Chapter: 12

State(s): Oregon

Recovery Unit Name: Imnaha-Snake Rivers Recovery Unit

Region 1
U S Fish and Wildlife Service
Portland, Oregon

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect the 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 or the official positions or indicate the approval of any individuals or agencies involved in the 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.

Literature Citation: U.S. Fish and Wildlife Service. 2002. Chapter 12, Imnaha-Snake Rivers Recovery Unit, Oregon. 86 p. *In*: U.S. Fish and Wildlife Service. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Portland, Oregon.

ACKNOWLEDGMENTS

Members of the Imnaha-Snake Rivers Recovery Unit Team who assisted in the preparation of this chapter include:

Ken Bronec, U.S. Forest Service
Ralph Browning, U.S. Forest Service
Don Bryson, Nez Perce Tribe
Mary Hanson, Oregon Department of Fish and Wildlife
Bill Knox, Oregon Department of Fish and Wildlife
Sam Lohr, U.S. Fish and Wildlife Service
Jeff Oveson, Grande Ronde Model Watershed Group
Paul Sankovich, Oregon Department of Fish and Wildlife
Gretchen Sausen, U.S. Forest Service
Brad Smith, Oregon Department of Fish and Wildlife

Additional review and comments were provided by:

Jim Chandler, Idaho Power Company

IMNAHA-SNAKE RIVERS RECOVERY UNIT
CHAPTER OF THE BULL TROUT RECOVERY PLAN

EXECUTIVE SUMMARY

CURRENT SPECIES STATUS

The U.S. 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 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 unit team with membership from the States of Washington, Oregon, Idaho, and Montana, as well as Native American Tribes, was established to develop a framework for the recovery plan, provide guidance on technical issues, and insure consistency through the recovery planning process. Within the Columbia River Distinct Population Segment, the recovery unit 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. To facilitate the recovery planning process and avoid duplication of effort, the recovery unit team considered the frameworks put forth in Kostow (1995) and Buchanan *et al*. (1997) to develop recovery units in Oregon. The Imnaha-Snake Rivers Recovery Unit was identified as one of the 22 recovery units for bull trout. Use of these existing frameworks will allow for better coordination during both salmon (*Oncorhynchus spp.*) and bull trout recovery planning and implementation.

The Imnaha-Snake Rivers Recovery Unit Team identified three core areas, the Imnaha River, Sheep Creek, and Granite Creek. For the purposes of recovery planning, a core area represents the closest approximation of a biologically functioning unit. Core areas consist of both habitat that could supply all the necessary elements for every lifestage of bull trout (*e.g.*, spawning, rearing, migratory, and adult), and have one or more groups of bull trout (see Chapter 1 for glossary). Research needs apply to areas where the recovery unit team feels more information is needed in order to accurately plan and implement recovery actions.

Based on survey data and professional judgement as well as Kostow (1995) and Buchanan *et al*. (1997), the Imnaha-Snake Rivers Recovery Unit Team has also identified local populations of bull trout which currently exist within each core area. In the Imnaha Core Area (which is entirely in Oregon), local populations currently include the Imnaha River (above the mouth of Big Sheep Creek), upper Big Sheep Creek (above the Wallowa Valley Improvement diversion and in the canal), lower Big Sheep Creek (below the Wallowa Valley Improvement diversion), Little Sheep Creek, and McCully Creek. One local population, the Sheep Creek population, was identified in the Sheep Creek Core Area. One local population, the Granite Creek population, was identified in the Granite Creek Core Area. Both the Sheep Creek and Granite Creek Core Areas (which are entirely in Idaho) are defined at their lower ends by the Snake River.

Key information gaps that need to be addressed in the Imnaha-Snake Rivers Recovery Unit include: (1) the extent to which bull trout from the three core areas use the mainstem of the Snake River and interact with each other, (2) specific information on the suitability of potential spawning and rearing areas in each subbasin, (3) increased inventory in each subbasin to establish more accurately the current distribution and abundance, and (4) a complete limiting factors analysis to identify site specific actions needed to recover bull trout within each core area. Information from each of these tasks is essential in order to define more accurately the recovered distribution and abundance in each core area. The

Imnaha-Snake Rivers Recovery Unit Team believes that it is essential that efforts to collect information be coordinated with local watershed councils and working groups.

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 Imnaha-Snake Rivers Recovery Unit chapter. Within the Imnaha-Snake Rivers Recovery Unit, historical and current land use activities have impacted bull trout local populations. There have been a combination of human-induced factors that affect bull trout including forest management practices, irrigation withdrawals, livestock grazing, past bull trout harvest, and introduction of non-native species. Lasting effects from some, but not all, of these activities still act to limit bull trout production in the Imnaha, Sheep Creek, and Granite Creek 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 throughout 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 Imnaha-Snake Rivers Recovery Unit:

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Imnaha-Snake Rivers 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 Imnaha-Snake Rivers 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 six local populations in the Imnaha-Snake Rivers Recovery Unit.** Within all core areas, local populations should express migratory life history patterns. Designation of local populations is based upon the professional judgement of Imnaha-Snake Rivers Recovery Unit Team members. Further genetic studies are needed to more accurately delineate local populations and quantify spawning site fidelity and straying rates.

2. **Abundance criteria will be met when the estimated abundance of bull trout among all local populations in the Imnaha-Snake Rivers Recovery Unit is at least 5,000 adults.** This abundance estimate is only for the Imnaha Core Area. Recovered abundance estimates in the Sheep Creek and Granite Creek Core Areas are considered a research need. Recovered abundance for the Imnaha Core Area was derived using the professional judgement of the recovery unit team and estimation of productive capacity of identified local populations. Resident and migratory life history forms are included in this estimate, but the relative proportions of each 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. This criterion should be achieved within 25 to 50 years.

3. **Trend criteria will be met when adult bull trout local populations exhibit a stable or increasing trend for at least two generations at or**

above the recovered abundance level. This criterion should be achieved within 25 to 50 years.

4. **Connectivity criteria will be met when specific barriers to bull trout migration in the Imnaha-Snake Rivers Recovery Unit have been addressed.** Within the Imnaha-Snake Rivers Recovery Unit, specific barriers (mostly associated with the Wallowa Valley Improvement Canal) may be inhibiting the recovery of bull trout. However, the recovery unit team expressed great uncertainty about whether many of the barriers can be corrected in a manner that would benefit bull trout.

The Imnaha-Snake Rivers Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. Recovery criteria for the Imnaha-Snake Rivers Recovery Unit were established to assess whether recovery actions have resulted in the recovery of bull trout. Recovery criteria developed for bull trout address quantitative measurements of bull trout distribution and population characteristics. The recovery objectives were based on our current knowledge and may 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 Endangered Species 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 Imnaha-Snake Rivers Recovery Unit is fully contributing to recovery of the species.

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 action 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 Imnaha-Snake River Recovery Unit is estimated at about $ 24 million. This estimate does not include areas outside the Imnaha River, Sheep Creek and Granite Creek, which are considered research needs. Total costs include estimates of expenditures by local, Tribal, State, and Federal governments and by private business and individuals. Successful recovery of bull trout in the aforementioned core areas is contingent on removing barriers, improving habitat conditions, and removal of nonnative species within the recovery unit. 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

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.

In the Imnaha-Snake Rivers Recovery Unit several local populations have relatively good abundance, but many are poorly connected. Degradation and fragmentation of bull trout habitat have resulted in populations that are at risk of extinction. Ultimately, these threats must be addressed in the near future for recovery to be achieved. If identified actions are implemented, the recovery unit team anticipates that recovery could occur within 25 to 50 years.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

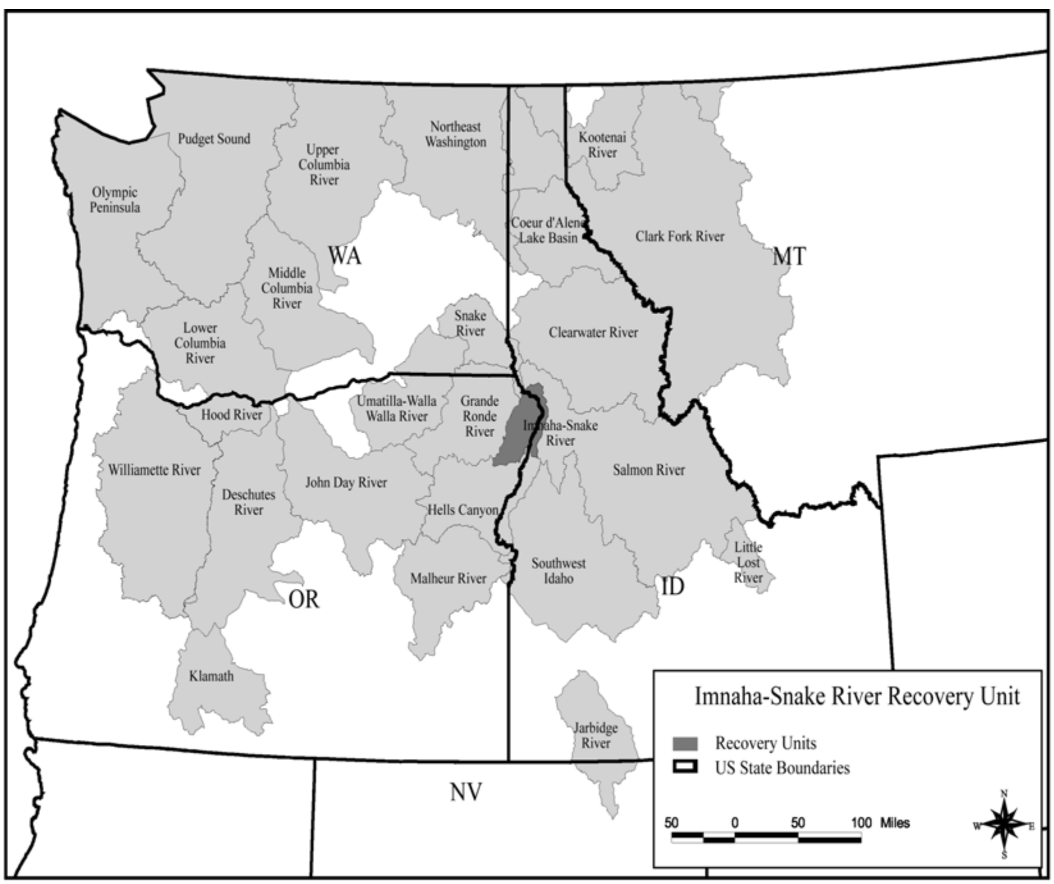
Recovery Unit Designation

The U.S. 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). An emergency rule listing the Jarbidge River population as endangered due to road construction activities was published on August 11, 1998 (63 FR 42757), and the population was subsequently listed as threatened on April 8, 1999 (64 FR 17110), when the emergency rule expired. 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, that is, the U.S. Fish and Wildlife has concluded that they meet the requirements of the joint policy with the National Marine Fisheries Service regarding the recognition of distinct vertebrate populations (61 FR 4722).

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 of bull trout. An overall recovery unit team with membership from the states of Washington, Oregon, Idaho, and Montana, as well as Native American Tribes was established to develop a framework for the recovery plan, provide guidance on technical issues, and insure consistency through the recovery planning process. Within the Columbia River Distinct Population Segment, the recovery unit team has identified 22 recovery units. Recovery unit teams were established to identify specific reasons for decline and develop 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. The Imnaha-Snake Rivers Recovery Unit was identified as one of the 22 recovery units for bull trout. To facilitate the recovery planning process and avoid duplication of effort, the Imnaha-Snake Rivers Recovery Unit Team considered the frameworks put forth in Kostow (1995) and Buchanan *et al*. (1997) to develop recovery units in Oregon. Use of these existing frameworks will allow for better coordination during both salmon and bull trout recovery planning and implementation.

Figure 1. Bull trout recovery units in the United States. The Imnaha-Snake Rivers Recovery Unit is highlighted.



The Imnaha-Snake Rivers Recovery Unit includes bull trout from the Imnaha River, Sheep Creek, and Granite Creek watersheds (Figure 2). The entire Imnaha River subbasin, which constitutes the majority of the recovery unit, is in the State of Oregon. The Sheep Creek and Granite Creek subbasins are located in the State of Idaho.

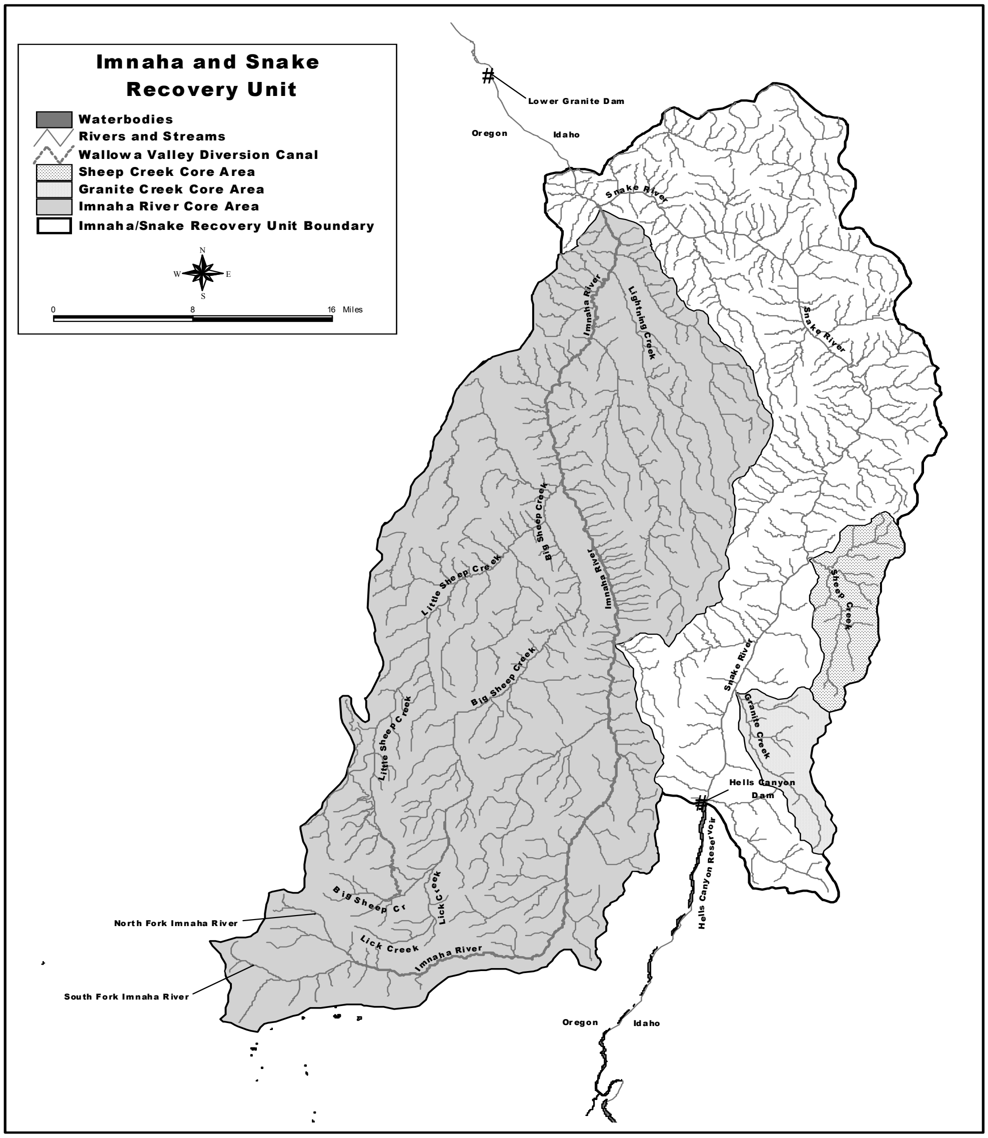
After considering information that is currently available, including that in Ratliff and Howell (1992), Kostow (1995), and Buchanan *et al*. (1997), the recovery unit team identified seven extant, local populations of bull trout within the Imnaha-Snake Rivers Recovery Unit. A local population is considered to be fish from a given species which spawn in a particular lake or stream(s) at a particular season, and which to a substantial degree do not interbreed with any group spawning in a different place, or in the same place at a different season.

The risk of any given population going extinct varies within the recovery unit. The risk of the Imnaha River local population going extinct is low (Ratliff and Howell 1992). The risk of either the local populations above or below the diversion in Big Sheep Creek going extinct is of special concern (see Ratliff and Howell 1992). The risk of the McCully Creek local population going extinct is considered moderate (Buchanan *et al*. 1997). The risk of the Little Sheep Creek local population going extinct is considered high (Buchanan *et al*. 1997). From the Idaho portion of the recovery unit, reports exist of bull trout in Sheep and Granite Creeks. However, information on the status of these stocks is not available, their risk of extinction cannot be determined, and both are considered research needs.

All stocks identified in the recovery unit are believed to be native fish. There have been no known releases of hatchery-origin bull trout anywhere in the recovery unit. There are also no plans to release hatchery-origin bull trout in the recovery unit.

This recovery unit geographically overlaps ceded lands of the Nez Perce Tribe. The tribe has guaranteed treaty fishing rights for both anadromous and resident fish species. When the Imnaha-Snake Rivers Recovery Unit has

Figure 2. Imnaha-Snake Rivers Bull Trout Recovery Unit (Imnaha River, Sheep Creek, and Granite Creek Core Areas of Oregon and Idaho).



achieved its goal, the Oregon Department of Fish and Wildlife and the Idaho Department of Fish and Game as well as the tribal nation will determine the location and level of bull trout harvest which can be sustained while maintaining healthy populations.

Geographic Description

Location. The Imnaha-Snake Rivers Recovery Unit is located in the northeast corner of Oregon and spans the State line into western Idaho. It is defined by a combination of the Imnaha River subbasin and a portion of the Snake River watershed, from the confluence of the Salmon River south to Hells Canyon Dam. A large portion of the recovery unit lies within the boundaries of the Wallowa-Whitman National Forest, the Nez Perce National Forest, and the Hells Canyon Wilderness. The recovery unit drains an area of approximately 2,847 square kilometer (1,112 square miles). The headwaters of the Imnaha River originate in the Eagle Cap Wilderness area. The mainstem Imnaha is formed at an elevation of 1,615 meters (5,300 feet) and flows in a northerly direction for approximately 101 kilometers (63.5 miles) to its confluence with the Snake River at river kilometer 306 (river mile 191) (U.S. Forest Service 1994; Northwest Power Planning Council 2001).

Topography. The Imnaha-Snake Rivers Recovery Unit is diverse in elevation and topographic relief (see Northwest Power Planning Council 2001). The Imnaha River subbasin is characterized by high mountain peaks, high tablelands, and deeply incised valleys. Elevations range from nearly 3,050 meters (10,000 feet) in the Wallowa Mountains to 300 meters (975 feet) at the river's mouth, while the plateaus, such as Lord Flat Plateau, rise to nearly 2,100 meters (7,000 feet). Slopes in the Imnaha River subbasin range from vertical in the Wallowa Mountains to 5 to 15 percent in the shallow slopes of the river valley corridor.

The Snake River subbasin, downstream of Hells Canyon Dam, flows through a canyon that varies in depth from about 1,675 meters (5,500 feet) in the Hells Canyon area to approximately 215 meters (705 feet) in the Lewiston area.

The subbasin is characterized by an elevated mountainous mass cut by the deep canyons of the Snake River. Steep side slopes and narrow valleys typify the Snake River watershed between Hells Canyon Dam and the Salmon River. The corridor alternates from rolling benches to steep, rocky canyon walls. Included in this area, is Hells Canyon, the deepest gorge in North America (see Northwest Power Planning Council 1990).

Climate. The climate in the recovery unit may be classified as temperate, continental, and dry with the Cascade Mountains acting as a barrier to the moisture-bearing winds from the Pacific Ocean (see Northwest Power Planning Council 1990, 2001). However, microclimates do occur as both temperature and precipitation are greatly influenced by elevation. Mean summer temperatures below 914 meters (3,000 feet) are 27 to 32 degrees Celsius (80 to 90 degrees Fahrenheit) and mean winter temperatures are approximately 0 degrees Celsius (32 degrees Fahrenheit). Between 900 and 1,800 meters (3,000 and 6,000 feet), the mean summer temperature is 16 degrees Celsius (61 degrees Fahrenheit) and the mean winter temperature is -7 degrees Celsius (20 degrees Fahrenheit). At greater than 1,800 meters (6,000 feet), the mean summer temperature is 12 degrees Celsius (54 degrees Fahrenheit) and the mean winter temperature is -10 degrees Celsius (14 degrees Fahrenheit) (see Northwest Power Planning Council 2001). Estimates for precipitation range from 23 centimeters (nine inches) per year at the confluence of the Imnaha and Snake Rivers, to 191 centimeters (75 inches) annually at the headwaters. Above 1,525 meters (5,000 feet), more than 70 percent of the annual precipitation is in the form of snow (see Northwest Power Planning Council 1990).

Soils. Landforms in the Imnaha-Snake Rivers Recovery Unit provide a unique and diverse area for soil development (see Northwest Power Planning Council 2001). Varying rock type, topography, and climatic conditions have a large impact on soil-forming processes. In the Imnaha River subbasin, soils are generally derived from the weathering of local bedrock or colluvial rock materials (called residual soils). However, forces other than weathering of bedrock have also been active in the region. Wind derived soils (loess) and ash deposits from the eruptions of Glacier Peak (12,000 years ago) and Mount Mazama (6,600 years ago) have contributed to the productivity of the local soils. Sedimentation in the upper portion of the subbasin occurs due to the instability of the barren granitic peaks. In these areas, the primary mechanism for sediment delivery into the aquatic system is debris flows caused by significant rain and snow events. At lower elevations, in the central part of the valley, the soils have volcanic ash and loess content and are well-developed fertile soils that support modern agriculture.

Soils in the Snake River subbasin are of two types (see Northwest Power Planning Council 1990). At higher elevations, the cold soils are formed from diorite, quartz, monzonite, granite, gneiss, schist, and in volcanic ash overlying basalt. Lower elevation soils were formed mainly from basalt with a thin loess cover and, in smaller areas, from granite. Plateaus and south-facing slopes in this unit have mesic soil temperature and most north slopes are frigid.

Geology. The Imnaha River subbasin is formed by Wallowa granite from the Cretaceous/Jurassic (160 to 120 million years ago) period (see Northwest Power Planning Council 2001). This weather-resistant granite forms the high peaks of the Wallowa mountains where the headwaters of many intermittent creeks form tributaries that merge at terminal moraines of crushed rock and fine sediment. These formations form the beginnings of the Imnaha River and Big and Little Sheep Creeks. As the Imnaha River flows east, cobbles of limerock line the river and creek bed which slowly transition into metamorphosed sedimentary and volcanic rock. As the Imnaha River and its tributaries flow north, they cut through the overlying and more durable Grande Ronde basalt to form deep V-shaped valleys. Quarternary alluvial deposits form narrow river terraces along the banks of the Imnaha River and its major tributaries. The Imnaha River enters the Snake River through an alluvial fan of river-rock and sand, as well as tailings from early mining operations (Vallier 1998).

Geology in the Snake River portion of the recovery unit consists of metamorphosed marine sedimentary and volcanic rocks, granitic and dioritic intrusives, and basalt lavas (see Northwest Power Planning Council 2001). The highly folded and metamorphosed (oldest) rocks are found principally along the lower, steep canyon walls of the Snake River corridor. These rocks consist of metamorphosed volcanic flows, sandstones, mudstones, shales, slates, schists, and greenstones. Basalt rocks are the youngest and most dominant surface rocks that overlie the older metamorphic rock. They formed from a series of basalt lava flows (known as the Columbia River Basalt) measuring from 610 to 1,427 meters (2,000 to 4,100 feet) deep, and are the most extensive rock type in the drainage.

Vegetation. In the Imnaha River subbasin, there are vast expanses of relatively undisturbed land (see Northwest Power Planning Council 2001). The uppermost part of the subbasin is above the tree line. Below the tree line, the watershed contains a mixture of subalpine communities that grade into forested and grassland stands at lower elevations. Lower elevations in the Imnaha River subbasin consist of grassland belonging to a variety of bunchgrass associations with dominants such as bluebunch wheatgrass (*Agropyron spicatum)*, Sandberg's bluegrass (*Poa sandbergii*), and Idaho fescue (*Festuca idahoensis*). Low elevation forest communities are dominated by Douglas fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), and grand fir (*Abies grandis*) (see U.S. Forest Service 1998). Mid-elevation areas are dominated by Douglas fir and ponderosa pine as well as grassland meadow communities consisting of the green fescue/Hood's sedge (*Festuca viridula/Carex hoodii*) association. High elevation areas are more heavily forested, primarily with grand fir, Douglas fir, and ponderosa pine. Subalpine fir (*Abies lasiocarpa*) and whitebark pine (*Pinus albicaulis*) associations dominate the highest elevations until they finally give way to true alpine plant associations in the Eagle Cap Wilderness Area's highest reaches.

Vegetation for the portion of the Snake River subbasin contained within the recovery unit is very similar to that of the Imnaha River subbasin (see Northwest Power Planning Council 1990). It varies according to elevation with bunchgrass associations dominating the flora at the lower elevations. At higher elevations, a mixed coniferous forest of ponderosa pine, Douglas fir, and grand fir predominates.

Hydrology. The Imnaha River subbasin drains an area of 2,266 square kilometers (885 square miles) with its headwaters beginning in the Eagle Cap

Wilderness (see Northwest Power Planning Council 2001). Major tributaries to the Imnaha River include Cow Creek, Lightning Creek, Horse Creek, Big Sheep Creek, Little Sheep Creek, and the South, Middle, and North Forks of the Imnaha River. The U.S. Geological Survey maintains a gauging station near the town of Imnaha. The discharge measured at this gauging station represents approximately 72 percent of the discharge within the subbasin (U.S. Forest Service 1994). The river's mean annual discharge at the Imnaha gauging station is 14.6 cubic meters per second (517 cubic feet per second) based on 73 years of flow data.

The largest irrigation diversion in the Imnaha River subbasin is the Wallowa Valley Improvement Canal (see Northwest Power Planning Council 2001). The project began in the 1800's and presently, it diverts water from both the Big Sheep and Little Sheep Creek watersheds into the Wallowa Valley. Within the entire Imnaha River subbasin, there are approximately 128 water rights with an additional 36 recent filings that have yet to be approved.

In the Snake River portion of the recovery unit, Hells Canyon Dam has had a major influence on the hydrology of the watershed (see Northwest Power Planning Council 2001). The dam is operated by Idaho Power Company for electricity generation and has resulted in daily river flow fluctuations due to variations in demand. The mean monthly flows for the Snake River at Hells Canyon Dam from 1966 to 1996 vary from 309 cubic meters per second (10,920 cubic feet per second) in November to 844 cubic meters per second (29,810 cubic feet per second) in July. The mean river flow at the dam tends to be higher in the summer and lower in the winter. Hells Canyon Dam also affects the flow of sediment throughout the Snake River watershed. Large dams may be up to 99 percent effective in trapping upstream sediment and result in a decrease in the size and number of sandbars in the downstream river. The ability of the system to transport sediments remains high, but little sediment is available for transport. Besides Hells Canyon Dam, other water diversions from the Snake River watershed in the Imnaha-Snake Rivers Recovery Unit are minimal. The only other water diversion within present bull trout habitat (excluding the Snake River) is located on Sheep Creek.

Land Use. Approximately 75 percent of the Imnaha River subbasin is under public ownership (see Northwest Power Planning Council 2001). The majority of the subbasin lies within the Wallowa-Whitman National Forest and is managed by three Ranger Districts (Eagle Cap, Hells Canyon National Recreation Area, and Wallowa Valley). Ranching and grazing, timber harvest, transportation, mining, recreation, and agriculture are primary forms of land use in the subbasin.

Over the past three centuries, domestic livestock grazing has occurred within the subbasin for horses, cattle, and sheep (see Northwest Power Planning Council 2001). Sheep grazing, once prevalent in the subbasin, no longer occurs. Cattle grazing, despite its decline in the late 19th century, remains the major land use activity on private lands in the Imnaha River subbasin (Beamesderfer *et al*. 1996). Evidence of grazing exists throughout the watershed and includes streambank disturbances, soil compaction, and changes to plant communities (U.S. Forest Service 1998). Agriculture within the subbasin is mainly for livestock and grazing. Major crops that are grown within the subbasin are barley, wheat, and hay (see Northwest Power Planning Council 2001).

Prior to 1950, the majority of timber harvested in the Imnaha River subbasin was large diameter Douglas fir, ponderosa pine, and western larch (*Larix occidentalis*) trees accessible from roads (U.S. Forest Service 2000). Due to the growing demand for timber in the late 1950's, even-aged timber management began to increase. However, forest management practices and priorities have changed over the past few decades and timber harvest on Federal lands in the Imnaha River basin has declined significantly. This area includes the Eagle Cap Wilderness Area, established in 1964, and the Hells Canyon Recreation Area, established in 1975. The Imnaha River was designated as a Wild and Scenic River in 1988. Current methods of harvest on federal lands are restricted to salvage logging and selective thinning (U.S. Forest Service 2000). Today, harvest only occurs in 21 percent of the watershed. Currently, 2,067 kilometers (1,292 miles) of open and closed roads exist in the Imnaha River watershed (U.S. Forest Service 2000). Of these, 1,334 kilometers (834 miles) occur on land administered by the Wallowa-Whitman National Forest, and 701 kilometers (438 miles) occur on private, State, and Bureau of Land Management land (U.S. Forest Service 2000).

Historically, gold, silver, copper and cinnabar mining have all occurred in the Imnaha River watershed (U.S. Forest Service 1998). There are currently no active mining claims in the Imnaha River watershed (U.S. Forest Service 1998). Regulations associated with the establishment of Hells Canyon National Recreation Area, Eagle Cap Wilderness, and Imnaha Wild and Scenic River designation withdrew lands associated with these areas from mineral entry. The remainder of the watershed, although open for mineral entry, is unlikely to be mined as it is composed entirely of basalt, which does not contain a marketable source of minerals.

Due to the Wilderness designation, the Wild and Scenic designation, and the Hells Canyon National Recreation Area designation, the Imnaha River watershed continues to draw a wide variety of users for recreational activity (U.S. Forest Service 1998). In the winter, snowmobilers, cross-country skiers and alpinists comprise the majority of recreationalists. In the summer, hiking, horseback riding, fishing, hunting, and camping are popular activities within the subbasin (see Northwest Power Planning Council 2001).

The Snake River subbasin is still in a relatively undeveloped state (see Northwest Power Planning Council 1990). This area contains most of the Hells Canyon National Recreation Area, which encompasses 264,258 hectares (652,488 acres), of which 78,623 hectares (194,132 acres) are designated as wilderness. The history of livestock and grazing in the Snake River watershed is similar to that of the Imnaha River subbasin. At present, grazing allotments are managed such that animals are rotated through areas according to the season, available forage, and resource objectives to minimize environmental impact.

Timber harvest has never been an extensive activity on National Forest lands in the Snake River watershed (U.S. Forest Service 2000). Prior to the late 1960's, timber harvest was restricted to sanitation and salvage logging on the upper plateau areas. No timber harvest is currently ongoing or proposed on

National Forest land in the watershed at this time. At present, there are over 320 kilometers (200 miles) of open and closed roads in the watershed, of which 222 kilometers (138.5 miles) occur on land administered by the Wallowa-Whitman National Forest. The road density for open and closed roads on this portion of the watershed is 0.18 kilometer per square kilometer (0.29 mile per square mile).

Small mining operations occurred in the Snake River watershed during the late 1800's and early 1900's (see Northwest Power Planning Council 2001). However, most activities ceased by the 1930's. It became clear that the inaccessibility of the corridor would prevent mining from ever being a lucrative business. The establishment of Hells Canyon National Recreation Area in 1975 prevented any new mineral entry. Since 1992, no active mining claims have been registered with the U.S. Forest Service or Bureau of Land Management in the Snake River watershed. Therefore, we are unaware of any existing valid mineral rights for this area.

Recreational uses of the Snake River watershed include backpacking, berry picking, camping, cross-country skiing, all terrain vehicle use, fishing, hiking, horseback riding, hunting, mountain biking, mushroom harvesting, boating, snowmobiling, and wildlife viewing and photography. Current management of the recreational facilities include public contacts by U.S. Forest Service personnel in the spring and summer. Trails are also maintained for some of the recreational uses mentioned above. The trail system includes 314 kilometers (196 miles) of trail in Idaho and 310 kilometers (193.6 miles) of trail in Oregon.

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

The Imnaha-Snake Rivers Recovery Unit currently has six populations of bull trout that have been identified. In the final listing rule (63 FR 31647) the U.S. Fish and Wildlife Service identified four bull trout subpopulations in the Imnaha River subbasin. These subpopulations were the Imnaha River, Big Sheep Creek, Little Sheep Creek, and McCully Creek and included both resident and migratory fish. Since the final listing rule (63 FR 31647) the U.S. Fish and Wildlife Service has identified two additional bull trout subpopulations in this unit: Sheep Creek and Granite Creek. Both of these subpopulations are in tributaries, from the State of Idaho, that flow directly into the Snake River.

At the time of listing (June 1998), the status of and trend in these subpopulations was unknown. These subpopulations were not considered to be at risk of extirpations due to natural events. The U.S. Fish and Wildlife Service determined that there were four major threats to the Imnaha-Snake River subpopulations of bull trout. These threats were dams, forestry, grazing, and agriculture.

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 both the current understanding of bull trout life history and conservation biology theory. Therefore, the term subpopulation will not be used in this chapter. Population terminology is provided in Chapter 1.

Current Distribution and Abundance

In the past, wild bull trout occurred throughout the Imnaha-Snake Rivers Recovery Unit. Although bull trout were probably never as abundant as other salmonids in the subbasin, they were probably more abundant and more widely distributed than they are today. Reports from anglers who fished the Imnaha River in the 1940's suggest that large bull trout were relatively abundant.

Currently, the U.S. Fish and Wildlife Service considers there to be three core areas in the Imnaha-Snake Rivers Recovery Unit: the Imnaha River, Sheep Creek, and Granite Creek. Four bull trout local populations have been recognized in the Oregon portion of the recovery unit (Ratliff and Howell 1992): the Imnaha River (above the mouth of Big Sheep Creek), Big Sheep Creek, Little Sheep Creek, and McCully Creek. In the Idaho portion of the recovery unit, Oregon Department of Fish and Wildlife (Buchanan *et al*. 1997), Idaho Fish and Game, and the U.S. Forest Service generally recognize one local population of bull trout in Sheep Creek, and one local population of bull trout in Granite Creek. Although there have also been bull trout observed in the mouths of Deep and Wolf Creeks, there does not appear to be a distinct local population of bull trout in these creeks (B. Knox, Oregon Department of Fish and Wildlife, pers. comm. 2002; Buchanan *et al*. 1997). All bull trout in the Imnaha-Snake Rivers Recovery Unit are native fish sustained by wild production. There is very little information to indicate whether these stocks are genetically distinct. The Oregon Department of Fish and Wildlife separated stocks based on geographical, physical, and thermal isolation of the spawning populations.

For the purposes of the recovery plan bull trout local populations within the Imnaha-Snake Rivers Recovery Unit have been designated based on re-establishment of connectivity and reduction of threats (See Strategy for Recovery). The Oregon Department of Fish and Wildlife in cooperation with the U.S. Fish and Wildlife Service, U.S. Forest Service, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe, conduct annual bull trout spawning ground surveys in selected locations within the basin. This data represents the best census information available for abundance within the Imnaha River subbasin. The U.S. Fish and Wildlife Service is unaware of any census information for the Sheep Creek and Granite Creek stocks of bull trout.

Imnaha River. Depending on the season, bull trout can be found throughout the Imnaha River (see Buchanan *et al*. 1997). For examples, summer distribution in the mainstem Imnaha River extends from at least river kilometer 64 (river mile 39.8) to the Forks at river kilometer 118 (river mile 73.3), whereas fall and spring distributions include the lower Imnaha and Snake Rivers. Bull trout have been observed throughout the mainstem of the Imnaha River as well as in the South Fork, Middle Fork, and North Fork of the Imnaha. In the Middle Fork, upstream distribution appears to be limited by a waterfall that is approximately 2 river kilometers (1.2 river miles) from the mouth. Bull trout have also been observed in Bear, Blue, and Soldier Creeks, all tributaries to the South Fork of the Imnaha River. Although there have been isolated reports of bull trout in Lightning Creek (Buchanan *et al*. 1997), standard surveys have not been able to document meaningful numbers of spawning and rearing fish.

Spawning in the Imnaha River presumably occurs in the headwater areas as well as in some headwater tributaries. Most known summer rearing and holding areas in the Imnaha River are on National Forest or wilderness lands above Summit Creek. On an intermittent basis, bull trout can also be found distributed throughout the mainstem Imnaha River, perhaps migrating to and from various tributaries or following sources of food. It is certain that some fluvial bull trout from the Imnaha River migrate out of the Imnaha River and overwinter in the Snake River and, given recent radiotelemetry data (Chandler and Richter 2001), fish found in the Imnaha River below Summit Creek are probably moving between summer or spawning habitat and overwinter habitat in the lower Imnaha or Snake Rivers. Fluvial adults appear to migrate upstream in the Imnaha River during the months of May, June, July, and perhaps August. Fluvial adults appear to move downstream in the Imnaha River during the months of August, September, October, and perhaps November.

Limited information is available on the abundance of bull trout in the Imnaha River. Standard redd counts (G. Sausen, U.S. Forest Service, pers. comm. 2001) have been conducted only recently. Migratory adults captured at a chinook salmon weir (near river kilometer 74; river mile 46) have been enumerated since the mid-1980's (P. Sankovich, Oregon Department of Fish and Wildlife, pers. comm. 2002). However, in many years the weir did not begin operating until after the middle of July (S. Parker, Oregon Department of Fish and Wildlife, pers. comm. 2002). In some years, standard creel surveys are conducted between September and April for a summer steelhead fishery (Flesher, *in litt.* 2002). Although these surveys collect some information on bull trout, they are not done in a manner conducive to estimating abundance. Ratliff and Howell (1992) considered bull trout from the Imnaha River at low risk of extinction. Little information is available on the size of these fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, or survival rates. It seems likely that bull trout in this population complex exhibit both resident and fluvial life history forms.

Big Sheep Creek. Bull trout in Big Sheep Creek have been observed throughout the mainstem as well as in the Middle and South Forks of the Imnaha River, Salt Creek, and Lick Creek (Buchanan *et al*. 1997). Summer distribution extends from approximately river kilometer 43 to 61 (river mile 26.7 to 37.9) in Big Sheep Creek, from river kilometer 0 to 11 (river mile 0 to 6.8) in Lick Creek, and includes the lower 2.5 river kilometers (1.6 river miles) of Salt Creek. Historically, summer distribution likely extended downstream in Big Sheep Creek to around the mouth of Coyote Creek. Although Smith and Knox (1992) concluded that at least 300 spawning bull trout were probably present, no specific population estimates have been conducted in Big Sheep Creek. Ratliff and Howell (1992) considered bull trout in Big Sheep Creek between a low and moderate risk of extinction. Although there is poor information on the dynamics of bull trout in Big Sheep Creek, the majority of summer rearing appears to occur above river kilometer 50 (river mile 31) near Owl Creek (Buchanan *et al*. 1997). Presumably spawning occurs in the headwater tributaries. Resident fish in Big Sheep Creek were found to mature at a fork length of approximately 160 mm (6.3 inches) (Smith and Knox 1992). Otherwise, very little information is available on the size of fluvial fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, and survival rates. Few, if any, attempts have been made to capture fluvial bull trout migrating in Big Sheep Creek. However, it seems likely that bull trout in this population exhibit fluvial and resident life history forms. A diversion for the Wallowa Valley Improvement Canal exists at approximately river kilometer 61 (river mile 37.9) of Big Sheep Creek. Fish can be found on both sides of this diversion, which has segregated the population of bull trout in Big Sheep Creek. While fish may occasionally ‘spill’ downstream, fish cannot pass upstream of the diversion.

Little Sheep Creek. Bull trout in Little Sheep Creek have been observed throughout the mainstem as well as in Cabin and Redmont Creeks (Buchanan *et al*. 1997). The summer distribution extends from approximately river kilometer 37 to 45 (river mile 23 to 28) in Little Sheep Creek and includes the lower few kilometers of both Cabin and Redmont Creeks. Bull trout were observed in Little Sheep Creek during presence/absence surveys in 1991 but not in 1992. No specific population estimates have been conducted for bull trout in Little Sheep Creek. Very little information is available on the size of fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, and survival rates. Buchanan *et al*. (1997) considered bull trout in Little Sheep Creek at a high risk of extinction.

Although there is poor information on the dynamics of bull trout in Little Sheep Creek, the majority of summer rearing appears to occur above the canal diversion at approximately river kilometer 41 (river mile 25.5) (Buchanan *et al*. 1997). Presumably spawning occurs above river kilometer 41 (river mile 25.5) in Little Sheep Creek and in the lower portions of Cabin and Redmont Creeks. Fluvial bull trout migrating upstream in Little Sheep Creek have been captured at the Oregon Department of Fish and Wildlife's steelhead facility (weir). The weir is at approximately river kilometer 8 (river mile 5) and generally operates between March and June. Although this evidence suggests that a fluvial component still exists in this population, it seems likely that bull trout in this population also exhibit a resident life history form.

A diversion for the Wallowa Valley Improvement Canal exists at approximately river kilometer 41 (river mile 25.5) of Little Sheep Creek. This diversion has segregated the population of bull trout in Little Sheep Creek. While fish may occasionally 'spill' downstream, fish cannot pass upstream of the diversion. In addition, fish above the diversion may not have originated in Little Sheep Creek but may have originated from any number of streams (*e.g.*, Big Sheep Creek) being diverted into the canal. Finally, some of the tributaries to Little Sheep Creek (*i.e.*, Redmont Creek) have also been segregated by a diversion for the canal.

McCully Creek. Bull trout have been observed throughout McCully Creek (Buchanan *et al*. 1997). Summer distribution extends from the uppermost reaches of McCully Creek down to the canal diversion (at approximately river kilometer 4.5 or river mile 2.8). Bull trout from McCully Creek are probably distributed in the canal. Fish movement up the canal is likely limited by a 9 meter (29.5 foot), cascading waterfall that is approximately 4 kilometers (2.5 miles) from McCully Creek. Fish movement down the canal is probably limited, at least seasonally, by poor water quality conditions and warm water temperatures that would force fish back into McCully Creek. Smith and Knox (1992) estimated approximately 8 bull trout per 100 square meters of McCully Creek, and extrapolated a total population estimate of 2,500 fish. However, Buchanan *et al*. (1997) considered bull trout in McCully Creek at a moderate risk of extinction because of the isolated nature of this population.

Although there is poor information on the dynamics of bull trout in McCully Creek, summer rearing and spawning appears to occur throughout the creek, particularly in National Forest and Wilderness areas (Buchanan *et al*. 1997). Very little information is available on the size of fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, and survival rates. Fluvial bull trout appear to exist in all other populations of the Imnaha River subbasin, including Little Sheep Creek, to which McCully Creek is a tributary. Hence, it seems probable that McCully Creek once supported bull trout that expressed a fluvial life history. However, bull trout in McCully Creek have essentially been isolated above the canal diversion since the 1880's. Thus, bull trout in McCully Creek are no longer able to express a fluvial life history form, and instead exhibit a resident life history form.

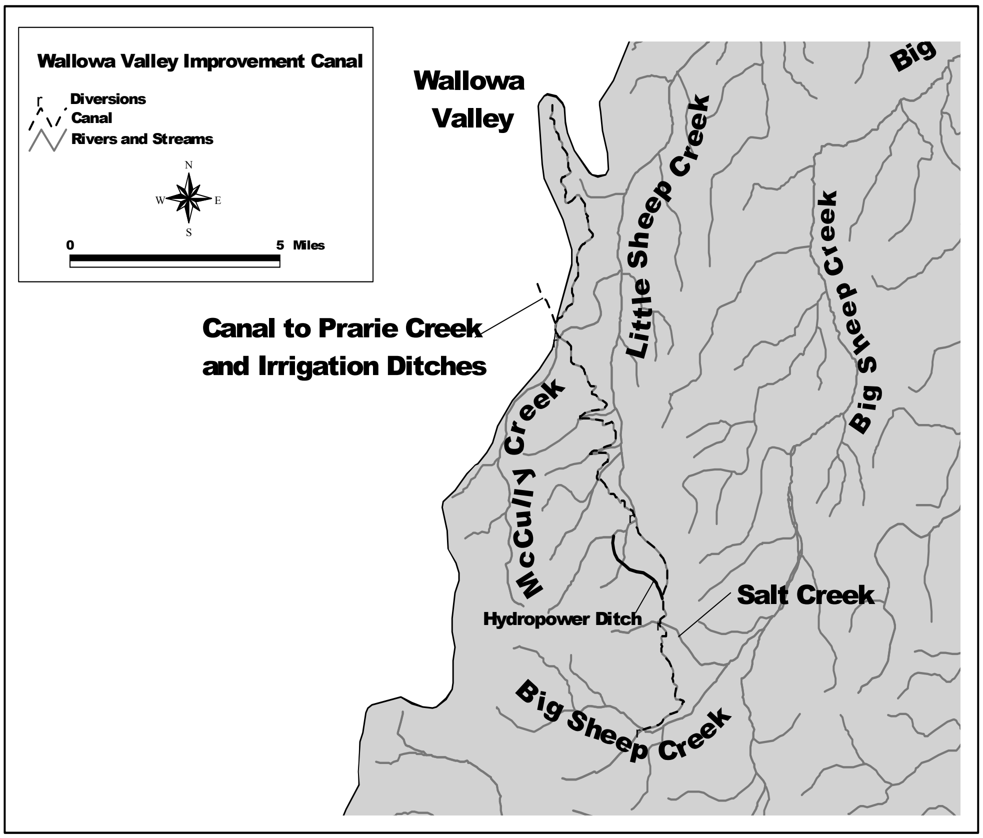
The Wallowa Valley Improvement Canal diversion exists at approximately river kilometer 4.5 (river mile 2.8) of McCully Creek. This diversion has isolated the population of bull trout in McCully Creek to areas above the canal. While fish may occasionally 'spill' downstream, fish cannot pass upstream of the diversion. In addition, fish above the diversion may have originated from McCully Creek or from any number of streams (*e.g.*, Big Sheep Creek) being diverted into the canal.

Wallowa Valley Improvement Canal. Bull trout have been observed throughout the Wallowa Valley Improvement Canal (Buchanan *et al*. 1997). Construction of this canal began in the 1800's. The canal begins near Big Sheep Creek and carries water from various tributaries (*e.g.*, Big Sheep Creek, Salt Creek, Little Sheep Creek, McCully Creek) into Prairie Creek or assorted irrigation canals found in the Wallowa Valley (which is part of the Grande Ronde Recovery Unit for bull trout) (Figure 3). Parts of the canal were constructed while other parts utilized existing stream channels. The canal has a waterfall approximately 1 river kilometer (0.6 mile) below Ferguson Creek that is likely impassable to bull trout. Bull trout in the canal have not been recognized as a distinct population. The majority of bull trout in the canal probably originated from Big Sheep Creek, but some fish may be from a variety of streams (*e.g.*, Salt Creek, Little Sheep Creek, McCully Creek). The number of bull trout in the canal is unknown. Although there is poor information on the dynamics of bull trout in the canal, summer rearing and spawning appears to occur throughout, but particularly in the uppermost reaches of the canal (Buchanan *et al*. 1997). All fish in the canal are resident; the fluvial life history form cannot be expressed by bull trout in the canal.

Sheep Creek. Sheep Creek (Idaho) flows directly into the Snake River. A population of bull trout exists in Sheep Creek (Buchanan *et al*. 1997). Bull trout in Sheep Creek likely express both fluvial and resident life history forms (see Chandler and Richter 2001). The number of bull trout in the Sheep Creek is unknown. The distribution, abundance and life history characteristics of bull trout in Sheep Creek have been identified as research needs.

Granite Creek. Granite Creek (Idaho) flows directly into the Snake River. A population of bull trout exists in Granite Creek (Buchanan *et al*. 1997). Bull trout in Granite Creek likely express both fluvial and resident life history forms (see Chandler and Richter 2001). The number of bull trout in Granite Creek is unknown. The distribution, abundance, and life history characteristics of bull trout in Granite Creek have been identified as research needs.

Figure 3. Wallowa Valley Improvement Canal, Wallowa County, Oregon.



REASONS FOR DECLINE

Dams

Dams can affect bull trout by altering habitats; flow, sediment, and temperature regimes; migration corridors; and interspecific interactions, especially between bull trout and introduced species (Rode 1990; Washington Department of Wildlife 1992; Craig and Wissmar 1993; ODFW, *in litt*. 1993; Rieman and McIntyre 1993; Wissmar *et al*. 1994; Bodurtha, *in litt.* 1995). In addition, hydroelectric facilities can directly impact bull trout via entrainment, and by direct injury or mortality by passing through turbines. Impassable dams and other barriers have caused declines of bull trout primarily by preventing access of migratory fish to spawning and rearing areas in headwaters and precluding recolonization of areas where bull trout have been extirpated (Rieman and McIntyre 1993; Montana Bull Trout Scientific Group 1998).

The Imnaha River as well as Sheep and Granite Creeks flow into the Snake River between Lower Granite and Hells Canyon Dams. Bull trout from the Imnaha River, Sheep Creek (Chandler and Richter 2001), and likely Granite Creek express a fluvial life history form, migrating to and overwintering in the mainstem of the Snake River. Dams in the Snake River have impaired the connectivity between bull trout local populations from the Imnaha-Snake Rivers Recovery Unit and those from below Lower Granite Dam or above Hells Canyon Dam. Lower Granite Dam has also changed the habitat where bull trout potentially overwinter from a free-flowing river to a reservoir. The specific impacts of these dams to bull trout from the Imnaha-Snake Rivers Recovery Unit are unclear. Please refer to Chapter 1 of this recovery plan for further discussion on mainstem issues.

Forest Management Practices

Past and present forest management practices on Federal, private and State lands have and continue to adversely affect riparian and stream habitat as well as bull trout. Past practices such as logging (for example, Little Sheep Creek watershed), thinning of riparian vegetation, the destruction of riparian vegetation and increased sedimentation from forest roads (for examples, Imnaha River watershed) have impacted bull trout. Agricultural clearing (for example, Big Sheep Creek between the forest boundary and Coyote Creek), loss of woody debris from campground development (for example, Lick Creek), and harvest-related wildfire have also decreased the function of the existing riparian vegetation in many areas.

The riparian functions that have been compromised include the ability of the vegetation to act as a sediment filter and provide streambank stability, overhead shade, detritus, and a source of instream wood. Riparian species size and composition have decreased from historical conditions and buffer widths between roads and streams are too narrow in many drainages to filter out all soil movement before it reaches the stream. The abundance of large instream wood has been reduced in some watersheds due to the lack of recruitment sources in riparian areas logged in the past or burned in historical wildfires. Some bank erosion has occurred where timber harvest and/or wildfire has removed vegetation with roots integral to the bank stability.

Streambank conditions, in certain areas, are poor with low vegetative coverage and high erosiveness due to past timber harvest and/or the imprint of a road located within the riparian vegetation. Soil movement from harvest sites and road systems adds to the existing high embeddedness level of the streambed substrate where riparian vegetation buffers are insufficiently wide to intercept this material. This high embeddedness decreases the amount of suitable spawning and rearing habitat through the filling of interstitial spaces and filling of pool habitat. The combination of eroding streambanks, high sediment loading and lack of large woody debris have caused sections of stream channel to have higher bankfull width/depth ratios than would be expected of the channel type. These degraded stream segments are wider and shallower than normal. Furthermore, diverse benthic fauna is beneficial to native trout species at all life stages and embedded substrates can have detrimental effects on invertebrate density and species diversity.

Although habitat in the recovery unit has been impacted and may affect bull trout, impacts to bull trout from degraded habitat should be assessed while considering the context in which bull trout use the impacted area. For example, embeddedness is less of an issue in migratory corridors than it is in spawning areas. Some of the habitat impacts found in this recovery unit are outside of the summer rearing or spawning areas used by bull trout.

Livestock Grazing

Livestock grazing has contributed to the decline of bull trout through impacts to both upland and riparian areas of many tributaries in the recovery unit. For example, livestock use affects habitat between Owl Creek and Lick Creek (Big Sheep Creek watershed) and in the lower several kilometers of Lick Creek. Significant livestock grazing (as well as some feedlot development) also exists in the lower portion of Little Sheep Creek. The result of poor livestock management is overgrazing of the riparian vegetation. This overutilization leads to the reduced effectiveness of species that cover and stabilize streambanks. The compacting and cutting action of the hooves of livestock on moist soils causes the sloughing of banks where localized use for feeding, watering, and crossing occurs. The indirect effects are increased bank erosion and embeddedness of the streambed substrate, widening of the stream channel and an increase in water temperature due to lack of overhanging vegetation. Livestock may also cause direct mortality of eggs or alevin if the redd (spawning bed) is trampled during watering or crossing.

Agricultural Practices

The construction and operation of dams and diversions, both within and outside the Imnaha-Snake Rivers Recovery Unit, has contributed to the decline of bull trout populations. Within the Imnaha River subbasin, diversions exist in association with the Wallowa Valley Improvement Canal. Barriers have been constructed in Big Sheep Creek, Little Sheep Creek, and McCully Creek (Figure 3). These barriers divert water into the canal, which carries the water to the Wallowa Valley (part of the Grande Ronde River subbasin and Grande Ronde

Recovery Unit) primarily for irrigation. The diversion at McCully Creek (for example) has effectively isolated bull trout since the 1880's (Buchanan *et al*. 1997).

All of these diversions were constructed without fish passage facilities. Lack of passage prevents bull trout from below the diversions from being connected with bull trout above the diversions. Lack of passage also prevents bull trout from above the diversions from being connected to bull trout below the diversions or to the mainstems of the Imnaha and Snake Rivers. All of these diversions were constructed without screens to prevent fish from entering the canal. As a result, some bull trout have entered and spawn and rear in the canal (Buchanan *et al*. 1997). Bull trout populations above the canal diversions may connect to each other through the canal. However, a waterfall exists in the canal less than 1 river kilometer (0.6 river mile) below Ferguson Creek. Bull trout in the canal above this waterfall likely originated from Big Sheep Creek whereas bull trout in the canal below the waterfall likely originated from McCully Creek. As a result, the canal may not provide much opportunity for populations to be connected.

Bull trout within the Imnaha-Snake Rivers Recovery Unit have been and continue to be adversely affected by irrigation diversions and water withdrawals. Unscreened or inadequately screened irrigation diversions may strand bull trout (and other fish) in irrigation canals, sometimes resulting in high mortality. In addition, water withdrawals from streams for irrigation, particularly in late summer, exacerbate natural low-flow conditions and in some streams. Low flows in late summer can prevent bull trout, which are preparing to spawn, from reaching spawning grounds and can strand them. Low stream flows can also strand rearing juvenile fish in dry channel beds. Low flows can also result in elevated water temperatures which can delay spawning. When irrigation water is returned to streams and rivers, it carries sediment and nonpoint pollution from agricultural chemicals which degrade water quality. Specific concerns include, for example, much of the Little Sheep Creek watershed, which has water withdrawals that reduce summer and fall flows in the upper reaches of the system.

Transportation Network

Although roads exist in the Imnaha-Snake Rivers Recovery Unit, road densities are not particularly high in many of the watersheds. Depending upon their location, roads may have made some contribution to the reduction of riparian vegetation or disconnected the habitat at stream crossings. However, the recovery unit team did not believe that the transportation network in the Imnaha-Snake Rivers Recovery Unit was a substantial reason for the decline of bull trout.

Mining

Although small mines exist in the Imnaha-Snake Rivers Recovery Unit, there are no major mines nor is there a tremendous number of mines. Depending upon their location, mines may have had some minor impact on bull trout habitat. However, the recovery unit team did not believe that mines in the Imnaha-Snake Rivers Recovery Unit were a substantial reason for the decline of bull trout.

Residential Development

Residential development has contributed to the decline of bull trout. For example, residential developments have encroached on much of Little Sheep Creek. As the human population in the recovery unit increases more development and subsequent impacts to riparian areas, water quality, and bull trout are likely. Impacts to bull trout from previous and future development may include loss of riparian habitat, increases in nutrient loading from septic systems, increases in chemical inputs, and additional road construction.

Fisheries Management

Harvest. Bull trout tend to be aggressive and easily caught through angling. However, the species was considered undesirable until recently. Historical harvest of bull trout may have eliminated populations in small tributaries and contributed to the overall decline. For example, before the 1990's bull trout angling was permitted in the State of Oregon. Angling in the Imnaha

River watershed was controlled by standard statewide seasons and limits for trout. Over the course of the 1990's, fishing for bull trout in Oregon became severely restricted (see, for example, Oregon Department of Fish and Wildlife 2001). By 1994, angling to harvest bull trout in the Imnaha River watershed was prohibited as catch and release regulations were implemented. Currently, both the States of Oregon and Idaho prohibit angling for bull trout in the Imnaha-Snake Rivers Recovery Unit (see Oregon Department of Fish and Wildlife 2001; Idaho Department of Fish and Game 2001).

Although illegal, harvest of bull trout still occurs in the Imnaha River subbasin. Angling pressure is moderate to high near the many campground areas in the subbasin. Anglers likely still harvest bull trout from the Imnaha River, Big Sheep Creek, and Little Sheep Creek watersheds. Although brook trout are not prevalent in the subbasin, some of this bull trout harvest results from the difficulty in distinguishing between bull trout and brook trout. As a result, anglers sometimes mistake a bull trout for a brook trout and accidentally harvest the fish. In general, there is limited understanding on the amount and threat of harvest and angling mortality in the recovery unit. Improved understanding will determine the degree of threat and assist in developing management activities (*e.g.*, additional enforcement, public education and outreach) to reduce the threats.

Hatcheries. Barriers associated with hatchery operations may also be contributing to the decline of bull trout populations within the Imnaha-Snake Rivers Recovery Unit. Weirs to capture adult chinook (Imnaha River) and adult steelhead (Little Sheep Creek) are operated by Oregon Department of Fish and Wildlife. These weirs are designed to operate at a time when fluvial bull trout may also be moving upstream, and do capture bull trout. By impeding the migration of fish, these weirs may alter when and where bull trout spawn. Acclimation facilities are also present at the weir sites in the Imnaha River and Little Sheep Creek. Water intakes to these facilities, and screens associated with these intakes, may divert or impinge juvenile bull trout. As such, these intakes and screens may negatively impact the migration of juvenile bull trout.

Brook and Rainbow Trout. Other trout species exist in the recovery unit. For example, rainbow trout (*Oncorhynchus mykiss*)can be found in Little Sheep Creek (Oregon) and Sheep Creek (Idaho). It is unclear whether and to what extent bull trout compete with rainbow trout. In addition, brook trout (*Salvelinus fontinalis*) may exist in the recovery unit. However, brook trout have not been documented in the Imnaha Core Area. Although interactions with other trout species are possible, they are probably not responsible for the decline of bull trout in this recovery unit.

Anadromous Salmonids. Anadromous salmonids have declined throughout the Imnaha-Snake Rivers Recovery Unit and many are currently listed under the Endangered Species Act (*i.e.*, chinook, *Oncorhynchus tshawytscha*; steelhead, *O. mykiss*) (see National Marine Fisheries Service 2000c). Juvenile salmonids produced by anadromous parents are considered to have been a primary food source of bull trout. Thus, a reduction in prey base has likely contributed to the decline of bull trout in the Imnaha-Snake Rivers Recovery Unit.

Disease. No significant fish disease issues for bull trout have been observed in the recovery unit at this time. However, diseases that could impact bull trout (for example, whirling disease) do exist in the Snake River watershed. These diseases may be impacting bull trout in a manner that is not simple to quantify and may have the potential to impact bull trout in the recovery unit.

Isolation and Habitat Fragmentation

Isolation through habitat fragmentation has resulted from a variety of events. Habitat fragmentation has primarily occurred due to road and dam construction. For example, some fluvial bull trout from the Imnaha River exhibit behavior patterns (*i.e.,* leave the Imnaha River and swim upstream in the Snake River until they reach Hells Canyon Dam) which suggest their migration may be blocked by Hells Canyon Dam. Although the recovery unit team did not consider culverts a major threat to bull trout, it is unknown whether culvert placement prevents upstream migration and precludes bull trout from some tributaries in the recovery unit. Loss of riparian habitat, primarily, has resulted in water temperatures during the summer that may be warmer than they were historically. On a seasonal basis, this warm water may act as a thermal barrier to isolate bull trout.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Efforts to recover salmonid species, including bull trout, are ongoing in the Imnaha-Snake Rivers Recovery Unit. There is a relatively high level of cooperation among fishery entities on various projects. For example, spawning surveys to assess and monitor status and abundance are a cooperative effort involving the Oregon Department of Fish and Wildlife, Oregon State Police, U.S. Forest Service, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, and local volunteers. The following represents some of the major, ongoing efforts within the recovery unit.

Oregon Department of Fish and Wildlife has a number of ongoing efforts to conserve bull trout. The department has reduced or eliminated trout stocking programs; adopted changes in angling regulations to prohibit take of bull trout; modified regulations on other fisheries to reduce incidental take; made changes to in-water work periods to better address bull trout needs; developed and distributed bull trout identification posters; and hired a bull trout coordinator in 1995 to complete statewide bull trout status assessment, map bull trout distribution, and develop conservation strategies for bull trout. When bull trout were listed the coordinator's effort shifted to recovery planning. Oregon Department of Fish and Wildlife also receives funding through a section 6 cooperative agreement with the U.S. Fish and Wildlife Service, which has helped support spawning surveys for bull trout. In 1994, the Oregon Department of Fish and Wildlife modified fishing regulations in the Imnaha River subbasin, closing it to the harvest of bull trout. The Oregon Department of Fish and Wildlife modified operations at their weir on the Imnaha River to provide timely passage for bull trout migrating upstream. They also collect abundance and timing information on fluvial bull trout migrating upstream to spawn.

The Oregon Department of Fish and Wildlife, Oregon State Police, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, U.S. Forest Service, and Idaho Power Company staff work cooperatively on spawning and habitat surveys, research, telemetry, and abundance projects. The U.S. Forest Service and Oregon Department of Fish and Wildlife implemented a bull trout research project in 2001 in the Imnaha River subbasin. This research focuses on the fluvial migrations, spawning locations and temperature requirements of bull trout. The project will contribute to status assessments as well as recovery planning. The project is ongoing. Idaho Power Company has been conducting and continues to conduct radiotelemetry surveys in the area around Hells Canyon Dam and in tributaries below Hells Canyon Dam.

In 2002, the States of Oregon and Idaho are scheduled to complete a Water Quality Management Plan for the Imnaha River subbasin as well as for that portion of the Snake River which is in the Imnaha-Snake Rivers Recovery Unit. In other recovery units, Water Quality Management Plans have identified high water temperatures as a threat to bull trout recovery. Water temperature is also one of the parameters identified in the Total Maximum Daily Load process and its improvement would benefit bull trout populations in the basin. This process is mandated by the Federal Clean Water Act.

The Nez Perce Tribe is planning to initiate a gene conservation effort which would include the application of cryogenic technology for bull trout in the Imnaha River subbasin. This technology seeks to preserve genetic diversity of listed bull trout subpopulations before further population decline and loss of genetic diversity occurs.

RELATIONSHIP TO OTHER CONSERVATION EFFORTS

State of Oregon

On January 14, 1999, Governor Kitzhaber expanded the Oregon Plan for Salmon and Watersheds to include all at-risk wild salmonids throughout the State through Executive Order 99-01. The goal of the Oregon Plan is to "restore populations and fisheries to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits". Components of this plan include (1) coordination of efforts by all parties, (2) development of action plans with relevance and ownership at the local level, (3) monitoring progress, and (4) making appropriate corrective changes in the future. It is a cooperative effort of State, local, Federal, tribal and private organizations, and individuals.

The Oregon Department of Fish and Wildlife and Oregon Water Resources Department have established priorities for restoration of streamflow as part of the Oregon Plan for Salmon and Watersheds (Measure IV.A.8). The Oregon Department of Fish and Wildlife has prioritized streamflow restoration needs by ranking biophysical factors, water use patterns, and the extent that water limits fish production in a particular area. Oregon Water Resources Department watermasters will incorporate the priorities into their field work activities as a means to implement flow restoration measures. The needs priorities will be used by the Oregon Watershed Enhancement Board as one criterion in determining funding priorities for enhancement and restoration projects. Watershed councils and other entities may also use the needs priorities as one piece of information to determine high priority restoration projects. Bull trout occupied streams in the recovery unit are included in the highest priority designation for streamflow restoration (Northwest Power Planning Council 2001).

Opportunities to convert existing out-of-stream flows to instream flows in Oregon are available through a variety of legislatively mandated programs administered by Oregon Water Resources Department, for example, transfers of type and place of use (Oregon Revised Statute 536.050(4)), voluntary written agreements among water users to rotate their use of the supply to which they are collectively entitled (Oregon Revised Statute 540.150 and Oregon Administrative Rule 690-250-0080), allocating “conserved water” to instream use (Oregon Revised Statute 537.455 to 537.500), leasing all or a portion of consumptive water rights to instream purposes (Oregon Revised Statute 537.348, Oregon Administrative Rule 690-77-070 to 690-77-077, exchanging a water right for an instream purpose to use water from a different source, being stored water, surface or ground water (Oregon Revised Statute 540.533 to 540.543), and substituting a ground water right for a primary surface water right (Oregon Revised Statute 540.524). Oregon Water Trust provides purchase of water rights from willing landowners for conversion to instream water rights.

Under an agreement with the Environmental Protection Agency, the State of Oregon’s Department of Environmental Quality is conducting Total Maximum Daily Load surveys and developing Water Quality Management Plans. For example, in the Imnaha River subbasin, Total Maximum Daily Load surveys are scheduled to be completed throughout the subbasin by 2002 (http://www.deq.state.or.us/wq/TMDLs). These plans should addresses forest, agricultural, urban and transportation sources of water quality impairment.

The Agricultural Water Quality Management Program, established through the State Senate Bill 1010 process (Oregon Revised Statute 568.900 through 568.933), addresses water pollution associated with agricultural lands and activities.

The Oregon Department of Fish and Wildlife developed a management plan for native trout (Oregon Department of Fish and Wildlife 1988), which includes bull trout. Oregon’s trout plan focuses on protecting native fish and the habitats in which they exist. The plan provides specific guidance to managers and is consistent with much of the recovery plan.

Columbia River Intertribal Fish Commission

The Columbia River Intertribal Fish Commission developed the Tribal Columbia River Fish Restoration Plan, or Wy-Kan-Ush-Mi Wa-Kish-Wit (http://ccrh.org/comm/river/docs/critfcp.htm). Recommendations set forth in this plan for salmon recovery address three types of actions: institutional, technical, and watershed, with the goal of putting fish back in the river. Objectives and strategies specific to the Imnaha River subbasin are included in this restoration plan and will ultimately benefit bull trout.

Nez Perce Tribe

Much of this recovery unit is ceded lands of the Nez Perce Tribe. The Nez Perce Tribe is responsible for managing, protecting, and enhancing treaty fish and wildlife resources and habitats in the Imnaha River subbasin. The Nez Perce Tribe co-manages fishery resources with the Oregon Department of Fish and Wildlife and implements restoration and mitigation activities throughout areas of northeast Oregon. The Nez Perce Tribe individually and/or jointly implements restoration and mitigation activities in the subbasin. The Nez Perce Tribe's Department of Fisheries Resources Management is responsible for managing fisheries resources to provide for healthy self-sustaining populations of historically present species, and to promote healthy ecosystem processes and rich species diversity (see Northwest Power Planning Council 2001).

Confederated Tribes of the Umatilla Indian Reservation

Much of this recovery unit is usual and accustomed territory for the Confederated Tribes of the Umatilla Indian Reservation. The Confederated Tribes of the Umatilla Indian Reservation is responsible for protecting and enhancing treaty fish and wildlife resources and habitats. Members of the Confederated Tribes of the Umatilla Indian Reservation have fishing and hunting rights in much of the recovery unit. Confederated Tribes of the Umatilla Indian Reservation fish and wildlife activities relate to all aspects of management (see Northwest Power Planning Council 2001).

Northwest Power Planning Council's 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 tributaries. The Northwest Power Planning Council develops and oversees the Columbia River Basin Fish and Wildlife Program that is implemented by the Bonneville Power Administration, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and 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 in part accomplished through the development of subbasin summaries, which identify the status of fish and wildlife resources, limiting factors, and recommended actions at the subbasin level.

Draft Imnaha and Snake-Hells Canyon subbasin summaries were completed in June 2001 (see http://www.cbfwa.org/files/province/blue/ subsum/010601Imnaha.pdf and http://www.cbfwa.org/files/province/blue/ subsum/010601SnakeHell.pdf). These summaries encompass the Imnaha-Snake Rivers Recovery Unit, and are consistent with bull trout recovery planning efforts to identify limiting factors. The draft subbasin summaries identify elevated temperature, degraded channel conditions, reduced instream habitat diversity, insufficient flow, degraded riparian habitat, and lack of passage as contributing to the decline of bull trout. The recovery unit team will continue to utilize this planning process to identify and seek funding for projects to aid bull trout recovery.

National Marine Fisheries Service

Salmon and steelhead from Snake River tributaries are also listed under the Endangered Species Act. In 1992 the National Marine Fisheries Service listed the Snake River spring/summer chinook Evolutionarily Significant Unit as well as the Snake River fall chinook Evolutionarily Significant Unit (57 FR 23458). In

1997 the National Marine Fisheries Service listed the Snake River steelhead Evolutionarily Significant Unit (62 FR 43937). These Evolutionarily Significant Units encompass the Imnaha-Snake Rivers Recovery Unit. As part of the recovery planning process for chinook and steelhead the National Marine Fisheries Service has issued technical guidance for the development of recovery plans (National Marine Fisheries Service 2000a). Currently, there are 26 Evolutionarily Significant Units which have been listed as either threatened or endangered. The framework for steelhead and salmon recovery plan development is divided into distinct geographic areas, or domains, which may contain multiple Evolutionarily Significant Units. Recovery plans for listed salmon and steelhead will contain the same basic elements as the bull trout recovery plan, both which are 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. Time frames for recovery plan development for chinook and steelhead have not been finalized, but the Imnaha-Snake Rivers Recovery Unit Team will coordinate the implementation of bull trout recovery actions with salmon and steelhead measures to maximize the use of available resources and avoid duplication.

Numerous biological opinions have been issued by the National Marine Fisheries Service regarding salmon and steelhead in the Imnaha-Snake Rivers Recovery Unit. These include, for example, opinions on operations of the Federal Columbia River Power System (National Marine Fisheries Service 2000b). More specifically, in December 2000, the National Marine Fisheries Service issued a biological opinion on the “Effects to Listed Species from Operation of the Federal Columbia River Power System”. Although designed for salmon and steelhead, reasonable and prudent alternatives in the biological opinion are consistent with many of the needs identified by the recovery unit team for bull trout.

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, as well as for 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.

Three core areas were defined for this recovery unit, one in the Imnaha River subbasin (Oregon), one in the Sheep Creek subbasin (Idaho) and one in the Granite Creek subbasin (Idaho) (Figure 2). The Imnaha River Core Area encompasses tributaries containing local populations (both current and potential as identified by the recovery unit team) and the mainstem Imnaha River from the headwaters downstream to the Snake River. The Sheep Creek Core Area encompasses tributaries containing a local population and the mainstem from the headwaters downstream to the Snake River. The Granite Creek Core Area encompasses tributaries containing a local population and the mainstem from the headwaters downstream to the Snake River.

Imnaha Core Area. In a recovered condition, this core area includes four natural, local populations: Imnaha River, Big Sheep Creek, Little Sheep Creek and McCully Creek. This core area also includes one derived, local population in the Wallowa Valley Improvement Canal. The canal has been colonized by native bull trout, mostly originating from Big Sheep Creek above the diversion. Functionally, bull trout from upper Big Sheep Creek and in the canal act as a fifth population. Some of these populations may represent a single, local population whereas others may consist of more than one local population. For example, the Imnaha River Core Area may have one local population in the North Fork and one in the South Fork. For the present however, or until research shows otherwise, each is considered one local population. Many of these local populations (*i.e.*, McCully Creek) have the potential to become core areas if further research shows the local populations cannot or do not connect with other local populations.

Sheep Creek Core Area. This core area includes the Sheep Creek local population. Most, if not all, of the current spawning activity likely occurs in Sheep Creek.

Granite Creek Core Area. This core area includes the Granite Creek local population. Most, if not all, of the current spawning activity likely occurs in Granite Creek.

The current distribution of bull trout in the Imnaha-Snake Rivers Recovery Unit includes the Imnaha River, Big Sheep Creek, Little Sheep Creek, McCully Creek, the Wallowa Valley Improvement Canal, Sheep Creek, and Granite Creek. To the best of our knowledge, historical distribution is generally reflected in the current distribution. The exception to this is the current distribution of bull trout in the Wallowa Valley Improvement Canal, which did not exist historically. Although it is clear that bull trout from the Imnaha River and Sheep Creek migrate to the Snake River and back, the extent of their use and distribution in the Snake River mainstem is uncertain. Information on bull trout use patterns within the Snake River mainstem has been defined as a primary research need.

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 throughout 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 Imnaha-Snake Rivers Recovery Unit:

- Maintain the current distribution of bull trout and restore distribution in previously occupied areas within the Imnaha-Snake Rivers Recovery Unit.

- Maintain stable or increasing trends in bull trout abundance.

- Restore and maintain suitable habitat conditions for all life history stages and forms.

- Conserve genetic diversity and provide opportunity 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 Imnaha-Snake Rivers Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Imnaha-Snake Rivers 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 Imnaha-Snake Rivers 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.

This approach to developing recovery criteria acknowledges that the status of populations in some core areas may remain 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 Imnaha-Snake Rivers 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 (Meffe and Carroll 1994) (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. Based on the above guidance, the Imnaha River (5 local populations), Sheep Creek (one local population), and Granite Creek (one local population) Core Areas are each considered to be at increased risk from stochastic events.

Adult Abundance. The recovered abundance levels in the Imnaha-Snake Rivers 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 from genetic drift.

Overall, adult abundance in the Imnaha River Core Area was estimated at approximately 4,000 adults and was not considered at risk from genetic drift. Abundance estimates in the Sheep Creek, and Granite Creek Core Areas were not available, so the risk to local populations from inbreeding depression and the risk to core areas for genetic drift could not be determined at this time.

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.

Since estimates of the total population size are rarely available in the Imnaha-Snake Rivers Recovery Unit, 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 which is below recovered abundance levels but moving toward recovery would be expected to exhibit an increasing trend in the indicator. Based on limit information (less than five years of data) each core area was considered at increased risk.

Connectivity. The presence of the migratory life history form within the Imnaha-Snake Rivers 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 is present but local populations lack connectivity, the core area was considered to be at increased risk. If the migratory life form persists 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. Finally, 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 Imnaha River Core Area, one major physical barrier currently exists which obstructs connectivity. However, migratory bull trout are present in many local populations, so the core area is considered to be at intermediate risk. Within the Sheep Creek and Granite Creek Core Areas, no major physical barriers obstruct connectivity, and migratory forms are present resulting in a diminished risk level.

Recovery Criteria

Recovery criteria for bull trout in the Imnaha-Snake Rivers Recovery Unit are the following:

1. **Distribution criteria will be met when bull trout are distributed among at least six local populations in the recovery unit.** There are four local populations in the Imnaha River Core Area, and one each in the Sheep Creek and Granite Creek Core Areas. In the Imnaha River Core Area, local populations would include at least the Imnaha River, Big Sheep Creek, Little Sheep Creek, and McCully Creek. For the recovered condition in the Imnaha River Core Area, the current local populations occurring in Big Sheep Creek (above and below the Wallowa Valley

Improvement Canal) would be reconnected resulting in 4 local populations (See Table 1). In the Sheep Creek Core Area a local population of bull trout would exist in Sheep Creek and its tributaries. In the Granite Creek Core Area a local population of bull trout would exist in Granite Creek and its tributaries. Additional population studies, and a better understanding of bull trout fidelity to their natal streams, is needed to better define local populations in the recovery unit (See Research Needs). There is potential to further separate bull trout from the Imnaha River Core Area into eight populations. After further evaluation, it may be determined that local populations do or should exist in Lick Creek, both forks of the Imnaha River as well as the mainstem of the Imnaha River below the forks, and Lightning Creek.

2. **Abundance criteria will be met when estimated abundance of bull trout among all local populations in the Imnaha-Snake Rivers Recovery Unit is at least 5,000 adults.** This abundance estimate is only for the Imnaha River Core Area. Recovered abundance estimates in the Sheep Creek and Granite Creek Core Areas are considered a research need. Recovered abundance for the Imnaha River Core Area was derived using the professional judgement of the recovery unit team, an estimation of productive capacity of identified local populations (see Table 1), and conservation biology theory. Estimates of the resident and fluvial life history components of local populations, or within a core area, are also considered a research need. These goals may be refined as more information becomes available through monitoring and research. In the Imnaha River Core Area, increased population abundance is expected to occur by securing the distribution in the Imnaha River, and by securing and expanding the seasonal distribution of bull trout in Little Sheep Creek, Big Sheep Creek, and McCully Creek. Spawning habitat in the Imnaha River, McCully Creek, and upper Big Sheep Creek needs to be protected, and in lower Big Sheep Creek and Little Sheep Creek it needs to be protected and expanded. There are opportunities to protect and enhance migratory habitat throughout Little Sheep Creek, and in the lower portions of the Imnaha River and Big Sheep Creek. To insure that fish from

populations throughout the core area are connected, it will be necessary to assess the feasibility of providing passage at diversions in the Wallowa Valley Improvement Canal. Opportunities to protect spawning and rearing habitat on private lands through purchase from willing sellers, conservation easements, land exchange or other means should be pursued. Restoration efforts to improve anadromous salmonid production in the Imnaha River Core Area can be expected to benefit existing and potential migration corridors and overwintering habitat for bull trout as well as improve their prey base.

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 identified core areas.** In the Imnaha-Snake Rivers Recovery Unit, long-term, reliable information is not available on the trends in bull trout population abundance. In addition, for bull trout in general, current methods to assess the population status of bull trout are often inadequate. Existing monitoring efforts should continue and new methods should be developed and implemented. This criterion should be achieved within 25 to 50 years.

4. **Connectivity criteria will be met when specific barriers to bull trout migration in the Imnaha-Snake Rivers Recovery Unit have been addressed.** Passage barriers within the Imnaha-Snake Rivers Recovery Unit need to be addressed, ensuring opportunities for connectivity among local populations within the core area. In the Imnaha Core Area this includes evaluating and addressing dams and diversions for irrigation and channelization (primarily associated with the Wallowa Valley Improvement Canal) as well as culverts which are potential passage barriers to bull trout throughout the core area. This also includes assessments of the impacts of barriers outside the core areas that affect core area local populations, such as Lower Granite Dam and Hells Canyon Dam, both in the mainstem of the Snake River. This also includes assessing methods and implementing actions to provide connectivity that has been disrupted by the Wallowa Valley Improvement Canal. The canal

has effectively isolated bull trout in upper Big Sheep Creek and McCully Creek. Research is needed to evaluate the impacts of this isolation on (for example) population genetics and population viability.

Identification of these barriers does not imply that other actions associated with passage and habitat degradation are not crucial for recovery to occur. To achieve recovery in the Imnaha-Snake Rivers Recovery Unit, all four recovery criteria (local populations, abundance, population trends, and barrier removal) must be achieved. It is unlikely that meeting all four recovery criteria will be accomplished by removing or otherwise addressing only the barriers identified in criteria four.

Table 1. Current local populations of bull trout within the Imnaha-Snake Rivers Recovery Unit (Oregon and Idaho) and streams with potential to expand existing bull trout distribution.

Core Area	Local Populations	Creeks with Expansion Potential
Imnaha River	Imnaha and upper tributaries	Lightning Creek
	Big Sheep and tributaries (above and including Wallowa Valley Improvement Canal)	
	Little Sheep and tributaries	
	McCully Creek and tributaries	
	Big Sheep and tributaries (below Wallowa Valley Improvement Canal)	
Sheep Creek	Sheep Creek	
Granite Creek	Granite Creek	

Recovery criteria for the Imnaha-Snake Rivers Recovery Unit were established to assess whether recovery actions are resulting in the recovery of bull trout. The Imnaha-Snake Rivers 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 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 Imnaha-Snake Rivers Recovery Unit is fully contributing to recovery of the population segment.

Research Needs

Based on the best scientific information available, the recovery unit team has identified recovery criteria and actions necessary for recovery of bull trout within the Imnaha-Snake Rivers Recovery Unit. However, the recovery unit team recognizes that many uncertainties exist regarding bull trout population abundance, distribution, and recovery actions needed. The recovery unit team feels that if effective management and recovery are to occur, the recovery plan for the Imnaha-Snake Rivers Recovery Unit should be viewed as a "living" document, to be updated as new information becomes available. As part of this adaptive management approach, the Imnaha-Snake Rivers Recovery Unit Team has identified essential research needs within the recovery unit.

General: The Snake River. A primary research need is a complete understanding of the current, and future, role that the Snake River should play in the recovery of bull trout. It is likely that fluvial bull trout life histories involved, at the very least, seasonal use of the mainstem Snake River. Bull trout have and do use the Snake River for part of their life history. It is essential to establish with greater certainty the current bull trout distribution and seasonal use areas within the Imnaha-Snake Rivers Recovery Unit. To this end, the recovery unit team recommends the development and application of a scientifically accepted, statistically rigorous, standardized protocol for determining the present distribution of bull trout. Application of such a protocol will improve the recovery team's ability to identify additional core areas, or revise the current classification. Specifically, tributaries from which there are isolated or anecdotal reports of bull trout using the mainstem of the Snake River should be targeted to clarify bull trout distribution within the recovery unit. This includes, but is not limited to, the mainstem of the Imnaha River and Sheep Creek.

The Imnaha River flows into the Snake River between Lower Granite and Hells Canyon Dams. Both of these dams could be a barrier to bull trout as could the reservoir created by Lower Granite Dam. Although Lower Granite Dam has a ladder for passage of anadromous species, Hells Canyon Dam does not provide for fish passage. Hells Canyon Dam is an Idaho Power facility that is a terminal barrier to upstream movement. Whether bull trout are attempting to move upstream in the Snake River and are being blocked by Hells Canyon Dam needs to be further evaluated. Lower Granite Dam is part of the Federal Columbia River Power System. Incidental catch of bull trout at Federal Columbia River Power System facilities has only been recorded in the Fish Passage Center database since 1997. Prior to 1997, a bull trout sighting could have been noted as a “comment”, but would not have been recorded in the database. Records prior to 1997 need to be examined for any documentation of bull trout in the comments. Passage facilities and reservoir operations at Lower Granite Dam need to be evaluated as to their suitability for bull trout.

General: Distribution and Abundance. The Imnaha-Snake Rivers Recovery Unit Team based estimates of recovered abundance levels and the number of local populations on the best available information and professional judgement. Information about historical abundance levels and distribution of spawning populations is very limited. The recovery unit team realizes that recovery criteria will most likely be revised as recovery actions are implemented and bull trout populations begin to respond. The 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 adaptive management approach will identify actions that maximize the ability to achieve recovery objectives. In addition, this approach will provide a better understanding of key uncertainties crucial to long-term management actions.

The Imnaha-Snake Rivers Recovery Unit Team has identified an urgent need for the development of a standardized monitoring and assessment program that would more accurately describe the current status of bull trout within the recovery unit, as well as identify improvements in current sampling protocols that would allow for monitoring the effectiveness of recovery actions. This recovery unit chapter is the first step in the planning process for bull trout recovery in the Imnaha-Snake Rivers 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. An important component in recovery implementation and the use of adaptive management will be the evaluation of recommended actions. Development and application of models that assess population trend and extinction risk will be useful in refining recovery criteria as the recovery process proceeds.

Specific Information Needs: Snake River. There are a number of research needs regarding habitat use and movements of bull trout. One such research need is data on the movement and seasonality of use of different habitat types in the mainstem Snake River by fluvial bull trout from the Imnaha River, Sheep Creek, and Granite Creek. For fluvial bull trout using the mainstem Snake River, the timing of use (arrival and departure), the habitat conditions in the mainstem associated with these movements, the manner in which fish use the mainstem (including the reservoir behind Lower Granite Dam), the frequency with which fish enter or leave the mainstem, and the fidelity that fish have to a particular tributary all need to be determined. These studies should be conducted in conjunction with studies on bull trout from adjacent recovery units, for example, Grande Ronde, Clearwater, etc. to determine areas of overlapping use and possible interactions. Additional information is needed on the distribution and abundance of bull trout in Sheep Creek, Little Sheep Creek, Granite Creek, and Lightning Creek as well as on the presence/absence of bull trout in other tributaries to the Snake River. Studies are also needed to determine the migration timing and pathways in and between tributaries within the Imnaha-Snake Rivers Recovery Unit.

As discussed in Chapter 1, a standardized, statistically sound bull trout population monitoring program should be designed and implemented. Methods should include techniques appropriate for monitoring the abundance of fluvial, resident, and mixed local populations. Periodic monitoring should include potential habitat (core habitat) where the status of bull trout is unknown or re-establishment is anticipated. Databases should be reviewed and updated with bull trout distribution records. A centralized database should be developed and maintained for all bull trout distribution and monitoring data. This activity needs to be supported directly and should include data from Tribal, State, and Federal activities.

Research should be conducted to determine life history characteristics of both local resident and migratory bull trout (including limiting factors). Studies should include an evaluation of population structure (life table) of existing local populations, determination of age- and size-specific fecundity and longevity of both resident and fluvial bull trout, and comparison of the characteristics of relatively strong and weak populations (*e.g.*, Big Sheep Creek and Little Sheep Creek). Research is also needed to determine the range of temperature tolerances for bull trout life stages in different habitats and the mechanism by which resident life forms undergo transition to migratory forms. The resulting data should be used to evaluate the adequacy of existing State water quality regulations. Additional data on the food habits of bull trout is needed to assess whether the prey base necessary for increased bull trout abundance is available. Specifically, the relationship between the prey base needed by bull trout and efforts to increase chinook and steelhead populations (particularly through hatchery supplementation) should be explored.

Another research need is to evaluate connectivity among local populations. This will include determining whether bull trout from McCully Creek, upper Big Sheep Creek, and the rest of the Imnaha Core Area need to be connected to achieve recovery. The consequences of genetic fragmentation/population isolation due to human-made barriers should also be evaluated (for example, low, warm water conditions in the lower portion of the

Imnaha River). Feasibility assessments should be conducted for establishing connectivity where it is required to achieve recovery criteria for the recovery unit.

Studies will be needed to assess progress and response of habitat/local populations to implementation of recovery tasks. The effectiveness of different active and passive habitat restoration techniques in restoring watershed function and local bull trout populations should be evaluated (*e.g.* grazing management projects on Big Sheep Creek).

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 species' range; they appear in *italic type*. These tasks may or may not 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 (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and 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 Imnaha-Snake Rivers Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Imnaha-Snake Rivers Recovery Unit chapter should be updated or revised as recovery tasks are accomplished, environmental conditions change, or monitoring results or other new information becomes available. Revisions to the Imnaha-Snake Rivers 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 Imnaha-Snake Rivers Recovery Unit Team should meet annually to review annual monitoring reports and summaries, and make recommendations to the U.S. Fish and Wildlife Service.

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 Identify sources of sediment delivery. Roads are a main source of sediment in the Imnaha-Snake Rivers Recovery Unit. Use existing Oregon Department of Transportation as well as proposed U.S. Forest Service road assessments to identify areas where action is necessary to correct problems associated with roads. Landslides are also a significant source. Use existing habitat surveys to identify problem areas and U.S. Forest Service regulatory processes to help correct the problem.

1.1.2 Assess effects on bull trout from nonpoint source pollution. Impacts to bull trout in terms of nutrients (*i.e.*, feedlots in Little Sheep Creek and winter feeding of livestock in valley bottoms) are unknown. At least in part, they could be determined through the Total Maximum Daily Load or SB1010 processes.

1.1.3 Conduct a trail assessment in the Sheep Creek and Granite Creek watersheds. Both watersheds have an extensive trail system. Recreational use of the upper elevations of the watershed are limited to summer and fall. The goal is to assess the contribution of the trail systems in each watershed to erosion and sediment delivery to streams. Specific areas in need of maintenance and repair should be identified and prioritized.

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

1.2.1 Assess the feasibility of installing appropriate fish passage structures around diversions or removing related migration barriers. Diversions considered migration barriers include the Wallowa Valley Improvement Canal diversions on Big Sheep Creek, Little Sheep Creek, and McCully Creek.

1.2.2 Assess the feasibility of installing appropriate fish screening structures in the Wallowa Valley Improvement Canal. It may be appropriate to screen the canal so that bull trout remain in their natural stream of origin. However, during certain times of the year, it may be difficult to maintain screens that function properly.

1.2.3 Restore connectivity and opportunities for migration. At least in part, this could be accomplished by restoring instream flows in McCully Creek, Little Sheep Creek, and Big Sheep Creek. To accomplish this, explore options such as purchasing or leasing water rights.

1.2.4 Assess whether hatchery weirs are impacting bull trout. Hatchery weirs in the Imnaha River (Oregon Department of Fish and Wildlife) acting as passage barriers may be influencing the spawning distribution and spawning time of bull trout. This potential impact should be evaluated.

1.2.5 Assess whether hatchery intakes are impacting bull trout. Assess the impacts to bull trout of operating hatchery intakes at Oregon Department of Fish and Wildlife's Imnaha Satellite Facility. Insure that these intakes are screened properly.

1.2.6 Salvage stranded bull trout. In areas where fish become stranded because of low water conditions (*i.e.*, the Wallowa Valley Improvement Canal), conduct salvage operations.

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

1.3.1 Restore riparian zones associated with bull trout habitat. Revegetate to restore shade and canopy, riparian cover, and native vegetation, for example, in Big Sheep Creek from Coyote to Owl Creek as well as in upper Little Sheep Creek and its tributaries.

1.3.2. Maintain riparian zones associated with bull trout habitat. Manage streams (*i.e.*, Big Sheep Creek) in a manner designed to maintain existing riparian growth and function.

1.3.3. Reduce grazing impacts. Management alternatives exist (*e.g.*, fencing, changes in timing and use of riparian pastures, off site watering and salting) which have been proven to reduce grazing impacts. These should be used in (for example) Big Sheep Creek from Coyote to Owl Creek.

1.3.4. Assess the need for stream channel restoration activities. Potential bull trout habitat on National Forest lands and on private lands needs to be assessed. For example, assess restoring the channel at the spillway on the canal and the upper Little Sheep Creek road crossing.

1.3.5. Maintain long-term wood recruitment in the Imnaha River subbasin.

1.3.6 Conserve existing high quality bull trout habitat in Sheep Creek, Granite Creek, and the Snake River. The conservation of existing habitat, spawning, and early rearing as well as sub-adult and adult rearing habitat, along with the current bull trout populations in these areas, is essential to avoid further loss of, or increased risk to, the species. All available scientific, land management, and political means should be used to assess and manage human actions in these areas to assure conservation of the existing high quality habitat and the populations of bull trout.

1.3.7 Conduct a stream assessment in Sheep and Granite Creeks. The goals are to evaluate stream conditions and to develop and apply basin management plans, if needed, based upon the current condition of the streams. Most measures should be aimed at determining the quality of fish habitat with an additional component of fish surveying. Problems should be identified and prioritized.

1.3.8 Protect, maintain, and enhance anadromous fish habitats to increase available forage species for bull trout. Anadromous fish historically provided abundant forage to bull trout. Steelhead and chinook salmon have drastically declined from historical levels and the current limited availability of these prey may be limiting bull trout distribution and abundance. Increasing abundance of anadromous fish will provide a greater prey base to bull trout. Bull trout may use accessible fish bearing tributaries as foraging habitat, particularly in fall, winter, and spring, when water temperatures are cooler. Activities to improve anadromous fish habitats in watersheds with mixed ownership may require coordinated watershed management plans and acquisition of conservation easements for private land enhancement/protection measures.

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

1.4.1. <u>Evaluate the impacts of Lower Granite Dam and Hells Canyon Dam</u>. Bull trout from the Imnaha-Snake Rivers Recovery Unit enter the mainstem of the Snake River. However, how bull trout use the mainstem of the Snake River and whether they attempt to pass either dam has not been determined, and impacts of hydropower facility operation have not been well defined.

1.4.2. <u>Review reservoir operations</u>. The impacts to bull trout from various aspects of reservoir operations, including but not limited to, water level manipulation, physical entrainment, and gas entrainment need to be thoroughly explored. As a result of these reviews, operational recommendations should be provided through the Federal Energy Regulatory Commission, State relicensing processes, and Federal consultations. For examples, assess operations of Lower Granite Dam and the Hells Canyon Complex.

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

1.5.1 <u>Assess current risk of catastrophic fire to bull trout populations</u>. Vulnerable areas include Lick Creek and Big Sheep Creek.

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 Evaluate enforcement policies for preventing illegal transport and introduction of nonnative fishes.

2.2.1 Evaluate enforcement of fish stocking regulations. Improve enforcement of laws governing illegal transport and introduction of live fish. For example, in Oregon illegal transport of live fish is a priority for the Coordinated Enforcement Program. Develop standard and effective procedures for responding to illegal introductions of nonnative fishes throughout the States of Oregon, Idaho and Washington, particularly in the Snake River.

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

2.3.1 Provide information to the public. Implement an educational effort about the problems and consequences of unauthorized fish introductions.

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 Assess the interactions between bull trout and introduced fishes. Determine site-specific levels of competition and hybridization of bull trout with introduced fish and assess impacts of those interactions; especially lake trout, rainbow trout, brook trout, brown trout, northern pike, largemouth and smallmouth bass, and walleye.

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

2.6.1 Implement management actions to reduce the distribution and abundance of nonnative species where bull trout will benefit.

2.6.2 Investigate feasibility of screening the outlet at Twin Lakes. This would help reduce the risk of brook trout entering the Imnaha River during high water years.

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 integrating adaptive research.

3.1.1 Coordinate plans associated with fish management. Incorporate bull trout recovery actions and adaptively integrate research results into The Oregon Plan for Salmon and Watersheds, Idaho Native 5-Year Plan, the Northwest Power Planning Council's subbasin plans, Federal land management plans, the Wallowa County and Nez Perce Multi-Species Plan, local watershed council action plans, and other relevant fish and habitat management plans. Request assistance with implementation of recovery strategies for bull trout through all relevant plans.

3.1.2 Coordinate recovery efforts on bull trout, salmon and steelhead. Coordinate bull trout recovery with recovery efforts being developed for other listed species (*e.g.*, Snake River Spring/Summer chinook salmon). Implement recovery plans for other listed species.

3.1.3 Evaluate and improve fisheries management guidelines and policies designed to protect native species. Examples include the U.S. Forest Service's and Bureau of Land

Management's, Land and Resource Management Plans and associated aquatic conservation strategy (PACFISH/INFISH), and Oregon Department of Fish and Wildlife's Native Fish Conservation Policy.

3.1.4 Emphasize and support compliance with management plans that improve Snake River anadromous fish smolt:adult return ratios or fish production for the upper Snake River Basin. Anadromous fish historically provided abundant forage to bull trout. Steelhead and chinook salmon have drastically declined from historical levels and the current limited availability of these prey may be limiting bull trout distribution and abundance. Increasing abundance of anadromous fish will provide a greater prey base to bull trout.

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

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.*

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

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 <u>Conduct watershed assessments</u>. Evaluate historical and present conditions in each habitat type by watershed.

5.2.2 <u>Determine the range of temperature tolerances for bull trout life stages in different habitats</u>. Use the results of ongoing temperature studies to address the adequacy of existing regulations. The recovery unit team identified this as a need range-wide.

5.2.3 <u>Determine the seasonal movement patterns of adult and sub-adult migratory bull trout</u>. This action would include bull trout which use different habitat types, including the mainstem Snake River. This information is necessary to determine how bull trout from the Imnaha-Snake Rivers Recovery Unit are related to each other as well as other bull trout populations in Snake River watersheds.

5.2.4 <u>Evaluate food web interactions</u>. This action is particularly relevant in drainages most affected by introduced fishes and reservoir operations. For example, the mainstem of the Snake River and the lower Imnaha River.

5.3 Conduct evaluations of the adequacy and effectiveness of current and past Basin Management Plans 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.

5.4.1 <u>Maintain fish health screening and transplant protocols</u>. This will help reduce risk of disease transmission. Include discussion of fish health in the terms and conditions in permits for hatchery operations for guidance.

5.4.2 <u>Provide information to the public</u>. Produce a whirling disease informational pamphlet for public distribution. This should contain current information of this parasites distribution in Oregon and Washington and list precautions that should be taken by the fishing public to help prevent its spread to other watersheds.

5.4.3 <u>Monitor for effects of fish pathogens on Oregon bull trout populations</u>. Follow Oregon Department of Fish and Wildlife protocols (in development) for handling and disposition of bull trout mortalities, for example, submission to Oregon Department of Fish and Wildlife fish pathology laboratories for disease assessment.

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

5.5.1 Determine life history requirements. Local resident and migratory bull trout populations both exist in the recovery unit and may have different requirements.

5.5.2. Investigate the relationship between bull trout and anadromous species. This relationship is particularly important relative to predator-prey interactions. Evaluate the dependence of bull trout on anadromous prey.

5.5.3. Continue to survey for bull trout. Periodically monitor for bull trout in potential habitat where their status is unknown or recolonization is anticipated.

5.5.4 Compare weak and strong populations. The characteristics of relatively strong (*e.g.*, abundant, well distributed) and relatively weak but otherwise similar populations (for example, the McCully Creek and Little Sheep Creek populations) may be very different. This information is necessary to understand the factors limiting bull trout populations.

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

5.6.1 Determine the consequences of genetic fragmentation and isolation. This isolation may be due to human-made or natural barriers (*e.g.*, the Wallowa Valley Improvement Canal). The recovery unit team identified this as a need range-wide.

5.6.2 Investigate use of the mainstem Snake River by bull trout from all three core areas. It is essential to understand how important this area is in the life history of bull trout from this recovery unit. This should be done in conjunction with studies on bull trout from adjacent recovery units (*e.g.*, Grande Ronde, and Clearwater) to determine areas of overlapping use and possible interactions.

5.6.3 Evaluate the population structure of bull trout in the recovery unit. Assess whether the recovery unit consists of one large population or multiple populations and whether there appears to be any metapopulation structuring. This information would be used to assess, and refine if needed, the current local population designations.

5.6.4 Evaluate basic life history characteristics. Determine the age- and size- specific fecundity of fluvial and resident bull trout. For both fluvial and resident bull trout, determine the age at first spawning, size at first spawning, longevity, and the number of spawns during a life time.

5.6.5 Evaluate survival rates. Determine the embryo to fry, fry to age 'X', and age 'X' to first spawn survival rates as well as parent to progeny ratios. Generate a life table. Identify which life stages have the greatest mortality and what factors may be associated with that mortality.

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 Provide long-term habitat protection. This may be accomplished through conservation easements, management plans, purchase from willing sellers, and land exchanges or other means. Specifically, explore whether these opportunities exist in the Big Sheep and Little Sheep creek watersheds.

6.1.2 Work cooperatively with neighboring States and governments. Many of these watersheds span interstate and tribal boundaries. Cooperation will be necessary to implement recovery actions.

6.1.3 Provide information to the public. Develop educational materials on bull trout and their habitat needs, for example, watershed form and function, riparian and side channel restoration, and large wood placement.

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

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.

7.1.1 Develop a participation plan to support implementation in the recovery unit. Consider a combined coordination meeting for the Grande Ronde and Imnaha-Snake Rivers Recovery Units. Share results and data, check progress toward recovery, and coordinate work for coming field season.

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

7.3 Revise strategy for recovery as suggested by new information.

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 five years, if available, and comments. These tasks, when accomplished, are expected to lead to recovery of bull trout in the Imnaha-Snake Rivers Recovery Unit. Costs estimates are not provided for tasks which are normal agency responsibility under existing authorities.

Parties with authority, responsibility, or expressed interest to implement 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.

BPA	Bonneville Power Administration
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
IDFG	Idaho Fish and Game
NMFS	National Marine Fisheries Service
NPT	Nez Perce Tribe
NPPC	Northwest Power Planning Council
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OSP	Oregon State Police
USACE	U.S. Army Corp of Engineers
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service

Bolded type indicates agency or agencies that have the lead role for task implementation and coordination, though not necessarily sole responsibility.

<u>Cost Estimates</u>: 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 include 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 the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
1	1.2.1	Assess the feasibility of installing appropriate fish passage structures around diversions or removing related migration barriers.	2	**ODFW**, USFS, USFWS	100	50	50				If necessary, install appropriate fish passage structures around diversions or remove related migration barriers. Actions 1.2.1 and 1.2.2 should be considered simultaneously.
1	1.2.3	Restore connectivity and opportunities for migration.	5	ODFW, USFS, USFWS, **Wallowa Valley Irrigation District**	500	50	100	200	100	50	Pending the assessments of 1.2.1 and 1.2.2.
1	1.3.1	Restore riparian zones associated with bull trout habitat.	25	**BLM**, IDFG, NPT, ODFW, **USFS**	375	15	15	15	15	15	

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
1	1.3.2	Maintain riparian zones associated with bull trout habitat.	25	**BLM**, IDFG, NPT, ODFW, **USFS**	*						
1	1.4.1	Evaluate the impacts of Lower Granite Dam and Hells Canyon Dam.	5	IDFG, ODFW, USACE, USFS, **USFWS**	1000	200	200	200	200	200	
1	1.4.2	Review reservoir operations at Federal Columbia River Power System facilities.	5	IDFG, USACE, ODFW, **USFWS**	250	50	50	50	50	50	Recommendations should be provided through the FERC, state relicensing processes, and Federal consultations.
1	2.3.1	Provide information to the public about introduced fishes.	5	**IDFG, ODFW,** USFWS	50	10	10	10	10	10	

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
1	3.1.1	Coordinate plans associated with fish management.	25	BPA, IDFG, ODFW, Northwest Power Planning Council, NPT, USACE, USFS, **USFWS**	250	10	10	10	10	10	
1	5.2.2	Determine range of temperature tolerances for bull trout life stages in different habitats.	5	**IDFG, ODFW**, USFS, **USFWS**	75	15	15	15	15	15	
1	5.2.3	Determine the seasonal movement patterns of adult and sub-adult, migratory bull trout.	5	**IDFG, ODFW**, USACE, USFS, USFWS	750	150	150	150	150	150	

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
1	5.4.2	Provide information to the public about whirling disease.	5	**IDFG, ODFW**	50	10	10	10	10	10	
1	5.5.1	Determine life history requirements.	10	BPA, BOR, BLM, IDFG, NPT, ODFW, USACE, USFS, **USFWS**	1500	150	150	150	150	150	
1	5.5.3	Continue to survey for bull trout.	25	BPA, **IDFG,** NPT, **ODFW,** USFS, USFWS	625	25	25	25	25	25	
1	5.6.1	Determine the consequences of genetic fragmentation and isolation.	10	BPA, **IDFG,** **ODFW,** USACE, USFS, **USFWS**	500	50	50	50	50	50	

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
1	5.6.2	Investigate use of the mainstem Snake River by Imnaha-Snake Rivers bull trout.	5	**IDFG, ODFW,** USACE, **USFWS**	750	150	150	150	150	150	
1	5.6.3	Evaluate the population structure of bull trout in the recovery unit.	3	BPA, IDFG, ODFW, USFS, **USFWS**	500	100	200	200			
1	5.6.5	Evaluate survival rates (by life stage).	10	BPA, **IDFG, ODFW**, USFS, **USFWS**	1000	100	100	100	100	100	
1	6.1.1	Provide long-term habitat protection.	25	BLM, BOR, BPA, **IDFG, ODFW**, USFS, USFWS	500	25	25	25	25	25	
1	6.1.3	Provide information to the public about habitat.	5	**IDFG, ODFW**, USFWS	50	10	10	10	10	10	

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
2	1.1.1	Identify sources of sediment delivery.	3	BLM, BOR, **IDFG, ODFW**, USFS	45	15	15	15			Take corrective action if necessary and appropriate.
2	1.1.2	Assess effects on bull trout from nonpoint source pollution.	5	BLM, BOR, **IDFG**, ODEQ, **ODFW**, ODOT, USFS	75	15	15	15	15	15	Implement the Water Quality Management Plan for the Imnaha River subbasin. Development of the Water Quality Management Plan was scheduled to have begun in 2001.
2	1.1.3	Conduct a trail assessment in the Sheep and Granite creek watersheds.	2	**USFS**	30	15	15				Implement maintenance and repair as necessary.

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
2	1.2.2	Assess the feasibility of installing appropriate fish screening structures in the Wallowa Valley Improvement Canal.	3	**ODFW**, USFS	45	15	15	15			Take action based on assessment. The provisions of passage and need for screening in the canal are complimentary. Thus, actions 1.2.1 and 1.2.2 should be considered simultaneously.
2	1.2.4	Assess whether hatchery weirs are impacting bull trout.	5	**NPT, ODFW,** USFWS	125	25	25	25	25	25	If significant impacts are found they should be addressed.
2	1.3.3	Reduce grazing impacts.	10	**BLM, BOR**, IDFG, ODFW, **USFS**	200	10	15	20	15	10	

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
2	1.3.6	Conserve existing high quality bull trout habitat in Sheep Creek, Granite Creek and the Snake River.	25	**IDFG**, ODFW, USFS	*						
2	1.3.7	Conduct a stream assessment in Sheep and Granite creeks.	3	**IDFG**, USFS	90	30	30	30			
2	2.5.1	Assess the interactions between bull trout and introduced fishes.	5	BPA, **IDFG, ODFW, USFWS**	125	25	25	25	25	25	If appropriate, design and implement programs to control or extirpate nonnative fishes.
2	5.4.1	Maintain fish health screening and transplant protocols.	25	**IDFG, ODFW**	*						
2	5.5.2	Investigate the relationship between bull trout and anadromous species.	3	BPA, **IDFG**, NMFS, **ODFW**, USFS, **USFWS**	150	50	50	50			

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
2	5.5.4	Compare weak and strong populations.	10	BPA, IDFG, ODFW, USACE, USFS, **USFWS**	250	25	25	25	25	25	
2	5.6.4	Evaluate basic life history characteristics.	10	BPA, IDFG, ODFW, USACE, USFS, **USFWS**	1000	100	100	100	100	100	
3	1.2.5	Assess whether hatchery intakes are impacting bull trout.	2	**NPT, ODFW**, USFWS	30	15	15				Insure that intakes are screened properly.
3	1.2.6	Salvage stranded bull trout.	25	**IDFG, ODFW**	125	5	5	5	5	5	
3	1.3.4	Assess the need for stream channel restoration activities.	3	**ODFW**	30	10	10	10			Implement if necessary.

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
3	1.3.5	Maintain long-term wood recruitment in the Imnaha River subbasin.	25	**USFS**	250	10	10	10	10	10	
3	1.3.8	Protect, maintain, and enhance anadromous fish habitats to increase available forage species for bull trout.	25	**IDFG, ODFW**, USFS, USFWS	*						
3	1.5.1	Assess current risk of catastrophic fire to bull trout populations.	3	**USFS**	45	15	15	15			Take corrective action to reduce risks.
3	2.2.1	Evaluate enforcement of fish stocking regulations.	25	**IDFG, ODFW**, OSP	*						
3	2.6.1	Implement management actions to reduce nonnatives where bull trout will benefit.	5	**IDFG, ODFW**, USFS	50	10	10	10	10	10	
3	2.6.2	Investigate feasibility of screening the outlet at Twin Lakes.	1	**ODFW**	5	5					

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit											
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
3	3.1321.2	Coordinate recovery efforts on bull trout, salmon and steelhead.	25	**NMFS, USFWS**	*						
3	3.1.4	Evaluate and improve fisheries management guidelines and policies designed to protect native species.	25	**IDFG, ODFW**, USFS, USFWS	*						
3	3.1.5	Comply with management plans that improve Snake River anadromous fish smolt:adult return ratios or fish production for the upper Snake River basin.	25	**IDFG, ODFW**	*						
3	5.2.1	Conduct watershed assessments.	3	**ODEQ**	225	75	75	75			
3	5.2.4	Evaluate food web interactions.	4	**IDFG, ODFW**	300	100	100	100			
3	5.4.3	Monitor for effects of fish pathogens on bull trout populations.	25	**ODFW**	125	5	5	5	5	5	

Implementation schedule for the bull trout recovery plan: Imnaha-Snake Rivers Recovery Unit												
Priority number	**Task number**	**Task description**	**Task duration (years)**	**Responsible parties (Alphabetical)**	**Cost estimates ($1,000)**						**Comments**
					Total cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
3	6.1.2	Work cooperatively with neighboring states and governments.	25	**ALL**	*						
3	7.1.1	Develop a participation plan to support implementation in the recovery unit.	25	**USFWS**	*						

REFERENCES

Beamesderfer, R.C.P., H.A. Schaller, M.P. Zimmerman, C.E. Petrosky, O.P. Langness and L. LaVoy. 1996. Spawner-Recruit Data for Spring and Summer Chinook Salmon Populations in Idaho, Oregon, and Washington. *In*: D.R. Marmorek, editor. Plan for Analyzing and testing hypotheses (PATH) final report for fiscal year 1998. ESSA Technologies Ltd., Vancouver, B.C.

Buchanan, D.V., M.L. Hanson, and R.M. Hooton. 1997. Status of Oregon's Bull Trout. Oregon Department of Fish and Wildlife, Portland, Oregon.

Chandler, J.A. and T.J. Richter. 2001. Downstream fall migrations of native salmonids from major tributaries associated with the Hells Canyon Complex - Snake River. Technical Bulletin No. 01-4, Idaho Bureau of Land Management, Boise, Idaho.

Craig, S.D., and R.C. Wissmar. 1993. Habitat conditions influencing a remnant bull trout spawning population, Gold Creek, Washington. Draft report, Fisheries Research Institute, University of Washington, Seattle, Washington.

Crow, J.F. and M. Kimura. 1970. An introduction to population genetics theory. Harper and Row, New York.

Franklin, I.R. 1980. Evolutionary changes in small populations. Pages 135-149 in M.E. Soule and B.A.. Wilcox, editors. Conservation Biology: An evolutionary-ecological perspective. Sinauer Associates, Sunderland, Massachusetts.

Idaho Department of Fish and Game. 2001. Fishing regulations for the State of Idaho. Boise, Idaho.

Kostow, K. 1995. Biennial report on the status of wild fish in Oregon. Oregon department of Fish and Wildlife, Portland, Oregon.

Lande, R. 1988. Genetics and demography in biological conservation. Science 241: 1455-1460.

Meffe, G.K. and C.R. Carroll. 1994. Principles of conservation biology. Sinauer Associates, Sunderland, Massachusetts.

Montana Bull Trout Scientific Group. 1998. The relationship between land management activities and habitat requirements of bull trout. Montana Bull Trout Restoration Team, Helena, Montana.

National Marine Fisheries Service. 2000a. Draft Recovery Planning Guidance for Technical Recovery Teams. National Marine Fisheries Service, Washington, D.C.

National Marine Fisheries Service. 2000b. Reinitiation of consultation on operation of the Federal Columbia River Power System, including the juvenile fish transportation program, and 19 Bureau of Reclamation projects in the Columbia Basin draft recovery planning guidance for technical recovery teams. National Marine Fisheries Service, Washington, D.C.

National Marine Fisheries Service. 2000c. National Oceanic and Atmospheric Administration, Federal Register notice, 50 CFR Part 223, Endangered and Threatened Species; Salmon and Steelhead; Final Rules, Page 42422.

Northwest Power Planning Council. 1990. Snake River subbasin salmon and steelhead production plan. Portland, Oregon.

Northwest Power Planning Council. 2001. Draft Imnaha Subbasin Summary. Prepared by D. Bryson.

Oregon Department of Fish and Wildlife. 1988. Oregon's trout plan, a plan for the management of Oregon's trout. Portland, Oregon.

Oregon Department of Fish and Wildlife. 2001. Fishing regulations for the State of Oregon. Portland, Oregon.

Ratliff, D.E. and P.J. Howell. 1992. The status of bull trout populations in Oregon. Pages 10-17 *In:* P.J. Howell and D.V. Buchanan, editors. Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Rieman, B.E., and F.W. Allendorf. 2001. Effective populations size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-764.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S. Forest Service, Intermountain Research Station, General Technical Report INT-302, Ogden, Utah.

Rode, M. 1990. Bull trout, *Salvelinus confluentus* Suckley, in the McCloud River: status and recovery recommendations. Administrative Report Number 90-15, California Department of Fish and Game, Sacramento, California.

Smith, B., and W. Knox. 1992. Report of findings, bull trout density sampling. Unpublished report, Oregon Department of Fish and Wildlife, Wallowa Fish District, Enterprise, Oregon.

Soule, M.E. 1980. Thresholds for survival: Maintaining fitness and evolutionary potential. Pages 151-170 *In:* M.E. Soule and B.A. Wilcox, editors. Conservation Biology: An evolutionary-ecological perspective. Sinauer and Associates, Sunderland, Massachusetts.

U.S. Fish and Wildlife Service. 1998. Klamath River and Columbia River bull trout population segments: status summary. Prepared by the U.S. Fish and Wildlife Service's bull trout listing team. Boise, Idaho.

U.S. Forest Service. 1994. Imnaha River section 7 watershed assessment of ongoing and proposed activities. Final report. Wallowa-Whitman National Forest, Baker City, Oregon.

U.S. Forest Service. 1998. Steelhead Consultation for Imnaha River Section 7 Watershed: Assessment of Ongoing and Proposed Activities. Wallowa-Whitman National Forest.

U.S. Forest Service. 2000. Bull Trout Consultation for Imnaha River Section 7 Watershed: Assessment of Ongoing and Proposed Activities. Wallowa-Whitman National Forest.

Vallier, T. 1998. Islands and Rapids: A Geologic Story of Hells Canyon. Confluence Press, Lewiston , Idaho.

Washington Department of Wildlife. 1992. Bull trout/Dolly Varden management and recovery plan. Washington Department Number 92-22, Fisheries Management Division, Olympia, Washington.

Wissmar, R.C., J.E. Smith, B.A. McIntosh, H.W. Li., G.H. Reeves, and J.R. Sedell. 1994. A history of resource use and distribution in riverine basins of eastern Oregon and Washington (Early 1800s-1900s). Northwest Science Special Issue 68:1-34.

In Literature

Bodurtha, T., U.S. Fish and Wildlife Service. 1995. Bull trout threats from hydropower in Washington.

Flesher, M., Oregon Department of Fish and Wildlife, La Grande, Oregon. 2002. Bull trout captured in standard steelhead creel surveys.

Oregon Department of Fish and Wildlife. 1993. NE Oregon bull trout summary: 1993.

Personal Communications

Knox, B., Oregon Department of Fish and Wildlife. 2002. Enterprise, Oregon.

Parker, S., Oregon Department of Fish and Wildlife. 2002. Newport, Oregon.

Sankovich, P., Oregon Department of Fish and Wildlife. 2002. La Grande, Oregon.

Sausen, G., U.S. Forest Service. 2001. Enterprise, Oregon.

Appendix A: List of Chapters

Chapter 1 - Introductory
Chapter 2 - Klamath River Recovery Unit, Oregon
Chapter 3 - Clark Fork River Recovery Unit, Montana, Idaho, and Washington
Chapter 4 - Kootenai River Recovery Unit, Montana and Idaho
Chapter 5 - Willamette River Recovery Unit, Oregon
Chapter 6 - Hood River Recovery Unit, Oregon
Chapter 7 - Deschutes River Recovery Unit, Oregon
Chapter 8 - Odell Lake Recovery Unit, Oregon
Chapter 9 - John Day River Recovery Unit, Oregon
Chapter 10 - Umatilla-Walla Walla Rivers Recovery Unit, Oregon and Washington
Chapter 11- Grande Ronde River Recovery Unit, Oregon
Chapter 12 - Imnaha-Snake Rivers Recovery Unit, Oregon and Idaho
Chapter 13 - Hells Canyon Complex Recovery Unit, Oregon and Idaho
Chapter 14 - Malheur River Recovery Unit, Oregon
Chapter 15 - Coeur d'Alene River Recovery Unit, Idaho
Chapter 16 - Clearwater River Recovery Unit, Idaho
Chapter 17 - Salmon River Recovery Unit, Idaho
Chapter 18 - Southwest Idaho Recovery Unit, Idaho
Chapter 19 - Little Lost River Recovery Unit, Idaho
Chapter 20 - Lower Columbia Recovery Unit, Washington
Chapter 21 - Middle Columbia Recovery Unit, Washington
Chapter 22 - Upper Columbia Recovery Unit, Washington
Chapter 23 - Northeast Washington Recovery Unit, Washington
Chapter 24 - Snake River Washington Recovery Unit, Washington
Chapter 25 - Saint Mary - Belly Recovery Unit, Montana