Chapter: 11

States: Oregon and Washington

Recovery Unit Name: Grande Ronde River

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 11, Grande Ronde River Recovery Unit, Oregon and Washington. 95 p. *In*: U.S. Fish and Wildlife Service. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Portland, Oregon.

ACKNOWLEDGMENTS

Members of the Grande Ronde River Recovery Unit Team who assisted in the preparation of this chapter include:

Tim Cummings, U.S. Fish and Wildlife Service,
Bob Danehy, Boise Cascade Corporation
Colleen Fagan, Oregon Department of Fish and Wildlife
Mary Hanson, Oregon Department of Fish and Wildlife
Christine Kelly, Environmental Protection Agency
Bill Knox, Oregon Department of Fish and Wildlife
Lyle Kuckenbecker, Grande Ronde Model Watershed Council
Jim Leal, U.S. Forest Service
Bill Lovelace, Powder Basin Watershed Council,
John Manwell, Boise Cascade Corporation
Bob Mason, U.S. Forest Service
Glen Mendel, Washington Department of Fish and Wildlife
Mike Northrup, U.S. Forest Service
Craig River, U.S. Forest Service
Mark Robertson, U.S. Fish and Wildlife Service
Wade Sams, U.S. Forest Service
Paul Sankovich, Oregon Department of Fish and Wildlife
Gretchen Sausen, U.S. Forest Service
Tim Walters, Oregon Department of Fish and Wildlife
Jeff Zakel, Oregon Department of Fish and Wildlife

Additional review and comments were provided by:

Mike McLean, Confederated Tribes of the Umatilla Indian Reservation

GRANDE RONDE 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 population of bull trout as a threatened species on June 10, 1998 (63 FR 31647). 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 Grande Ronde River subbasin was identified as one of 22 recovery units for bull trout within the Columbia River Distinct Population Segment. Use of these existing frameworks will allow for better coordination during both salmon and bull trout recovery planning and implementation.

The Grande Ronde River Recovery Unit Team identified two core areas, the Grande Ronde and the Little Minam. Wenatchee Creek (also referred to as Menatchee Creek) is potentially a core area but lacks sufficient survey data to include it as a core area at this time. Inclusion of other areas within the Grande Ronde River Recovery Unit (*e.g.*, the Wallowa River upstream of the dam at Wallowa Lake) have been identified as research needs. Research needs apply to areas where the recovery unit team feels more information is needed 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 Grande Ronde River Recovery Unit Team has identified local populations of bull trout within each core area. In the Grande Ronde Core Area, local populations include the Upper Grande Ronde complex, Catherine Creek, Indian Creek, the Minam River/Deer Creek complex, the Lostine River/Deer Creek complex, upper Hurricane Creek, the Wenaha River, and Lookingglass Creek. One local population, the Little Minam complex, was identified in the Little Minam Core Area. The Little Minam Core Area is defined at the lower end by a barrier waterfall. Additional distribution and genetic

information within the Grande Ronde River Recovery Unit will help refine the current classification.

Habitat Requirements and Limiting Factors

A detailed discussion of bull trout biology and habitat requirements is provided in Chapter 1 of this recovery plan. Within the Umatilla-Walla Walla Recovery Unit, historic and current land use activities have impacted bull trout local populations. Historic land use activities that have impacted bull trout local populations include construction and operation of dams and roads, forestry practices, agricultural development, and mining. Some of the historic activities that resulted in passage barriers may have significantly reduced important fluvial populations. Lasting effects from some of these early land use activities still limit bull trout distribution/abundance in the Grande Ronde Recovery Unit. Existing land use activities that contribute to fish habitat problems include operation and maintenance of dams, riparian road construction and use, riparian grazing, agricultural development, residential developments, recreational use of riparian areas, and competition with nonnative species.

Recovery Goal 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 Grande Ronde River Recovery Unit:

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Grande Ronde River 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 identified for the Grande Ronde River Recovery Unit are as follows.

1. **Bull trout are distributed among at least nine local populations in the Grande Ronde River Recovery Unit.** In a recovered condition the recovery unit would include at least nine local populations. In the Grande Ronde Core Area local populations would include the Upper Grande Ronde complex, Catherine Creek, Indian Creek, the Minam River/Deer Creek complex, The Lostine River/Bear Creek complex, Hurricane Creek, Lookingglass Creek, and the Wenaha River. In the Little Minam Core Area a local population of resident bull trout would exist in the Little Minam River above the barrier waterfall. Designation of local populations is based upon the professional judgement of Grande Ronde River Recovery Unit Team members. Further genetic studies are needed to more accurately delineate local populations and quantify spawning site fidelity and straying rates.

2. **Estimated abundance of bull trout among all local populations in the Grande Ronde River Recovery Unit is at least 6,000 adults.** Recovered abundance 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.

3. **Adult bull trout populations exhibit a stable or increasing trend for at least two generations at or above the recovered abundance level.**

4. **Specific barriers to bull trout migration in the Grande Ronde River Recovery Unit have been addressed.** Passage barriers within the Grande Ronde Core Area need to be addressed to ensure opportunities for connectivity among local populations within the core area. In the Grande Ronde Core Area this includes evaluating and addressing dams (*e.g.*, Wallowa River Dam and Beaver Creek Dam) and diversions (*e.g.,* Upper Alder Slope/Moonshine ditch in Hurricane Creek, South Fork Catherine Creek, upper Wallowa River near Joseph), as well as culverts which are potential passage barriers to bull trout (*e.g.,* Sage Creek, Sand Pass Creek, and near the Indian Creek hydropower facility). Potential impacts from weirs (*e.g.,* Upper Grande Ronde River, Catherine Creek, Lookingglass Creek, and Lostine River) and hatchery intakes (*e.g.,* Wallowa and Lookingglass fish hatcheries, Big Canyon satellite facility, and satellite facilities in the Lostine River, Upper Grande Ronde River, and Catherine Creek) also need to be addressed. This also includes evaluating possible thermal barriers from warm water temperatures (*e.g.,* Upper Grande Ronde River, Bear Creek watershed, Lostine River, and Hurricane Creek below the upper Alder Slope irrigation ditch). This also includes impact assessments of the Lower Granite and Hells Canyon dams, both in the mainstem Snake River.

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 conditions and access to them that allow for the expression of various life-history forms. Seven categories of actions needed are discussed in Chapter 1; tasks specific to this recovery unit are provided in this chapter.

Estimated Cost of Recovery

Total estimated cost of bull trout recovery in the Grande Ronde River Recovery Unit is estimated at $17 million spread over a 25 year recovery period. Total costs include estimates of expenditures by local, Tribal, State, and Federal governments and by private business and individuals. 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. 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.

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 Grande Ronde River Recovery Unit several local populations are relatively strong, but the majority are at relatively low numbers. Degradation and fragmentation of bull trout habitat have resulted in populations that are at high risk. Ultimately, these threats must be addressed in the near future for recovery to be achieved.

TABLE OF CONTENTS

List of Figures

List of Tables

INTRODUCTION

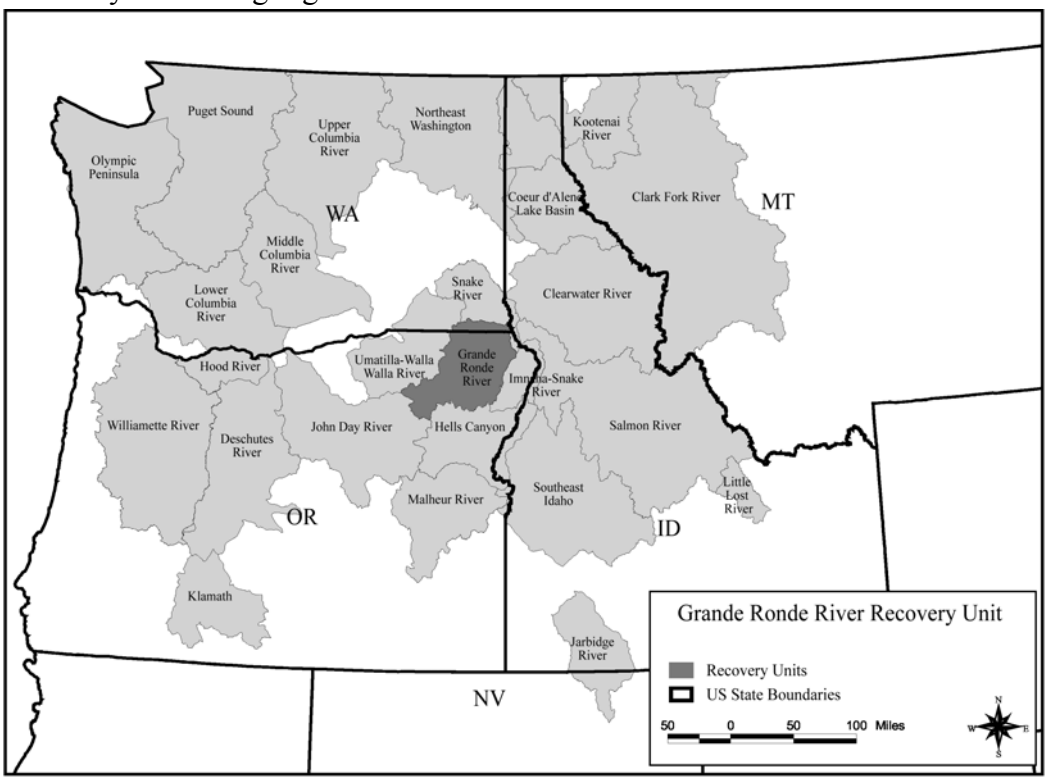
Recovery Unit Designation

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, *i.e.*, the U.S. Fish and Wildlife Service 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 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,

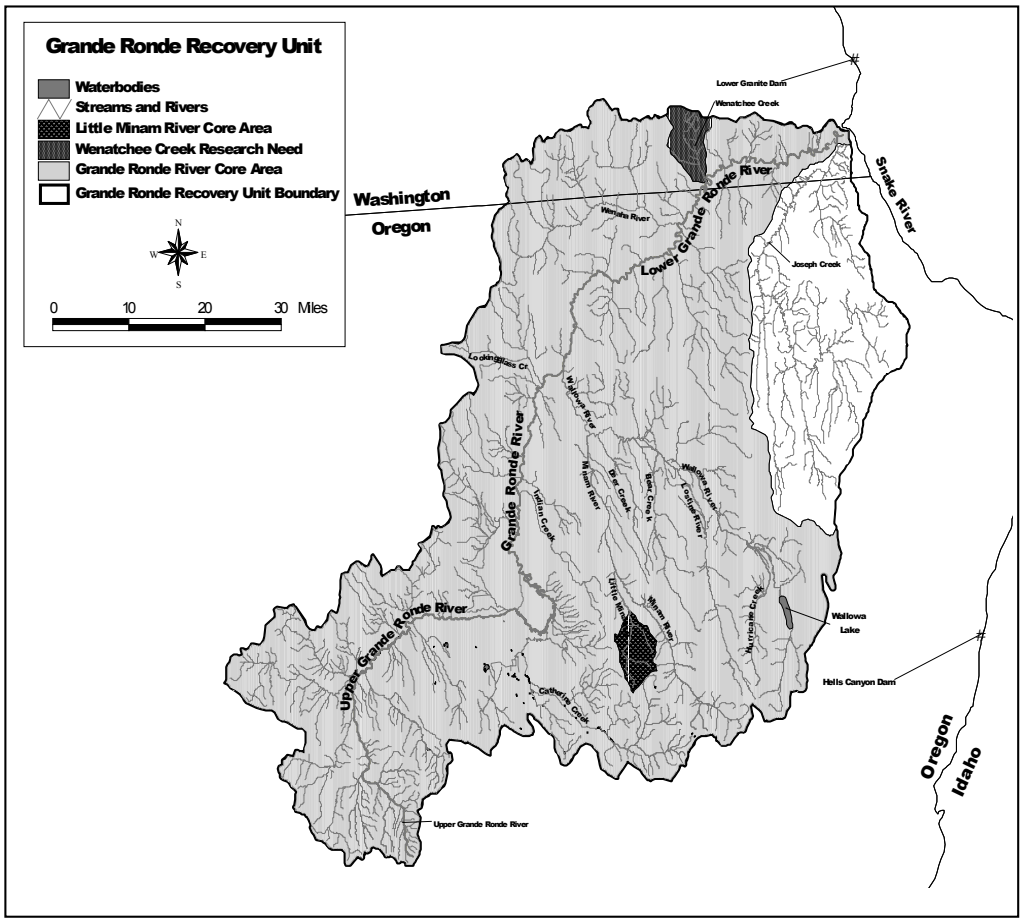
Figure 1. Bull trout recovery units in the United States. The Grande Ronde River Recovery Unit is highlighted.



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 Grande Ronde River subbasin was identified as one of the 22 recovery units for bull trout within the Columbia River Distinct Population Segment.

The Grande Ronde River Recovery Unit includes bull trout from one watershed, the Grande Ronde River (Figure 2). The majority of this watershed is in the State of Oregon. The lower portion of the Grande Ronde River, tributaries to this portion of the river, as well as tributaries to the mainstem of the Wenaha River (a major tributary to the Grande Ronde River) are located in the State of Washington.

Figure 2. Grande Ronde River Recovery Unit (Grande Ronde and Little Minam Core Areas) for bull trout in Oregon and Washington.



After considering information that is currently available, including that in Ratliff and Howell (1992), Kostow (1995), Buchanan *et al.* (1997), and Washington Department of Fish and Wildlife (1998), the recovery unit team identified nine extant, local populations (or stocks) of bull trout within the Grande Ronde River subbasin. A local population is considered to be fish of 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 (see Chapter 1).

The risk of any given local population going extinct varies within the recovery unit. The risk of the Little Minam River and Wenaha River local populations going extinct is low (Ratliff and Howell 1992; Washington Department of Fish and Wildlife 1998). Relative to extinction, the Minam River/Deer Creek complex is composed of a low risk component (Minam River) (Ratliff and Howell 1992) and a component of special concern (Deer Creek) (see Buchanan *et al.* 1997). The risk of the Upper Hurricane Creek local population going extinct is of special concern (Ratliff and Howell 1992). Relative to extinction, the Lostine River/Bear Creek complex is composed of a moderate risk component (Lostine River) and a component of special concern (Bear Creek) (Ratliff and Howell 1992). The risk of the local populations in the Upper Grande Ronde River complex and Indian Creek (Ratliff and Howell 1992) as well as Catherine Creek and Lookingglass Creek (Buchanan *et al.* 1997) going extinct is moderate. A local population of bull trout previously from Wallowa Lake/River is now considered to be extinct (Ratliff and Howell 1992). From the Washington portion of the Grande Ronde River subbasin, anecdotal reports also exist of bull trout in Wenatchee Creek. However, Washington Department of Fish and Wildlife (1998) did not describe or distinguish bull trout from Wenatchee Creek as a distinct local population. Additional research needs to be conducted on whether such a local population exists and its relative risk of extinction.

All local populations 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. In the 1990's, one transfer of bull trout from Little Sheep Creek (Imnaha River subbasin) did occur into Wallowa Lake. There is no evidence, however, that these fish established a self-sustaining population or still exist (B. Smith, Oregon Department of Fish and Wildlife, pers. comm., 2002). In the 1970's bull trout/Dolly Varden from Alaska were also released into Wallowa Lake. Again, there is no evidence that these fish still exist or established a self-sustaining population (Buchanan *et al.* 1997).

This recovery unit geographically overlaps ceded lands of both the Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe. These Tribes have guaranteed treaty fishing rights for both anadromous and

resident fish species. When the Grande Ronde River Recovery Unit has achieved its recovery goal, the Oregon and Washington departments of fish and wildlife as well as the Tribal Nations will determine the location and level of bull trout harvest which can be sustained while maintaining healthy populations.

Geographic Description

The Grande Ronde River subbasin is located in the southwest portion of the Blue Mountains ecological province, encompassing an area of about 10,240 square kilometers (4,000 square miles) in northeastern Oregon and southeastern Washington (see Northwest Power Planning Council 2001). The subbasin is characterized by rugged mountains and two major river valleys, and is defined by the Blue Mountains to the west and northwest, and the Wallowa Mountains to the southeast. It is in these mountain ranges, with peaks as high as 7,700 feet (2,347 meters) in the Blue Mountains and nearly 10,000 feet (3,048 meters) in the Wallowa Mountains, where the headwater streams of the Grande Ronde River begin. The Grande Ronde River flows generally northeast 212 miles (339 kilometers) from its origin to join the Snake River at River Mile 169 (River kilometer 270), about 20 miles (32 kilometers) upstream of Asotin, Washington and 493 miles (789 kilometers) from the mouth of the Columbia River. The Grande Ronde River begins in the Blue Mountains near the Anthony Lakes recreation area, flows north, then northeast and through the cities of La Grande and Island City (River Mile 157, River kilometer 251). In the valley, the river slows and meanders the valley floor before continuing north-northeast through the towns of Imbler, and Elgin. A State ditch, which eliminated approximately 20 River Miles (32 River kilometers), was developed to channelize the river through the Grande Ronde valley. Downstream of Elgin the river enters into a canyon, passes through Troy, Oregon (River Mile 46, River kilometer 74), then it crosses into Washington at River Mile 38.7 (River kilometer 62) before joining the Snake River. There are eight dams on the Columbia and Snake rivers between the Grande Ronde River and the Pacific Ocean. Major streams flowing into the Grande Ronde are Catherine and Joseph creeks and the Wallowa and Wenaha rivers.

Geology

The Grande Ronde subbasin has a complex geologic history (see Northwest Power Planning Council 2001). Rocks of the Columbia River Basalt Group dominate the surface geology of the area. Rocks older than the Columbia River Basalts occur only in the headwaters areas of the Grande Ronde River, the Wallowa River and Catherine Creek. These rocks consist of granitic intrusives and older volcanics with associated sedimentary deposits. Some of these older rocks are visible in the Wallowa Mountains where the andesitic core was exposed during uplift of the mountain range (Baldwin 1964). Some older rocks may be visible near the mouth of the Grande Ronde River where the channel cuts into rock below the basalt layers. The structural geology of the area is also complex. Regional deformation has included easterly and southeasterly tilting and uplift and northwesterly compression. Because of these forces, many faults cut the bedrock formations. These faults follow a general northwest-southeast trend. Some structural deformation continues in the area as evidenced by offsets in modern alluvial and colluvial deposits. The southern portion of the subbasin is subsiding faster than the northern portion as demonstrated by the large bend in the Grande Ronde River to the south. The presence of hot springs and regional, deep groundwater flow systems also indicate ongoing tectonic activity.

Climate

The relief of the Blue and Wallowa mountains creates several localized climatic effects (see Northwest Power Planning Council 2001). The diversity of landscapes between mountain ranges, rolling topography and deep, dissected canyons influences local climatic patterns. However, the major influence to the regional climate comes from the Cascade Mountains lying nearly 200 miles (320 kilometers) to the west. These mountains form a barrier against the modifying effects of moist winds from the Pacific Ocean, resulting in a modified Continental climate in the Grande Ronde River subbasin. Winters are cold and moist. January is the coldest month, with an average daily minimum temperature of 24 degrees Fahrenheit (-4 degrees Celsius). Summers in the subbasin are warm and dry. July is the warmest month with an average daily maximum of 84 degrees Fahrenheit (29 degrees Celsius). Temperature and precipitation vary considerably with elevation. In winter, valleys tend to be colder than lower slopes of adjacent

mountains due to cold air drainage. Average annual precipitation increases from 14 inches (36 centimeters) on the valley floor to more than 60 inches (152 centimeters) in some mountain areas. On average, precipitation increases approximately 5 inches (13 centimeters) with each 1,000-foot (305 meter) rise in elevation. Precipitation occurs in the mountains throughout the year but falls primarily as winter snow. The average annual frost-free period in the Grande Ronde River is 160 days. The cooler Wallowa River valley may experience frost at any time of the year but the average frost-free period is 130 days.

Hydrology

Due to the varying physiography in the Grande Ronde River subbasin, the timing of spring runoff and peak discharge is also variable (see Northwest Power Planning Council 2001). The upper Grande Ronde River, flowing out of the relatively low elevation Blue Mountains, generally experiences seasonal peak flows in March or April while peak flows in Catherine Creek, originating in the Wallowa Mountains, usually occur in May or June. Flows in the Wallowa River, which also originates from mostly north-facing slopes of the higher elevation Wallowa Mountains, generally do not peak until late May or June.

Gauging stations operated by the U.S. Geological Survey, the Oregon Water Resources Department, Oregon Watershed Enhancement Board and the Wallowa Soil and Water Conservation District, measure and record stream flows throughout the subbasin (see Northwest Power Planning Council 2001). Average annual discharge of the Grande Ronde River at Troy, Oregon, the lowest gauging station presently in use, is approximately 2.25 million acre feet (3101 cubic feet per second or 88 cubic meters per second). The only major tributary adding to the Grande Ronde River below this station is Joseph Creek, which is ungauged. Daily flows at gauging stations throughout the basin can vary 100-fold in as little as one month and differences between the annual minimum and maximum flows can be even greater. The gaging station on Catherine Creek near Union, Oregon, recorded a minimum flow in 1998 of 1.4 cubic feet per second (0.04 cubic meters per second) and a maximum the same year of 2,160 cubic feet per second (61.13

cubic meters per second). The average annual discharge of Catherine Creek at this gaging station is approximately 85,500-acre feet (3.34 cubic meters per second).

Most surface- and ground-water use is for irrigation (see Northwest Power Planning Council 2001). Information regarding the number of water diversions for irrigation is unavailable, as is the number of water rights holders in the subbasin. Sales and subdivision of water rights over the years has created a situation where there are many small water rights holders and few accurate records. Despite the lack of information regarding water rights and diversions, it is known that the water in the Grande Ronde River subbasin is fully appropriated; during the summer, there is no remaining unappropriated water.

Water Quality

The Oregon Department of Environmental Quality has identified many stream segments within the Grande Ronde subbasin as water quality limited (see Northwest Power Planning Council 2001). Many of these streams include habitat areas important for chinook salmon, summer steelhead and bull trout. Water quality limited means instream water quality fails to meet established standards for certain parameters for a portion of the year. Oregon's 1998, 303(d) List of Water Quality Limited Waterbodies identifies nine parameters of concern in the upper Grande Ronde River subbasin: algae, bacteria, dissolved oxygen, flow modification, habitat modification, nutrients, pH, sedimentation and temperature. All of these concerns exist within the Grande Ronde River valley portion of the subbasin. Three of these nine concerns – temperature, sediment and habitat modification – are widespread throughout the rest of the subbasin outside the Grande Ronde River valley.

Land Uses

Until the mid-1800's, the Grande Ronde subbasin was utilized solely by the Cayuse, Umatilla, Walla Walla and Nez Perce Tribes (James 1984). The Confederated Tribes of the Umatilla Indian Reservation ceded all of their lands in northeast Oregon and southeast Washington to the Federal government under the Treaty of 1855 (Confederated Tribes of the Umatilla Indian Reservation 1996).

The Nez Perce Tribe retained claim to its lands in the subbasin until the Treaty of 1863, when all of the Oregon territory was removed from the Nez Perce Reservation. The tribes maintain reserved rights for these lands that include harvesting salmon, wildlife and vegetative resources (USACE 1997). As European settlers moved into the area, significant timber harvest, livestock grazing and agricultural production began (McIntosh 1992).

The U.S. Forest Service and the Bureau of Land Management manage about 46 percent (1,901 square miles or 4,867 square kilometers) of the land in the Grande Ronde River subbasin, with a small amount of additional public land managed by the states of Oregon and Washington (see Northwest Power Planning Council 2001). The percentage of public land is higher in Wallowa County than in Union County with 65 percent of the county in public ownership (U.S. Forest Service, Bureau of Land Management, State of Oregon). The Grande Ronde River, Catherine Creek, Wallowa River and its tributaries, and Joseph Creek originate in the Wallowa-Whitman National Forest. The Wenaha River originates in the Umatilla National Forest. With the exception of those areas that lie within the Eagle Cap and Wenaha-Tucannon Wilderness Areas, the National Forests are managed for multiple use including, primarily, timber production, livestock grazing, and recreation. Seasonal recreation use of the forest, including big game hunting and mushroom harvest is economically significant to communities in the subbasin.

Privately owned land is generally at lower elevations along streams and on the valley floors (see Northwest Power Planning Council 2001). Nearly all of the agricultural lands of the Grande Ronde and Wallowa valleys are privately owned, as are portions of the Joseph Creek headwaters and high elevation meadows of the Upper Grande Ronde River. Primary uses of private land are forest, range and cropland.

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final listing rule (63 FR 31647) the U.S. Fish and Wildlife Service identified one bull trout subpopulation in the Grande Ronde River subbasin. This subpopulation included both resident and migratory fish as well as fish that spawn and rear in (for example) the Upper Grande Ronde River, Catherine Creek, Lookingglass Creek, Wallowa River, Minam River, and Wenaha River. Although believed to be extirpated, bull trout used to spawn and rear in the Wallowa Lake/River complex in Oregon and Wenatchee Creek in Washington. At the time of listing (June 1998), the status of and trend in the Grande Ronde River subpopulation was unknown. The subpopulation was not considered to be at risk of extirpation due to natural events.

The U.S. Fish and Wildlife Service determined there were four major threats to the Grande Ronde River subpopulation of bull trout: agricultural practices, grazing, quality issues, and nonnative brook trout. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology to better reflect the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter.

Current Distribution and Abundance

In the past, wild bull trout occurred throughout the Grande Ronde River subbasin. Although bull trout were probably never as abundant as other salmonids in the subbasin, they were certainly more abundant and more widely distributed than they are today. Currently, the U.S. Fish and Wildlife Service considers there to be two core areas in the Grande Ronde River subbasin: the upper Grande Ronde River, and the Little Minam River. Although Wenatchee Creek has the potential to be a core area, it is currently considered a research need.

The Oregon Department of Fish and Wildlife recognizes nine local populations of bull trout within the Oregon portion of the basin (Buchanan *et al.* 1997). Distinct local populations are present in the Upper Grande Ronde River, Catherine Creek, Indian Creek, Minam River/Deer Creek complex, Lostine River/Bear Creek complex, upper Hurricane Creek, Wenaha River, Lookingglass Creek, and the Little Minam River. While Washington Department of Fish and Wildlife also recognizes the Wehana River local population of bull trout, they are uncertain about the existence of bull trout in Wenatchee Creek (Washington Department of Fish and Wildlife 1998). Finally, although the original local population of bull trout in the Wallowa River/Lake complex is believed to have been extirpated (Buchanan *et al.* 1997), bull trout from the Imnaha River subbasin were recently introduced into this complex (B. Smith, Oregon Department of Fish and Wildlife, pers. comm., 2002). The current status of bull trout that were introduced into the Wallowa River/Lake comples is unknown. All extant local populations of bull trout in the Grande Ronde River subbasin are native fish sustained by wild production. There is very little information to indicate whether these local populations are genetically distinct. The Oregon Department of Fish and Wildlife separated local populations based on geographical, physical and thermal isolation of the spawning populations.

For purposes of the recovery plan local populations of bull trout within the Grande Ronde River subbasin have been aggregated based on the potential to reestablish connectivity and reduce 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 (Table 1). This information represents the best census information available for bull trout distribution and abundance within the Grande Ronde River subbasin.

Upper Grande Ronde River

In the upper portion of the Grande Ronde River subbasin, small groups of bull trout appear to be present all year in the mainstem, in Limber Jim, Indiana and Clear creeks (Buchanan *et al.* 1997), as well as Hoodoo Creek (a tributary to

Beaver Creek) and Lookout Creek (a tributary to Fly Creek) (J. Zakel, Oregon Department of Fish and Wildlife, pers. comm., 2002). An isolated sighting has also been reported from Five Points Creek (Zakel, *in litt.* 1995). On an intermittent basis, bull trout can also be found distributed throughout the mainstem, perhaps migrating to and from various tributaries or following sources of food. Limited information is available on the abundance of bull trout in the upper Grande Ronde River. Standard redd counts or creel surveys are not conducted on a regular basis. Buchanan *et al.* (1997) reported that these fish were at moderate risk of extinction. Spawning and rearing appears to occur in relatively small, headwater areas including the upper Grande Ronde River, Limber Jim, Indiana and Clear creeks. Essentially no information is available on the size of these fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, and survival rates. It seems likely that bull trout in this population exhibit a resident life history form. Although little information is available on the prevalence of fluvial bull trout in the Upper Grande Ronde River, the Confederated Tribes of the Umatilla Indian Reservation have trapped fluvial fish at a weir during the late summer and early fall (P. Lofy, Bonneville Power Administration, pers. comm., 2002).

Table 1. Bull trout spawning ground survey schedule in the Grande Ronde River Recovery Unit during 2001.

Core Area	Stream	Survey Area	Survey Time
Little Minam	Little Minam River	Complete	Every other week, mid-September through the end of October.
Grande Ronde	Lostine River	Complete	Once in September and October.
	Lookingglass Creek	Complete (National Forest only)	Once in September and October.
	Wenaha River	Partial	Once in October.

Catherine Creek

Bull trout in Catherine Creek have been observed throughout the mainstem as well as in the North Fork Catherine Creek, South Fork Catherine Creek, Middle Fork Catherine Creek, Sand Pass Creek, Collins Creek and Pole Creek (Buchanan *et al.* 1997). Although presence/absence surveys suggest that numbers are low (West and Zakel, *in litt.* 1993), no specific population estimates have been conducted in Catherine Creek. Buchanan *et al.* (1997) considered bull trout in Catherine Creek at moderate risk of extinction. Although bull trout are occasionally observed during the summer as low in the watershed as the town of Union, the majority of summer rearing appears to occur above river kilometer 50 (River Mile 31) in the mainstem or in the headwater tributaries (Zakel, *in litt.* 1995). Presumably spawning also occurs in these headwater tributaries. Bull trout migrating downstream have been captured near the town of Union (M. Keefe., Montgomery-Watson-Harza, pers. comm., 2002). These fish ranged from 121 to 255 mm (4.76 to 10 inches) in fork length and were captured during the months of September and October. Otherwise, very little information is available on the size of these fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, and survival rates. It seems likely that bull trout in this population exhibit a resident life history form. Although little information is available on the prevalence of fluvial bull trout in Catherine Creek, the Confederated Tribes of the Umatilla Indian Reservation have also trapped fluvial fish at an upstream weir during the late summer and early fall (P. Lofy, Bonneville Power Administration, pers. comm., 2002).

Indian Creek

Bull trout have been observed in the mainstem of Indian Creek as well as the East Fork of Indian Creek and Camp Creek (Buchanan *et al.* 1997). All known holding and rearing areas are on National Forest lands in the headwaters of the drainage. Presumably spawning also occurs in these headwater tributaries. Historically, fish were probably distributed throughout the mainstem of Indian Creek and connected to the Grande Ronde River. However, habitat in the lower reaches of Indian Creek is severely degraded and there are no recent reports of bull trout in these reaches. No information is available on the abundance of bull trout in Indian Creek. Standard redd counts or creel surveys are not conducted on

a regular basis. No information is available on the size of these fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, and survival rates. It seems likely that bull trout in this population exhibit a resident life history form.

Minam River/Deer Creek complex

The Minam River and Deer Creek are both tributaries to the Wallowa River. The mouths of the Minam River and Deer Creek are separated by less than 3 River kilometers (1.86 River Miles). Given the potential for fluvial fish in these streams as well as their relative proximity, the U.S. Fish and Wildlife Service has grouped bull trout from the Minam River and Deer Creek as one local population complex (bull trout from more than one tributary that presumably function, both demographically and genetically, as one unit).

Bull trout have been observed throughout the mainstem of the Minam River, the North Fork Minam River and Elk Creek (Buchanan *et al.* 1997). All known summer rearing and holding areas in the Minam River are on National Forest lands (designated wilderness) above River kilometer 35 (River Mile 21.7). Spawning presumably occurs in these headwater areas as well as in headwater tributaries. Based on radiotelemetry data on bull trout from drainages adjacent to the Minam River (*i.e.* Lookingglass Creek and the Lostine River), fish found in the Minam River below River kilometer 35 (River Mile 21.7) are probably moving between summer or spawning habitat and overwinter habitat in the Wallowa, Grande Ronde or Snake Rivers. Although the La Grande District of Oregon Department of Fish and Wildlife conducted some surveys in the mid-1990's, limited information is available on the abundance of bull trout in the Minam River. Standard redd counts or creel surveys are not conducted on a regular basis. Buchanan *et al.* (1997) considered fish from the Minam River at low risk of extinction. No 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.

Bull trout have been observed throughout the mainstem of Deer Creek and in the mouth of Sage Creek. All known summer rearing and holding areas in the

Deer Creek watershed are on National Forest lands (designated wilderness) between River kilometer 15 and River kilometer 25 (River Miles 9.3 and 15.5). Spawning presumably occurs in these headwater areas as well as in headwater tributaries. Between fall and spring, bull trout have also been observed between River kilometer 0 and River kilometer 15 (River Miles 0 and 9.3) of Deer Creek. Based on radiotelemetry data on bull trout from drainages adjacent to the Deer Creek (*i.e.* Lookingglass Creek and the Lostine River), fish found in Deer Creek below River kilometer 15 (River Mile 9.3) are probably moving between summer or spawning habitat and overwinter habitat in the Wallowa, Grande Ronde or Snake Rivers.

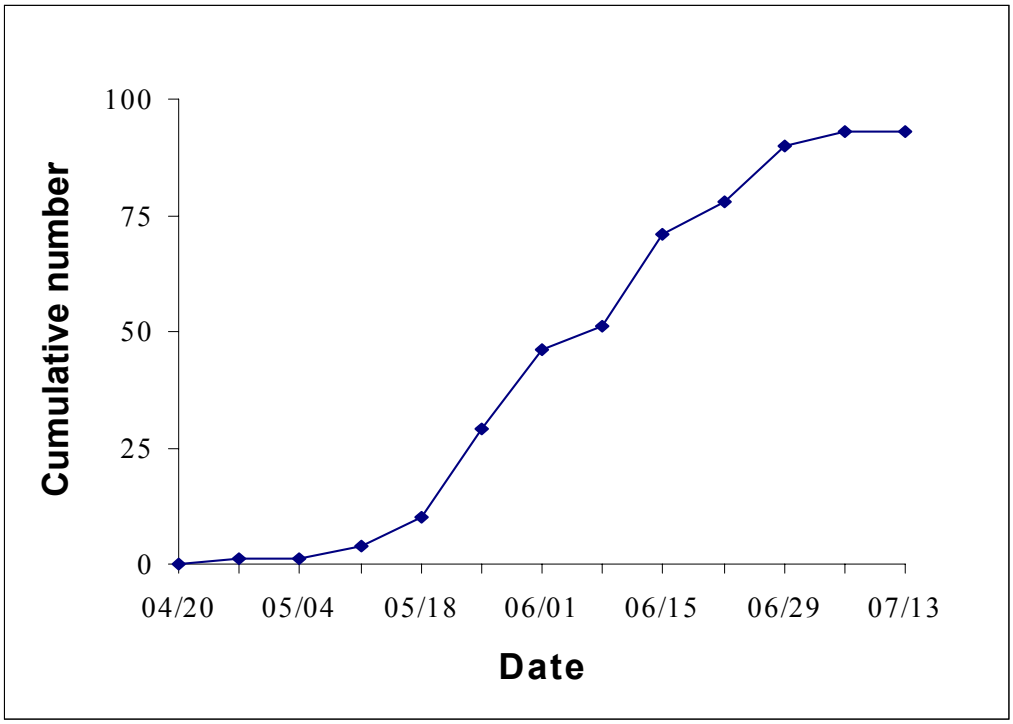
Limited information is available on the abundance of bull trout in Deer Creek. One recent sampling effort observed 18 fish/100 square meters as well as 6.5 kilometers (4 miles) of habitat supporting that density (Oregon Department of Fish and Wildlife, *in litt.* 1993). Approximately 50 percent of these fish were longer than 160 millimeters (6.3 inches) in fork length, which is the approximate size when resident fish in the Grande Ronde River subbasin become mature (Hemmingsen *et al.* 2001c). Given this and other habitat data, it has been estimated that the summer rearing population of bull trout in Deer Creek is approximately 3,000 yearling or older fish. Standard redd counts or creel surveys are not conducted on a regular basis. Buchanan *et al.* (1997) listed the status of fish from Deer Creek as special concern. No information is available on age at maturation, sex ratio, fecundity, time of emergence, or survival rates. It seems possible that bull trout in Deer Creek exhibit both resident and fluvial life history forms.

Lostine River/Bear Creek complex

The Lostine River and Bear Creek are both tributaries to the Wallowa River. The mouths of the Lostine River and Bear Creek are separated by less than 11 River kilometers (6.8 River Miles). Given that fluvial fish exist in the Lostine River and may exist in Bear Creek as well as the relative proximity of the streams, the U.S. Fish and Wildlife Service has grouped bull trout from the Lostine River and Bear Creek as one local population complex.

Bull trout have been observed throughout the mainstem of the Lostine River, as well as the mouths of Silver and Lake creeks (Buchanan *et al.* 1997). All known summer rearing and holding areas in the Lostine River are on National Forest lands (that are bounded by designated wilderness) above River kilometer 20 (River Mile 12.4). Spawning presumably occurs in these headwater areas as well as in some headwater tributaries. Based on recent radiotelemetry data (P. Sankovich, Oregon Department of Fish and Wildlife, pers. comm., 2002), fish found in the Lostine River below River kilometer 20 (River Mile 12.4) are probably moving between summer or spawning habitat and overwinter habitat in the Wallowa, Grande Ronde or Snake rivers. Fluvial adults appear to move into the Lostine River in the months of June, July, and August. Fluvial adults appear to move out of the Lostine in the months of September, October, and November. Limited information is available on the abundance of bull trout in the Lostine River. Standard redd counts as well as counts of migratory adults captured at

Figure 3. Fluvial bull trout captured moving upstream in the Lostine River during 2001. Fish were captured in a weir operated near the river's mouth by the Nez Perce Tribe (J. Harbeck, Nez Perce Tribe, pers. comm., 2002).



salmon weirs (Figure 3); data provided by have been conducted only recently. Standard creel surveys are not conducted on a regular basis. Ratliff and Howell (1992) considered fish from the Lostine River at moderate 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. River at moderate risk of extinction.

Bull trout have been observed throughout the mainstem of Bear Creek as well as throughout Little Bear Creek and the mouth of Goat Creek (below a waterfall). All known summer rearing and holding areas in the Bear Creek drainage are on National Forest lands (much of which is designated wilderness). This distribution occurs primarily above River kilometer 19 (River Mile 11.8) in Bear Creek and above River kilometer 5 (River Mile 3.1) in Little Bear Creek. Summer distribution is currently (and presumably historically) disrupted by a loss of surface flow between Goat and Granite creeks. Spawning presumably occurs in the headwaters of Bear and Little Bear creeks. Between fall and spring, bull trout have also been observed between River kilometers 0 and 19 (River Miles 0 and 11.8) of Bear Creek and between River kilometers 0 and 5 (River Miles 0 and 3.1) of Little Bear Creek. Given radiotelemetry data on bull trout from drainages adjacent to the Bear Creek (*i.e.* the Lostine River), fish found in these downstream reaches are probably moving between summer or spawning habitat and overwinter habitat in the Wallowa, Grande Ronde or Snake Rivers. Limited information is available on the abundance of bull trout in Bear Creek. Standard redd counts or creel surveys are not conducted on a regular basis. Ratliff and Howell (1992) listed the status of fish from Bear Creek as special concern. No information is available on age at maturation, sex ratio, fecundity, time of emergence, or survival rates. It seems probable that bull trout in Bear Creek exhibit both resident and fluvial life history forms.

Upper Hurricane Creek

Bull trout have been observed in the mainstem of Hurricane Creek (Buchanan *et al.* 1997). All known holding and rearing areas are above River kilometer 16 (River Mile 9.9) and about half of this distribution is on National

Forest lands that are designated wilderness. Spawning presumably occurs in the headwaters of Hurricane Creek. Between fall and spring, bull trout have also been observed between River kilometers 0 and 16 (River Miles 0 and 9.9) of Hurricane Creek. Given radiotelemetry data on bull trout from drainages adjacent to the Hurricane Creek (*i.e.* the Lostine River), fish found in these downstream reaches are probably moving between summer or spawning habitat and overwinter habitat in the Wallowa, Grande Ronde or Snake Rivers. No information is available on the abundance of bull trout in Hurricane Creek. Standard redd counts or creel surveys are not conducted on a regular basis. No information is available on the size of these fish at spawning, age at maturation, sex ratio, fecundity, time of emergence, and survival rates. It seems likely that bull trout in this population exhibit both resident and fluvial life history forms.

Wenaha River

The Wenaha River drainage may have the most abundant and well distributed population of bull trout in the Grande Ronde River subbasin (Buchanan *et al.* 1997). Bull trout have been observed throughout the mainstem of the Wenaha River, South Fork Wenaha River, North Fork Wenaha River, Butte Creek, and Crooked Creek, as well as Milk Creek (tributary to South Fork Wenaha River), First Creek and Third Creek (tributaries to Crooked Creek) (Buchanan *et al.* 1997). All known summer rearing and holding areas in the Wenaha River or its tributaries are on National Forest lands (designated wilderness) above River kilometer 9 (River Mile 5.6) of the Wenaha River. Spawning occurs in the headwater areas of the Wenaha River and many of its tributaries. Radiotelemetry data on bull trout from the Wenaha River (for example see Hemmingsen *et al.* 2001b) suggests that fish found below River kilometer 9 (River Mile 5.6) appear to be moving between summer or spawning habitat and overwinter habitat in the Grande Ronde and Snake rivers. In at least one case, a bull trout tagged in the Wenaha River also moved up the Grande Ronde River and entered Lookingglass Creek (Hemmingsen *et al.* 2001a). Limited information is available on the abundance of bull trout in the Wenaha River. Standard redd counts or creel surveys are not conducted on a regular basis. Buchanan *et al.* (1997) considered fish from the Wenaha 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 exhibit both resident and fluvial life history forms.

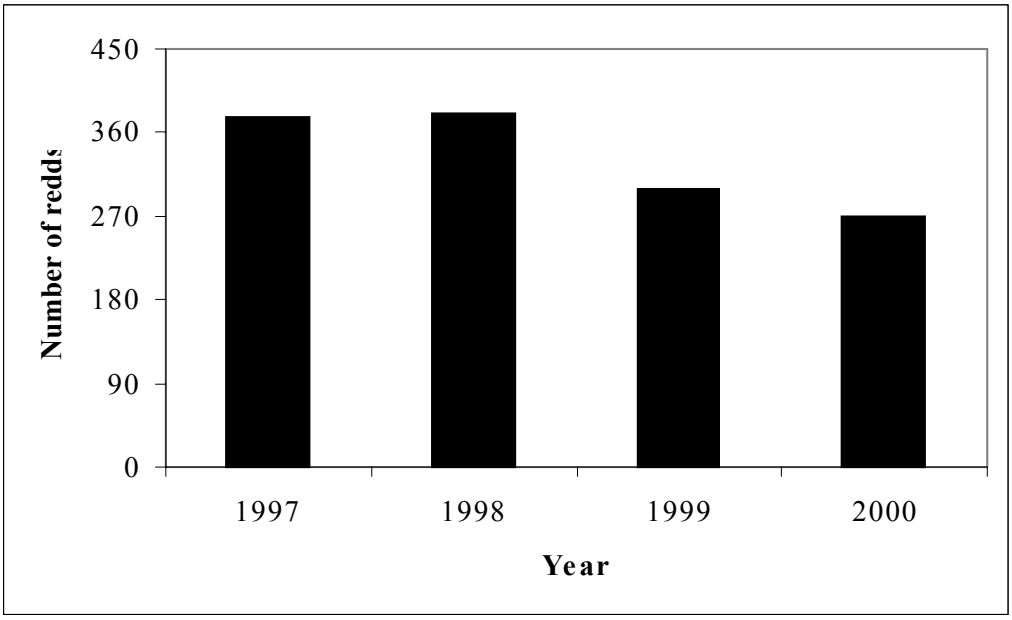
Lookingglass Creek

Bull trout have been observed throughout the mainstem of Lookingglass Creek as well as in the lower half of Little Lookingglass Creek (Buchanan *et al.* 1997). Lookingglass Creek is primarily spring-fed with relatively moderate water temperatures. Bull trout are known to rear and hold during the summer in all areas of Lookingglass Creek. The upper half of this distribution is on National Forest lands. Spawning occurs in the headwater areas of Lookingglass and Little Lookingglass creeks and may also occur in other tributaries. Radiotelemetry data on bull trout from the Lookingglass Creek (for example see Hemmingsen *et al.* 2001a) suggests that fluvial bull trout may overwinter in the Grande Ronde or Snake rivers. In at least one case, a bull trout tagged in the Wenaha River also moved up the Grande Ronde River and entered Lookingglass Creek (Hemmingsen *et al.* 2001a). Limited information is available on the abundance of bull trout in the Lookingglass Creek. Spawning ground surveys of index areas have been conducted recently. In 2001, 54 redds were observed during bull trout spawning ground surveys on National Forest land (P. Sankovich, Oregon Department of Fish and Wildlife, pers. comm., 2002). In general, spawning ground and presence/absence surveys have suggested that bull trout abundance is low in the Lookingglass Creek drainage (West and Zakel, *in litt.* 1993). Standard creel surveys are not conducted on a regular basis. Buchanan *et al.* (1997) considered fish from Lookingglass Creek at moderate 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 exhibit both resident and fluvial life history forms.

Little Minam River

Bull trout have been observed in the Little Minam River as well as in the lower portion of Boulder Creek and throughout Dobbin Creek, both tributaries to the Little Minam River (Buchanan *et al.* 1997). A waterfall exists at approximately River kilometer 9 (River Mile 5.6) of the Little Minam River

Figure 4. Number of redds observed in the Little Minam River watershed from 1997-2000. This includes counts in the Little Minam River and Dobbin Creek.



which is believed to prevent the upstream movement of most fish, including bull trout. Thus, a resident population of bull trout, which does not experience immigration of bull trout from other areas in the Grande Ronde River, exists above River kilometer 9 (River Mile 5.6). Bull trout are believed to rear and hold during the summer in all these areas of the Little Minam River drainage. The entire distribution of bull trout in the Little Minam River is on National Forest lands (designated wilderness). Spawning occurs in the headwater areas of the Little Minam River and throughout Dobbin Creek. Limited information is available on the abundance of bull trout in the Little Minam River. Spawning ground surveys have been conducted over the last several years (Figure 4) (Bellerud *et al.* 1997; Hemmingsen *et al.* 2001a, 2001b, 2001c, 2001d). Spawning ground surveys included all areas where bull trout could spawn in the Little Minam River and Dobbin Creek. In general, surveys were conducted once every two weeks during September and October. In 2001, 434 redds were counted in the Little Minam River and Dobbin Creek (P. Sankovich, Oregon Department of Fish and Wildlife, pers. comm., 2002). Standard creel surveys are not conducted on a regular basis. Ratliff and Howell (1992) considered fish from the Little Minam River at low risk of extinction. Fish spawning in the Little

Minam River and Dobbin Creek are generally between 150 and 250 millimeters (5.9 to 9.8 inches) in fork length (Bellerud *et al.* 1997). Little additional information is available on the size of these fish by age, age at maturation, sex ratio, fecundity, time of emergence, or survival rates. Given that fluvial fish are unlikely to immigrate to the Little Minam River (above River kilometer 9 or River Mile 5.6) for spawning it seems likely that this population of bull trout functions as a resident life history form. However, bull trout produced in the Little Minam River may emigrate to other areas (i.e. the Minam, Wallowa, and Grande Ronde rivers) in the Grande Ronde River subbasin.

Wallowa Lake/River

Historically, bull trout were present in the Wallowa River above Wallowa Lake, however, this population is believed to have been extirpated by the 1950's (Buchanan *et al.* 1997). Although a reintroduction program using bull trout and Dolly Varden (from Alaska) was initiated in 1968, this program was unsuccessful and terminated in 1978 (Buchanan *et al.* 1997). No bull trout or Dolly Varden were captured in the Wallowa Lake fishery between 1980 and 1996 (B. Smith, Oregon Department of Fish and Wildlife, pers. comm., 2002). In 1997, 600 bull trout from Big Sheep Creek, a tributary to the Imnaha River, were introduced into Wallowa River above Wallowa Lake (B. Smith, Oregon Department of Fish and Wildlife, pers. comm., 2002). The current status of these fish is unknown.

Wenatchee Creek

Historically, fluvial-sized bull trout (longer than 46 centimeters or 18 inches) were be found far up into Wenatchee Creek (D. Groat, U.S. Forest Service, pers. comm., 2002). However, in the 1960's a barrier waterfall formed near River kilometer 4 (River Mile 2.5) of Wenatchee Creek and currently, it is unlikely that fluvial bull trout would be able to get above this waterfall (D. Groat, U.S. Forest Service, pers. comm., 2002). In the mid-1980's, one account of resident bull trout existing above the barrier waterfall in Wenatchee Creek was published in the Lewiston Tribune (G. Mendel, Washington Department of Fish and Wildlife, pers. comm., 2002). However, recent surveys have not been able to confirm the presence of resident bull trout in Wenatchee Creek.

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; Oregon Department of Fish and Wildlife, *in litt.* 1993; Rieman and McIntyre 1993; Wissmar *et al.* 1994). 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 construction and operation of dams, both within and outside the Grande Ronde River Recovery Unit, has contributed to the decline of bull trout populations. Within the Grande Ronde River subbasin, dams exist in the Wallowa River and in Beaver Creek. The dam in the Wallowa River was built at approximately River kilometer 97 (River Mile 60.3), completed in 1931, currently maintains Wallowa Lake and provides multiple stream diversions into the Wallowa River valley. The dam in Beaver Creek was built at River kilometer 20 (River Mile 12.4), completed in 1915, and currently maintains a reservoir that supplies water to the city of La Grande, Oregon. Both of these dams were constructed without fish passage facilities and prevent bull trout from access to historic spawning habitat within the Grande Ronde River subbasin. In addition, the Grande Ronde River flows into the Snake River between Lower Granite and Hells Canyon dams. Bull trout from the Grande Ronde River that express a fluvial life history form may migrate to and overwinter in the mainstem of the Snake River (for example see Baxter 2002). Dams in the Snake River have impaired the connectivity between bull trout from the Grande Ronde River 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 Grande Ronde River Recovery Unit are unclear.

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 thinning of riparian vegetation, the construction of splash dams utilizing the stream to transport logs, the construction of log flumes and diversion of streamflow from the creek, the destruction of riparian vegetation through the building of timber railroads and forest roads, the use of smaller side drainages as skid trails and harvest-related wildfire have decreased the function of the existing riparian vegetation in many areas. Bull trout in tributaries, for example Bear Creek, have been impacted through significant habitat degradation from road development and logging. Bull trout in mainstem areas, for example the upper Grande Ronde River (Oregon Department of Fish and Wildlife, *in litt.* 1993), have been impacted through increased water temperatures resulting in thermal barriers, siltation of spawning gravel, and loss of instream structure (*i.e.* large wood).

The riparian functions that have been historically 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 historic conditions and buffer widths between roads and streams are too narrow in many drainages to filter out all soil movement before reaching the stream. The abundance of large instream wood is low in many drainages due to the lack of recruitment sources in riparian areas logged in the past or burned in historic wildfires. 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 add to the existing high embeddedness level of the streambed substrate where riparian vegetation is 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 density and species diversity.

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 examples, significant livestock grazing (as well as some feedlot development) exists in the upper Grande Ronde River, the upper Wallowa River and the lower portion of Bear Creek. The result of poor livestock management is the overgrazing of the riparian vegetation and excessive nutrient inputs to waterways. 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 effect is to increase 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

Bull trout within the Grande Ronde River Recovery Unit have been and continue to be adversely affected by irrigation diversions and water withdrawals. Unscreened or inadequately screened irrigation diversions 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 in some streams. Low flows in late summer can prevent bull trout, which are preparing to spawn from reaching

spawning grounds and can also strand them. Low stream flows can also strand rearing juvenile fish in dry channel beds and 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 many of the watersheds in the Grande Ronde River subbasin. Much of the Bear Creek watershed has little or no flow during the summer due to irrigation diversions. In the Lostine River the lower reaches of suspected historic summer distribution are substantially impacted by irrigation withdrawal, erosion control activities and irrigation return flow. Between River kilometer 0 and 10 (River Mile 0 to 5.6) of the Lostine River, low summer flows resulting (in part) from water diversions appear to impair the upstream movement of bull trout from July through September. This impact is especially significant during low flow years. The U.S. Forest Service and Oregon Department of Fish and Wildlife have begun a radiotelemetry investigation to examine this relationship further (see Oregon Department of Fish and Wildlife 2001a). Below the Upper Alder Slope Irrigation Ditch, Hurricane Creek is currently separated from the remainder of the habitat, substantially simplified due to channelization, impacted by warm water and sediment, and a 5 kilometer (2.6 mile) reach is dewatered by the irrigation withdrawal. Historically, the Lookingglass Creek, Catherine Creek, and Indian Creek watersheds experienced significant riparian loss and channel alterations which resulted in increased water temperatures, siltation, and loss of instream structure (Oregon Department of Fish and Wildlife, *in litt.* 1993). Since the 1970's, however, riparian loss and channel alteration in the Lookingglass Creek watershed has been minimized and water temperature has remained unchanged (M. McLean, Confederated Tribes of the Umatilla Indian Reservation, pers. comm., 2002). In addition, grazing has been limited to a 3 kilometer (1.6 mile) section of Lookingglass Creek and the Boise Cascade Corporation has eliminated grazing by the creek (M. McLean., Confederated Tribes of the Umatilla Indian Reservation, pers. comm., 2002).

Culverts and diversions have contributed to the decline of bull trout populations within the Grande Ronde River Recovery Unit. Numerous diversions

and culverts exist throughout the recovery unit and may act as barriers to bull trout movement. For example, the Upper Alder Slope/Moonshine Ditch diversion in Hurricane Creek and the culvert at the Indian Creek hydropower facility (Oregon Department of Fish and Wildlife, *in litt.* 1993) are likely barriers to the upstream movement of bull trout. Low flows during the summer and fall may exacerbate the impact of these culverts and diversions as barriers by contributing to elevated water temperatures that result in a thermal barrier. In any event, these barriers have reduced both the connectivity between local populations as well as the habitat available to bull trout.

Transportation Network

Road densities are high in many watersheds in the Grande Ronde River Recovery Unit. Federal, State and county road construction, reconstruction and maintenance had and continue to have impacts on water quality and aquatic habitat as well as contribute to the decline of bull trout. Depending upon their location, roads have contributed to the reduction of riparian vegetation and disconnected the habitat at stream crossings. In addition, culverts, depending upon condition and position, may be blockages to upstream fish passage. Poorly located and designed roads, through maintenance and use, are constant sources of soil movement into adjacent stream systems. Soil that enters a stream may increase the level of turbidity and embeddedness of the streambed substrate, fill pool habitat and widen channels within low gradient areas.

Fragmentation of habitat by culvert installation and sediment input are the major problems caused by road maintenance and construction. As with other watersheds with a history of timber harvest, many of the roads are within the riparian zone are causing sedimentation in streams. These problems are apparent in many watersheds of the recovery unit. For example, roads parallel most of the streams in the Deer Creek watershed and the Bear Creek watershed (excepting the upper-most reaches). The presence and maintenance of these roads contribute to increased stream temperatures during the summer, increased sediment and lack of channel diversity, particularly in the lower portions of the creeks. In addition, there are culverts (for examples: on Sage Creek, a tributary to Deer Creek, and

Sand Pass Creek (Road 650), a tributary to Catherine Creek) which may be passage barriers at certain times of the year (Oregon Department of Fish and Wildlife, *in litt.* 1993).

Mining

Past mining activities likely contributed to the decline of bull trout. Mining in the Lostine River, Hurricane Creek and Upper Grande Ronde River watersheds has resulted in decreased channel stability which may result in disrupted or lost habitat for bull trout. Little mining currently occurs in the Grande Ronde River Recovery Unit.

Residential Development

Residential development has contributed to the decline of bull trout. Areas within the Grande Ronde River Recovery Unit have grown in popularity as preferred areas for home sites and recreation areas. For example, a State park and popular tourist site have been developed around Wallowa Lake and the river above the lake. In part as a result of this development, the river above the lake has been channelized. Additional stream channelization has occurred as residential developments have encroached the lower reaches of the Lostine River and Hurricane Creek (below the National Forest boundary). 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 and chemical applications.

Fisheries Management

Harvest

Bull trout tend to be aggressive and easily caught through angling. Historic 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 Grande Ronde

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. By 1994, angling for bull trout in the Grande Ronde River watershed was prohibited. Currently, both the states of Oregon and Washington prohibit angling for bull trout in the Grande Ronde River watershed (see Oregon Department of Fish and Wildlife 2001b; Washington Department of Fish and Wildlife 2001).

Although regulations prohibit it, harvest of bull trout still occurs in the Grande Ronde River subbasin. Anglers have been known to harvest bull trout from the Wallowa, Lostine, Grande Ronde, and Wenaha Rivers as well as Hurricane, Bear, Lookingglass, Catherine, and Deer Creeks. Some of this unauthorized 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.

Hatcheries

Barriers associated with hatchery operations may also be contributing to the decline of bull trout populations within the Grande Ronde River Recovery Unit. Weirs to capture adult chinook exist in the upper Grande Ronde River and Catherine Creek (operated by Confederated Tribes of the Umatilla Indian Reservation), Lookingglass Creek (operated by Oregon Department of Fish and Wildlife), and the Lostine River (operated by Nez Perce Tribe). These weirs are designed to operate at a time when fluvial bull trout would also be moving upstream and they do capture bull trout. By impeding the migration of fish, these weirs may alter when and where bull trout spawn. Weirs also exist in Deer Creek and Spring Creek (in the Wallowa River watershed). However, these weirs are designed to capture adult steelhead and do not typically operate when fluvial bull trout are moving upstream. The major hatcheries in the Grande Ronde River Recovery Unit are the Wallowa Fish Hatchery and Lookinglass Fish Hatchery. Intakes to these hatcheries, and screens associated with these intakes, may also impact the migration of juvenile bull trout.

Brook Trout

Brook trout (*Salvelinus fontinalis)* are an exotic species that was introduced into the Grande Ronde River subbasin before the turn of the century. Brook trout were stocked in streams, rivers and high mountain lakes. Recently, brook trout that were stocked illegally into Langdon Lake were discovered and eradicated by the Oregon Department of Fish and Wildlife (T. Walters, Oregon Department of Fish and Wildlife, pers. comm., 2002). Brook trout have done relatively well in these nonnative habitats and are now abundant in many of the tributaries in the Grande Ronde River subbasin. Brook trout can be found in the Wallowa, Minam, Lostine, and Grande Ronde Rivers as well as Hurricane, Bear, Lookingglass, and Beaver creeks. Brook trout can be found in both public and private areas. Brook trout have contributed to the decline of bull trout populations primarily through competition and hybridization (for description, see Gunckel 2001). Brook trout are difficult to eradicate from a watershed and will likely impact bull trout well into the future.

Anadromous Salmonids

Anadromous salmonids have declined throughout the Grande Ronde River subbasin and are either extinct (coho *Oncorhynchus kisutch*, sockeye *O. nerka*) or listed under the Endangered Species Act (chinook *O. tshawytscha*, steelhead *O. mykiss*) (see National Marine Fisheries Service 2000). Juvenile salmonids produced by anadromous parents are considered to have been a primary food source of bull trout. This reduction in prey base has contributed to the decline of bull trout in the Grande Ronde River Recovery Unit. A reduced prey base is of particular concern in the Upper Grande Ronde River, Catherine Creek and Indian Creek watersheds.

Disease

There are no significant fish disease issues known in the recovery unit at this time. Bull trout populations, although low in abundance, generally appear to be in good health. However, diseases which may impact bull trout are present in the recovery unit (*i.e.* whirling disease has been present since the 1980's) and monitoring and screening efforts currently underway should continue. Although

bull trout in the recovery unit have not exhibited symptoms, disease issues can be difficult to detect in the natural environment.

Bull trout may be inherently resistant to some diseases that are more devastating to other salmonids. In studies conducted by Oregon State University researchers, Metolius (Deschutes) bull trout exposed to high and low doses of the infectious stages of *Myxobolus cerebralis* (causative agent in whirling disease) showed no signs of infection as measured by presence of spores, clinical disease signs, or histopathology. Rainbow trout exposed simultaneously showed high infection prevalence and disease severity. Nor were infections detected in Metolius (Deschutes) bull trout exposed to infection by *Ceratamyosis shasta* (Bartholomew 2001). Disease studies conducted on bull trout from the Deschutes River subbasin, showed them to be relatively resistant to all strains of Infectious Hematopeietic Necrosis Virus tested. Bull trout had detectable levels of antigen to *Renibacter salmoninarum* (bacterial kidney disease) but no evidence of the disease.

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, resident populations of bull trout in Hurricane Creek have been isolated above irrigation diversions. Culvert placement preventing upstream migration has precluded bull trout from some tributaries in the watershed. Loss of riparian habitat, primarily, has also resulted in water temperatures during the summer that are warmer than they were historically. On a seasonal basis, this warm water can act as a thermal barrier to isolate bull trout.

For example, warm water temperatures in the Grande Ronde River (particularly between the towns of La Grande and Elgin) may inhibit the ability of fluvial bull trout to migrate from the lower Grande Ronde River to spawning habitat in the upper Grande Ronde River.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Efforts to recover salmonid species, including bull trout, are ongoing in the Grande Ronde River subbasin. There is good cooperation between fishery entities on various projects. For example, spawning surveys to assess and monitor status and abundance have been a cooperative effort for many years involving 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 Grande Ronde River subbasin also has an active local watershed group dedicated to finding workable solutions to restoring native fish runs. The following represents many of the ongoing efforts within the recovery unit.

Oregon Department of Fish and Wildlife

Oregon Department of Fish and Wildlife initiated a bull trout research project in 1994 in the Grande Ronde subbasin. This research involves the genetics, habitat needs, limiting factors, and life history of bull trout in the basin. The project has contributed to status assessments as well as recovery planning and is ongoing. Oregon Department of Fish and Wildlife 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 effort shifted to recovery planning.

The Oregon Department of Fish and Wildlife modified fishing regulations for bull trout in the Grande Ronde River subbasin. In 1994 it became illegal to angle for bull trout in this watershed. Oregon Department of Fish and Wildlife has also modified regulations on other fisheries to reduce incidental take, reduced or eliminated brook trout stocking programs, made changes to instream work periods to better address bull trout needs, and developed and distributed bull trout identification posters to provide information to anglers. Oregon Department of Fish and Wildlife has a section 6 cooperative agreement with the U.S. Fish and Wildlife Service. Funding through section 6 has, in part, enabled spawning ground surveys to be conducted.

The Oregon Department of Fish and Wildlife implemented a project to eradicate brook trout from Langdon Lake to prevent their establishment in Lookingglass Creek. The Oregon Department of Fish and Wildlife also modified hatchery operations at Lookingglass Creek to provide timely passage for bull trout migrating upstream.

Oregon Department of Environmental Quality

In 2000, the Oregon Department of Environmental Quality completed a water quality management plan for the Grande Ronde basin. High water temperatures have been identified 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.

U.S. Forest Service

The U.S. Forest Service has ongoing riparian enhancement projects in the upper reaches of the Grande Ronde River. Improved riparian structure will be beneficial to all aquatic species, including bull trout.

Tribes

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

The Nez Perce Tribe and Confederated Tribes of the Umatilla Indian Reservation operate weirs on the Lostine River as well as Catherine Creek and the upper Grande Ronde River, respectively. Both tribes collect information on abundance and timing of fluvial bull trout migrating upstream to spawn.

Multi-agency Efforts

Oregon Department of Fish and Wildlife, Oregon State Police, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, and U.S. Forest

Service staff work cooperatively on spawning and habitat surveys, research, telemetry, and abundance projects.

Bonneville Power Administration, the State of Oregon, and other Federal agencies have provided funding for numerous anadromous and bull trout habitat and research projects by the Oregon Department of Fish and Wildlife, Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation in the recovery unit.

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.

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). 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, *e.g.*, transfers of type and place of use (ORS 536.050(4)), voluntary written agreement among water users to rotate their use of the supply to which they are collectively entitled (ORS 540.150

and OAR 690-250-0080), allocation of "conserved water" to instream use (ORS 537.455 to 537.500), lease all or a portion of consumptive water rights to instream purposes (ORS 537.348, OAR 690-77-070 to 690-77-077, exchange of a water right for an instream purpose to use water from a different source, being stored water, surface or ground water (ORS 540.533 to 540.543), and substitute a ground water right for a primary surface water right (ORS 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. In the Grande Ronde River subbasin, total maximum daily load surveys have been completed throughout the subbasin (http://www.deq.state.or.us/wq/TMDLs/UprGR/UprGRTMDL.pdf). In April 2000, a water quality management plan was also developed for the Upper Grande Ronde River (http://www.deq.state.or.us/wq/TMDLs/UprGR/UprGRWQMP.pdf). This plan 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 (ORS 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.

State of Washington

The Governor's office in Washington State has developed a Statewide strategy that describes how State agencies and local governments will work

together to address habitat, harvest, hatcheries, and hydroelectric power generation as they relate to recovery of listed species. The Salmon Recovery Act, passed in 1998, provides the structure for salmonid protection and recovery at the local level (counties, cities, and watershed groups).

The Washington Department of Fish and Wildlife has developed a bull trout management plan that addresses both bull trout and Dolly Varden (Washington Department of Fish and Wildlife 1992). The Washington Department of Fish and Wildlife no longer stocks brook trout in streams or lakes connected to bull trout waters. Fishing regulations prohibit harvest of bull trout, except for a few areas where populations are considered healthy, within the State. The Washington Department of Fish and Wildlife is also currently involved in a mapping effort to update bull trout distribution data within the State of Washington, including all known occurrences, spawning and rearing areas, and potential habitats. The salmon and steelhead inventory and assessment program is currently updating their database to include the entire State, which consists of an inventory of stream reaches and associated habitat parameters important for the recovery of salmonid species and bull trout.

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

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

The Washington Department of Ecology is responsible for maintaining stream flows and does this by (1) supporting development of water restoration plans, (2) conducting technical studies and adopting instream flow rules, (3) buying water rights to restore flows, (4) using the hydro power relicensing program to restore flows, (5) obtaining trust water through the Trust Water Right Program (RCW 90.42) in Endangered Species Act areas, and (6) developing a State position to Federal management of the Columbia and Snake rivers (http://www.ecy.wa.gov/programs/wr/wrhome.html).

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 overriding goal of simply putting fish back in the river. Objectives and strategies specific to the Grande Ronde basin are included in this restoration plan and will ultimately benefit bull trout.

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 Federal reserve fishing and hunting rights. Confederated Tribes of the Umatilla Indian Reservation comanages fishery resources with Oregon Department of Fish and Wildlife and implements restoration and mitigation activities throughout the areas of northeast Oregon and southeast Washington. Confederated Tribes of the Umatilla Indian Reservation holds aboriginal title and exercised usual and accustomed use to lands including but not limited to the Grande Ronde subbasin.

Nez Perce Tribe

The Nez Perce Tribe is responsible for managing, protecting, and enhancing treaty fish and wildlife resources and habitats in the Grande Ronde subbasin. The Tribe individually and/or jointly implements restoration and mitigation activities in the subbasin. The 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 promote healthy ecosystem processes and rich species diversity.

Local Planning Efforts

The Grande Ronde Model Watershed Program (http://www.fs.fed.us/pnw/modelwatershed/) was selected in 1992 by the Northwest Power Planning Council as the model watershed project in Oregon. The Grande Ronde Model Watershed Program has a Board of Directors, composed of local representatives, Tribes and natural resource management agencies, to coordinate policy of the program. For the last nine years the Grande Ronde Model Watershed Program has served as an example of a watershed management partnership among local residents, agency staffs and public interest groups. The program coordinates the implementation, maintenance and monitoring of habitat restoration projects. To date the program has facilitated the implementation of nearly 300 restoration projects.

The Nature Conservancy protects the lands and waters, which plant and animal species need to survive. It is instrumental in purchasing lands for habitat protection, working with agencies with similar objectives, and has been involved in the Grande Ronde River subbasin.

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 coordinates 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 done through the development of subbasin summaries , which identify status of fish and wildlife resources, limiting factors, and recommended actions at the subbasin level.

A draft of the Grande Ronde subbasin summary was completed in June 2001 (http://www.cbfwa.org/files/province/blue/subsum/010601Grande.pdf). The summary encompasses the Grande Ronde River Recovery Unit, and is consistent with bull trout recovery planning efforts to identify limiting factors. The draft Grande Ronde subbasin summary identifies temperature, channel conditions, instream habitat diversity, flow, riparian, and passage as contributing to the decline of bull trout. The Grande Ronde River Recovery Unit Team will continue to utilize this planning process to identify and seek funding for projects to aid bull trout recovery.

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.

Two core areas were defined for the recovery unit, one for the Grande Ronde, one for the Little Minam (Figure 2). Whether bull trout exist in Wenatchee Creek was identified as a research need. If bull trout do exist in Wenatchee Creek, it would be a third core area in the recovery unit. The area above the barrier waterfall near the mouth of Wenatchee Creek is the area where research is needed.

Little Minam Core Area

This core area includes the local population complex defined as the Little Minam. Most, if not all, of the current spawning activity appears to occur in the mainstem of the Little Minam River above the barrier waterfall or in Dobbin Creek.

Grande Ronde Core Area

This core area includes eight extant, local populations: Upper Grande Ronde complex, Catherine Creek and tributaries, Indian Creek and tributaries, Minam River/Deer Creek complex, Lostine River/Bear Creek complex, Upper Hurricane Creek, Wenaha River, and Lookingglass Creek. This core area also includes Wallowa Lake and the Wallowa River above the lake where native bull trout are believed to have been extirpated. The Upper Grande Ronde, Minam River/Deer Creek, and Lostine River/Bear Creek populations may consist of more than one local population. For example, The Minam River/Deer Creek complex may have one local population in the Minam River and another local population in Deer Creek. For the present, or until research shows otherwise, they are

considered one local population, referred herein as various complexes. The Upper Grande Ronde, Catherine Creek and Indian Creek systems have the potential to become separate core areas if further research shows the local populations cannot or do not connect with the rest of the Grande Ronde local populations.

Current distribution of bull trout in the Grande Ronde River Recovery Unit includes the mainstem Grande Ronde River from its headwaters to the confluence with the Snake River; tributaries including Catherine Creek, Indian Creek, Lookingglass Creek, Wallowa River and its tributaries (Minam, Deer, Bear, Lostine, and Hurricane creeks), and the Wenaha River and its tributaries. To the best of our knowledge, with the exception of the Wallowa River above Wallowa Dam, historic distribution is closely reflected by the current distribution.

For purposes of recovery, the Grande Ronde River Recovery Unit contains two core areas: the Grande Ronde Core Area and the Little Minam Core Area (Figure 2). The Grande Ronde Core Area encompasses tributaries containing local populations (both current and potential as identified by the recovery unit team) and the mainstem Grande Ronde River from headwaters downstream to the Snake River. The Little Minam Core Area encompasses tributaries containing local populations and the mainstem above the barrier waterfall at approximately River kilometer 9 (River Mile 5.6). Wenatchee Creek has been defined as an area that needs to be surveyed for bull trout occurrence. It encompasses tributaries and the mainstem above the barrier waterfall at approximately River kilometer 4. It may not currently contain bull trout, but did historically. Additional assessment is needed to determine its suitability as a core area. The survey has been defined as a primary research need. Should surveys identify suitable habitat and the presence of bull trout, this recovery unit chapter will be revised to include Wenatchee Creek as a third core area.

Although we know Grande Ronde bull trout migrate to the Snake River and back, we do not have a clear understanding of the extent of their use and distribution in the Snake River mainstem. Once this information is available, the Grande Ronde Core Area may be extended to include portions of the Snake River

mainstem. Until then bull trout use patterns in 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 Grande Ronde River Recovery Unit:

5. The current number and distribution of bull trout populations within the Grande Ronde River Recovery Unit is maintained in the Little Minam and, potentially, Wenatchee core areas, as well as expanded in the Grande Ronde Core Area to suitable habitat (as noted in Table 2).

6. Stable or increasing trends in abundance of bull trout within the Grande Ronde River Recovery Unit are achieved.

7. Suitable habitat conditions for all bull trout life history stages and strategies are restored and maintained within the Grande Ronde River Recovery Unit.

8. Bull trout within the Grande Ronde River Recovery Unit are conserved by providing opportunities for genetic exchange between the local populations.

The current and recovered status of bull trout in the recovery unit were evaluated based on four population elements. These elements were derived from the best scientific information available concerning bull trout population dynamics and habitat requirements (Rieman and McIntyre 1993; Rieman and Allendorf 2001). The four elements were: 1) number of local populations, 2)

Table 2. Local populations and streams with potential to expand existing bull trout distribution in the Grande Ronde River Recovery Unit.

Core Area	Local Populations	Creeks with expansion potential
Grande Ronde	Upper Grande Ronde complex (upstream of La Grande)	Sheep Creek and East Fork Sheep Creek, Beaver Creek tributaries (below the dam); Five Points Cr; Lookout Cr (Little Fly system)
	Catherine Creek and tributaries	Little Catherine Creek
	Indian Creek and tributaries	Little Indian Creek
	Minam/Deer Creek complex	Sage Creek
	Lostine/Bear Creek complex	Mainstem Bear expand downstream; Little Bear Creek
	Upper Hurricane Creek	
	Wallowa Lake/River	
	Wenaha River	
	Lookingglass Creek	
Little Minam	Little Minam complex	

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).

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 Grande Ronde River 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. In the Grande Ronde Core Area, there are currently eight known local populations (although additional information is needed to better characterize local populations in the core area); the Little Minam Core Area currently contains one local population. Based on the above guidance, bull trout in the Grande Ronde Core Area are at an intermediate risk category, and bull trout in the Little Minam Core Area are at an increasing risk. Additional local populations may be needed in the Grande Ronde Core Area, and are needed in the Little Minam Core Area, to reduce the risk from deterministic or stochastic events which may threaten bull trout.

Evaluation of the status of bull trout in Wenatchee Creek was identified as a research need. If a population of bull trout exists in Wenatchee Creek, this population would be in a similar situation to that in the Little Minam Core Area. The level of extinction risk and threats are currently unknown.

Adult Abundance

The recovered abundance levels in the Grande Ronde River 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.

Bull trout in the Grande Ronde River Recovery Unit persist at moderate numbers. In the Grande Ronde Core Area the best estimates are that approximately 4,000 bull trout spawned in each of the past few years. The majority of spawning likely occurs in the Wenaha River and Minam River/Deer Creek complex, both which exists primarily in wilderness areas. In the Little Minam Core Area the best estimates are that approximately 750 bull trout spawned in each of the past few years. All of this spawning occurred in a wilderness area above the barrier waterfall in the Little Minam River. Based on

the aforementioned guidance, bull trout in the Grande Ronde and Little Minam Core Areas are at a diminished risk of genetic drift.

Productivity

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

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

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

Given the overall lack of long-term population census information in the Grande Ronde and Little Minam Core Areas (trend information in both is based on less than 5 years of data), and the variability in abundance estimates, bull trout in the Lower Columbia Recovery Unit were classified at increased risk.

Connectivity

The presence of the migratory life history form within the Grande Ronde River Recovery Unit was used as an indicator of the functional connectivity of the recovery unit and both core areas. 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.

There are few physical or thermal barriers obstructing connectivity and migratory forms are present in many local populations within the Grande Ronde Core Area. Assuming all of the local populations in the Grande Ronde Core Area are connected, bull trout in this core area are currently at an intermediate threat level. If bull trout from (for example) Catherine Creek are not connected to those in the rest of the core area, the level of threat would increase accordingly. In contrast, the local population in the Little Minam Core Area contains resident life history forms only as they are isolated from other bull trout populations in the Minam River by a barrier waterfall. Although this local population currently contains relatively high numbers of spawners, this population is not connected with other local populations and is at increased risk.

Recovery Criteria

Recovery criteria for bull trout in the Grande Ronde River Recovery Unit are the following:

1. **Bull trout are distributed among nine local populations in the recovery unit, eight in the Grande Ronde Core Area and one in the Little Minam Core Area.** In a recovered condition the recovery unit would include nine local populations. In the Grande Ronde Core Area local populations would include the Upper Grande Ronde complex, Catherine Creek, Indian Creek, the Minam River/Deer Creek complex, The Lostine River/Bear Creek complex, Hurricane Creek, Lookingglass Creek, and the Wenaha River. In the Little Minam Core Area a local population of resident bull trout would exist in the Little Minam River above the barrier waterfall. Native bull trout are believed to have been extirpated above the dam at Wallowa Lake and bull trout distribution above this point would not be considered necessary for recovery. Additional research is needed in the Wenatchee Creek Core Area. If resident bull trout currently exist above the barrier waterfall in Wenatchee Creek, then a recovered condition would also include a local population of resident bull trout in Wenatchee Creek, or a total of 10 local populations. 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. There is potential to further separate the population within the Upper Grande Ronde complex into multiple local populations, the Minam River/Deer Creek complex into two local populations, and the Lostine River/Bear Creek complex into two local populations.

2. **Estimated abundance of adult bull trout is at least 6,000 adults in the recovery unit distributed in each core area as follows: Grande Ronde Core Area (5,000), Little Minam Core Area (1,000).** Recovered abundance was derived using the professional judgement of the recovery unit team, an estimation of productive capacity of identified local populations, and conservation biology theory. Estimates of the resident and fluvial life history component within the recovery unit are considered a research need. Recovered abundance levels do not include estimates for the Wenatchee Creek Core Area, which are considered a research need. These goals may be refined as more information becomes available, through monitoring and research.

In the Grande Ronde Core Area, increased population abundance is expected to occur by securing the distribution in Hurricane and Lookingglass creeks as well as the Wenaha River, and by securing and expanding seasonal distribution in the Upper Grande Ronde, Minam/Deer, and Lostine/Bear complexes as well as in Catherine and Indian creeks. Spawning habitat in the Wenaha River needs to be protected, and in the other local populations it needs to be protected and expanded. There are opportunities to protect and expand rearing and migration habitat in the Upper Grande Ronde complex and Catherine Creek on private, Tribal and public lands. To insure that fish from the Upper Grande Ronde complex, Catherine Creek, and the lower Grande Ronde River populations are connected, it will be necessary to monitor and possibly improve the migration of fluvial fish through the Grande Ronde River valley.

In the Little Minam Core Area, increased population abundance is expected to occur within the existing population complex. The recovery unit team estimated that 750 adult bull trout occur in this core area. However, the only information we have to make this estimate is from spawning ground surveys for resident fish. These surveys can yield highly variable results.

3. **Adult bull trout exhibit stable or increasing trends in abundance in the recovery unit, at the recovered abundance level, for at least two generations.** In the Grande Ronde River 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. Trends in abundance should be evaluated over at least a 10 year period.

4. **Specific barriers inhibiting recovery have been addressed.** Passage barriers within the Grande Ronde Core Area need to be addressed, ensuring opportunities for connectivity among local populations within the core area. In the Grande Ronde Core Area this includes evaluating and

addressing dams (*e.g.,* Wallowa River Dam and Beaver Creek Dam) and diversions for irrigation and channelization (*e.g.,* upper Alder Slope/Moonshine ditch in Hurricane Creek, South Fork Catherine Creek, upper Wallowa River near Joseph) as well as culverts which are potential passage barriers to bull trout throughout the core area (*e.g.,* Sage Creek, Sand Pass Creek, and near the Indian Creek hydropower facility). This also includes addressing potential impacts from weirs (*e.g.*, upper Grande Ronde River, Catherine Creek, Lookingglass Creek, and Lostine River) and hatchery intakes (*e.g.,* Wallowa and Lookingglass fish hatcheries, Big Canyon satellite facility, and satellite facilities in the Lostine River, Upper Grande Ronde River, and Catherine Creek). This also includes assessments of the impacts of Lower Granite Dam and Hells Canyon Dam, both in the mainstem of the Snake River. This also includes evaluating possible thermal barriers from warm water temperatures (*e.g.,* upper Grande Ronde River, Bear Creek watershed, Lostine River, and Hurricane Creek below the upper Alder Slope irrigation ditch). In particular, connectivity between local populations via the Grande Ronde River where it flows through the Grande Ronde valley (between the towns of La Grande and Elgin) may become an important factor in bull trout recovery. Additional monitoring and research is needed to assess whether this section of river functions as a passage barrier and its relative importance.

Most likely, there are additional barriers that have not yet been identified and are important to recovery of bull trout. A list of all barriers should be developed in the first 5 years of implementation of this recovery plan. Substantial progress must be made in providing passage over the majority of these sites, consistent with the protection of other native fishes, in order to meet the bull trout recovery criteria for connectivity.

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 Grande Ronde River Recovery Unit, all four recovery criteria (local populations, abundance, population trends, and barrier removal)

must be achieved. It is likely that meeting all four recovery criteria will not be accomplished by addressing these barriers.

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

General Information Needs

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 from the Grande Ronde River Recovery Unit are known to 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 of the Snake River by bull trout from the Grande Ronde River 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 Wenaha River.

The Grande Ronde 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 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.

Distribution and Abundance

The Grande Ronde River Recovery Unit Team based estimates of recovered abundance levels and number of local populations on the best available information and professional judgement. Information about historic 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 Grande Ronde River Recovery Unit Team has identified an urgent need for the development of a standardized monitoring and assessment program that would more accurately describe 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 Grande Ronde River subbasin. 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

There are a number of research needs regarding the use of the mainstem Snake River by Grande Ronde bull trout and its importance in their life history. One such research need is data on the movement and seasonality of use of different habitat types in the Snake River by adult and subadult bull trout. For fluvial bull trout using the mainstem of the Snake, 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. In addition, the impact of hydropower facilities on the mainstem Snake River on bull trout and their habitat should be evaluated. These studies should be done in conjunction with studies on bull trout from adjacent recovery units, *e.g.*, Imnaha-Snake, Clearwater, etc. to determine areas of overlapping use and possible interactions. Studies are also

needed to determine the migration timing and pathways in and between tributaries within the Grande Ronde 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. Monitoring should include potential habitat (core habitat) where the status of bull trout is unknown or recolonization is anticipated.

A centralized database repository 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 histories of both local resident and migratory bull trout (including limiting factors), and to evaluate relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks. To assess progress and response of habitat/local populations to implementation of recovery tasks, baseline data on historic and present conditions in each habitat type should be gathered for each watershed (particularly Bear Creek, Deer Creek, and Wallowa River watersheds). Studies should include assessment of habitat potential for expanding or reestablishing local populations (*i.e.* Little Catherine Creek, Indian Creek and Little Indian Creek), evaluation of population structure (life table) of existing local populations, and evaluation of the relationship between life history forms. Additional information is needed on the distribution and abundance of bull trout in the Upper Grande Ronde, Indian Creek, and Wenatchee Creek. Further sampling in the mainstem Indian Creek is needed to identify lower distribution limits of spawning and rearing habitat.

Another research need is to evaluate connectivity of local populations, especially in Catherine Creek, the Upper Grande Ronde River, and the lower Grande Ronde River, and to determine whether this connectivity is essential for recovery. The consequences of genetic fragmentation/population isolation due to human-made barriers, or from natural barriers (*i.e.* Little Minam River) should

also be evaluated. Additional data is needed on the impacts of diversions (low, warm water) on migrations of fluvial fish (for example, in the Lostine River and Hurricane Creek).

Food webs in drainages occupied by bull trout should be evaluated to determine whether introduced species are impacting bull trout and to assess whether the prey base necessary for increased bull trout abundance is available.

An additional research need is to determine the effects of whirling disease on bull trout. If it is a concern, monitoring for presence of whirling disease in important bull trout spawning and rearing areas is needed. Screening should also be conducted in potential habitat prior to reestablishment of any local populations. General fish health screening and transplant protocols should be maintained to reduce the chance of disease transmission.

ACTIONS NEEDED

Recovery Tasks 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 Grande Ronde River Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Grande Ronde River 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 Grande Ronde River 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 Grande Ronde River 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 and reduce sources of excessive fine sediment delivery.** Roads, grazing, agricultural practices, and urban development are main sources of excessive fine sediment in the Grande Ronde River Recovery Unit. Use existing Oregon Department of Transportation as well as proposed U.S. Forest Service and Boise Cascade road assessments to identify areas where action is necessary to correct problems associated with roads.

1.1.2 **Assess effects on bull trout from nonpoint source pollution.** Impacts to bull trout in terms of nutrients (winter feeding of livestock in valley bottoms in Wallowa Valley) and chemicals (agricultural use in Grande Ronde Valley in summer) are unknown. At least in part, they could be determined through the total maximum daily load or SB1010 processes.

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

1.2.1 **Assess whether tributary diversions act as migration barriers and restore passage where necessary.** Numerous irrigation diversions in the Wallowa River watershed need to be assessed for their effects on bull trout movement. An assessment of diversions in the Lostine watershed has been funded through the Grande Ronde Model Watershed Program. Diversions which are currently considered migration barriers include the upper Alder Slope/Moonshine Ditch diversion on Hurricane Creek.

1.2.2 **Assess whether tributary diversions and irrigation ditches are screened appropriately and remediate where necessary.** Assess diversions and irrigation ditches above anadromous fish distribution for screening needs to protect bull trout. For example, South Fork Catherine Creek ditch may be a problem, and diversions in the upper Wallowa River near Joseph have not been assessed. Screen needs in upper Hurricane Creek are currently being assessed by Oregon Department of Fish and Wildlife.

1.2.3 **Evaluate, and where necessary, reduce impacts of hatchery weirs on bull trout.** Hatchery weirs in Lookingglass Creek (Oregon Department of Fish and Wildlife), the Upper Grande Ronde River and Catherine Creek (Confederated Tribes of the Umatilla Indian Reservation), and the Lostine River (Nez Perce Tribe) acting as passage barriers may be influencing the spawning distribution and spawning time of bull trout. This potential impact should be evaluated and remediated where necessary.

1.2.4 **Ensure that hatchery intakes are not impacting bull trout.** Assess the impacts to bull trout of operating hatchery intakes at Lookingglass Fish Hatchery, Wallowa Fish Hatchery, the Big Canyon satellite facility, and satellite facilities in the Lostine River, Upper Grande Ronde River, and Catherine Creek. Insure that these intakes are screened properly.

1.2.5 **Assess whether road and trail crossings are acting as barriers to bull trout movement and provide passage wherever feasible.** Assess structures associated with road and trail crossings in tributaries in the Grande Ronde River Recovery Unit. For example, tributaries of the lower Grande Ronde need to be assessed, as well as the culvert on Sage Creek

(Deer Creek) and on Sand Pass Creek (Catherine Creek). Use the Oregon Department of Transportation culvert inventory on State and county roads, as well as the U.S. Forest Service culvert inventory and the Boise Cascade Corporation road assessment. Provide passage where feasible.

1.2.6 **Salvage stranded bull trout.** In areas where fish become stranded because of low water conditions (*e.g.,* Moonshine Ditch), conduct salvage operations.

1.2.7 **Secure appropriate instream flows.** Work with landowners on a voluntary basis to secure more instream water rights for fish use. Securing instream flows and water rights will help restore connectivity and opportunities for migration.

1.2.8. **Monitor the effects of diversions and withdrawals on stream temperature and bull trout migration, and modify as necessary**. For example, manage the Lostine River to provide flows and water temperatures necessary for the upstream migration of bull trout from July through September.

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 *(e.g.*, in the Wallowa subbasin, Little Bear Creek from mouth to Allen Canyon ditch, Bear Creek downstream of mouth of Little Bear Creek, Catherine Creek between Union and the State Park, Indian Creek below the forest boundary, and Lookingglass Creek as well as those areas included in the total maximum daily load report).

1.3.2. **Maintain riparian zones associated with bull trout habitat.** Manage streams (*i.e.* Bear Creek and Deer 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 employed in (for example) Little Bear Creek from mouth to Allen Canyon ditch, Bear Creek downstream of mouth of Little Bear Creek, the Wallowa River upstream of Enterprise, South Fork Catherine Creek, and Indian Creek below the forest boundary.

1.3.4. **Assess the need for stream channel restoration activities and implement where necessary.** National Forest lands and private lands need to be assessed for areas that are potential bull trout habitat. Some action has already been taken on National Forest lands in bull trout occupied habitat. Stream channel restoration would include recruitment of large wood to improve stream hydraulics and fish habitat where warranted and cost-effective.

1.3.5 **Protect, maintain, and enhance anadromous fish habitat to increase available forage species for bull trout.** Juvenile salmonids are considered to have been a primary food source of bull trout. This reduction in prey base has contributed to the decline of bull trout in the Grande Ronde River Recovery Unit and is of particular concern in the Upper Grande Ronde River, Catherine Creek and Indian Creek watersheds.

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

1.4.1. **Evaluate the impacts of Lower Granite Dam and Hells Canyon Dam.** Bull trout from the Grande Ronde River Recovery Unit

enter the mainstem of the Snake River. However, how bull trout use the mainstem of the Snake River, whether they attempt to pass either dam has not been determined, and impacts of hydropower facility operation has not been well defined.

1.4.2. **Review reservoir operations at Federal Columbia River power system facilities, and revise as necessary.** The impacts to bull trout of (for example) water level manipulation, physical entrainment, and gas entrainment resulting from reservoir operations need to be thoroughly investigated. The results of these studies should be incorporated in operational recommendations provided through the Federal Energy Regulatory Commission, State relicensing processes, and Federal consultations. For examples, the operations of Lower Granite Dam and the East Fork Wallowa hydropower project should be assessed for impacts to bull trout.

1.4.3. **Evaluate and reduce the impacts of tributary dams.** Evaluate current conditions above the dam in the Wallowa River and the dam in Beaver Creek. Assess the benefits and detriments of connecting bull trout local populations in these areas and determine whether such a connection is essential for recovery. Reduce adverse impacts of tributary dams wherever feasible.

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

1.5.1 **Assess current risk of catastrophic fire to bull trout populations and reduce where necessary.**

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

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

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

2.2.1 **Review efficacy of and compliance with 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.

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

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

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

2.5.1 **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 **Where necessary, implement management actions to reduce the distribution and abundance of nonnative species where bull**

trout are likely to benefit. Task 2.5.1 will provide information to determine locations in which actions to reduce the distribution/abundance of nonnative species are necessary.

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, 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.

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

3.2.1 **Evaluate the impact of current sport angling regulations on bull trout.** These regulations should attempt to minimize the effects of incidental mortality on recovery of bull trout in fisheries closed to bull trout harvest. For example, implement management

actions to reduce angler pressure in areas where incidental mortality continues to be detrimental to recovery.

3.2.2 **Enforce sport angling regulations.** Ensure compliance with regulations and policies and target problem areas for enforcement. Work with Oregon State Police through the Coordinated Enforcement Program to determine enforcement priorities and needs.

3.2.3 **Provide information to the public about low-impact angling.** Provide information to anglers about bull trout identification, special regulations, how to reduce hooking mortality of bull trout caught incidentally, and the value of bull trout and their habitat and their place in the ecosystem.

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.

4.1.1 **Document and monitor genetic baselines for each local population.** Assess the population structure and relatedness of bull trout form various watersheds and tributaries withing the recovery unit.

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

4.2.1 **Manage local populations (numbers and life forms) to maintain long-term viability.** Once local populations are identified, they should be managed as specific units.

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

4.3.1 **Assess the potential for re-establishment of local populations in Wenatchee Creek and above the Wallowa Lake Dam.** Assess the feasibility and appropriateness of reestablishing local populations in previously occupied habitat.

4.3.2 **Reestablish bull trout in Wenatchee Creek and above the Wallowa Lake Dam if feasible.** If appropriate and feasible, propose and gain approval for specific reintroductions. Monitoring and criteria for evaluating results should follow State and Federal guidelines for public process, donor stocks, disease factors, impacts on other native species, and genetic concerns. Proceed with reintroductions after obtaining State and Federal approval and funding.

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.

5.1.1 **Design and implement a standardized, statistically sound bull trout population monitoring program.**

5.1.2 **Assess habitat restoration techniques.** Evaluate effectiveness of different active and passive habitat restoration techniques in restoring watershed function and local bull trout populations. For example, Bonneville Power Administration and U.S. Forest Service fencing and grazing management projects.

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

5.2.1 **Conduct further sampling in the mainstem Indian Creek to identify lower distribution limits of spawning and rearing habitat.**

5.2.2. **Evaluate habitat condition and determine bull trout use of the Grande Ronde valley.** Assess habitat conditions in the Grande Ronde River between La Grande and Elgin. Determine how, when and in what capacity bull trout use this portion of the river. Determine if conditions (*i.e.* thermal) in this area prevent or inhibit the migration of fluvial bull trout. Determine if bull trout from the Upper Grande Ronde River and Catherine Creek are connected to each other as well as to other local populations within the recovery unit.

5.2.3. **Assess habitat potential for expanding local populations.** As identified in Table 2, bull trout have the potential to expand into various areas within the Grande Ronde River Recovery Unit. This is particularly true in Little Catherine Creek and Indian Creek as well as on lands owned by Boise Cascade.

5.2.4. **Conduct watershed assessments.** Evaluate historic and present conditions in each habitat type by watershed. This has been completed for the Grande Ronde and Lostine watersheds but needs

to be done for Bear Creek, Deer Creek, and Wallowa River watersheds.

5.2.5. **Determine range of temperature tolerances for bull trout life stages in different habitats.** Use the results of ongoing temperature studies to address the adequacy of existing regulations. The recovery unit team identified this as a need rangewide.

5.2.6. **Determine the seasonal movement patterns of adult and subadult migratory bull trout.** 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 Grande Ronde River Recovery Unit are related to each other as well as other bull trout populations in Snake River watershed *(e.g.*, Imnaha, Clearwater, and Salmon Rivers), and the extent of their habitat requirements.

5.2.7. **Evaluate food web interactions.** This action is particularly relevant in drainages most affected by introduced fishes, *Mysis* shrimp, and reservoir operations. For example, food web interactions with *Mysis* shrimp and lake trout in Wallowa Lake.

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.

5.3.1 **Develop, implement, and evaluate basin management plans.** These would address a variety of unregulated activities that can be detrimental to bull trout recovery. For example, an inventory of dispersed recreation in the National Forests has been scheduled.

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

5.4.1 **Research effects of whirling disease on bull trout.** If it is a concern, monitor for presence of whirling disease in important bull trout spawning and rearing areas. Currently the Grande Ronde River subbasin is quarantined. The recovery unit team identified this as a need rangewide.

5.4.2 **Maintain fish health screening and transplant protocols.** This will help reduce risk of disease transmission. Include discussion of fish health in the terms and conditions in section 10 permits for hatchery operations for guidance.

5.4.3 **Provide information to the public about fish disease issues.** Produce a whirling disease informational pamphlet for public distribution. This would contain current information of this parasite's distribution in Oregon and Washington and list precautions that should be taken by the fishing public to help prevent its spread to other watersheds.

5.4.4 **Survey for whirling disease.** Continue Oregon's Statewide survey of hatchery and wild fish populations for the presence of *Myxobolus cerebralis*, agent of whirling disease. Periodic planned surveys should be conducted in watersheds where past known exposure of infected fish occurred, *e.g.*, Grande Ronde Basin.

5.4.5 **Monitor for effects of fish pathogens on Oregon bull trout populations.** Follow Oregon Department of Fish and Wildlife protocols (in development) for handling and disposition of bull trout mortalities, *e.g.*, 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. The recovery unit team identified this as a need rangewide.

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 presence/absence of bull trout in potential habitat where their status is unknown or recolonization is anticipated.

5.5.4 **Maintain a central database.** Identify funding and personnel to develop and centralize all distribution and monitoring data for bull trout in the recovery unit. Review and periodically update databases for bull trout distribution records.

5.5.5 **Compare characteristics of weak and strong populations of bull trout.** The characteristics of relatively strong and relatively weak but otherwise similar populations (for example, the Wenaha River and Lookingglass Creek) 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 mechanism by which migratory life forms undergo transition to resident forms.** The recovery unit team identified this as a need rangewide.

5.6.2 **Evaluate the relationship between life history forms.** Specifically, address whether resident adults produce migratory (fluvial) progeny and whether migratory (fluvial) adults produce resident progeny.

5.6.3 **Determine the consequences of genetic fragmentation and isolation.** This isolation may be due to human-made or natural barriers (*e.g.*, Little Minam River). The recovery unit team identified this as a need rangewide.

5.6.4 **Investigate use of the mainstem Snake River by bull trout from the Grande Ronde River subbasin.** 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.*, Imnaha-Snake, Clearwater, to determine areas of overlapping use and possible interactions.

5.6.5 **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.

5.6.6 **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.

5.6.7 **Evaluate survival rates by life stage.** 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 **Support collaborative efforts by local watershed groups.** These groups often accomplish site specific protection/restoration activities.

6.1.2 **Provide long-term habitat protection.** This may be accomplished through purchase, conservation easements, management plans, and land exchanges. Specifically, explore whether these opportunities exist in the Lookingglass Creek drainage.

6.1.3 **Work cooperatively with neighboring States and governments to implement recovery actions.** Many of these watersheds span interstate and Tribal boundaries; such cooperation is necessary to implement recovery actions.

6.1.4 **Provide educational and outreach opportunities to the public about bull trout habitat needs.** Develop educational materials on bull trout and their habitat needs, *e.g.*, watershed form and function, riparian and side channel restoration, large wood placement, and marking storm drains in urban areas.

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

6.3 *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 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 scope of recovery as suggested by new information.

7.3.1 **Periodically assess progress and determine needs for changes in recovery unit plan.**

7.3.2 **Periodically assess the priority of actions in the context of how to emphasize actions in core areas.**

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 and estimates for the next 5 years, if available, and comments. These tasks, when accomplished, will lead to recovery of bull trout in the Grande Ronde River Recovery Unit. The estimated time to recovery is 25 to 50 years and the total estimated cost is $17 million.

Parties with authority, responsibility, or expressed interest to implement a specific recovery task are identified in the Implementation Schedule. Where federally or privately operated facilities have been included as a part of potential recovery tasks, potentially impacted entities have been identified as the lead or co-lead in assessing the feasibility of the proposed action. Lead parties are designated in **bold** type. Listing a responsible party does not imply that prior approval has been given or require that a party participate or expend any funds. However, willing participants will benefit 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 recovery effort to recover bull trout.

Following are definitions to column headings and keys to abbreviations and acronyms used 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, habitat quality, or 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 tasks narrative. 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 can reduce the time needed for task completion.

Responsible or Participating Party: The following organizations are those with the responsibility or capability to fund, authorize, or carry out the corresponding recovery task. Lead agencies are indicated in bold type. Additional identified agencies or parties are considered cooperators in restoration efforts. Identified parties include:

BCC	Boise Cascade Corporation
BLM	Bureau of Land Management
BPA	Bonneville Power Administration
BOR	Bureau of Reclamation
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GRMWP	Grande Ronde Model Watershed Program
NMFS	National Marine Fisheries Service
NPPC	Northwest Power Planning Council
NPT	Nez Perce Tribe
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OSP	Oregon State Police
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
USACE	U.S. Army Corp of Engineers

USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife

Cost Estimates: Cost estimates are rough estimates and are only provided for general guidance. Total costs are estimated for both the duration of the task, are itemized annually for the next 5 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.

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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 whether tributary diversions act as migration barriers and restore passage where necessary	2	**ODFW**, USFS, **WDFW**	100	50	50				Install appropriate fish passage structures around diversions or remove related migration barriers
1	1.2.5	Assess whether road and trail crossings are acting as barriers to bull trout movement and provide passage wherever feasible	2	BCC, ODFW, **ODOT**, **USFS**, WDFW	200	100	100				Implement solutions to address those that impact bull trout
1	1.2.8	Monitor the effects of diversions and withdrawals on stream temperature and bull trout migration, and modify as necessary	3	**ODFW**, USFS, WDFW	450	150	150	150			Modify the management of diversions and withdrawals as necessary for bull trout
1	1.3.1	Restore riparian zones associated with bull trout habitat.	25	**BCC**, **BLM**, CTUIR, GRMWP, NPT, ODFW, **USFS**, WDFW	375	15	15	15	15	15	
1	1.3.2	Maintain riparian zones associated with bull trout habitat.	25	**BCC, BLM**, CTUIR, GRMWP, NPT, ODFW, **USFS**, WDFW	*						

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	1.4.1	Evaluate the impacts of Lower Granite Dam and Hells Canyon Dam.	5	ODFW, USACE, USFS, **USFWS**, WDFW	1000	200	200	200	200	200	
1	1.4.2	Review reservoir operations at Federal Columbia River Power System facilities and revise as necessary	5	USACE, ODFW, **USFWS**, WDFW	250	50	50	50	50	50	Recommend-ations should be provided through the Federal Energy Regulatory Commission, State relicensing processes, and Federal consultations
1	3.1.1	Coordinate plans associated with fish management	25	BPA, CTUIR, ODFW, NPPC, NPT, USACE, USFS, **USFWS**, WDFW	250	10	10	10	10	10	
1	3.2.2	Enforce sport angling regulations	25	ODFW, **OSP**, WDFW	250	10	10	10	10	10	
1	3.2.3	Provide information to the public about low-impact angling	5	**ODFW, WDFW**	50	10	10	10	10	10	

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	4.1.1	Document and monitor genetic baselines for each local population	3	ODFW, **USFWS**, WDFW	500	100	200	200			
1	4.2.1	Manage local populations (numbers and life forms) to maintain long-term viability	25	**ODFW, WDFW**	*						
1	5.1.1	Design and implement a standardized, statistically sound bull trout population monitoring program	25	BLM, ODFW, USFS, **USFWS**, WDFW	1950	150	75	75	75	75	
1	5.2.1	Conduct further sampling in the mainstem Indian Creek to identify lower distribution limits of spawning and rearing habitat	3	BCC, **ODFW**, USFS	45	15	15	15			
1	5.2.2	Evaluate habitat condition and bull trout use of the Grande Ronde valley	3	**GRMWP**, ODFW	140	60	20	20	20	20	
1	5.2.5	Determine range of temperature tolerances for bull trout life stages in different habitats	5	**ODFW**, USFS, **USFWS, WDFW**	75	15	15	15	15	15	

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	5.2.6	Determine the seasonal movement patterns of adult and subadult, migratory bull trout	5	**ODFW**, USACE, USFS, USFWS, **WDFW**	750	150	150	150	150	150	
1	5.5.1	Determine life history requirements	10	BPA, BOR, BLM, CTUIR, NPT, ODFW, USACE, USFS, **USFWS**, WDFW	1500	150	150	150	150	150	
1	5.5.3	Continue to survey for bull trout	25	BPA, CTUIR, NPT, **ODFW**, USFS, USFWS, **WDFW**	625	25	25	25	25	25	
1	5.6.1	Determine the mechanism by which migratory life forms undergo transition to resident forms	10	BPA, **ODFW**, USACE, USFS, **USFWS**, **WDFW**	500	50	50	50	50	50	

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	Evaluate the relationship between life history forms	10	BPA, **ODFW**, USACE, USFS, **USFWS**, **WDFW**	500	50	50	50	50	50	
1	5.6.3	Determine the consequences of genetic fragmentation and isolation	10	BPA, **ODFW**, USACE, USFS, **USFWS**, **WDFW**	500	50	50	50	50	50	
1	5.6.4	Investigate use of the mainstem Snake River by bull trout from the Grande Ronde River subbasin	5	**ODFW**, USACE, **USFWS**, **WDFW**	750	150	150	150	150	150	
1	5.6.5	Evaluate the population structure of bull trout in the recovery unit	3	BPA, ODFW, USFS, **USFWS**, WDFW	500	100	200	200			
1	5.6.7	Evaluate survival rates (by life stage)	10	BPA, **ODFW**, USFS, **USFWS**, **WDFW**	1000	100	100	100	100	100	

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	6.1.2	Provide long-term habitat protection	25	BCC, BLM, BOR, BPA, GRMWP, **ODFW**, USFS, USFWS, **WDFW**	500	25	25	25	25	25	This may be accomplished through purchase, conservation easements, management plans, and land exchanges
1	6.1.4	Provide educational information to the public about bull trout habitat needs	5	**GRMWP**, ODFW, WDFW	50	10	10	10	10	10	
2	1.1.1	Identify and reduce sources of excessive fine sediment delivery	3	BCC, BLM, BOR, **ODFW**, USFS, **WDFW**	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	BCC, BLM, BOR, **ODFW**, ODOT, USFS, **WDFW**	75	15	15	15	15	15	Implement the water quality management plan for the Upper Grande Ronde, Wallowa and Lower Grande Ronde watersheds
2	1.2.2	Assess whether tributary diversions and irrigation ditches are screened appropriately and remediate where necessary	3	**ODFW**, USFS, **WDFW**	45	15	15	15			Take action based on assessment

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	1.2.3	Evaluate, and where necessary reduce, impacts of hatchery weirs on bull trout	5	**CTUIR, 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**, ODFW, **USFS**, WDFW	200	10	15	20	15	10	
2	1.3.5	Protect, maintain, and enhance anadromous fish habitat to increase available forage species for bull trout	25	**ODFW, USFWS, USFS, WDFW**	*						Ongoing
2	2.5.1	Assess the interactions between bull trout and introduced fishes	5	BPA, **ODFW, USFWS, WDFW**	125	25	25	25	25	25	If appropriate, design and implement programs to control or extirpate nonnative fishes
2	5.2.3	Assess habitat potential for expanding local populations	3	BPA, BCC, **ODFW**, USFS, USFWS, **WDFW**	450	15	15	15			

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	5.3.1	Develop and evaluate basin management plans	4	BPA, CTUIR, NPPC, NPT, **ODFW**, USFS, USFWS, **WDFW**	100	25	25	25	25		
2	5.4.2	Maintain fish health screening and transplant protocols	25	**ODFW, WDFW**	*						
2	5.5.2	Investigate the relationship between bull trout and anadromous species	3	BPA, NMFS, **ODFW**, USFS, **USFWS, WDFW**	150	50	50	50			
2	5.5.4	Maintain a central database	25	**ODFW**	250	10	10	10	10	10	
2	5.5.5	Compare characteristics of weak and strong populations of bull trout	10	BPA, ODFW, USACE, USFS, **USFWS**, WDFW	250	25	25	25	25	25	

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	5.6.6	Evaluate basic life history characteristics	10	BPA, ODFW, USACE, USFS, **USFWS**, WDFW	1000	100	100	100	100	100	
2	6.1.1	Support collaborative efforts by local watershed groups	25	**ODFW**, USFWS, **WDFW**	*						
3	1.2.4	Ensure that hatchery intakes are not impacting bull trout	2	**CTUIR, NPT, ODFW**, USFWS	30	15	15				Insure that intakes are screened properly
3	1.2.6	Salvage stranded bull trout	25	**ODFW**, WDFW	125	5	5	5	5	5	
3	1.2.7	Secure appropriate instream flows	10	**ODFW**, WDFW	125	5	5	5	5	5	
3	1.3.4	Assess the need for stream channel restoration activities and implement where necessary	3	**ODFW**, WDFW	30	10	10	10			Implement if necessary
3	1.4.3	Evaluate and reduce the impacts of tributary dams	5	**ODFW**, USFS	75	15	15	15	15	15	

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	1.5.1	Assess current risk of catastrophic fire to bull trout populations and reduce where necessary	3	**BCC, USFS**	45	15	15	15			
3	2.2.1	Review efficacy of and compliance with fish stocking regulations	25	**ODFW**, OSP, **WDFW**	*						
3	2.6.1	Where necessary, implement management actions to reduce the distribution/abundance of nonnative species	28	**ODFW, USFWS, USFS, WDFW**	*						
3.1.2 3	3.1.2	Coordinate recovery efforts on bull trout, salmon, and steelhead	25	**NMFS, USFWS**	*						
3	3.2.1	Evaluate the impact of current sport angling regulations on bull trout	25	**ODFW, WDFW**	*						
3	4.3.1	Assess the potential for reestablishment of local populations in Wenatchee Creek and above the Wallowa Lake Dam	3	BPA, **ODFW**, USFWS, **WDFW**	45	15	15	15			
3	4.3.2	Reestablish bull trout in Wenatchee Creek and above the Wallowa Lake Dam if feasible	10	**ODFW, WDFW**	NA						Dependent on 4.3.2.

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	5.1.2	Assess habitat restoration techniques	10	**BLM, BOR**, BPA, GRMWP, ODFW, **USFS**, WFDW	250	25	25	25	25	25	
3	5.2.4	Conduct watershed assessments	3	**ODEQ**	225	75	75	75			
3	5.2.7	Evaluate food web interactions	4	**ODFW**	300	100	100	100			
3	5.4.1	Research effects of whirling disease on bull trout	3	**ODFW**	150	50	50	50			Monitor for the presence of whirling disease in important areas
3	5.4.3	Provide educational opportunities to the public about whirling disease	5	**ODFW**	50	10	10	10	10	10	
3	5.4.4	Survey for whirling disease	3	**ODFW**	90	30	30	30			
3	5.4.5	Monitor for effects of fish pathogens on Oregon bull trout populations	25	**ODFW**	125	5	5	5	5	5	
3	6.1.3	Work cooperatively with neighboring states and governments to implement recovery actions	25	**ALL**	*						

GRANDE RONDE RECOVERY UNIT - IMPLEMENTATION SCHEDULE											
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	7.1.1	Develop a participation plan to support implementation in the recovery unit	25	**USFWS**	*						
3	7.3.1	Periodically assess progress and determine needs for changes in recovery unit plan	25	**USFWS**	*						
3	7.3.2	Periodically assess the priority of actions in the context of how to emphasize actions in core areas	25	**USFWS**	*						

REFERENCES

Allendorf, F.W., and N. Ryman. 2002. The role of genetics in population viability analysis. Pages 50 to 85 *In*: S.R. Beissinger and D.R. McCullough, eds. Population viability analysis. University of Chicago Press, Chicago, Illinois.

Baldwin, E. 1964. Geology of Oregon. Edwards Brothers, Inc., Ann Arbor, Michigan.

Bartholomew, J. 2001. Fish health risk assessment - Oregon State University 2000 progress report. *In:* Portland General Electric, Pelton Round Butte Fisheries Workshop, Spring, 2001. Portland General Electric Company. Portland, Oregon.

Baxter, C. 2002. Fish movement and assemblage dynamics in a Pacific Northwest riverscape. Dissertation, Department of Fisheries Science, Oregon State University, Corvallis, Oregon.

Bellerud, B.L., S.L. Gunckel, A.R. Hemmingsen, D.V. Buchanan, and P.J. Howell. 1997. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 1996 Annual Report. Bonneville Power Administration, Portland, Oregon.

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.

Confederated Tribes of the Umatilla Indian Reservation. 1996. The Comprehensive Plan. Mission, Oregon.

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.

Dunham, J.B., and B.E. Rieman. 1999. Metapopulation structure of bull trout: Influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications 9: 642-655.

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

Gunckel, S. 2001. Feeding behavior and diet of native bull trout *Salvelinus confluentus* and introduced brook trout *S. fontinalis* in two eastern Oregon streams. Masters Thesis, Department of Fisheries Science, Oregon State University, Corvallis, Oregon.

Hemmingsen, A.R., B.L. Bellerud, D.V. Buchanan, S.L. Gunckel, J.S. Shappart, and P.J. Howell. 2001a. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 1997 Annual Report. Bonneville Power Administration, Portland, Oregon.

Hemmingsen, A.R., B.L. Bellerud, S.L. Gunckel, and P.J. Howell. 2001b. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 1998 Annual Report. Bonneville Power Administration, Portland, Oregon.

Hemmingsen, A.R., S.L. Gunckel, and P.J. Howell. 2001c. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 1999 Annual Report. Bonneville Power Administration, Portland, Oregon.

Hemmingsen, A.R., S.L. Gunckel, P.M. Sankovich, and P.J. Howell. 2001d. Bull trout life history, genetics, habitat needs, and limiting factors in central and northeast Oregon, 2000 Annual Report. Bonneville Power Administration, Portland, Oregon.

James, G. 1984. Grande Ronde River basin recommended salmon and steelhead habitat improvement measures. Confederated Tribes of the Umatilla Indian Reservation, Mission, Oregon.

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 to 1460.

Lande, R. 2002. Incorporating stochasticity in population viability analysis. Pages 18-40 *In*: S.R. Beissinger and D.R. McCullough, eds. Population viability analysis. University of Chicago Press, Chicago, Illinois.

McIntosh, B. 1992. Historical changes in anadromous fish habitat in the upper Grande Ronde River, Oregon, 1941 to 1992. Masters Thesis, Oregon State University, Corvallis, Oregon.

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. 2000. 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. 2001. Draft Grande Ronde Subbasin Summary. Prepared by M.C. Nowak.

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. 2001a. Characterize the migratory patterns, population structure, food habits, and abundance of bull trout from subbasins in the Blue Mountain Province. Blue Mountain Province, Proposal 199405400, Bonneville Power Administration, Portland, Oregon.

Oregon Department of Fish and Wildlife. 2001b. 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 to 17 *In*: P.J. Howell and D.V. Buchanan, eds. 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.

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.

Spruell, P. and F. Allendorf. 1997. Nuclear DNA analysis of Oregon bull trout. Final report to the Oregon Department of Fish and Wildlife. Division of Biological Sciences, University of Montana.

U.S. Army Corps of Engineers. 1997. Walla Walla River Watershed Oregon and Washington Reconnaissance Report. Walla Walla District, Walla Walla, Washington.

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. Fish and Wildlife Service. 2000. Biological Opinion. Effects to listed species from Operations of the Federal Columbia River Power System. U.S. Fish and Wildlife Service, Region 1 (Portland, Oregon) and Region 6 (Denver, Colorado).

Waples, R.S. 2002. Definition and estimation of effective population size in the conservation of endangered species. Pages 147-168 *In*: S.R. Beissinger and D.R. McCullough, eds. Population viability analysis. University of Chicago Press, Chicago, Illinois.

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

Washington Department of Wildlife. 1998. Washington State salmonid stock inventory, bull trout/Dolly Varden. Olympia, Washington.

Washington Department of Fish and Wildlife. 2001. Fishing regulations for the State of Washington. Olympia, Washington.

Washington Forest Practices Board. 2000. Washington forest practices: rules – WAC 222 (including emergency rules), board manual (watershed manual not included), Forest Practices Act, RCW 76.09. Washington Forest Practices Board, 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 1800's-1900's). Northwest Science Special Issue 68:1-34.

In Literature

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

Zakel, J. 1995. Fish stock status of the La Grande fish district. Unpublished report. Oregon Department of Fish and Wildlife, La Grande, Oregon.

West, D., and J. Zakel. 1993. Bull Trout Population summaries in the Grande Ronde subbasin. Unpublished report. Oregon Department of Fish and Wildlife, La Grande, Oregon.

Personal Communications

Groat, D., 2002. U.S. Forest Service, Asotin, Washington.

Harbeck, J., 2002. Nez Perce Tribe, Enterprise, Oregon.

Keefe, M., Montgomery-Watson-Harza, 2002. Portland, Oregon.

Lofy, P., 2002. Bonneville Power Administration, Portland, Oregon.

Mendel, G., 2002. Washington Department of Fish and Wildlife, Asotin, Washington.

McLean, M., 2001. Confederated Tribes of the Umatilla Indian Reservation, La Grande, Oregon.

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

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

Walters, T., 2002. Oregon Department of Fish and Wildlife, La Grande, Oregon.

Zakel, J., 2002. Oregon Department of Fish and Wildlife, La Grande, Oregon.

APPENDIX A: List of Chapters