Problems with non-native species in the Upper Columbia Recovery Unit focus primarily on brook trout (WSCC 1999; 2000; 2001). Brook trout are well established above Entiat Falls, and have been observed at lower levels below the falls (WDFW 1998; USFS 1996a; WSCC 1999). The presence of this strong brook trout population directly upstream of the primary bull trout habitat in the Entiat River is a concern.

In the Wenatchee River, a major concern is presence of brook trout in the Chiwawa River including Chikamin and Big Meadow creeks (USFS 1999b). The introduction of brook trout into Schaefer Lake in the 1940's was most likely the source population. Efforts to eradicate brook trout from Schaefer Lake have been unsuccessful. Given the importance of the Chiwawa River system to bull trout, the potential for brook trout to invade additional areas is a concern.

Brook trout are widespread within the Methow River and the potential for introgression with bull trout is a concern (NPPC 2001c). Brook trout are well established in Beaver and Eightmile Creeks and are thought to have resulted in the loss of bull trout from these systems (WDFW 1998). Brook trout are also known to inhabit portions of the Twisp River (NPPC 2001c). Additional survey work is needed to verify the distribution of brook trout within the basin, assess potential impacts, and recommend corrective actions.

Harvest

Currently, the harvest of bull trout is prohibited on all stocks in the Upper Columbia Recovery Unit with the exception of the Lost River in the Methow drainage. Fishing may have been a factor leading to the decline of bull trout in the Upper Columbia Recovery Unit. Certain areas within the recovery unit (*e.g.,* Lake Wenatchee) were targeted bull trout fisheries, and large numbers of bull trout were harvested (WDFW 1992). Bull trout were rarely targeted in the mainstem Entiat but may have been harvested incidentally in trout fisheries, especially when hatchery rainbows were planted. Hatchery trout have not been stocked since 1996. With the cessation of stocking in the Entiat, selective fishery regulations, and the closure of steelhead fishing, incidental harvest should be reduced. However, bait fishing is legal in some areas, and may result in incidental hooking mortality. It is suspected that a few anglers (and poachers) may still target bull trout in certain areas of the Mad and Methow Rivers (DeLaVergne, pers. comm., 2001).

The Lost River above Drake Creek is the only area within the recovery unit open to bull trout harvest (WDFW 1998). The abundance of bull trout in this area (210 catchable-sized fish per mile) was thought to be sufficient to allow

retention of bull trout as part of a two fish catch limit. Fishery rules include a bait prohibition and a 36 centimeter (14 inch) minimum size intended to permit most females to spawn at least once. Angling is minimized by the lack of direct access to the lower end of this reach. The canyon reach is accessible only in late summer when stream flows recede enough for fording. Almost no fishing occurs in this reach. Some fishing occurs below Cougar Lake, in the vicinity of the horsecamp around Diamond Creek, and in the area just above the mouth of Drake Creek. Due to the importance of bull trout in the Lost River, the fishery should be intensively monitored to gage its impact on bull trout.

Although fishing regulations for bull trout have been restricted, there are still some current regulations that may cause incidental take of bull trout. Incidental catch of bull trout during otherwise lawful fishing seasons has been raised as a concern in Lake Wenatchee, the Lost River, and portions of the Chiwawa River (DeLaVergne, pers. comm., 2001). Incidental catch during open seasons for mountain whitefish (*Prosopium williamsoni*) has also been implicated as a possible source of bull trout mortality in the Wenatchee, Entiat, and Methow Rivers. In addition, harvest of bull trout may occur within their range due to misidentification. Schmetterling and Long (1999) found that only 44 percent of anglers correctly identified bull trout, and anglers frequently confused related species. Resource managers should cooperatively analyze available information on incidental take, misidentification of bull trout, and instream disturbance and suggest corrective measures when warranted (*e.g.,* selective gear restrictions and modifying timing of fishing seasons).

Eggs and alevins in redds are vulnerable to wading-related mortality during the incubation period. Under Statewide regulations most streams are open June 1 through October 31. Most bull trout in this recovery unit spawn during September and October. Egg mortality of up to 46 percent can occur from a single wading event (Roberts and White 1992).

Forage (Prey) Base

Throughout the Upper Columbia Recovery Unit there have been declines in the numbers of native salmonids. Both spring chinook salmon and steelhead

are listed under the Endangered Species Act in this area, and with few exceptions, continue to exhibit low abundances. In addition to decreasing the forage base for bull trout, the decline of salmon and steelhead has reduced a historic energy source coming into the basin through the dying and recycling of nutrients from adult carcasses, eggs, and juveniles. Coordination and support of spring chinook and steelhead restoration efforts is important for the success of bull trout recovery in the Upper Columbia Recovery Unit.

Spring Chinook Egg Collection and Captive Broodstock Collection

The collection of Upper Columbia River spring chinook salmon eggs and juveniles occurs in the supplementation and captive broodstock program by the Department of Washington State Fish and Wildlife (WDFW 1999a). This program is in response to projects that were developed as part of the Mid-Columbia River Habitat Conservation Plan with the Chelan and Douglas County Public Utility Districts. In the Wenatchee River, eggs and juveniles are collected in Nason Creek and the White River. Bull trout temporally and spatially overlap spring chinook spawning areas in both of these Wenatchee River tributaries. Future plans have identified possible collection sites in the Methow River. Misidentification of redds may occur in these overlaping spawning areas, resulting in direct bull trout mortality. The possible impact to bull trout needs to be evaluated.

Summary of Fisheries Management Effects

Introduced nonnative brook trout present a definite threat to bull trout in the Upper Columbia Recovery Unit. Impacts to current bull trout local populations need to be evaluated, and where appropriate, management actions should be initiated to reduce brook trout distribution and abundance. Illegal harvest of bull trout is a problem in certain areas within the recovery unit, and increased enforcement of current regulations should be initiated in sensitive bull trout spawning areas. In areas where harvest of bull trout is legal (*i.e.,* Lost River), or where incidental catch of bull trout occurs, impacts to bull trout should be evaluated. If warranted, regulation changes should be enacted to protect sensitive local populations of bull trout. The Upper Columbia Recovery Unit Team recommends coordination and support of salmon and steelhead recovery

efforts in order to restore the historic forage base within the recovery unit. Impacts to bull trout from the Spring Chinook Egg Collection program should be evaluated.

Isolation and Habitat Fragmentation

Dikes

In the Methow Core Area, lotic habitats have been fragmented, resulting in loss of floodplain and off-channel habitats that could provide important rearing areas for bull trout (WSCC 2000). Existing dikes in the Methow River that contribute to habitat fragmentation are the McKinney Mountain Dike, People Mover Dike, and the dike on the Lost River. Alteration of habitat from channel modification (*e.g.,* bank revetment and riparian alterations) have disconnected floodplains and impacted normal stream function. Specific areas of concern include: Goat Creek, lower Early Winters Creek, and the Twisp River. A complete review of existing dikes, and the associated deleterious modifications to instream habitat need to be identified, and corrective actions prioritized and implemented.

Road Culverts

Road culverts in watersheds with bull trout can block or impede upstream passage (WSCC 1999; 2000; 2001; NPPC 2001a; 2001b; 2001c). Culverts may preclude bull trout from entering a drainage during spawning migrations, outmigration of juveniles, and foraging activities, and may also limit access to refuge habitat needed to escape high flows, sediment, or higher temperatures. Culverts have been identified as a limiting factor for salmonids in the Methow River basin (NPPC 2001c; WSCC 2000). There is a need for a specific limiting-factors analysis throughout the Upper Columbia Recovery Unit to identify culverts that would impact bull trout recovery. Culverts that have already been identified as possible passage barriers include: Peshastin and Nason Creeks (Wenatchee River); Twisp River, Beaver Creek, Gold Creek, Little Bridge Creek, and East Fork Buttermilk Creek (Methow River).

ONGOING RECOVERY UNIT CONSERVATION MEASURES

The Entiat and Mad Rivers are classified as a "key watersheds" under the Record of Decision for the Northwest Forest Plan. Road restoration work has been on-going in the watershed, particularly in the mainstem and headwaters of Mad River tributaries. As noted previously, the Mad River has been closed to all angling within the range of bull trout, and the Entiat River within the range of bull trout is under selective fishery regulations with no harvest of bull trout allowed. Stocking of hatchery trout has stopped in the mainstem Wenatchee and Entiat Rivers. Specifically, there is no longer an active stocking program for brook trout within the basin.

Currently, timber management on U.S. Forest Service lands is guided by several land management plans. The Northwest Forest Plan is implemented in the Wenatchee River, Entiat River, and the west half of the Methow River (USFS and BLM 1994). Land management activities relative to bull trout in the eastern half of the Methow River are guided by standards contained in INFISH (USFS 1995e). These strategies are overlaid with on-site forest management plans that, when implemented, are designed to reduce impacts to aquatic species, riparian areas, and listed fish.

RELATIONSHIP TO OTHER CONSERVATION EFFORTS

Subbasin Planning

As part of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, the Bonneville Power Administration has the responsibility to protect, mitigate and enhance fish and wildlife resources affected by operation of Federal hydroelectric projects in the Columbia River and its tributaries. The Northwest Power Planning Council develops and implements the Columbia River Basin Fish and Wildlife Program, which is also implemented by the Bonneville Power Administration, U.S. Army Corps of Engineers, and the Federal Energy Regulatory Commission. Coordination of Bonneville Power Administration's responsibilities for protection, enhancement, and mitigation, and incorporation of recommendations by Northwest Power Planning Council, is done in part through the development of subbasin summaries that identify the status of fish and wildlife resources, limiting factors, and recommended actions.

The draft Wenatchee, Entiat, and Methow subbasin summarys were completed in October 2001, and overlap with the Upper Columbia Recovery Unit for bull trout (NPPC 2001a; 2001b; 2001c). Each subbasin summary goal emphasizes the need to maintain, protect, or restore the ecological functions necessary to maintain habitat, increase productivity, and maintain diversity for fish and wildlife resources. Each draft subbasin summary identifies objectives and strategies to deal with degraded habitat and water quality conditions, loss of connectivity due to dams and irrigation withdrawal, introduction of nonnative species, and disruption of normal hydrologic processes that have contributed to the decline of native salmonids. Overall, the identified objectives and strategies dealing with salmonids in the subbasin summarys are consistent with actions identified in the Upper Columbia Recovery Unit Chapter. The Upper Columbia Recovery Unit Team will continue to coordinate with these planning efforts through the development of subbasin plans.

Salmon Recovery Efforts

The National Marine Fisheries Service listed spring chinook and steelhead in 1997 and 1999, respectively, in the upper-Columbia Evolutionarily Significant Units as endangered under the Endangered Species Act. These Evolutionary Significant Units overlap with the Upper Columbia Recovery Unit for bull trout. As part of the recovery planning process for chinook and steelhead, the National Marine Fisheries Service has issued guidance for the technical development of recovery plans (NMFS, *in litt.*, 2001). The framework for steelhead and salmon recovery plan development is divided into distinct geographic areas, or domains that may contain multiple Evolutionarily Significant Units. Recovery plans for listed salmon and steelhead will contain the same basic elements as mandated by the Endangered Species Act, and include: 1) objective measurable criteria, 2) description of site-specific management actions necessary to achieve recovery, and 3) estimates of cost and time to carry out recovery actions. Timeframes for recovery plan development for Upper Columbia River spring chinook and steelhead have not been finalized, but the Upper Columbia Recovery Unit Team will coordinate the implementation of bull trout recovery actions with salmon and steelhead measures to avoid duplication and maximize the use of available resources.

State of Washington

Salmon Recovery Act

The Governor's Office in Washington State has developed a Statewide strategy (WGSRO 1999) that describes how State agencies and local governments will work together to address habitat, harvest, hatcheries, and hydropower as they relate to recovery of listed species. The Salmon Recovery Act, passed in 1998, provides the structure for salmonid protection and recovery at the local level (counties, cities, and watershed groups).

The Salmon Recovery Planning Act of 1998 directs the Washington State Conservation Commission, in consultation with local government and treaty Tribes, to invite private, Federal, State, Tribal, and local government personnel with appropriate expertise to convene as a Technical Advisory Group. The purpose of the Technical Advisory Group is to identify habitat-limiting factors for

salmonids. Limiting factors are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon, including all species of the family Salmonidae." The bill further clarifies the definition by stating, "These factors are primarily fish passage barriers and degraded estuarine areas, riparian corridors, stream channels, and wetlands." It is important to note that the responsibilities given to the Conservation Commission in Eng Substitute House Bill 2496 do not constitute a full limiting-factors analysis. This report is based on a combination of existing watershed studies and knowledge of the Technical Advisory Group participants.

Upper Columbia Salmon Recovery Board

The Upper Columbia Salmon Recovery Board is a broad-based partnership group that includes Chelan, Douglas, and Okanogan Counties, the Colville Confederated Tribes, and the Yakima Nation (UCSRB 2001). The Upper Columbia Salmon Recovery Board works in cooperation with local, State, and Federal partners to develop strategies to protect and restore salmonid habitat. The mission of the Upper Columbia Recovery Board is to restore viable and sustainable populations of salmon, steelhead, and other at-risk-species through the collaborative efforts, combined resources, and wise resource management of the Upper Columbia Region. The Upper Columbia Region overlaps with the Upper Columbia Recovery Unit for bull trout, and encompasses the mainstem Columbia River from Rock Island Dam upstream to Chief Joseph Dam, including major tributaries in the geographic area.

Released in July 2001, a discussion draft entitled "A Strategy to Protect and Restore Salmonid Habitat in the Upper Columbia Region" (UCSRB 2001) categorizes watershed habitat conditions and species status within the Upper Columbia Region. The report identifies priority areas in species distribution, needed habitat activities, and identifies general interim goals for each basin. As part of an overall effort, a compilation of limiting habitat factors for salmon, steelhead, and bull trout is being prepared in seven Water Resource Inventory Areas. The limiting habitat factors analysis for the Wenatchee, Entiat, and Methow Rivers is a valuable source of information for the Upper Columbia

Recovery Unit. Coordination with the Upper Columbia River Recovery Board in implementing bull trout recovery actions will be essential in the future.

Washington State Bull Trout Management Plan

The Washington Department of Fish and Wildlife has developed a bull trout management plan that addresses both bull trout and Dolly Varden (*S. malma*) (WDFW 2000). The Washington Department of Fish and Wildlife no longer stocks brook trout in streams or lakes connected to bull trout waters. Fishing regulations prohibit harvest of bull trout, except in a few areas where stocks are considered "healthy" within the State of Washington. The Washington Department of Fish and Wildlife is also currently involved in a mapping effort to update bull trout distribution data within the State of Washington, including all known occurrences, spawning and rearing areas, and potential habitats. The salmon and steelhead inventory and assessment program is currently updating their database to include the entire state; an inventory of stream reaches and associated habitat parameters important for the recovery of salmonid species and bull trout.

Forest Practices

In January 2000, the Washington Forest Practices Board adopted new emergency forest practice rules based on the Forest and Fish Report (WFPB 2000). These rules address riparian areas, roads, steep slopes, and other elements of forest practices on non-Federal lands. Although some provisions of forest practice rules represent improvements over previous regulations, the plan relies on an adaptive management program for assurance that the new rules will meet the conservation needs of bull trout. Research and monitoring being conducted to address areas of uncertainty for bull trout include protocols for detection of bull trout, habitat suitability, forestry effects on groundwater, field methods or models to identify areas influenced by groundwater, and forest practices influencing cold water temperatures. The Forest and Fish Report development process relied on broad stakeholder involvement, and included State agencies, counties, Tribes, forest industry and environmental groups. A similar process is being used for agricultural communities in Washington, and is known as "Agriculture, Fish, and

Water." The Service is considering the possible impacts and potential benefits from both of these State processes relative to bull trout recovery.

Biological Opinion on the Federal Columbia River Power System

On December 20, 2000, the Service issued a biological opinion on the "Effects to Listed Species from Operation of the Federal Columbia River Power System" (USFWS 2000b). The opinion identifies the need for continued research into distribution of bull trout within the mainstem Columbia River. The Biological Opinion recognizes that as recovery actions are implemented, bull trout will likely increase their use of the mainstem Columbia. Reasonable and prudent measures in the Biological Opinion are consistent with primary research needs identified by the Upper Columbia Recovery Unit Team. As recovery proceeds, the need for research to investigate problems associated with fish ladder use, entrainment, spill, flow attraction, and water quality will need to be addressed through the formal consultation process.

Habitat Conservation Plans

The U.S. Fish and Wildlife Service and National Marine Fisheries Service are in the process of preparing an environmental assessment or environmental impact statement related to the proposed approval of a Habitat Conservation Plan and the issuance of an incidental take permit in accordance with section 10(a) of the Endangered Species Act. The permit applicant is Chewuch Basin Council, which is comprised of the three irrigation companies operating in the Chewuch Basin (Chewuch Canal Company, Fulton Ditch Company, and the Skyline Ditch Company). These companies own and operate independent diversion structures, fish screens, irrigation ditches, pipes, canals, and reservoirs, and appurtenant structures located on and adjacent to the Chewuch River in the vicinity of Winthrop, Washington. The application is related to water withdrawals from the Chewuch River located in southern Okanogan County, Washington. The ditch companies intend to request a permit for chinook salmon, steelhead trout, and bull trout. In accordance with the Endangered Species Act, the Chewuch Basin Council will prepare a plan to minimize and mitigate for future watershed management activities within the irrigation reach.

STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout, including for both spawning and rearing, foraging, migrating, and overwintering) and a core population (*i.e.*, bull trout inhabiting a core habitat) constitutes the basic core area upon which to gauge recovery within a recovery unit. Within a core area, many local populations may exist.

For purposes of recovery, the Upper Columbia Recovery Unit has three core areas, including the Wenatchee, Entiat, and Methow Rivers. Although we know bull trout in the Upper Columbia migrate to the Columbia River and back, we do not clearly understand the extent of their use and distribution in the Columbia River mainstem. Factors considered when identifying core areas included: the extent of historic and current migratory connectivity, existence natural barriers, survey and movement data, and genetic information where available. Except where supported by biological or geographic evidence, core areas are considered to be distinct, and their boundaries do not overlap. Additional genetic information within the Upper Columbia Recovery Unit may help refine the current classification.

Within each core area, many local populations may exist. A local population is defined as a group of bull trout that spawn within a particular stream or portion of a stream system. A local population is assumed to be the smallest group of fish that is known to represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Based on survey data and professional judgement, the Upper Columbia Recovery Team identified 16 local populations in the Wenatchee (6), Entiat (2) and Methow (8) core areas.

Recovery Goals and Objectives

The goal of the bull trout recovery plan is to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed across the native range of the species, so that it can be delisted. To achieve this goal, the following objectives have been identified for bull trout in the Upper Columbia Recovery Unit:

- Maintain the current distribution of bull trout and restore distribution in previously occupied areas within the Upper Columbia Recovery Unit.

- Maintain stable or increasing trends in abundance of bull trout.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunities for genetic exchange.

Rieman and McIntyre (1993) and Rieman and Allendorf (2001) evaluated the bull trout population numbers and habitat thresholds necessary for long-term viability of the species. They identified four elements, and the characteristics of those elements, to consider when evaluating the viability of bull trout populations. These four elements are: 1) number of local populations; 2) adult abundance (defined as the number of spawning fish present in a core area in a given year); 3) productivity, or the reproductive rate of the population (as measured by population trend and variability); and 4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Upper Columbia Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Upper Columbia Recovery Unit Team also evaluated each element under a potential recovered condition to produce recovery criteria. Evaluation of

these elements under a recovered condition assumed that actions identified within this chapter had been implemented. Recovery criteria for the Upper Columbia Recovery Unit reflect: 1) the stated objectives for the recovery unit, 2) evaluation of each population element in both current and recovered conditions, and 3) consideration of current and recovered habitat characteristics within the recovery unit. Recovery criteria will probably be revised in the future as more detailed information on bull trout population dynamics becomes available. Given the limited information on bull trout, both the level of adult abundance and the number of local populations needed to lessen the risk of extinction should be viewed as a best estimate.

In this approach to developing recovery criteria, the status of populations in some core areas may fall short of ideals described by conservation biology theory. Some core areas may be limited by natural attributes or by patch size, and may always remain at a relatively high risk of extinction. Because of limited data within the Upper Columbia Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations

Metapopulation theory is important to consider in bull trout recovery. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (see Chapter 1). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events. In part, distribution of local populations in such a manner is an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than 5 local populations are at increased risk, core areas with between 5 and 10 local populations are at intermediate risk, and core areas with more than 10 interconnected local populations are at diminished risk.

Currently, local populations of migratory bull trout in the Wenatchee Core Area include: Chiwaukum Creek, Chiwawa River (including Chikamin, Rock, Phelps, Alpine, Buck, and James Creeks), White River (including Canyon and Panther Creeks), Little Wenatchee (below the falls), Peshastin Creek (including

Ingalls Creek), and Nason Creek (including Mill Creek). Migratory local populations in the Entiat Core Area include the mainstem Entiat and Mad Rivers. The Methow Core Area has migratory bull trout local populations in Gold Creek (including Crater Creek), Twisp River (including North and Reynolds Creeks and mainstem, East and West Fork Buttermilk Creeks), Wolf Creek, Chewuch River, Goat Creek, Early Winters Creek (including Cedar and Huckleberry Creeks), Lost River (including Cougar Lake, First Hidden Lake, Middle Hidden Lake and Monument Creek), and Upper Methow River. Bull trout in the Wenatchee and Methow Core Areas are considered at a intermediate risk, while bull trout in the Entiat Core Area are at an increased risk. Resident bull trout are known to occur in each core area within the recovery unit. However, an accurate description of their current distribution is unknown, and the identification of resident local populations is considered a research need.

Adult Abundance

The recovered abundance levels in the Upper Columbia Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information, and the professional judgment of recovery team members. In general, effective population size is a theoretical concept that allows us to predict potential future losses of genetic variation within a population due to small population sizes and genetic drift (see Chapter 1). For the purpose of recovery planning, effective population size is the number of adult bull trout that successfully spawn annually. Based on standardized theoretical equations (Crow and Kimura 1970), guidelines have been established for maintaining minimum effective population sizes for conservation purposes. Effective population sizes of greater than 50 adults are necessary to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980). To minimize the loss of genetic variation due to genetic drift and to maintain constant genetic variance within a population, an effective population size of at least 500 is recommended (Franklin 1980; Soule 1980; Lande 1988). Effective population sizes required to maintain long-term genetic variation that can serve as a reservoir for future adaptations in response to natural selection and changing environmental conditions are discussed in Chapter 1 of the recovery plan.

For bull trout, Rieman and Allendorf (2001) estimated that a minimum number of 50 to 100 spawners per year is needed to minimize potential inbreeding effects within local populations. In addition, a population size of between 500 and 1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation from drift.

For the purposes of bull trout recovery planning, abundance levels were conservatively evaluated at the local population and core area levels. Local populations containing fewer than 100 spawning adults per year were classified as at risk from inbreeding depression. Bull trout core areas containing fewer than 1,000 spawning adults per year were classified as at risk of genetic drift.

Overall, bull trout in the Wenatchee, Entiat, and Methow core areas persist at low abundance. The strongest population in the Wenatchee Core Area is the Chiwawa River. Since 1999, the Chiwawa River has ranged between 246 and 462 redds annually. Conservative estimates (2 fish per redds) would result in an estimate of 492 to 924 spawning adults in the Chiwawa local population. Based on the aforementioned guidance, the Chiwawa River local population is not at risk of inbreeding depression. All other local populations in the Wenatchee Core Area persist at low abundance levels, and are considered at risk of inbreeding depression. Accurate abundance estimates for the Wenatchee Core Area are not available. However, results from the 2001 redd surveys in the Wenatchee Core Area indicate that the annual spawning population is probably less than 1,000 individuals, and should be considered at risk of genetic drift. Both local populations in the mainstem Entiat and Mad rivers persist at low abundance levels (less than 100 individuals), and are considered at risk of inbreeding depression. The low abundance in the Entiat Core Area places it at risk of genetic drift. Seven of the local populations in the Methow Core Area are mostly under 100 adults annually and are at risk of inbreeding depression. The most recent 4-year average for adult abundance (174) in the Twisp River indicates that this local population may not be at risk of inbreeding depression. However, the high variability in redd counts in the Twip River is a source of concern, and the genetic risk for this local population should continue to be monitored. Based on available

information, adult spawning abundance in the Methow Core Area is probably less than 1,000 adults and therefore is at risk of the deleterious effects of genetic drift.

Productivity

A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.*, productivity over the entire life cycle) that indicate a population is consistently failing to replace itself also indicate an increased risk of extinction. Therefore, the reproductive rate should indicate that the population is replacing itself, or growing.

Since estimates of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population that is below recovered abundance levels, but that is moving toward recovery, would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of probability of extinction. This probability cannot be measured directly, but it can be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient for the population to replace itself from generation to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time.

In the Upper Columbia Recovery Unit, bull trout were classified as having an increased risk due to either the short duration of population census information, or the incomplete record of the redd count surveys within each core area.

Connectivity

The presence of the migratory life history form within the Upper Columbia Recovery Unit was used as an indicator of the functional connectivity of the recovery unit. If the migratory life form was absent, or if the migratory form was present but local populations lacked connectivity, the core area was considered to be at increased risk. If the migratory life form was persisting in at least some local populations, with partial ability to connect with other local populations, the core area was judged to be at intermediate risk. If the migratory life form was present in all or nearly all local populations, and had the ability to connect with other local populations, the core area was considered to be at diminished risk.

Within the Wenatchee and Entiat Core Areas, the migratory life history form is predominant within the existing local populations, and both areas were considered at a diminished risk. While localized habitat problems currently exist that may impede connectivity, there are no large scale man-made migration barriers within either system. Conversely, habitat degradation within the Methow Core Area has fragmented bull trout populations within the basin. Reduction in habitat quality resulting from irrigation water withdrawals, diversion dams, grazing, and passage barriers associated with culverts have collectively contributed to the decline of bull trout in the basin. Bull trout in the Methow Core Area were considered to be at an increased risk.

Recovery Criteria

Recovery criteria for bull trout in the Upper Columbia Recovery Unit are as follows:

1. **Distribution criteria will be met when bull trout are distributed among at least 16 local populations in the Upper Columbia Recovery Unit.** The 16 identified local populations are currently distributed within the Wenatchee (6), Entiat (2) and Methow (8) core areas and are comprised of the migratory life history form. For recovery to occur, the distribution of these migratory local populations should be maintained while abundance is increased. The recovered distribution places the Wenatchee and Methow Core Areas at an intermediate risk from stochastic events. The Entiat Core Area, under a recovered condition, would remain at an increased risk from stochastic events. The Upper Columbia Recovery Unit Team recognizes that natural habitat features within the Wenatchee, Entiat, and Methow Rivers may limit the expansion of bull trout distribution. Designation of local populations is based on survey data and the professional judgement of Upper Columbia Recovery Unit Team members. Further genetic studies are needed in order to more accurately delineate local populations, and quantify spawning site fidelity and straying rates. The complete distribution of resident local populations in the recovery unit is unknown. The Upper Columbia Recovery Unit Team recommends that further studies be conducted in the Wenatchee, Entiat, and Methow Core Areas to elucidate the current and recovered distribution of resident bull trout in the recovery unit. Geographic distribution of resident local populations should be identified within 3 years, and actions needed to implement reintroduction efforts should be incorporated into review of the Upper Columbia Recovery Unit plan. Additional local populations may be added to this total as additional information is gathered in areas outside the currently designated core areas for this recovery unit.

2. **Abundance criteria will be met when the estimated abundance of adult bull trout among all local populations in the Upper Columbia Recovery Unit (Wenatchee, Entiat, and Methow Core Areas) is between 6,322 to 10,426 migratory fish (see Appendix 2).** Recovered abundance ranges for the Wenatchee (1,876 to 3,176), Entiat (836 to 1,364), and Methow (3,610 to 5,886) Core Areas were derived using the

professional judgement of the team and estimation of productive capacity of identified local populations. Resident life history forms are not included in this estimate, but are considered a research need. As more data is collected, recovered population estimates will be revised to more accurately reflect both the migratory and resident life history components. The established recovered abundance levels assume that threats (including fragmentation of local populations) have been addressed and that each core area is a functioning metapopulation. While the recovered abundance for each core area falls short of long-term idealized estimates for effective population size (see Chapter 1), the Upper Columbia Recovery Team feels that the estimated ranges accurately reflect achievable recovered abundance levels. In the Wenatchee and Methow core areas, the identified recovered abundance levels should prevent inbreeding depression and minimize the loss of genetic variation due to genetic drift. The natural productive capacity of the Entiat Core Area may keep it below 1,000 spawning adults annually, and at risk of genetic drift. The U.S. Fish and Wildlife Service will evaluate the identified abundance levels relative to the maintenance of long-term genetic variation that would provide the population the ability to adapt to natural selection and changing environmental conditions.

3. **Trend criteria will be met when adult bull trout exhibit a stable or increasing trend for at least two generations at or above the recovered abundance level within the Wenatchee, Entiat, and Methow Core Areas.** The development of a standardized monitoring and evaluation program that would accurately describe trends in bull trout abundance is identified as a priority research need. As part of the overall recovery effort, the U.S. Fish and Wildlife Service will take the lead in addressing this research need by forming a multi-agency technical team to develop protocols to evaluate trends in bull trout populations.

4. **Connectivity criteria will be met when specific barriers to bull trout migration in the Upper Columbia Recovery Unit have been addressed.** The Upper Columbia Recovery Unit Team recommends that

to adequately address habitat problems in the Methow Core Area (*e.g.,* low instream flows, grazing, culverts, and diversion dam barriers), and to recover bull trout, basin-wide Habitat Conservation Plans must be developed. The U.S. Fish and Wildlife Service, working with Federal, State, and private entities, and in coordination with local governments, need to secure quality habitat conditions for bull trout. These efforts should be coordinated with ongoing National Marine Fisheries Service salmon recovery actions to avoid duplication in planning and implementation.

Recovery criteria for the Upper Columbia Recovery Unit were established to assess whether recovery actions are resulting in the recovery of bull trout. The Upper Columbia Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. While removal of bull trout as a species listed under the Endangered Species Act (*i.e.*, delisting) can only occur for the entity that was listed (Columbia River Distinct Population Segment), the criteria listed above will be used to determine when the Upper Columbia Recovery Unit is fully contributing to recovery of the population segment.

Research Needs

Based on the best scientific information available, the Upper Columbia Recovery Unit Team has identified recovery criteria and actions necessary for recovery of bull trout within the recovery unit. However, the recovery unit team recognizes that many uncertainties exist regarding bull trout population abundance, distribution, and actions needed. The recovery team feels that if effective management and recovery are to occur, the recovery plan for the Upper Columbia Recovery Unit must be viewed as a "living" document that will be updated as new information becomes available. As part of this adaptive management approach, the recovery unit team has identified research needs that are essential within the recovery unit. Research needs apply to areas where the recovery unit team feels more information is needed in order to accurately

determine full recovery in this recovery unit and to implement effective recovery actions.

Columbia River and Tributaries

Recent information on migration and use of the mainstem Columbia River has been verified. Movements of bull trout tagged and released at Rock Island, Rocky Reach, and Wells Dams have been monitored through tagging studies conducted by the Chelan County Public Utilities District (Kreiter 2001; 2002). In addition, studies conducted by the U.S. Fish and Wildlife Service have verified the movement of adult bull trout into the lower Wenatchee River, and most likely the mainstem Columbia River. The mainstem Columbia River contains core habitat elements for bull trout that are important for migration, feeding, overwintering, and eventual recovery.

The Upper Columbia Recovery Team recommends that current studies on migration and use of the mainstem Columbia River be expanded and coordinated with genetic investigations in order to better understand the role that the Columbia River can play in recovery. Increased knowledge of the use of the mainstem Columbia River may revise core area descriptions and could have management and operational implications for mainstem Columbia River hydropower facilities. Research needs identified in the U.S. Fish and Wildlife Service's Biological Opinion on the "Effects to Listed Species from Operation of the Federal Columbia River Power System" are applicable to mainstem facilities in the Upper Columbia Recovery Unit (USFWS 2000b). Reasonable and prudent measures in the Biological Opinion are consistent with information data gaps identified in the Upper Columbia Recovery Unit. Research designed to investigate problems associated with fish ladder use, entrainment, spill, flow attraction, and water quality should be initiated.

The Upper Columbia Recovery Unit Team also considers the Lake Chelan basin and the Okanogan River basin to be research needs. The Lake Chelan basin historically supported adfluvial bull trout. The Upper Columbia Recovery Team feels that the application of a rigorous methodology to determine presence within tributaries to Lake Chelan is necessary to validate the current status. If bull trout are not found in the basin, the Upper Columbia Recovery Team recommends that a study to assess the feasibility of reintroducing bull trout into the basin be

conducted. Recent investigations (Kreiter 2001) indicated that radio-tagged bull trout temporarily moved into the lower portions of the Okanogan River. Historic evidence of local populations of bull trout in the Okanogan River is limited (N. Wells, U.S. Forest Service, pers. comm., 2001). The Upper Columbia Recovery Unit Team recommends that the potential use of the Okanogan River by bull trout be investigated.

Monitoring and Evaluation

The Upper Columbia Recovery Unit Team realizes that recovery criteria will most likely be revised as recovery actions are implemented and bull trout populations begin to respond. In addition, the Upper Columbia Recovery Unit Team will rely on adaptive management to better refine both abundance and distribution criteria. Adaptive management is a continuing process of planning, monitoring, evaluating management actions, and research. This approach will involve a broad spectrum of user groups and will lay the framework for decision making relative to recovery implementation and ultimately, the possible revision of recovery criteria in this recovery unit.

This recovery unit chapter is the first step in the planning process for bull trout recovery in Upper Columbia Recovery Unit. Monitoring and evaluation of population levels and distribution will be an important component of any adaptive management approach. The U.S. Fish and Wildlife Service will take the lead in developing a comprehensive monitoring approach that will provide guidance and consistency in evaluating bull trout populations. Development and application of models that assess extinction risk relative to abundance and distribution parameters are critical in refining recovery criteria as the recovery process proceeds. Application of agreed upon methods for evaluating recovery would benefit the scientific community and user groups alike.

Genetic Studies

The Upper Columbia Recovery Unit Team recommends that studies be initiated to describe the genetic makeup of bull trout in the mainstem Columbia, Wenatchee, Entiat, and Methow Rivers. This information would be essential for a more complete understanding of bull trout interactions and population dynamics. In addition, a recovery unit-wide evaluation of the current and potential threat of

bull trout hybridization with brook trout is needed. The ability to evaluate the potential harm to specific local populations could be used in prioritizing management actions. Genetic baseline information would also be a necessity in the implementation of any artificial propagation program.

The Role of Artificial Propagation and Transplantation

The Upper Columbia Recovery Unit Team has determined that reaching a recovered condition within the Wenatchee, Entiat, and Methow Core Areas within 25 years could require the use of artificial propagation. Artificial propagation could involve the transfer of bull trout into unoccupied habitat within the historic range (ODFW 1997). In addition, artificial propagation could involve the use of Federal or State hatcheries to assist in recovery efforts (MBTSG 1996). The Upper Columbia Recovery Team recommends that studies be initiated to determine the effectiveness and feasibility of using artificial propagation in bull trout recovery.

Any artificial propagation program instituted in the Upper Columbia Recovery Unit must follow the joint policy of the U.S. Fish and Wildlife Service and the National Marine Fisheries Service regarding controlled propagation of listed species (65 FR 56916). The overall guidance of the policy is that every effort should be made to recover a species in the wild before implementing a controlled propagation program. If necessary, an appropriate plan would need to be approved that considers the effects of transplantation on other species as well as the donor bull trout populations. Transplanting listed species must be authorized by the U.S. Fish and Wildlife Service and meet applicable State fish-handling and disease policies.

While artificial propagation has played an important role in the recovery of other listed fish species, where possible, the overall recovery strategy for bull trout in the Upper Columbia Recovery Unit should emphasize the removal of threats and habitat restoration. Recovery should emphasize identifying and correcting threats affecting bull trout and their habitats. Artificial propagation programs should not be implemented unless reasons for decline have been addressed.

ACTIONS NEEDED

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical listing of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. Second-tier tasks that do not include specific third-tier actions are usually programmatic activities that are applicable across the range of the species; they appear in *italic type*. These tasks may have third-tier tasks associated with them (see Chapter 1 for more explanation). Some second-tier tasks may not be sufficiently developed to apply to the recovery unit at this time; they appear in *a shaded italic type*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and are intended to assist in generating information during the comment period for the draft recovery plan, a period when additional tasks may be developed. Third-tier entries are tasks specific to the Upper Columbia Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Upper Columbia Recovery Unit chapter should be updated or revised as recovery tasks are accomplished, environmental conditions change, monitoring results become available, or other new information becomes available. Revisions to the Upper Columbia Recovery Unit chapter will likely focus on priority streams or stream segments within core areas where restoration activities occurred, and habitat or bull trout populations have shown a positive response. The Upper Columbia Recovery Unit Team should meet annually to review annual monitoring reports and summaries, and make recommendations to the U.S. Fish and Wildlife Service for revision of the Upper Columbia Recovery Unit chapter.

1. Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Investigate alternatives to improve low flow conditions. Investigate alternatives to improve low flow conditions, evaluate ground water/surface water interactions, and evaluate human-induced changes. Specific areas to address include: lower Early Winters Creek, the two diversions at River Miles 1.4 and 0.6, the Methow River from Robinson Creek to Weeman Bride at River Mile 6 below Mazama Bridge, Lost River, Twisp River, Gold Creek near water diversions at River Miles 0.2 and 1.3, Peshastin Creek, Chiwaukum Creek, Chiwawa River, and Icicle Creek in the Wenatchee River.

1.2 Identify barriers or sites of entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 Reconnect floodplains. Reconnect floodplains and off-channel habitats that provide important spawning and rearing areas. In the Methow basin, the McKinney Mountain and People Mover Dikes should be considered for removal. Support restoration efforts planned for Goat Creek (a channel function restoration project in the lower 1.5 channelized miles and a stream restoration project between River Miles 6.5 and 9.5). Support projects that propose alternatives to maintaining the dike on Lost River. Support projects that propose to restore the lower 2 miles of Early Winters Creek, which has been riprapped and diked, had side-channels cut off, and had trees removed from riparian areas. Restore access to the floodplain and reconnect side channels in the lower 15 miles of the Twisp River.

1.2.2 Correct irrigation passage barriers. Develop a comprehensive list of irrigation diversion passage barriers in the Upper Columbia Recovery Unit that impact bull trout and their habitat. Correct identified barriers to allow fish passage, and correct or minimize impacts they have on bull trout habitat.

1.2.3 Screen diversions and irrigation ditches. Screen known water diversion and irrigation ditches to meet State, U.S. Fish and Wildlife Service, and the National Marine Fisheries Service screening criteria.

1.2.4 Assess impacts from proposed Lake Wenatchee Dam. Assess direct and indirect effects to bull trout of the proposed damming of Lake Wenatchee, including impacts to current populations and habitat.

1.3 Identify impaired stream channel and riparian areas and implement tasks to restore their appropriate functions.

1.3.1 Minimize further shoreline and floodplain development. Reduce current impacts from shoreline and floodplain development along the mainstem Methow, Entiat, and Wenatchee rivers. Minimize further development that will constrict or constrain the channel, degrade riparian areas, negatively impact ground water and surface water interactions, or in any other way degrade stream channel functions.

1.3.2 Develop road management strategy. Develop a road management strategy in coordination with U.S. Forest Service Road Analysis to enhance bull trout connectivity and restore habitat.

1.3.3 Develop and coordinate access and travel management plans. Coordinate public and private land owner development of access and travel management plans that will minimize effects of roads in bull trout watersheds.

1.3.4 Identify and repair, remove, or relocate culverts. Identify and repair, remove, or relocate culverts that are barriers for fish migration, restrict connectivity, or inhibit downstream transport of substrate and woody debris. Areas of concern include: Peshastin and Nason Creeks (Wenatchee River), Twisp River, Beaver Creek, Gold Creek, Little Bridge Creek, and East Fork Buttermilk Creek (Methow River).

1.3.5 Identify and repair, remove, or relocate roads. Identify and repair, remove, or relocate roads that are barriers for fish migration, restrict connectivity, increase sediment delivery, intercept ground water and surface water, detrimentally effect riparian and floodplain function, or alter normal hydraulic processes.

1.3.6 Avoid placement of new roads in riparian areas.

1.3.7 Assess forest practice regulations. Assess the effectiveness of current forest practice regulations to protect bull trout habitat.

1.3.8 Reduce road density and road-related sediment delivery. Reduce road density and road-related sediment delivery in bull trout core areas. In the Methow Core Area, priority watersheds include: Goat Creek, Beaver Creek, Chewuch River, Wolf Creek and tributary Gate Creek, Early Winters Creek, lower Methow River, Twisp River and tributaries Little Bridge Creek and Buttermilk Creek. In the Wenatchee Core Area, priority watersheds include: lower

Chiwawa River, middle Chiwawa River, Lake Wenatchee, lower White River, lower Little Wenatchee, upper Little Wenatchee, lower Nason Creek, upper Nason Creek, the headwaters of Nason Creek, Wenatchee River (upper, middle, and lower portions), lower Icicle Creek drainage, and Peshastin Creek. In the Entiat Core Area, priority watersheds include: lower Entiat River, middle Entiat River, lower Mad River, middle Mad River, and the upper Mad River.

1.3.9 Develop and implement habitat restoration and protection guidelines. Develop and implement habitat restoration and protection guidelines for bull trout that restore or maintain habitat elements (*e.g.,* sediment delivery, water temperature, normative hydrologic function) to provide for recovery.

1.3.10 Ensure enforcement of mineral prospecting and placer mining regulations. Ensure mineral prospecting and placer mining activities comply with the Washington State Hydraulic Code (Gold-N-Fish pamphlet).

1.3.11 Maintain unroaded portions of bull trout watersheds in current roadless condition.

1.3.12 Address access road impacts. Identify and close, or provide law enforcement for, roads that increase risk of poaching and fishing pressure, especially in bull trout spawning and staging areas.

1.3.13 Monitor mining activities. Monitor mining activities for compliance with the Gold Pamphlet and recovery actions to determine the effectiveness of regulations and recovery

actions in providing desired habitat and water quality conditions.

1.3.14 Ensure that bull trout are considered in all planning phases of new gold mining operations. Ensure that bull trout are considered in all planning phases of new gold mining operations in the North Creek drainage in the Twisp River and Chikamin Creek.

1.3.15 Implement and monitor stream nutrient enhancement projects. Implement projects to distribute salmon and steelhead carcasses in streams to increase stream nutrients and aid in the restoration of historic nutrient flows. Monitor their effectiveness.

1.3.16 Quantify grazing impacts. Identify and investigate grazing impacts and quantify impacts to bull trout habitat in the Upper Columbia Recovery Unit (*e.g.,* Rainy, Wolf, Goat, Buttermilk, Gold, and Libby Creeks). Focus on impacts to riparian areas and stream channel condition.

1.3.17 Develop and implement livestock grazing plans. Develop, implement, and adaptively manage livestock grazing plans that include actions (*e.g.,* riparian fencing), performance standards, and targets for floodplains, riparian vegetation, stream banks and channels, and wetlands that protect bull trout habitat and water quality.

1.3.18 Exclude grazing from sensitive habitat areas. Exclude grazing from sensitive bull trout habitat areas (*e.g.,* spawning grounds, early rearing habitats) during spawning and the incubation period (*e.g.,* September-April).

1.3.19 Identify and mitigate habitat impacts from highways and railroads. Identify reaches in the Wenatchee and Methow where highways and railroads have altered bull trout habitat (*e.g.,* Wenatchee River, Nason Creek, Peshastin Creek, Early Winters Creek, and the upper Methow River) and recommend mitigative actions.

1.3.20 Coordinate with grazing interests to minimize grazing disturbance. Coordinate, work with, and support conservation districts, counties, and private landowners to evaluate grazing disturbances and implement corrective actions in bull trout habitat.

1.3.21 Reduce sediment loading to streams. Reduce sediment loading from irrigation return flow and non-point source runoff (*e.g.,* Wolf Creek irrigation ditch).

1.3.22 Identify and, where feasible, correct man-made barriers to fish passage in foraging and refugia habitats. Identify and, where feasible, correct man-made barriers to fish passage in non-local population streams that provide foraging and high water refuge habitat.

1.3.23 Restore and protect habitat that is impacted by recreational campgrounds. Take corrective actions to restore and protect habitat that is impacted by recreational campgrounds. Priority areas include: Tumwater Campground at the confluence of Chiwaukum Creek and the Wenatchee River, Nason Creek Campground and dispersed sites on Nason Creek, Riverside Campground on the Little Wenatchee River and dispersed sites on the Little Wenatchee River, Pine Flat Campground on the Mad River, Roads End Campground on the Twisp River, and dispersed camping sites on the Chiwawa River.

1.4 Operate dams to minimize negative effects on bull trout in reservoirs and downstream.

1.4.1 Evaluate bull trout passage at Wells, Rock Island, and Rocky Reach Dams, and initiate passage studies at Wanapum Dam. Continue evaluation of bull trout passage at Wells, Rock Island, and Rocky Reach dams. Focus on level of use and adequacy of current passage facilities. Initiate bull trout passage studies at Wanapum Dam.

1.4.2 Assess feasibility of providing fish passage at Leavenworth National Fish Hatchery. Improve fish passage at Leavenworth National Fish Hatchery if feasible.

1.4.3 Evaluate downstream passage at Tumwater and Dryden Dams. Evaluate downstream passage at Tumwater and Dryden Dams, and if warranted investigate methods necessary to improve downstream passage.

1.5 *Identify upland conditions negatively affecting bull trout habitats and implement tasks to restore appropriate functions.*

2. Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 *Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.*

2.2 *Enforce policies for preventing illegal transport and introduction of nonnative fishes.*

2.3 *Provide information to the public about ecosystem concerns of illegal introductions of nonnative fishes.*

2.4 *Evaluate biological, economic, and social effects of control of nonnative fishes.*

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.5.1 Evaluate opportunities for experimental removal of brook trout or other competing nonnative fish species. Evaluate opportunities for experimental removal of brook trout or other competing nonnative fish species from selected streams. Initial priority areas include Twisp River, Chikamin and Minnow Creeks and Shaefer Lake on the Chiwawa River.

2.6 Develop tasks to reduce negative effects of nonnative taxa on bull trout.

2.6.1 Evaluate impacts of nonnative fish species on bull trout. Evaluate impacts of nonnative fish species on bull trout, especially when present in local populations. Evaluate predation, hybridization, and competition impacts to all life stages.

3. Establish fisheries management goals and objectives compatible with bull trout recovery, and implement practices to achieve goals.

3.1 *Develop and implement State and Tribal native fish management plans, and integrate adaptive research.*

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.2.1 Ensure compliance with harvest regulations. Ensure compliance with harvest regulations and policies, and target bull trout spawning and staging areas for enforcement in the Upper Columbia Recovery Unit. Priority areas include Mad River, Panther Creek, Rock Creek, Chiwawa River, Twisp River, and Lake Wenatchee based on past observations of poaching.

3.2.2 Reduce angler pressure. Reduce angler pressure in areas where incidental mortality continues to be detrimental to recovery. Utilize innovative techniques such as seasonal or permanent road closures, and establishment of conservative regulations or fisheries management policies.

3.2.3 Provide educational opportunities and materials to anglers. Provide anglers with information about bull trout identification, special regulations, and how to reduce hooking mortality of bull trout caught incidentally in recreational fisheries.

3.2.4 Develop and implement a bull trout fishery management plan. Develop and implement a bull trout fishery management plan for the Upper Columbia Recovery Unit to assess harvest and incidental take during other fisheries (*e.g.,* whitefish season).

3.2.5 Increase natural forage (prey) base. Implement restoration actions that increase natural production of salmon, steelhead, and other native species thereby improving the natural forage base for bull trout.

3.2.6 Evaluate impacts to bull trout from the general fishing season in the Lost River. Monitor effects of the current harvest regulations for the Lost River and evaluate their

adequacy to protect bull trout spawner abundance in this important local population.

3.2.7 Monitor scientific collection. Monitor scientific collection and regulate collection methods (techniques, intensity, timing). Specifically, address possible take of bull trout during spring chinook egg collection and recommend corrective actions if necessary.

3.3 Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.3.1 Discontinue stocking of brook trout. Discontinue stocking of brook trout in areas where impacts to bull trout may occur. Review stocking plans for lakes that are in bull trout watersheds and recommend changes that would benefit bull trout.

3.4 Evaluate effects of existing and proposed sport fishing regulations on bull trout.

3.4.1 Evaluate and implement harvest regulations that reduce nonnative fish populations impacting bull trout. Evaluate and implement harvest regulations that reduce nonnative fish populations where bull trout will benefit. Ensure that the liberalized limits targeting nonnatives do not increase incidental catch of bull trout.

4. Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 *Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.*

4.2 *Maintain existing opportunities for gene flow among bull trout populations.*

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

4.3.1 Establish genetic reserve protocols. Establish genetic reserve protocols and standards for initiating, conducting, and evaluating artificial propagation programs.

4.3.2 Establish genetic baselines. Genetic baseline descriptions of bull trout in the Columbia, Wenatchee, Entiat, and Methow Rivers is essential for a complete understanding of bull trout interactions and population dynamics.

4.3.3 Evaluate hybridization with brook trout. Recovery Unit wide evaluation of the current and potential threat of bull trout hybridization with brook trout is needed. The ability to evaluate the potential harm to specific local populations can be used in prioritizing management actions.

4.3.4 Determine feasibility and appropriateness of artificial propagation. Reestablishment of local populations within the Upper Columbia Recovery Unit may require the use of artificial propagation. Initiate studies to determine the effectiveness and feasibility of using fish transfers and hatcheries to assist in future reintroduction efforts.

5. Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 *Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.*

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.2.1 Develop and implement a monitoring program. Develop a monitoring program to assess the contribution of the resident life history form to overall population abundance.

5.3 *Conduct evaluations of the adequacy and effectiveness of current and past Best Management Practices in maintaining or achieving habitat conditions conducive to bull trout recovery.*

5.4 *Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects.*

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.5.1 Evaluate the current and potential bull trout use of the Columbia River and lower mainstem portions of the Methow, Entiat, and Wenatchee Rivers. Determine habitat use, foraging requirements, and migrational patterns within these mainstem areas.

5.5.2 Investigate the potential and feasibility for re-introducing bull trout to the Chelan basin.

5.5.3 Investigate potential use of the Okanogan River by bull trout, and investigate habitat suitability.

5.5.4 Conduct problem assessments for bull trout and identify site-specific threats that may be limiting recovery efforts. Coordinate with Water Resource Inventory Areas and the Northwest Power Planning Council's Subbasin Planning

process to fill data gaps related to the identification of site-specific threats that may be limiting recovery efforts.

5.5.5 Conduct population surveys. Conduct intensive population surveys to determine presence of bull trout and to fully describe the distribution of juvenile, sub-adult, and adults in the Upper Columbia Recovery Unit.

5.5.6 Assess the feasibility for using Patterson Lake bull trout to reestablish Methow River local populations.

5.6 *Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.*

6. Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 Protect high quality habitats. Protect existing high quality habitats in the Upper Columbia Recovery Unit and provide for long-term habitat protection through purchase from willing sellers, conservation easements, and management plans (*e.g.,* Entiat River, Peshastin Creek, White River, Chiwawa River, and mainstem Wenatchee and Methow Rivers). A conservation easement to secure riparian buffers should be pursued on the upper Methow River between Goat Creek and Mazama where accelerated erosion is occurring in areas impacted by agriculture and residential development.

6.1.2 Develop basin-wide habitat conservation efforts. Work with conservation districts, counties, State agencies, and

private landowners to develop basin-wide habitat conservation efforts (*e.g.,* Habitat Conservation Plans) to protect bull trout and their habitat in the Upper Columbia Recovery Unit (priority is the Methow River).

6.1.3 Work with watershed groups and landowners. Work with and support local watershed groups and private landowners to assess bull trout status, actions needed, and implementation of recovery.

6.2 Use existing Federal authorities to conserve and restore bull trout.

6.2.1 Assess impacts to bull trout during hydropower relicensing. Continue bull trout monitoring in the mainstem Columbia to gather necessary information to describe the effects of project operations at Wells, Rocky Reach, and Rock Island Dams. This information will be necessary to complete section 7 consultation for bull trout during the upcoming Federal Energy Regulatory Commission relicensing process.

6.3 Enforce existing Federal and State habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

6.3.1 Ensure implementation of Washington State habitat protection laws.

6.3.2 Ensure full compliance monitoring of Forest and Fish Report standards. Ensure full compliance monitoring associated with Forest and Fish Report standards and modify rules through adaptive management when indicated by effectiveness monitoring.

6.3.3 Implement Federal land management plans that protect fish habitat (*e.g.,* INFISH).

6.3.4 Develop, implement, and enforce water quality standards for surface water in the State of Washington. Develop, implement, and enforce water quality standards specific for bull trout.

6.3.5 Increase monitoring and enforcement of Hydraulic Permit Applications in the State of Washington.

6.3.6 Develop and implement county and local habitat protection laws and ordinances.

7. Assess the implementation of bull trout recovery by recovery units, and revise recovery unit plans based on evaluations.

7.1 *Convene annual meetings of each recovery unit team to generate progress reports on implementation of the recovery plan for the U.S. Fish and Wildlife Service.*

7.2 *Develop and implement a standardized monitoring program to evaluate the effectiveness of recovery efforts (coordinate with 5.1).*

7.3 Revise the scope of recovery as suggested by new information.

7.3.1 Periodically review progress toward recovery goals and assess recovery task priorities. Annually review progress toward population and adult abundance criteria and recommend changes, as needed, to the Upper Columbia Recovery Unit chapter. In addition, review tasks, task priorities, completed tasks, budget, timeframes, particular successes, and feasibility within the Upper Columbia Recovery Unit.

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows describes recovery task priorities, task numbers, task descriptions, duration of tasks, potential or participating responsible parties, total cost estimate, estimates for the next 5 years, if available, and comments. These tasks, when accomplished, are expected to lead to recovery of bull trout in the Upper Columbia Recovery Unit. Costs estimates are not provided for tasks that are normal agency responsibility under existing authorities. The total estimated cost of recovery actions is $15.5 million.

Parties with authority, responsibility, or expressed interest in implementing a specific recovery task are identified in the Implementation Schedule. Listing a responsible party does not imply that prior approval has been given, or require that party to participate, or expend any funds. However, willing participants may be able to increase their funding opportunities by demonstrating that their budget submission or funding request is for a recovery task identified in an approved recovery plan, and is therefore part of a coordinated effort to recover bull trout. In addition, section 7(a)(1) of the Endangered Species Act directs all Federal agencies to use their authorities to further the purposes of the Endangered Species Act by implementing programs for the conservation of threatened or endangered species.

The following are definitions to column headings in the Implementation Schedule:

Priority Number: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

> Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
>
> Priority 2: All actions that must be taken to prevent a significant decline in species population or habitat quality, or to prevent some other significant negative effect short of extinction.

Priority 3: All other actions necessary to provide for full recovery (or reclassification) of the species.

Task Number and Task Description: Recovery tasks as numbered in the recovery outline. Refer to the action narrative for task descriptions.

Task Duration: Expected number of years to complete the corresponding task. Study designs can incorporate more than one task, which when combined may reduce the time needed for task completion.

Responsible or Participating Party: The following organizations are those with responsibility or capability to fund, authorize, or carry out the corresponding recovery task. **Bolded type** indicates agency or agencies that have the lead role for task implementation and coordination, though not necessarily sole responsibility.

BPA	Bonneville Power Administration
CC	Chelan County
CCPUD	Chelan County Public Utilities District
CD's	Conservation Districts
CT	Colville Tribe
DCPUD	Douglas County Public Utilities District
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GCPUD	Grant County Public Utilities District
NRCS	Natural Resources Conservation Service
OC	Okanogan County
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOE	Washington Department of Ecology
WDOT	Washington Department of Transportation
YN	Yakama Nation

Cost Estimates: Cost estimates are rough approximations and provided only for general guidance. Total costs are estimated for the duration of the task, are itemized annually for the next five years, and includes estimates of expenditures by local, Tribal, State, and Federal governments and by private business and individuals.

An asterisk (*) in the total cost column indicates ongoing tasks that are currently being implemented as part of normal agency responsibilities under existing authorities. Because these tasks are not being done specifically or solely for bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Double asterisk (**) in the total cost column indicates that estimated costs for these tasks are not determinable at this time. Input is requested to help develop reasonable cost estimates for these tasks.

Triple asterisk (***) indicates costs are combined with or embedded within other related tasks.

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.1.1	**Investigate alternatives to improve low flow conditions**.	4	**WDNR, USFS**, **NRCS**, WDFW, OC, CC	200	50	50	50	50		
1	1.2.2	**Correct irrigation passage barriers.**	5	**USFS, OC, CC, CD's, WDNR**, **NRCS**	250	50	50	50	50	50	
1	1.2.3	**Screen diversions and irrigation ditches.**	4	**USFS, WDNR, NRCS**, OC, CC, USFWS, WDFW	500	300	50	50	100		
1	1.3.4	**Identify and repair, remove, or relocate culverts.**	10	**USFS, WDNR,** CD's, OC, CC	1000	100	100	100	100	100	

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.4.1	**Evaluate bull trout passage at Wells, Rock Island, and Rocky Reach dams, and initiate passage studies at Wanapum Dam.**	5	**CCPUD, DCPUD, GCPUD, BPA,** WDFW, USFWS	500	100	100	100	100	100	
1	3.3.1	**Discontinue stocking of brook trout.**	25	**WDFW**	*						
1	4.3.2	**Establish genetic baselines.**	3	**WDFW**, USFWS	180	70	100	10			
1	5.5.1	**Evaluate the current and potential use of the Columbia River and lower mainstem portions of the Methow, Entiat, and Wenatchee Rivers.**	5	**WDFW, USFWS, BPA,** CCPUD	250	50	50	50	50	50	

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	5.5.4	**Conduct problem assessments for bull trout and identify site-specific threats that may be limiting recovery efforts.**	3	**WDFW, USFS**, USFWS	90	30	30	30			
1	6.1.1	**Protect high quality habitats.**	10	**WDNR**, WDFW, USFWS, OC, CC	5000	500	500	500	500	500	
1	6.1.2	**Develop basin-wide habitat conservation efforts (*e.g.*, Habitat Conservation Plans).**	10	**CD's OC, CC, WDNR**, USFWS	1000	100	100	100	100	100	
1	6.2.1	**Assess impacts to bull trout during hydropower relicensing.**	10	**CCPUD, DCPUD**, **GCPUD,** FERC, USFWS	*						

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.2.1	**Reconnect floodplains.**	5	**USFS, WDNR**, WDFW	500	100	100	100	100	100	
2	1.2.4	**Assess impacts from proposed Lake Wenatchee Dam.**	3	**USFS, WDNR**, WDFW, USFWS, CC	75	25	25	25			
2	1.3.2	**Develop road management strategy.**	3	**USFS, WDNR, OC, CC**	*						
2	1.3.5	**Identify and repair, remove, or relocate roads.**	10	**USFS, WDNR,** NRCS, WDOT, CC, OC	2,000	200	200	200	200	200	
2	1.3.6	**Avoid placement of new roads in riparian areas.**	25	**USFS, WDNR**, **WDOT**	*						
2	1.3.7	**Assess forest practice regulations.**	5	**USFS, FWS, WDNR,** WDFW	*						Target areas adjacent to bull trout watersheds.

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.8	**Reduce road density and road-related sediment delivery.**	10	**USFS, WDNR**	500	50	50	50	50	50	
2	1.3.9	**Develop and implement habitat restoration and protection guidelines.**	3	**USFS, USFWS**, WDNR	*						
2	1.3.10	**Ensure enforcement of mineral prospecting and placer mining regulations.**	25	**USFS, WDNR, WDFW**	*						
2	1.3.12	**Address access road impacts.**	25	**USFS, WDFW**, USFWS	*						
2	1.3.13	**Monitor mining activities.**	25	**USFS, WDNR**, WDFW	*						

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.14	**Ensure that bull trout are considered in all planning phases of new gold mining operations.**	25	**USFS**, USFWS	*						
2	1.3.15	**Implement and monitor stream nutrient enhancement projects.**	10	**USFS, WDFW**, **YN**, NMFS, USFWS	100	10	10	10	10	10	
2	1.3.16	**Quantify grazing impacts.**	4	**WDFW, USFS**, USFWS, NRCS	400	100	100	100	100		
2	1.3.17	**Develop and implement livestock grazing plans.**	25	**WDNR, USFS**, USFWS, NMFS, CD's, NRCS	*						

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.20	**Coordinate with grazing interests to minimize grazing disturbance.**	3	**CD's, OC, CC,** USFWS, WDNR, USFS, NRCS	75	25	25	25			
2	1.4.2	**Assess feasibility of providing fish passage at Leavenworth National Fish Hatchery.**	2	**USFWS**	50	25	25				
2	2.5.1	**Evaluate opportunities for experimental removal of brook trout and other competing nonnative fish species.**	2	**WDFW, USFS**, USFWS	30	15	15				
2	2.6.1	**Evaluate impacts of nonnative fish species on bull trout.**	5	**WDFW**, USFWS, USFS	250	50	50	50	50	50	

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	3.2.1	**Ensure compliance with harvest regulations**.	25	**USFS, WDNR, WDFW**, NRCS	*						
2	3.2.2	**Reduce angler pressure.**	5	**WDFW**, USFS	*						
2	3.2.3	**Provide information to anglers.**	3	**WDFW**, USFS	45	15	15	15			
2	3.2.4	**Develop and implement a bull trout fishery management plan.**	3	**WDFW, YN**, USFWS	60	20	20	20			
2	3.2.5	**Increase natural forage (prey) base.**	3	**WDFW**, USFWS, CCPUD	300	100	100	100			
2	3.2.6	**Evaluate impacts to bull trout from the general fishing season in the Lost River.**	3	**WDFW**, USFWS, USFS	*						

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	3.2.7	**Monitor scientific collection.**	25	**USFWS,** WDFW	*						
2	3.4.1	**Evaluate and implement harvest regulations that reduce nonnative fish populations impacting bull trout.**	5	**WDFW, YN**	*						
2	4.3.4	**Determine feasibility and appropriateness of artificial propagation.**	3	**USFWS,** WDFW, YN	30	10	20	10			
2	5.5.5	**Conduct population surveys.**	5	**WDFW, USFS**, USFWS	500	100	100	100	100	100	
2	6.1.3	**Work with watershed groups and landowners.**	25	**CD's, OC CC, USFWS**	*						

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	6.3.1	**Ensure implementation of Washington State habitat protection laws.**	25	**WDNR, WDFW, WDOE**	*						
2	6.3.2	**Ensure full compliance monitoring of Forest and Fish Report standards.**	25	**WDNR, WDFW,**	*						
2	6.3.3	**Implement Federal land management plans that protect fish habitat (*e.g.*, INFISH).**	25	**USFS**	*						
2	6.3.4	**Develop, implement, and enforce water quality standards for surface water in the State of Washington.**	25	**WDOE, EPA,** USFWS, WDFW	*						
2	6.3.5	**Increase monitoring and enforcement of Hydraulic Permit Applications in the State of Washington.**	25	**WDNR**, WDFW	*						

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	6.3.6	**Develop and implement local habitat protection laws and ordinances.**	25	**Local Governments**, OC, CC	*						
3	1.3.1	**Minimize further shoreline and floodplain development.**	10	**USFS, OC, CC, WDNR**, USFWS	500	50	50	50	50	50	
3	1.3.3	**Develop and coordinate access and travel management plans.**	25	**USFS, WDFW**, **OC, CC**, USFWS	*						
3	1.3.11	**Maintain unroaded portions of bull trout watersheds in current roadless condition.**	25	**USFS, WDNR**	*						

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	1.3.18	**Exclude grazing from sensitive habitat areas.**	25	**USFS, WDNR**	*						
3	1.3.19	**Identify and mitigate habitat impacts from highways and railroads.**	2	**WDOT,** WDOE. WDNR	50	25	25				
3	1.3.21	**Reduce sediment loading to streams.**		**USFS, OC, WDNR**, USFWS, NMFS	130	30	100				
3	1.3.22	**Identify and, where feasible, correct man-made barriers to fish passage in foraging and refugia habitats.**	3	**USFS,** WDFW, USFWS	150	50	50	50			
3	1.3.23	**Restore and protect habitat that is impacted by recreational campgrounds.**	5	**USFS**	250	50	50	50	50	50	

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	1.4.3	**Evaluate downstream passage at Tumwater and Dryden dams.**	3	**WDFW, USFS** USFWS	150	50	50	50			
3	4.3.1	**Establish genetic reserve protocols.**	3	**USFWS,** WDFW, YN	*						
3	4.3.3	**Evaluate hybridization with brook trout.**	3	**WDFW**, **USFS** USFWS,	*						
3	5.2.1	**Develop and implement a monitoring program.**	3	**USFWS**, USFS, WDFW	*						
3	5.5.2	**Investigate potential and feasibility for reintroducing bull trout to the Chelan Basin.**	3	**WDFW**, USFS, USFWS	150	50	50	50			
3	5.5.3	**Investigate potential use of the Okanogan River by bull trout, and investigate habitat suitability.**	3	**WDFW, CT, USFS**	150	50	50	50			

IMPLEMENTATION SCHEDULE FOR BULL TROUT RECOVERY PLAN: UPPER COLUMBIA											
Priority number	Task number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	5.5.6	**Assess feasibility for using Patterson Lake bull trout to reestablish Methow River local populations.**	3	**USFS, WDFW**, OC, USFWS	75	25	25	25			
3	7.3.1	**Periodically review progress toward recovery goals and assess recovery task priorities.**	25	**USFWS, NMFS**	*						

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Appendix A - Recovered Abundance Estimates

The recovered abundance levels for migratory bull trout in the Upper Columbia Recovery Unit were derived by combining redd density values and estimates of potential spawning and rearing habitat in local populations under a recovered condition (Table B1). Redd counts have been conducted in selected areas within the Wenatchee River since 1989. Fishing for bull trout has been prohibited since 1992. Redd counts from 1995 to present were selected to represent census data that excluded the influence of fishing mortality. Since 1995, the Chiwawa River local population complex (including Rock Creek, Chikamin Creek, Phelps Creek, and most recently the mainstem Chiwawa River and Buck Creek) has varied from 492 to 924 adults (246 and 462 redds). Redd density estimates from two areas within the Chiwawa River complex (Rock and Phelps creeks) were selected to develop an achievable recovered abundance range within the recovery unit. Habitat within Rock and Phelps creeks is considered to be in good condition and these populations are generally considered among the most secure in the Wenatchee Core Area. Redd densities in Rock Creek and Phelps Creek are 44 redds per mile and 27 redds per mile, respectively. While the habitat quality in Rock and Phelps creeks is similar, the total amount of available spawning area in Phelps Creek is restricted due to a barrier falls approximately 1 mile upstream from the confluence with the Chiwawa River. The Upper Columbia Recovery Unit Team believes that differences in redd density estimates between these local populations reflects natural variation in these relatively undisturbed stream reaches. These redd density values were then multiplied by the estimated number of available miles of spawning and rearing habitat in each local population to arrive at redd abundance. Finally, a range of recovered adult abundance for each local population was generated using a conservative estimate of two fish per redd.

Extrapolation of redd density estimates from Rock Creek to other local populations within the recovery unit would represent the “best case” scenario for a recovered abundance. Estimates from Phelps Creek would represent a “satisfactory” abundance level. The Upper Columbia Recovery Unit Team recognizes that under a recovered condition, some local populations may not

reach these estimated levels, even after recovery actions have been implemented. The Upper Columbia Recovery Unit Team acknowledges that this approach contains a number of inherent assumptions relative to the productivity of individual local populations. Variation in habitat characteristics in local populations including temperature regimes, instream habitat, as well as other factors will result in variation in recovered abundance estimates. Site specific studies need to be initiated to better refine the productive potential in each local population and recovered abundance estimates in the Upper Columbia Recovery Unit.

Recovered abundance estimates are only for the migratory life-history form. Abundance estimates for the Wenatchee Core Area do not include Icicle Creek. It is unknown whether or not bull trout could pass over the barrier falls on Icicle Creek. After evaluation of the possible passage barrier above the hatchery, recovered abundance estimates may be generated for migratory bull trout in Icicle Creek. Resident bull trout are known to exist in Icicle Creek above the falls. Abundance estimates for resident bull trout in Icicle Creek, and other tributaries, are considered a research need. Local population in the Methow are represented by complexes of spawning tributaries and encompass: Gold Creek (including Crater Creek), Twisp River (including North, West Fork Buttermilk, East Fork Buttermilk, Reynolds, Little Bridge, and War creeks), Beaver Creek (only Bluebuck Creek), Wolf Creek, Goat Creek, Lost River (including Monument Creek and Eureka Lake), Upper Methow River (including Trout, Robinson, and Rattlesnake creeks), Chewuch River (including Lake and Eightmile creeks), and Early Winters Creek (including Huckleberry and Cedar creeks).

Table 4. Recovered Abundance estimates for migratory bull trout in Wenatchee, Entiat, and Methow core areas.

Core Area	Local Population	Stream Miles	Number of Redds (Density-27 per mile)	Number of Redds (Density-44 per mile)	Recovered Abundance Range (2 fish per redd)	
Wenatchee	White River	2.8	76	123	152	246
	Nason Creek	5	135	220	270	440
	Chiwaukum Creek	5	135	220	270	440
	Ingalls Creek	6	162	264	324	528
	Little Wenatchee	6.8	184	299	368	598
	Chiwawa River	---	---	---	492	924
Wenatchee Core Area Total					**1,876**	**3,176**
Entiat	Mainstem Entiat	8	216	352	432	704
	Mad River	7.5	202	330	404	660
Entiat Core Area Total					**836**	**1,364**
Methow	Gold Creek	3.5	94	154	188	308
	Twisp River	18	486	792	972	1,584
	Beaver Creek	0.5	14	22	28	44
	Wolf Creek	3.5	94	154	188	308
	Goat Creek	4	108	176	216	352
	Lost River	7.3	197	321	394	642
	Upper Methow	7.5	202	330	404	660
	Chewuch River	18	486	792	972	1,584
	Early Winters Creek	4.6	124	202	248	404
Methow Core Area Total					**3,610**	**5,886**
Total in Recovery Unit					**6,322**	**10,426**

Appendix B - List of Chapters