WHAT IS A RECOVERY PLAN?

A recovery plan is a template for the recovery of a threatened or endangered species and its habitats. The recovery plan describes a process to remove the threats to the long-term survival and reverse the decline of a listed species. Recovery is the restoration of listed species such that they become secure, self-sustaining components of their ecosystem. For bull trout, recovery will require reducing threats to the long-term persistence of populations, maintaining multiple interconnected populations across the diverse habitats of the native range of bull trout, and preserving the diversity of bull trout life-history strategies (*e.g.*, resident and migratory forms, emigration age, spawning frequency, local habitat adaptations).

An approved recovery plan is not a decision document but is intended to provide information and guidance that the U.S. Fish and Wildlife Service believes will lead to recovery of a listed species, including its habitat. A recovery plan provides information necessary to describe the current status of the listed species as well as ongoing or proposed actions designed to aid in the ultimate recovery of the species. Many of the recovery actions (or tasks) in this document will require further environmental analysis and public review, especially those actions taken by Federal agencies.

DEVELOPMENT AND ORGANIZATION OF THE BULL TROUT RECOVERY PLAN

Because the threatened bull trout population segments are widely distributed over a large area and because population segments were subject to listing at different times, the U.S. Fish and Wildlife Service adopted a two-tiered approach to develop the draft recovery plan for bull trout. The first tier addresses broad aspects of bull trout recovery that apply at the level of population segments. The second tier addresses bull trout recovery in smaller areas, such as specific river basins or collections of river basins within population segments, termed "recovery units". There are 22 recovery units in the Columbia River, 1 in the Klamath River, 1 in the Jarbidge River, 1 in the St. Mary-Belly River, and 2 in the Coastal-Puget Sound Distinct Population Segments. This document includes the Columbia River, Klamath River, and the St. Mary-Belly River segments. Recovery plans for the remaining two segments will be released individually at a later time.

We relied on two types of teams to assist in developing the draft recovery plan. To address overall recovery issues, such as identifying an overall recovery strategy, designating recovery units, and providing guidance in developing the recovery plan, we convened an "overall" recovery team. Membership on the recovery team consisted of U.S. Fish and Wildlife Service biologists, a representative from State fish and wildlife resource agencies in each of the four northwestern states (Idaho, Montana, Oregon, and Washington), and a representative from the Upper Columbia United Tribes (Confederated Tribes of the Colville Reservation, Coeur d'Alene Tribe, Kalispel Tribe, Kootenai Tribe of Idaho, and Spokane Tribe).

To develop local recovery strategies at the recovery unit level, we enlisted the assistance of recovery unit teams, one for each recovery unit. Membership on the recovery unit teams consisted of persons with technical expertise in various aspects of bull trout biology within each recovery unit, typically representing Federal and State agencies, Tribes, and industry and interest groups. Major tasks of recovery unit teams included defining recovery for recovery units, including unit-specific objectives and criteria; reviewing factors affecting bull trout; estimating costs; and identifying site-specific actions. Members of the recovery team coordinated with recovery unit teams to ensure consistency among recovery units (see Figure 1 and Table 1 for recovery units).

Figure 1. Bull trout recovery units in the United States.

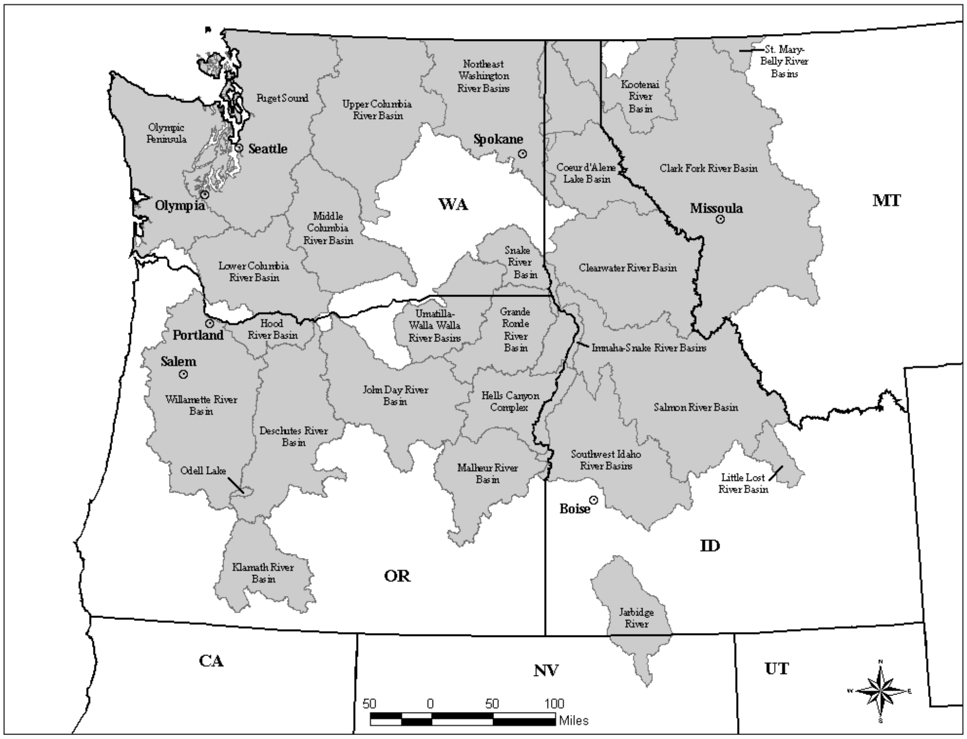


Table 1. Bull trout recovery units by distinct population segment and State(s).

Recovery unit	Distinct population segment	State(s)
Klamath River	Klamath River	Oregon
Clark Fork River	Columbia River	Idaho, Montana, Washington
Kootenai River	Columbia River	Idaho, Montana
Willamette River	Columbia River	Oregon
Hood River	Columbia River	Oregon
Deschutes River	Columbia River	Oregon
Odell Lake	Columbia River	Oregon
John Day River	Columbia River	Oregon
Umatilla-Walla Walla River	Columbia River	Oregon, Washington
Grande Ronde River	Columbia River	Oregon
Imnaha-Snake River[1]	Columbia River	Idaho, Oregon
Hells Canyon Complex[2]	Columbia River	Idaho, Oregon
Malheur River	Columbia River	Oregon
Coeur d'Alene Lake Basin	Columbia River	Idaho
Clearwater River	Columbia River	Idaho

Table 1. Bull trout recovery units by distinct population segment and State(s).

Recovery unit	Distinct population segment	State(s)
Salmon River	Columbia River	Idaho
Southwest Idaho[3]	Columbia River	Idaho
Little Lost River	Columbia River	Idaho
Lower Columbia River[4]	Columbia River	Washington
Middle Columbia River[5]	Columbia River	Washington
Upper Columbia River[6]	Columbia River	Washington
Northeast Washington[7]	Columbia River	Washington
Snake River Washington[8]	Columbia River	Oregon, Washington
Jarbidge River	Jarbidge River	Idaho, Nevada
Puget Sound	Coastal-Puget Sound	Washington
Olympic Peninsula	Coastal-Puget Sound	Washington
St. Mary-Belly River	St. Mary-Belly River	Montana

[1]Includes Imnaha River and Snake River and tributaries in Idaho.
[2]Includes Pine Creek, Powder River, and Snake River and tributaries in Idaho.
[3]Includes Boise River, Payette River, and Weiser River basins.
[4]Includes Klickitat River, Lewis River, and White Salmon River basins.
[5]Includes Yakima River basin.
[6]Includes Entiat River, Methow River, and Wenatchee River basins.
[7]Includes mainstem Columbia River and tributaries upstream of Chief Joseph Dam (Washington), Pend Oreille River basin (Washington), and Spokane River basin upstream to Post Falls (Idaho).
[8]Includes Asotin Creek basin and Tucannon River basin.

The bull trout recovery plan differs from many recovery plans in that it is organized into multiple chapters. This introductory chapter (Chapter 1) discusses programmatic issues that broadly apply to bull trout in the coterminous United States. This chapter describes the U.S. Fish and Wildlife Service's recovery strategy for the species, defines recovery, and identifies recovery tasks applicable to bull trout throughout its range.

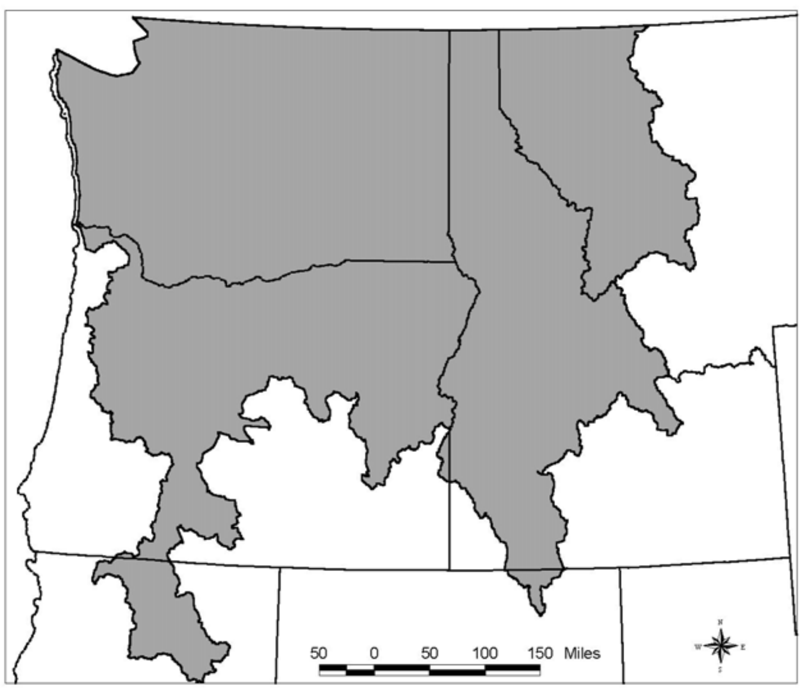
Each following chapter (Chapters 2 through 24 and Chapter 28) addresses a specific recovery unit and includes an executive summary, describes current conditions of the habitat and species within the recovery unit, outlines the strategy for recovery, defines recovery objectives and criteria, identifies specific recovery tasks, and estimates time and cost required to achieve recovery for a particular recovery unit. For a complete list of chapters, see Appendix 4 in this chapter or the last appendix in any of the following chapters.

Many of the states have their own bull trout conservation plans in varying stages of development and implementation. These plans each have unique attributes, but may not meet all statutory requirements for the contents of recovery plans, as described in section 4(f)(1)(B) of the Endangered Species Act including "(i) a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species; (ii) objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and (iii) estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal." The U.S. Fish and Wildlife Service's recovery planning process for bull trout builds upon the foundation established in State conservation plans and adopts portions of those plans, where appropriate.

INTRODUCTION

Bull trout (*Salvelinus confluentus*, family Salmonidae) are char native to the Pacific Northwest and western Canada. The historical range of bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978; Bond 1992). To the west, bull trout range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada, (Cavender 1978; Brewin and Brewin 1997). The historical range of bull trout in the coterminous United States is shown in Figure 2.

Figure 2. Estimated historical range of bull trout in the coterminous United States.

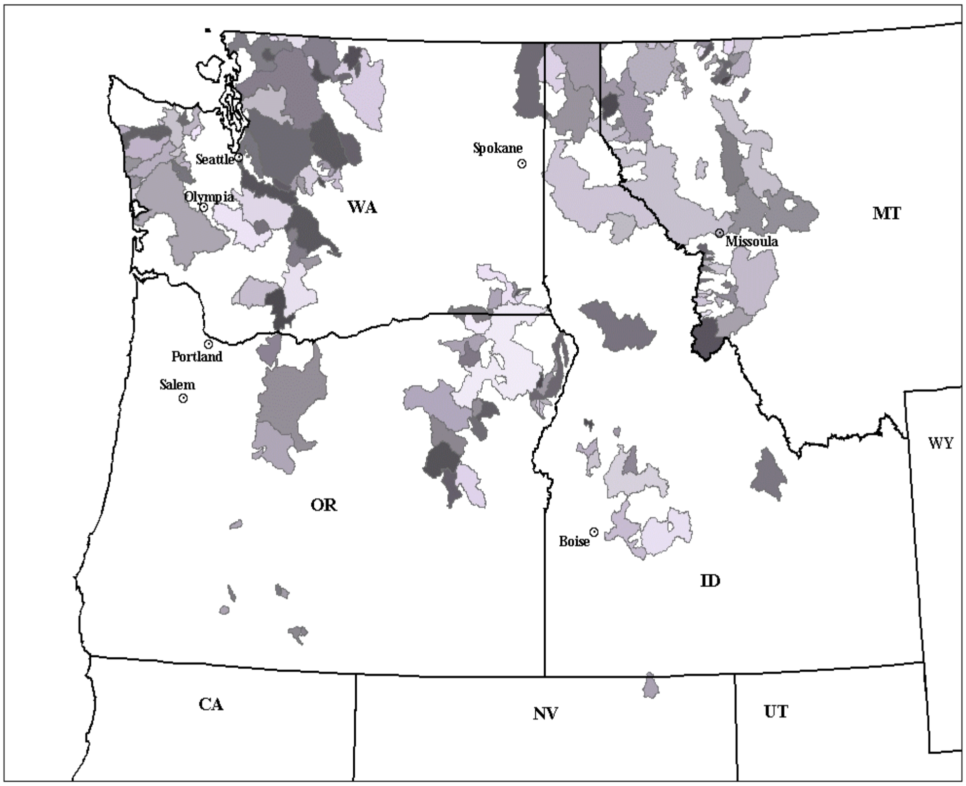


Although bull trout are presently widespread within their historical range in the coterminous United States, they have declined in overall distribution and abundance during the last century. For example, bull trout have been extirpated in the McCloud River basin, California, as well as locally in tributaries of other river basins. Declines resulted largely from habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, and the introduction of nonnative species. These factors resulted in the reduction or elimination of migratory bull trout. Retaining migratory forms of bull trout in a population is important because these forms allow fish access to more resources (*i.e.*, food and habitat), opportunities for genetic exchange, and the ability to recolonize habitats after local extirpations (*e.g.*, by a watershed-wide disturbance affecting all bull trout in a resident population).

On June 10, 1998, the U.S. Fish and Wildlife Service issued a final rule listing the Columbia River and Klamath River populations of bull trout as threatened (63 FR 31647) under the authority of the Endangered Species Act of 1973. This decision conferred full protection of the Endangered Species Act on bull trout occurring in four northwestern States. The Jarbidge River population was listed as threatened on April 8, 1999 (64 FR 17110). The Coastal-Puget Sound and St. Mary-Belly River populations were listed as threatened on November 1, 1999 (64 FR 58910), which resulted in all bull trout in the coterminous United States being listed as threatened. The five populations discussed above are listed as distinct population segments, *i.e.*, they meet the joint policy of the U.S. Fish and Wildlife Service and National Marine Fisheries Service regarding the recognition of distinct vertebrate populations (61 FR 4722). We do not consider recovery of bull trout in the McCloud River basin in this recovery plan.

In the rules listing bull trout as threatened, the U.S. Fish and Wildlife Service identified subpopulations (*i.e.*, isolated groups of bull trout thought to lack two-way exchange of individuals), for which status, distribution, and threats to bull trout were evaluated. Because habitat fragmentation and barriers have isolated bull trout throughout their current range, a subpopulation was considered a reproductively isolated group of bull trout that spawns within a particular river or area of a river system. Overall, we identified 187 subpopulations in the 5 distinct population segments, 7 in the Klamath River, 141 in the Columbia River, 1 in the Jarbidge River, 34 in the Coastal-Puget Sound, and 4 in the St. Mary-Belly River populations. Although subpopulations were an appropriate unit on which to conduct evaluations for listing purposes, alternative population units have been defined for recovery planning (see the Strategy for Recovery section for further detail). Therefore, subpopulations are not used in this draft recovery plan. The distribution of bull trout subpopulations identified by the U.S. Fish and Wildlife Service at the times of listing is shown in Figure 3.

Figure 3. Bull trout sub populations.



General Description and Life History

Bull trout have been defined as a distinct species (Cavender 1978), however, the genetic relationship among various groups of bull trout within the species can be complex (Rieman and Allendorf 2001). Biologists had previously confused bull trout with Dolly Varden (*Salvelinus malma*), largely because of the external similarity of appearance and the previous unavailability of adequate specimens of both species to any one taxonomist. Morphological (form and structure) analyses have confirmed the distinctiveness of the two species in their different, but overlapping, geographic distributions (Haas and McPhail 1991). Several genetic studies have subsequently confirmed the species distinction of bull trout and Dolly Varden (Phillips et al. 1989; Crane *et al.* 1994). Both species occur together in western Washington, for example, with little or no interbreeding (Leary and Allendorf 1997). Lastly, bull trout and Dolly Varden each appear to be more closely related genetically to other species of *Salvelinus* than they are to each other (Phillips *et al.* 1989; Greene *et al.* 1990; Phillips *et al.* 1991; Pleyte *et al.* 1992). For example, bull trout are most closely related to Japanese char (*S. leucomaenis*) whereas Dolly Varden are most closely related to Arctic char (*S. alpinus*).

With genetic theory, bull trout can be grouped into population units that share an evolutionary legacy, termed metapopulations and local populations (Kanda and Allendorf 2001). Metapopulations are composed of one or more local populations. For this recovery plan, bull trout have been grouped into distinct population segments, recovery units, core areas and local populations. Core areas are composed of one or more local populations, recovery units are composed of one or more core areas, and a distinct population segment is composed of one or more recovery units. The manner in which bull trout were grouped in the recovery plan represents an adaptive comparison of genetic population structure and management considerations. (See Strategy for Recovery section for additional discussion of recovery units, core areas, local populations and genetic structure of bull trout.)

Bull trout exhibit both resident and migratory life-history strategies (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear one to four years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989; Goetz 1989), or in certain coastal areas, to saltwater (anadromous) (Cavender 1978; McPhail and Baxter 1996; Washington Department of Fish and Wildlife. *et al.* 1997). Resident and migratory forms may be found together, and either form may give rise to offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993).

The size and age of bull trout at maturity depends upon life-history strategy. Resident fish tend to be smaller than migratory fish at maturity and produce fewer eggs (Fraley and Shepard 1989; Goetz 1989). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

Essential Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), fish should not be expected to simultaneously occupy all available habitats (Rieman et al.1997b1).

Migratory corridors link seasonal habitats for all bull trout life histories. For example, in Montana, migratory bull trout make extensive migrations in the Flathead River system (Fraley and Shepard 1989), and resident bull trout in tributaries of the Bitterroot River move downstream to overwinter in tributary pools (Jakober 1995). The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993; M. Gilpin, *in litt.* 1997; Rieman et al. 1997) (see also The Role of the Mainstem Columbia and Snake Rivers discussion). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed, or stray, to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants.

Bull trout are found primarily in the cold streams, although individual fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman et al. 1997). Water temperature above 15 degrees Celsius (59 degrees Fahrenheit) is believed to limit bull trout distribution, a limitation that may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995). Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992; Rieman and McIntyre 1993; Rieman et al. 1997; Baxter *et al.* 1999). Goetz (1989) suggested optimum water temperatures for rearing of about 7 to 8 degrees Celsius (44 to 46 degrees Fahrenheit) and optimum water temperatures for egg incubation of 2 to 4 degrees Celsius (35 to 39 degrees Fahrenheit). For Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 to 9 degrees Celsius (46 to 48 degrees Fahrenheit), within a temperature gradient of 8 to 15 degrees Celsius (46 to 60 degrees Fahrenheit). In Nevada, adult bull trout have been collected at 17.2 degrees Celsius (63 degrees Fahrenheit) in the West Fork of the Jarbidge River (S. Werdon, pers. comm. 1998) and have been observed in Dave Creek where maximum daily water temperatures were 17.1 to 17.5 degrees Celsius (62.8 to 63.6 degrees Fahrenheit) (Werdon, *in litt.* 2001). In the Little Lost River, Idaho, bull trout have been collected in water having temperatures up to 20 degrees Celsius (68 degrees Fahrenheit); however, these fish made up less than 50 percent of all salmonids when maximum summer water temperature exceeded 15 degrees Celsius (59 degrees Fahrenheit) and less than 10 percent of all salmonids when temperature exceeded 17 degrees Celsius (63 degrees Fahrenheit) (Gamett 1999).

All life-history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Pratt 1992; Thomas 1992; Rich 1996; Sexauer and James 1997; Watson and Hillman 1997). Jakober (1995) observed bull trout overwintering in deep beaver ponds or pools containing large woody debris in the Bitterroot River drainage, Montana, and suggested that suitable winter habitat may be more restricted than summer habitat. Maintaining bull trout habitat requires stability of stream channels and of flow stability (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993).

Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989) and water temperatures of 5 to 9 degrees Celsius (41 to 48 degrees Fahrenheit) in late summer to early fall (Goetz 1989). In the Swan River, Montana, abundance of bull trout redds (spawning areas) was positively correlated with the extent of bounded alluvial valley reaches, which are likely areas of groundwater to surface water exchange (Baxter *et al.* 1999). Survival of bull trout embryos planted in stream areas of groundwater upwelling used by bull trout for spawning were significantly higher than embryos planted in areas of surface-water recharge not used by bull trout for spawning (Baxter and McPhail 1999). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Water temperatures during spawning generally range from 4 to 10 degrees Celsius (39 to 51 degrees Fahrenheit). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1996). Migratory bull trout frequently begin spawning migrations as early as April and have been known to move upstream as far as 250 kilometers (155 miles) to spawning grounds in Montana (Fraley and Shepard 1989; Swanberg 1997). In Idaho, bull trout moved 109 kilometers (67.5 miles) from Arrowrock Reservoir to spawning areas in the headwaters of the Boise River (Flatter 1998). In the Blackfoot River, Montana, bull trout began spring migrations to spawning areas in response to increasing temperatures (Swanberg 1997). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992), and after hatching, juveniles remain in the substrate. Time from egg deposition to emergence of fry may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

Growth varies depending upon life-history strategy. Resident adults range from 150 to 300 millimeters (6 to 12 inches) total length, and migratory adults commonly reach 600 millimeters (24 inches) or more (Pratt 1985; Goetz 1989). The largest verified bull trout is a 14.6-kilogram (32-pound) specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish (Boag 1987; Goetz 1989; Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Leathe and Graham 1982; Fraley and Shepard 1989; Brown 1992; Donald and Alger 1993). In coastal areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (WDFW *et al.* 1997).

Aquatic Community

In the Columbia River and Klamath River basins, bull trout occur with native cutthroat trout (*Oncorhynchus clarki* subspecies), resident (redband) and migratory (steelhead) rainbow trout (*O. mykiss*), chinook salmon (*O. tshawytscha*), sockeye salmon (*O. nerka*), mountain whitefish (*Prosopium williamsoni*), and various sculpin (Cottidae), sucker (Catostomidae), and minnow (Cyprinidae) species (Mauser *et al.* 1988; WDF *et al.* 1993; WDFW 1998). In the Jarbidge River basin, bull trout occur with native redband trout, mountain whitefish, sculpin, bridgelip sucker (*Catostomus columbianus*), and various minnow species (Warren and Partridge 1993; Johnson and Weller 1994; Zoellick *et al.* 1996; Partridge and Warren 1998; Johnson 1999). In the Coastal-Puget Sound areas, bull trout occur with native cutthroat trout, steelhead, chinook salmon, coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), sockeye salmon, mountain whitefish, pygmy whitefish (*P. coulteri*), and various sculpin, sucker, and minnow species (R2 Resource Consultants, Inc. 1993; WDF *et al.* 1993; WDFW 1998). In the St. Mary-Belly River system, bull trout occur with native westslope cutthroat trout, lake trout (*S. namaycush*), mountain whitefish, northern pike (*Esox lucius*), trout-perch (*Percopsis omiscomaycus*), and various sculpin, sucker, and minnow species (Fredenberg 1996; Holton and Johnson 1996).

Bull trout habitat within the coterminous United States often overlaps with the range of several fishes listed as threatened, endangered, or proposed for listing under the Endangered Species Act, including endangered Snake River sockeye salmon (56 FR 58619), threatened Snake River spring/summer and fall chinook salmon (57 FR

14653), endangered Kootenai River white sturgeon (*Acipenser transmontanus*) (59 FR 45989), threatened and endangered steelhead (62 FR 43937), threatened Puget Sound chinook salmon (63 FR 11481), and threatened Hood Canal summer-run chum salmon and Columbia River chum salmon (64 FR 14507).

Nonnative salmonids (members of the trout and salmon family) have been widely introduced and have become established in numerous areas throughout the range of bull trout. These species include brook trout (*S. fontinalis*), lake trout (west of the Continental Divide, *i.e.*, excluding the St. Mary-Belly River system where they are native), brown trout (*Salmo trutta*), Arctic grayling (*Thymallus arcticus*), and lake whitefish (*Coregonus clupeaformis*). Kokanee (a freshwater form of *O. nerka*), nonnative strains of rainbow trout, and nonnative subspecies of cutthroat trout have also been introduced into areas where they did not occur naturally.

Reasons for Decline

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992; Schill 1992; Thomas 1992; Ziller 1992; Rieman and McIntyre 1993; Newton and Pribyl 1994; Idaho Department of Fish and Game, *in litt.* 1995; McPhail and Baxter 1996). Several local extirpations have been documented, beginning in the 1950's (Rode 1990; Ratliff and Howell 1992; Donald and Alger 1993; Goetz 1994; Newton and Pribyl 1994; Berg and Priest 1995; Light *et al.* 1996; Buchanan *et al.* 1997; WDFW 1998). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Moyle 1976; Rode 1990). Bull trout have been functionally extirpated (*i.e.*, few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (USFWS 1998a).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta *et al.* 1987; Chamberlin *et al.* 1991; Furniss *et al.* 1991; Meehan 1991; Nehlsen *et al.* 1991; Sedell and Everest 1991; Craig and Wissmar 1993; Frissell 1993; Henjum *et al.* 1994; McIntosh *et al.* 1994; Wissmar *et al.* 1994; USDA and USDI 1995, 1996, 1997; Light *et al.* 1996; MBTSG 1995a-e, 1996a-f).

Threats to bull trout in the coterminous United States fall into several categories including habitat isolation, loss or blockage of migratory corridors, poor water quality, and the introduction of nonnative species (63 FR 31647, 64 FR 17110, 64 FR 58910). The Jarbidge River population segment is additionally threatened by habitat degradation from past and ongoing land management activities such as road construction and maintenance, mining, and grazing; other activities such as recreational fishing (intentional and unintentional harvest); and interactions with stocked rainbow trout (64 FR 17110). Threats to the St. Mary-Belly River population also include irrigation dams, unscreened diversions, and interactions with nonnative brook trout (64 FR 58910). Additional threats to bull trout are the continuing effects of activities conducted in the past, activities that have been discontinued or modified in recent years to lessen negative effects.

Dams

Dams affect bull trout by altering habitats; flow, sediment, and temperature regimes; migration corridors; and creating additional interspecific interactions, mainly between bull trout and nonnative species (Rode 1990; WDW 1992; Craig and Wissmar 1993; Rieman and McIntyre 1993; Wissmar *et al.* 1994; T. Bodurtha, U.S. Fish and Wildlife Service, *in litt.* 1995; USDA and USDI 1996, 1997). Impassable dams have caused declines of bull trout by preventing migratory fish from reaching spawning and rearing areas in headwaters and recolonizing areas where bull trout have been extirpated (Rieman and McIntyre 1993; MBTSG 1998).

The extirpation of bull trout in the McCloud River basin, California, has been attributed primarily to construction and operation of McCloud Dam, which began operation in 1965 (Rode 1990). McCloud Dam flooded bull trout spawning, rearing, and migratory habitats. The dam also resulted in elevated water temperatures.

Although dams negatively affect bull trout (Rieman and McIntyre 1993; Gilpin, *in litt.* 1997), some dams can benefit bull trout by blocking introduced nonnative species from upstream areas (MBTSG 1995e). Some dams also increase the potential forage base for bull trout by creating reservoirs that support prey species (Faler and Bair 1991; Pratt 1992).

Some of the major effects to bull trout resulting from the Federal Columbia River Power System and from operation of other hydropower, flood control, and irrigation diversion facilities (see also Agricultural Practices) include the following: (1) fish passage barriers, (2) entrainment of fish into turbine intakes and irrigation canals, (3) inundation of fish spawning and rearing habitat, (4) modification of stream flows and water temperature regimes, (5) dewatering of shallow water zones during power peaking operations, (6) reduced productivity in reservoirs, (7) periodic gas supersaturation of waters downstream of dams, (8) water level fluctuations interfering with retention of riparian vegetation along reaches affected by power peaking operations, (9) establishment of nonnative riparian vegetation along reaches affected by power peaking operations, and (10) severe reductions in reservoir levels to accommodate flood control operations.

Hungry Horse, Libby, Albeni Falls, Dworshak, Chief Joseph, Keechelus, Tieton, and Grand Coulee dams, as well as others in the Columbia River basin and throughout the range of bull trout in the coterminous United States, were built without fish passage facilities and are barriers to bull trout migration. These barriers have contributed to the isolation of local populations of migratory bull trout. The lower Snake, middle Columbia, and lower Columbia River hydropower projects have both adult and juvenile fish passage facilities, but these fishways were designed specifically for anadromous salmonids, not for resident fish such as bull trout. The designs, therefore, address the migration needs of anadromous, primarily semelparous (*i.e.*, fish that spawn only once in a lifetime) of the genus *Oncorhynchus* (except steelhead, which in some instances can spawn more than once in a lifetime), but do not include consideration for iteroparous fish (*i.e.*, those that can spawn more than once), or fish that merely wander both upstream and downstream as adults to forage. Bull trout have been observed using upstream fish passage facilities at many of the hydropower projects on the Snake and Columbia rivers. However, as indicated above, even dams with fish passage facilities may be a factor in isolating bull trout local populations if they are not readily passable by bull trout and/or if the dams do not provide an adult downstream migration route.

Entrainment of bull trout may also occur at various projects in the Columbia River basin including Libby, Hungry Horse, Albeni Falls, Rocky Reach, Rock Island, Wells, Dworshak, Bonneville, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams. Fish can be killed or injured when passing the dams. Potential passage routes include through spill, the turbines, or the juvenile bypass systems, but the relative passage success of these routes for adult salmonids has not been thoroughly investigated. However, one study conducted in the early 1970's revealed that passage through turbines resulted in a 22 to 41 percent mortality rate for adult steelhead (Wagner and Ingram 1973). Additionally, a 40 to 50 percent injury rate for adult salmonids passing through the juvenile fish bypass system at McNary Dam has been noted (Wagner 1991; Wagner and Hilson 1993). Adult bull trout may experience similar mortality rates. In addition, those adult fish that survive passage at projects that do no have upstream passage facilities are isolated in downstream reaches away from their natal (native) streams. As indicated above, the loss of these larger, more fecund migratory fish is detrimental to their natal populations.

The creation of mainstem Columbia and Snake river pools (*i.e.*, the areas of slow moving water behind the dams) combined with introductions of piscivorous species (*e.g.*, bass, walleye) have also affected the habitat of bull trout and other salmonids. An increase in predator populations, both native (*e.g.*, northern pikeminnow) and nonnative, as a result of creating artificial habitat and concentrating prey is discussed as a factor for the decline of each listed Snake River salmon species (NMFS 1991a, b, and c). Ideal predator foraging environments have been created in these pools, particularly for warm water species in the summer. Smolts that pass through the projects are subjected to turbines, bypasses, and spillways, that may result in disorientation and increased stress, conditions that reduce their ability to avoid predators below the dams. Creation of the pools above the dams has resulted in low water velocities that increase smolt travel time and increase predation opportunity. Increased water temperatures, also a result of the impoundment of the river, have also been shown to increase predation rates on salmonid smolts (Vigg and Burley 1991). Because bull trout are apex (top) predators of other fish, negative effects to the salmonid smolt prey base, and the resulting decline in adult returns, are likely to affect bull trout negatively as well. Additionally, increased water temperatures, influenced by the presence of dams, also decreases the suitability of the lower Snake and Columbia river pools for bull trout in the late spring through early fall.

Uncontrolled spill, or even high levels of managed spill, at hydropower projects can produce extremely high levels of total dissolved gas that may impact bull trout and other species. These high levels of gas supersaturation can cause gas bubble disease trauma in fish. Gas bubble disease is caused by gas being absorbed into the bloodstream of fish during respiration. Effects can range from temporary debilitation to mortality, and supersaturation can persist for several miles below dams where spill occurs. The states of Oregon and Washington have established a 111 percent total dissolved gas level as State water quality standards. However, total dissolved gas levels of up to 120 percent have been experienced during recent years of managed spill in the Federal Columbia River Power System, with involuntary spill episodes resulting in total dissolved gas levels of as high as 140 percent at some sites (NMFS 2000). At levels near 140 percent, gas bubble disease may occur in over 3 percent of fish exposed. At levels of up to 120 percent the incidence of gas bubble disease decreases to a maximum of 0.7 percent of fish exposed (NMFS 2000).

Manipulated flow releases from storage projects alter the natural flow regime, affect water temperature, have the potential to destabilize downstream streambanks, alter the natural sediment and nutrient loads, and cause repeated and prolonged changes to the downstream wetted perimeter (MBTSG 1998). Power peaking operations, which change the downstream flow of the river on a frequent basis, cause large areas of the river margins to become alternately wet and then dry, adversely affecting aquatic insect survival and production (Hauer and Stanford 1997). Changes in water depth and velocity as a result of rapid flow fluctuations, and physical loss or gain of wetted habitat, can cause juvenile trout to be displaced, thus increasing their vulnerability to predation. Additionally, rapid flow reductions can strand young fish if they are unable to escape over and through draining or dewatered substrate. These effects also indirectly adversely affect bull trout by degrading the habitat of their prey (small fish) and the food upon which they depend (aquatic insects).

Reservoirs created by dams have also inundated bull trout habitat. For example, reservoirs created by the construction of Libby and Hungry Horse dams have inundated miles of mainstem river and tributary habitat previously used by many local populations of bull trout (BPA *et al.* 1999). Reservoir water level manipulations can create migration barriers at the confluence of tributaries entering the reservoir, as well as negatively affecting littoral rearing habitats for prey species of bull trout. Reservoir levels are often drawn down substantially during drought years, or annually as operators evacuate flood control reservoirs to make room for spring snowmelt runoff. Reduced volumes of water in reservoirs can affect their overall productivity, that may ultimately reduce the food base of predators such as bull trout. Some reservoir levels have periodically been reduced so severely that bull trout and other species have had to be physically removed and relocated to ensure their survival. Other reservoirs are unproductive and provide poor habitat for bull trout compared to natural riverine habitats (*e.g.*, Noxon and Cabinet Gorge). However, reservoirs such as Libby, Hungry Horse, and Dworshak now provide suitable habitat for adfluvial populations of bull trout that was not available prior to dam construction.

Forest Management Practices

Forest management activities, including timber extraction and road construction, affect stream habitats by altering recruitment of large woody debris, erosion and sedimentation rates, runoff patterns, the magnitude of peak and low flows, water temperature, and annual water yield (Cacek 1989; Furniss *et al.* 1991; Wissmar *et al.* 1994; Spence *et al.* 1996; Spencer and Schelske 1998; Swanson *et al.* 1998). Activities that promote excessive substrate movement reduce bull trout production by increasing egg and juvenile mortality, and reducing or eliminating habitat (*e.g.*, pools filled with substrate) important to later life-history stages (Fraley and Shepard 1989; Brown 1992). The length and timing of bull trout egg incubation and juvenile development (typically more than 200 days during winter and spring) and the strong association of juvenile fish with stream substrate make bull trout vulnerable to changes in peak flows and timing that affect channels and substrate (Goetz 1989; Pratt 1992; McPhail and Baxter 1996; MBTSG 1998).

Roads constructed for forest management are a prevalent feature on managed forested and rangeland landscapes. Roads have the potential to adversely affect several habitat features, (*e.g.*, water temperature, substrate composition and stability, sediment delivery, habitat complexity, and connectivity) (Baxter *et al.* 1999; Trombulak and Frissell 2000). Roads may also isolate streams from riparian areas, causing a loss in floodplain and riparian function. The aquatic assessment portion of the Interior Columbia Basin Ecosystem Management Project provided a detailed analysis of the relationship between road densities and bull trout status and distribution (Quigley and Arbelbide 1997). The assessment found that bull trout are less likely to use streams in highly roaded areas for spawning and rearing, and do not typically occur where average road densities exceed 1.1 kilometers per square kilometer (1.7 miles per square mile).

Although bull trout occur in watersheds where timber has been harvested, bull trout strongholds primarily occur in watersheds with little or no past timber harvest, such as the wilderness areas of central Idaho and the South Fork Flathead River drainage in Montana (Henjum *et al.* 1994; MBTSG 1995e; USDA and USDI 1997; Rieman et al. 1997b). However, the Swan River basin, Montana, has had extensive timber harvest and road construction, and is a bull trout stronghold (Watson and Hillman 1997). The overall effects of forestry practices on bull trout in parts of this basin are difficult to assess because of the complex geomorphology and geology of the drainage (MBTSG 1996a).

Roads may affect aquatic habitats considerable distances away. For example, increases in sedimentation, debris flows, and peak flows affect streams longitudinally so that the area occupied by a road can be small compared to the entire downstream area subjected to its effects (Jones *et al.* 2000; Trombulak and Frissell 2000). Upstream from road crossings, large areas of suitable habitats may become inaccessible to bull trout due to fish passage barriers (*e.g.*, culverts).

Livestock Grazing

Improperly managed livestock grazing degrades bull trout habitat by removing riparian vegetation, destabilizing streambanks, widening stream channels, promoting incised channels and lowering water tables, reducing pool frequency, increasing soil erosion, and altering water quality (Howell and Buchanan 1992; Mullan *et al.* 1992; Overton *et al.* 1993; Platts *et al.* 1993; Uberuaga 1993; Henjum *et al.* 1994; MBTSG 1995a,b,c; USDA and USDI 1996, 1997). These effects reduce overhead cover, increase summer water temperatures, and promote formation of anchor ice (ice attached to the bottom of an otherwise unfrozen stream, often covering stones, etc.) in winter, and increase sediment in spawning and rearing habitats.

Negative effects of livestock grazing on bull trout habitat may be minimized if grazing is managed appropriately for conditions at a specific site. Practices generally compatible with the preservation and restoration of bull trout habitat include fences to exclude livestock from riparian areas, rotation schemes, relocation of water and salting facilities away from riparian areas, and use of herders.

Agricultural Practices

Agricultural practices, such as cultivation, irrigation diversions, and chemical application, contribute to nonpoint source pollution in some areas within the range of bull trout (IDHW 1991; WDE 1992; MDHES 1994). These practices can release sediment, nutrients, pesticides, and herbicides into streams; increase water temperature; reduce riparian vegetation; and alter hydrologic regimes, typically by reducing flows in spring and summer. Irrigation diversions also affect bull trout by altering stream flow and allowing entrainment. The effects of the myriad of small irrigation diversion and hydropower projects throughout the range of bull trout are likely of even greater significance than the large hydropower and flood control projects. Many of these are located further up in watersheds and either physically block fish passage by means of a structure (*i.e.*, a dam), or effectively block passage by periodically dewatering a downstream reach (*e.g.*, diversion of flows through a penstock to a powerhouse; diversion of flows for the purposes of irrigation). Even if diversions are not so severe as to dewater downstream reaches, reduced flows can result in structural and thermal passage barriers. Other effects include water quality degradation resulting from irrigation return flows and runoff from fields and entrainment of bull trout into canals and fields (MBTSG 1998). Some irrigation diversion structures are reconstituted annually with a bulldozer as “push up” berms and not only affect passage, but also significantly degrade the stream channel. The prevalence of these structures throughout the range of bull trout has resulted in the isolation of bull trout populations in the upper watersheds in many areas.

Bull trout may enter unscreened irrigation diversions and become stranded in ditches and agricultural fields. Diversion dams without proper passage facilities prevent bull trout from migrating and may isolate groups of fish (Dorratcaque 1986; Light *et al.* 1996). Other effects of agricultural practices on aquatic habitat include stream channelization, and large woody debris removal (Spence *et al.* 1996).

Transportation Networks

Roads degrade bull trout habitats by creating flow constraints in ephemeral, intermittent, and perennial channels; increasing erosion and sedimentation; creating passage barriers; channelizing stream reaches; and reducing riparian vegetation (Furniss *et al.* 1991; Ketcheson and Megahan 1996; Trombulak and Frissell 2000). In the Clearwater River basin of Idaho, for example, Highway 12 is adjacent to much of the Clearwater River, and crosses the river at eight different bridge sites. The highway has constrained the river in some areas and highway maintenance may negatively affect bull trout and their habitats (CBBTTAT 1998). Moreover, the proximity of the highway to the Clearwater River increases the likelihood of hazardous materials or fuel spills entering the river. For example, in January, 2002, a truck overturned and spilled approximately 11,000 gallons in the Clearwater River upstream of Lewiston. Similar situations exist along primary and secondary highways across the range of bull trout.

A dirt road is adjacent to much of the West Fork of the Jarbidge River in Nevada and Idaho. McNeill *et al.* (1997) determined that construction and maintenance of the Jarbidge Canyon Road has influenced the morphology and function of the river. Within a single 4.8 kilometer (3 mile) reach, there are seven bridge crossings, and the largest bridge spans only 62 percent of the average width of the river (McNeill *et al.* 1997). Maintenance of the road and bridges requires frequent channel and floodplain modifications that affect bull trout habitat, such as channelization; removal of riparian trees and beaver dams; and placement of rock, sediment, and concrete (McNeill *et al.* 1997; J. Frederick, U.S. Forest Service (USFS), pers. comm. 1998; J. Frederick, U.S. Forest Service, 1998).

Transportation networks also affect bull trout habitats in protected areas such as National Parks. Roads have been constructed to provide access to the Hoh River and Quinault River basins, including areas within Olympic National Park. These roads were typically built following river valleys and often constrain the floodplains. As a result, these roads have been subjected to high flow events and shifts in river channels, forcing extensive streambank armoring to maintain them (Chad 1997; U.S. National Park Service 2000). Bank armoring impairs bull trout habitats through reduced habitat complexity, stream channelization, reduced riparian vegetation, and bank erosion downstream. Within Olympic National Park, about 1,770 meters (5,476 feet) of rip-rap were documented along the Hoh River in 1997 (Chad 1997), and additional bank stabilization projects have occurred since then.

Mining

Mining degrades aquatic habitats used by bull trout by altering water chemistry (*e.g.*, pH); altering stream morphology and flow; and causing sediment, fuel, and heavy metals to enter streams (Martin and Platts 1981; Spence *et al.* 1996). The types of mining that occur within the range of bull trout include extraction of hard rock minerals, coal, gas, oil, and sand and gravel. Past and present mining activities have adversely affected bull trout and bull trout habitats in Idaho, Oregon, Montana, Nevada, and Washington (Johnson and Schmidt 1988; Moore *et al.* 1991; WDW 1992; Platts *et al.* 1993; MBTSG 1995a, c, 1996b, c; McNeill *et al.* 1997; Ramsey 1997).

For example, it is thought that bull trout were widely distributed in the Coeur d'Alene River drainage, Idaho (Maclay 1940). However, extensive mining and associated operations have modified stream channels and floodplains, created barriers to fish movement, and released toxic substances, especially in the South Fork Coeur d'Alene River (PBTTAT 1998). Portions of the system were essentially devoid of aquatic life during surveys conducted in the 1940's. Bull trout have been functionally extirpated in the Coeur d'Alene River basin since 1992 (USFWS 1998a).

Residential Development and Urbanization

Residential development is rapidly increasing within portions of the range of bull trout. Residential development alters stream and riparian habitats through contaminant inputs, stormwater runoff, changes in flow regimes, streambank modification and destabilization, increased nutrient loads, and increased water temperatures (MBTSG 1995b). Indirectly, urbanization within floodplains alters groundwater recharge by rapidly routing water into streams through drains rather than through more gradual subsurface flow (Booth 1991).

Urbanization negatively affects the lower reaches of many of the large rivers and their associated side channels, wetlands, estuaries, and near-shore areas of Puget Sound, Washington. Activities such as dredging; removing large woody debris (*e.g.*, snags, log jams, drift wood); installing revetments, bulkheads, and dikes; and filling side channels, estuarine marshes, and mudflats have led to the reduction, simplification, and degradation of habitats (Thom *et al.* 1994; Spence *et al.* 1996; PSWQAT 2000). Pollutants associated with urban environments such as heavy metals, pesticides, fertilizers, bacteria, and organics (oil, grease) have contributed to the degradation of water quality in streams, lakes, and estuaries (NRC 1996; Spence *et al.* 1996).

Fisheries Management

Introductions of nonnative species by the Federal government, State fish and game departments, and private parties, across the range of bull trout have contributed to declines in abundance, local extirpations, and hybridization of bull trout (Bond 1992; Howell and Buchanan 1992; Leary *et al.* 1993; Donald and Alger 1993; Pratt and Huston 1993; MBTSG 1995b,d, 1996g,h; Platts *et al.* 1995; J. Palmisano and V. Kaczynski, Northwest Forest Resource Council, *in litt.* 1997).

Introduced brook trout threaten bull trout through hybridization, competition, and possibly predation (Thomas 1992; WDW 1992; Clancy 1993; Leary *et al.* 1993; Rieman and McIntyre 1993; MBTSG 1996h). Hybridization between brook trout and bull trout has been reported in Montana (MBTSG 1995a, b, 1996a, c, e; Hansen and DosSantos 1997), Oregon (Markle 1992; Ratliff and Howell 1992), Washington (WDFW 1998), and Idaho (Adams 1996; T. Burton, Boise National Forest, pers. comm. 1997). Hybridization results in offspring that are frequently sterile (Leary *et al.* 1993), although recent genetics work has shown that reproduction by hybrid fish is occurring at a higher level than previously suspected (Kanda 1998). Hybrids may be competitors; Dunsmoor and Bienz (L. Dunsmoor and C. Bienz, Klamath Tribe, *in* *litt.* 1997) noted that hybrids are aggressive and larger than resident bull trout, suggesting that hybrids may have a competitive advantage. Brook trout mature at an earlier age and have a higher reproductive rate than bull trout. This difference may favor brook trout over bull trout when they occur together, often leading to replacement of bull trout with brook trout (Clancy 1993; Leary *et al.* 1993; MBTSG 1995b). The magnitude of threats from nonnative fishes is highest for resident bull trout because they are typically isolated and exist in low abundance.

Brook trout apparently adapt better to degraded habitats than bull trout (Clancy 1993; Rich 1996; Dunsmoor and Bienz, *in litt.* 1997), and brook trout also tend to occur in streams with higher water temperatures (Adams 1994; MBTSG 1996h). Because elevated water temperatures and sediments are often indicative of degraded habitat conditions, bull trout may be subject to stresses from both interactions with brook trout and degraded habitat (MBTSG 1996h). In laboratory tests, growth rates of brook trout were significantly greater than those for bull trout at higher water temperatures when the two species were tested alone, and growth rates of brook trout were greater than those for bull trout at all water temperatures when the species were tested together (McMahon *et al.* 1998, 1999).

Nonnative lake trout (*i.e.*, west of the Continental Divide) also negatively affect bull trout (Donald and Alger 1993; MBTSG 1996h; Fredenberg 2000). A study of 34 lakes in Montana, Alberta, and British Columbia, Canada, found that lake trout likely limit foraging opportunities and reduce the distribution and abundance of migratory bull trout in mountain lakes (Donald and Alger 1993). Over 250 introductions of lake trout and other nonnative species have occurred in nearly 150 western Montana waters within the range of bull trout (J. Vashro, Montana Fish, Wildlife and Parks, *in litt.* 2000). The potential for introduction of lake trout into the Swan River basin and Hungry Horse Reservoir on the South Fork Flathead River, both in Montana, is considered a threat to bull trout (MBTSG 1995e, 1996a). The presence of several lake trout has been recently documented in Swan Lake (Montana Fish, Wildlife and Parks, *in litt.* 1999). In Idaho, lake trout and habitat degradation were factors in the decline of bull trout from Priest Lake (Mauser *et al.* 1988; Pratt and Huston 1993). Lake trout have invaded Upper Priest Lake and are a threat to the bull trout there (Fredericks 1999). Juvenile lake trout are also using some riverine habitats in Montana, possibly competing with bull trout (MBTSG 1996h).

Introduced brown trout are established in several areas within the range of bull trout and likely compete for food and space and prey on bull trout (Ratliff and Howell 1992; Platts *et al.* 1993; Pratt and Huston 1993). In the Klamath River basin for example, brown trout occur with bull trout in three streams and have been observed preying on bull trout in one (Light *et al.* 1996). Brown trout may compete for spawning and rearing areas and superimpose redds on bull trout redds (Pratt and Huston 1993; Light *et al.* 1996; MBTSG 1996h). Elevated water temperatures may favor brown trout over bull trout in competitive interactions (MBTSG 1996h). Brown trout may have been a contributing factor in the decline and eventual extirpation of bull trout in the McCloud River, California, after dam construction altered bull trout habitat (Rode 1990).

Nonnative northern pike have the potential to negatively affect bull trout. Northern pike were introduced into Swan Lake in the 1970's (MFWP 1997), and predation on juvenile bull trout has been documented (MBTSG 1996a) but the bull trout population has not declined. Northern pike were also introduced into Salmon, Inez, Seeley, and Alva lakes in the Clearwater River basin, and a tributary to the Blackfoot River, Montana (MFWP 1997). Northern pike numbers have increased in Salmon Lake and Lake Inez, having a negative effect on bull trout (R. Berg, MFWP, pers. comm. 1997). Northern pike in Seeley Lake and Lake Alva are also expected to increase in numbers (Berg, pers. comm. 1997).

Introduced bass (*Micropterus spp*.) may negatively affect bull trout (MFWP 1997). In the Clark Fork River, Montana, Noxon Rapids Reservoir supports fisheries for both smallmouth bass (*M. dolomieui*) and largemouth bass (*M. salmoides*). Both have been high priority sport fish species in management of Noxon Rapids Reservoir. The Montana fishery management objective for Cabinet Gorge Reservoir, downstream of Noxon Rapids Reservoir, is to enhance bull trout while managing the existing bass fishery (MFWP 1997). However, a 1999 Federal Energy Regulatory Commission settlement with the Avista Corporation for dam relicensing makes recovery of bull trout a management priority (Kleinschmidt Associates and Pratt 1998).

Managers are now attempting to balance these potentially conflicting objectives. In the North Fork Skokomish River, Washington, Cushman Reservoir supports largemouth bass, that may prey on juvenile bull trout rearing in the reservoir and lower river above the reservoir (WDFW 1998).

Opossum shrimp (*Mysis relicta*), a crustacean native to the Canadian Shield area, was widely introduced in the 1970's as supplemental forage for kokanee and other salmonids in several lakes and reservoirs across the northwest (Nesler and Bergersen 1991). The introduction of opossum shrimp in Flathead Lake changed the lake's trophic dynamics resulting in expanding lake trout populations and causing increased competition and predation on bull trout (T. Weaver, Montana Fish, Wildlife and Parks, *in litt.* 1993; MBTSG 1995d). Conversely, in Swan Lake, Montana, introduced opossum shrimp and kokanee increased the availability of forage for bull trout, contributing to the significant increase in bull trout numbers in the Swan River basin (MBTSG 1996a).

Nonnative fish threaten bull trout in relatively secure, unaltered habitats, including roadless areas, wildernesses, and national parks. For instance, brook trout occur in tributaries of the Middle Fork Salmon River within the Frank Church-River of No Return Wilderness, including Elk, Camas, Loon, and Big creeks (Thurow 1985) and Sun Creek in Crater Lake National Park (Light *et al.* 1996). Glacier National Park has self-sustaining populations of introduced nonnative species, including lake trout, brook trout, rainbow trout, Yellowstone cutthroat trout, lake whitefish, and northern pike (MBTSG 1995d). Although stocking in Glacier National Park was terminated in 1971, only a few headwater lakes contain exclusively native species, including bull trout. The introduction and expansion of lake trout into the relatively pristine habitats of Kintla Lake, Bowman Lake, Logging Lake, and Lake McDonald in Glacier National Park has nearly extirpated the bull trout due to predation and competition (L. Marnell, National Park Service, *in litt.* 1995; MBTSG 1995d; Fredenberg 2000).

Some introduced species, such as rainbow trout and kokanee, may benefit large adult bull trout by providing supplemental forage (Faler and Bair 1991; Pratt 1992; Vidergar 2000). However, introductions of nonnative game fish can be detrimental due to increased angling and subsequent incidental catch and harvest of bull trout (Rode 1990; Bond 1992; WDW 1992; MBTSG 1995d).

Isolation and Habitat Fragmentation

Although bull trout are widely distributed over a large geographic area, the effects of human activities over the past century have reduced their overall distribution and abundance. Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders *et al.* 1991). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, 1995).

Metapopulation concepts of conservation biology theory have been applied to the distribution and characteristics of bull trout (Rieman and McIntyre 1993; Dunham and Rieman 1999). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994). Local populations may be extirpated, but can be reestablished by individuals from other local populations. Thus, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. Habitat alteration, primarily through the construction of impoundments, dams, and water diversions, has fragmented habitats, eliminated migratory corridors, and isolated bull trout in the headwaters of tributaries

(Rieman et al. 1997b; Dunham and Rieman 1999; Spruell *et al.* 1999; Rieman and Dunham 2000). Based on population genetics, there is more divergence among bull trout than among salmon (Leary and Allendorf 1997), indicating less genetic exchange among bull trout populations. The recolonization rate for bull trout is very low and recolonization may require a very long time, especially in light of the man-made isolation of various bull trout populations.

Migratory corridors allow individuals access to unoccupied but suitable habitats, foraging areas, and refuges from disturbances (Saunders *et al.* 1991). Maintenance of migratory corridors for bull trout is essential to provide connectivity among local populations, and enables the reestablishment of extinct populations. Where migratory bull trout are not present, isolated populations cannot be replenished when a disturbance makes local habitats unsuitable (Rieman and McIntyre 1993; USDA and USDI 1997). Moreover, limited downstream movement was observed for resident bull trout in the Bitterroot River basin (Nelson 1999; Nelson *et al.* in review) suggesting that reestablishment of migratory fish and potential refounding of extinct bull trout populations may be a slow process, if it occurs at all.

Because isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by: (1) reducing geographical distribution; (2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993); (3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); (4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998); and (5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998; Rieman and McIntyre 1993), restoring connectivity and restoring the frequency of occurrence of the migratory form will be an important factor in providing for the recovery of bull trout. The manner and degree to which individual dams and diversions affect specific bull trout local populations is likely to vary depending on the specific physical factors at play and the demographic attributes of the local population in question. The individual recovery unit chapters specifically address dam and diversion issues affecting their respective local populations.

Evidence suggests that landscape disturbances, such as floods and fires, have increased in frequency and magnitude within the range of bull trout (Henjum *et al.* 1994; USDA and USDI 1997). Passage barriers and unsuitable habitat that prevent recolonization, have resulted in bull trout extirpation through these landscape disturbances (USDA and USDI 1997). Also, isolated populations are typically small, and more likely to be extirpated by local events than larger populations (Rieman and McIntyre 1995), and can exhibit negative genetic effects.

Land management activities have also altered the frequency and duration of floods or high flows (USDA and USDI 1997). Roads and clear cutting of forested areas tend to magnify the effects of floods, leading to higher flows, erosion, and bedload that scour channels McIntosh *et al.* 1994; USDA and USDI 1997; Spencer and Schelske 1998; Swanson *et al.* 1998), and degrade bull trout habitat (Henjum *et al.* 1994). Erosion from road landslides increases bedload to stream flows (Furniss *et al.* 1991). Increased bedload increases the scouring effect of high stream flows, increasing channel instability and loss of habitat diversity, especially pools (Henjum *et al.* 1994; McIntosh *et al.* 1994). Bull trout eggs and fry in the gravels during scouring likely survive at low rates (Henjum *et al.* 1994). For instance, hundreds of landslides associated with roads on the Clearwater National Forest and Panhandle National Forests resulted from high water in 1995 (R. Patten and J. Penzkover, Panhandle National Forest, *in litt.* 1996), likely reducing survival of bull trout eggs and fry. Habitat degradation has also reduced the number and size of bull trout spawning areas (USDA and USDI 1997).

Inadequacy of Existing Water Quality Standards

Temperature regime is one of the most important water quality factors affecting bull trout distribution (Rieman and McIntyre 1995; Adams and Bjornn 1997). Given the temperature requirements of bull trout (Buchanan and Gregory 1997), existing water quality criteria developed by the States under sections 303 and 304 of the Clean Water Act may not adequately support spawning, incubation, rearing, migration, or combinations of these life-history stages (see Montana 1996; Oregon 1996; 62 FR 41162; Washington 1997; NDEP, *in litt.* 1998; Hicks 2000).

The U.S. Environmental Protection Agency is working with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, State environmental quality agencies, and tribes in Oregon, Idaho, and Washington to develop regional temperature guidance. The goals for this project are to develop U.S. Environmental Protection Agency regional temperature criteria guidance that: (1) meet the biological requirements of native salmonid species for survival and recovery pursuant to the Endangered Species Act, provide for the restoration and maintenance of surface water temperature to support and protect native salmonids pursuant to the Clean Water Act, and meet the Federal trust responsibilities with treaty tribes for rebuilding salmon stocks, (2) recognize the natural temperature potential and limitations of water bodies, and (3) can be effectively incorporated by states and Tribes in programs concerned with water quality standards. States and Tribes will use the new criteria guidance to revise their temperature standards, and if necessary, the U.S.

Environmental Protection Agency and other agencies will use the new criteria guidance to evaluate State and Tribal standard revisions.

The Environmental Protection Agency is currently engaged in formal consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service regarding their approval of numeric water quality criteria for (nonconventional) toxic pollutants in the State of Idaho. Consultation on conventional pollutants (pH, dissolved oxygen, temperature) for the State of Oregon was completed in July 1999. We anticipate formal consultation on water quality criteria for temperature, dissolved oxygen, ammonia, and antidegradation in the State of Washington in 2003. Water quality criteria establish water column concentrations for various constituents, above which any waters of the State (excluding those waters on Tribal lands) should not exceed for the protection of aquatic life. These criteria will be used to evaluate discharge permits (National Pollution Discharge Elimination System and Total Maximum Daily Limits) and formulate consumption advisories where appropriate. Many states' waters contain elevated levels of toxic pollutants that are present in fish tissues and have resulted in fishing advisories throughout the range of bull trout (www.epa.gov/ost/fish). We do not anticipate formal consultation on current surface water quality standards for nonconventional pollutants in the states of Washington, Oregon, Nevada, and Montana in the near future.

Elevated levels of contaminants may result in either lethal (e.g. mortality) or sublethal effects to bull trout. Sublethal impacts may include reduced egg production, reduced survival of any life stage, reduced growth, impaired osmoregulation, and many subtle endocrine, immune, and cellular changes. Contaminants may also affect the foodchain and indirectly harm bull trout by reducing prey availability due to reduced habitat suitability for prey species. Lethal impacts from contaminant inputs are most likely from spills, whereas sublethal impacts may occur from such land uses as agriculture, residential/urban, mining, grazing, and forestry.

Conservation Measures

At present, there are several State, Federal, Tribal, and Canadian programs and conservation efforts that may help achieve recovery objectives for bull trout in the coterminous United States. Recovery planning for bull trout will proceed under the direction of an overall recovery team as well as individual recovery unit teams working to address bull trout conservation needs in specific geographic locations. Membership of the recovery unit teams has generally been extended to any and all interested parties, including biologists and experts in related disciplines from local, State, Tribal and Federal entities, stakeholder groups representing timber interests, water users, agriculture, power producers and distributors, landowners, conservation groups, tourism advocates and local government. The bull trout recovery planning process has built upon previous State and locally-driven processes throughout the range of the species. Some of these measures are described below.

State Bull Trout Conservation Actions

The following is a brief summary of the existing and ongoing conservation activities by the States of Idaho, Montana, Nevada, Oregon, and Washington.

Idaho. The Idaho Department of Fish and Game, in cooperation with several Federal and State agencies, developed a management plan for bull trout in 1993 (Conley 1993), and the State of Idaho approved the State of Idaho Bull Trout Conservation Plan for the conservation of bull trout in July 1996 (Batt 1996). The Plan identified an overall mission of maintaining or restoring interacting groups of bull trout throughout the species' native range in the State, and four goals to accomplish the mission: (1) maintenance of habitat conditions in areas supporting bull trout, (2) instituting cost-effective strategies to improve bull trout abundance and habitats, (3) establishing stable or increasing bull trout populations in a set of well-distributed sub-watersheds, and (4) providing for the economic viability of industries in Idaho (Batt 1996). The overall approach of the plan was to use existing, locally-developed groups established by Idaho legislation, *i.e.*, watershed advisory groups and basin advisory groups, which were formed to strengthen water quality protection and improve compliance with the Clean Water Act. The draft chapters of the bull trout recovery plan for Idaho rely on information contained in the draft and final problem assessments for the key watersheds developed under the State of Idaho Bull Trout Conservation Plan.

The watershed advisory groups have drafted 21 problem assessments throughout Idaho, which address all 59 key watersheds. To date, a conservation plan has been completed only for the Pend Oreille key watershed.

Angling regulations in Idaho have become more restrictive than in the past. Several conservation actions identified in the problem assessments have been completed or are ongoing, *e.g.*, activities improving bull trout access to habitat, investigations of methods to reduce abundance of nonnative fish species in bull trout habitats, and angler education.

Montana. Development of the bull trout recovery plan in Montana relied heavily upon, and was integrated with, State processes for bull trout conservation that began in 1992 with the implementation of the Montana Bull Trout Restoration planning process and resulted in the Montana Bull Trout Restoration Plan issued in 2000 (MBTRT 2000). In 1993, the Governor of Montana appointed the Montana Bull Trout Restoration Team to produce a plan that maintains, protects, and increases bull trout populations. These sources represent State input, as well as that of local and regional individuals and entities participating in the restoration team, basin workgroups, and the Montana Bull Trout Scientific Group. The team appointed a scientific group, the Montana Bull Trout Scientific Group, to provide the restoration planning effort with technical expertise. The scientific group produced 11 basin-specific status reports (MBTSG 1995a-e, 1996a-f) and 3 technical, peer-reviewed papers concerning the role of hatcheries (MBTSG 1996g), suppression of nonnative fish species (MBTSG 1996h), and land management (MBTSG 1998). A restoration plan, completed in June 2000, defines and identifies strategies for ensuring the long-term persistence of bull trout in Montana and provided the foundation for the Montana portion of the recovery unit chapters.

Watershed groups have been formed in some areas to lead local bull trout restoration efforts, and some habitat restoration projects, such as removal of fish passage barriers, screening irrigation diversions, riparian fencing, stream restoration projects, and habitat monitoring, have been completed or are underway (P. Graham, Montana Fish, Wildlife, Parks, and B. Clinch, Montana Department of Natural Resources and Conservation, *in litt.* 1997). Some recovery measures are occurring throughout the State with funding from State and Federal resource management agencies, as well as from habitat improvement funds (*e.g.*, Montana Fish, Wildlife, Parks Future Fisheries Improvement Program and the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program), and from mitigation projects (*e.g.*, in the Clark Fork, Flathead, and Kootenai Rivers). Also, angling regulations have become more restrictive than in the past, brook trout are no longer stocked, and there are ongoing genetic studies to assess bull trout populations.

Nevada. The Nevada Division of Wildlife wrote a Bull Trout Species Management Plan that recommends management alternatives to ensure that human activities will not jeopardize the future of bull trout in Nevada (Johnson 1990). The recommended program identifies actions including bull trout population and habitat inventories, life history research, and potential population reestablishment; State involvement in watershed land use planning; angler harvest assessment; official State sensitive species designation for regulatory protection; nonnative fish stocking evaluation and prohibition; and potential nonnative fish eradications. The Nevada Division of Wildlife scheduled these activities for implementation from 1991 to 2000, although many have yet to be initiated or fully implemented.

State angling regulations have become more restrictive in an attempt to protect bull trout in the Jarbidge River in Nevada. Bull trout harvest prohibitions and reduced daily and possession limits on other trout within the basin are in place throughout the Jarbidge River system. The State has also initiated public and angler awareness and education efforts relative to bull trout identification. The Nevada Division of Wildlife did not stock rainbow trout in the Jarbidge River system in 1999 (G. Weller, Nevada Department of Wildlife, pers. comm. 1999).

Oregon. Since 1990, the State of Oregon has taken several actions to address the conservation and recovery of bull trout. Initially, working groups were established that consisted primarily of State, Federal, and private individuals with bull trout expertise. After gathering initial information, membership on the working groups was expanded when the Oregon Department of Fish and Wildlife bull trout coordinator was hired in 1995, and included a range of people representing affected interests.

More restrictive harvest regulations were implemented beginning in 1990; by 1994 the harvest of bull trout was prohibited throughout the State with the sole exception of Lake Billy Chinook in central Oregon. Bull trout working groups have been established in the Klamath, Deschutes, Hood, Willamette, Odell Lake, Umatilla and Walla Walla, John Day, Malheur, and Pine Creek river basins for the purpose of developing bull trout conservation strategies. The Oregon Department of Fish and Wildlife reduced the stocking of hatchery-reared rainbow trout and brook trout in areas where bull trout occur, and genetic analysis for most bull trout populations was completed in 1997. Angler outreach and education efforts were also implemented in river basins with bull trout. Bull trout identification posters were placed at various campgrounds and trail heads, and bull trout identification cards were produced for distribution by the Malheur National Forest and the Oregon Department of Fish and Wildlife. Research to examine life history, genetics, habitat needs, and limiting factors of bull trout in Oregon was initiated in 1995, supported by funding from the Fish and Wildlife Program of the Northwest Power Planning Council. In 1998, a project was initiated to transfer bull trout fry from the McKenzie River watershed to the adjacent Middle Fork Willamette River, which is historical unoccupied, isolated habitat. Recent surveys documented several age classes of bull trout at release sites in the Middle Fork Willamette River.

The Oregon Department of Environmental Quality sets standards for water quality and administers Oregon's water quality program. Surface water temperatures may not exceed 10.0 degrees Celsius (50.0 degrees Fahrenheit) in waters that support or are necessary to maintain the viability of bull trout (Oregon 1996).

On January 14, 1999, Governor Kitzhaber expanded the Oregon Plan for Salmon and Watersheds (Oregon 1997) to include all at-risk wild salmonids throughout the State. 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. This process included chartering 84 locally-formed and represented “watershed councils” across the State. Membership on the watershed councils includes: landowners, businesses interests, agricultural interests, sport fishers, irrigation/water districts, individuals, State, Federal, and Tribal agencies, and local government officials. Information on watershed conditions prepared by local councils and working groups has been applied to developing bull trout recovery unit chapters in Oregon.

Washington. The draft Statewide Strategy to Recover Salmon, Extinction is not an Option, produced by the Washington Governor's Salmon Recovery Office (Washington Governor’s Salmon Recovery Office 1999) and Joint Natural Resources Cabinet, served as the template for recovery unit chapters in the Washington portion of the bull trout recovery plan. While the Washington Governor’s plan focuses primarily on salmon, many of the same factors affecting salmon also impact bull trout. The plan describes how State agencies and local governments will work together to address habitat, harvest, hatcheries, and hydropower as they relate to recovery of listed species. Overall goals and strategies identified in this document for restoring healthy populations of salmon are consistent with actions needed for bull trout recovery. In addition, recovery unit teams incorporated information from the Washington State Salmonid Inventory for Bull Trout/Dolly Varden (WDFW 1998) and the Bull Trout and Dolly Varden Management Plan (WDFW 2000), both prepared by the Washington Department of Fish and Wildlife.

The Washington State legislature established the Salmon Recovery Act (ESHB 2496) and Watershed Management Act (ESHB 2514) to assist in salmon recovery efforts. The Watershed Management Act provided funding and a planning framework for locally based watershed management addressing water quality and quantity. The Salmon Recovery Act provides the direction for the development of limiting factors analyses on salmon habitat and creates a list of prioritized restoration projects at the major watershed level. While not specifically targeting limiting factors for bull trout, these documents have played an important role in the development of bull trout recovery unit chapters. As offshoots of the Statewide Strategy to Recover Salmon, members of the Lower Columbia Fish Recovery Board and the Upper Columbia Salmon Recovery Board have been involved in the development and review of bull trout recovery unit chapters.

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

Overall, the States within the range of bull trout have developed, or are engaged in developing, conservation plans or strategies for the species. The U.S. Fish and Wildlife Service has, and continues to, encourage States to implement strategies and conservation actions that benefit bull trout.

Federal Activities

Endangered Species Act. Bull trout in the coterminous United States occur on lands administered by the Federal Government (*e.g.*, Bureau of Land Management, Forest Service, and National Park Service), various State-owned properties, and private and Tribal lands. The majority of bull trout spawning and rearing habitat occurs on Federal lands. Federal agency actions that occur on Federal lands or elsewhere with Federal funds or authorization may require consultation under the Endangered Species Act. These actions include U.S. Army Corps of Engineers involvement in projects such as the construction of roads and bridges, the permitting of wetland filling and dredging projects subject to section 404 of the Clean Water Act, construction, maintenance, and operation of dams and hydroelectric plants; Federal Energy Regulatory Commission-licensed hydropower projects authorized under the Federal Power Act; Forest Service and Bureau of Land Management timber, grazing, and recreation management activities; Environmental Protection Agency-authorized discharges under the National Pollutant Discharge Elimination System of the Clean Water Act; U.S. Housing and Urban Development projects; U.S. Bureau of Reclamation projects; and National Park Service activities. Because there are various policies, directives, and regulations providing management direction to Federal agencies and opportunities to conserve bull trout, *e.g.*, roadless area conservation on

Forest Service lands (66 FR 3244), we provide the following types of activities as examples.

Bull Trout Interim Conservation Guidance. The purpose of the Bull Trout Interim Conservation Guidance is to provide U.S. Fish and Wildlife Service biologists with a tool that is useful in conducting Endangered Species Act activities, including section 7 consultations, negotiating Habitat Conservation Plans that culminate in the issuance of section 10(a)(1)(B)-incidental take permits (see section 10(a)(1) discussion below), issuing recovery permits, and providing technical assistance in forest practice rule development and other interagency bull trout conservation and recovery efforts. This document is not intended to supersede any biological opinion that has been completed for Federal agency actions. Rather, it should be used as another tool to assist in consultation on those actions.

PACFISH/INFISH. Land management plans for the Bureau of Land Management and Forest Service lands within the range of bull trout have been amended by the Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH; USDA and USDI 1995) and the Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada (INFISH; USDA 1995). PACFISH, developed by the Bureau of Land Management and Forest Service, is intended to be an ecosystem-based, aquatic habitat and riparian-area management strategy for Pacific salmon, steelhead, and sea-run cutthroat trout habitat on lands administered by the two agencies that are outside the area subject to the Northwest Forest Plan. INFISH was developed by the Forest Service to provide an interim strategy for inland native fish in areas outside those where PACFISH and the Northwest Forest Plan apply. The U.S. Fish and Wildlife Service issued a programmatic non-jeopardy biological opinion on land and resource management plans of the Bureau of Land Management and Forest Service, as amended by PACFISH and INFISH, for the Klamath and Columbia River population segments of bull trout that endorsed implementation of additional commitments made by the two agencies (USFWS 1998b). The commitments included habitat restoration and improvement; standards and guidelines of PACFISH and INFISH; evaluation of key and priority watershed networks; completion of watershed analysis and monitoring; establishing goals for long-term conservation and recovery; and conducting section 7 consultation at the watershed level. The biological opinion also identified additional actions to help ensure conservation of bull trout. Consultations for site-specific actions are continuing, as are consultations for land and resource management plans in other bull trout population segments.

In December, 1998, the regional executives for the U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Forest Service and Bureau of Land Management chartered The Interagency Implementation Team. This Team is integral to the implementation of PACFISH and INFISH, under the direction of the regional executives, and is responsible for coordinating implementation of the biological opinions on the effects of the aquatic conservation strategies on listed salmon, steelhead and bull trout. The Team has directed the development of a PACFISH/INFISH Monitoring Task Team to develop a monitoring program for tracking implementation and effectiveness of PACFISH/INFISH.

Northwest Forest Plan. On April 13, 1994, the Secretaries of the Department of Agriculture and the Department of the Interior adopted the Northwest Forest Plan for management of late-successional forests within the range of the northern spotted owl. This plan contains objectives, standards, and guidelines to provide for a functional late-successional and old-growth forest ecosystem. Included in the plan is an aquatic conservation strategy involving riparian reserves, key watersheds, watershed analysis, and habitat restoration. The U.S. Fish and Wildlife Service issued a programmatic non-jeopardy biological opinion on the plan for the Coastal-Puget Sound, Columbia River, and Klamath River population segments of bull trout (USFWS 2000). The biological opinion also identified additional actions to be taken by the Federal land managers to help ensure conservation of bull trout. These actions included clearly documenting that proposed actions are consistent with the aquatic conservation strategy objectives, developing and implementing guidance for reducing effects of road management programs on bull trout, and responding quickly to mining notices on lands administered by the Bureau of Land Management in order to advise operators how to prevent adverse effects to bull trout. Consultations for site-specific actions are ongoing.

Federal Columbia Power System Biological Opinion. On December 15, 2000, the U.S. Fish and Wildlife Service issued a biological opinion to the U.S. Army Corps of Engineers, Bureau of Reclamation, and Bonneville Power Administration on the operation and maintenance of Federal hydroelectric and water storage dams within the Columbia River basin. The biological opinion was developed after consultations with the U.S. Army Corps of Engineers and the Bureau of Reclamation, which operate the Federal dams, and the Bonneville Power Administration, which sells the electricity generated at the dams. The dams included in the biological opinion are: Bonneville, The Dalles, John Day and McNary dams (Lower Columbia River facilities); Ice Harbor, Lower Monumental, Little Goose, Lower Granite and Dworshak dams (Lower Snake River and Clearwater facilities); Grand Coulee, Albeni Falls, Libby, Hungry Horse, and Chief Joseph dams and Banks Lake Pump Storage (Upper Columbia River facilities). These projects are located in the states of Oregon, Washington, Idaho, and Montana.

Impacts to bull trout occur mostly in the upper reaches of the Columbia River basin and the biological opinion recommended changes in operations that focus on the Upper Columbia River dams. Bull trout are known to occur in the mainstem

Columbia and lower Snake Rivers but their use of these areas is not well known (See the discussion of the mainstem Columbia and lower Snake Rivers in section G, Strategy for Recovery.) The focus of the consultations on operations at Libby and Hungry Horse dams and their effects to bull trout has been on 1) ramping rates; 2) minimum flows; 3) seasonal water management; 4) total dissolved gas concerns; and 5) fish passage and entrainment. The action agencies and the U.S. Fish and Wildlife Service have agreed on the need for ramping rates and minimum flows. Operations at Albeni Falls Dam to benefit kokanee salmon, a key food source for bull trout in Lake Pend Oreille, are also addressed in this opinion.

Coordination between the National Marine Fisheries Service and the U.S. Fish and Wildlife Service has been ongoing during the preparation of the draft and final biological opinions for the Federal Columbia River Power System. Specifically, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service have agreed to operations (ramping rates and minimum flows) at Hungry Horse and Libby dams that will benefit all resident species, and implementation of modified flood control operations at both dams to store additional water for resident fish and salmon. In low water years, the agencies have agreed to work out details of operation through the Technical Management Team process to balance the needs of listed species.

The U.S. Fish and Wildlife Service has also been coordinating with the Montana Department of Fish, Wildlife and Parks to better address listed species and reservoir management issues. Specifically, the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the action agencies, in coordination with Montana Department of Fish, Wildlife and Parks, have slightly revised the minimum flows and ramping rates to address Montana Department of Fish, Wildlife and Parks concerns. Other Columbia River basin consultations are addressing or have addressed operations of Federal dams and related activities in tributaries, including the Yakima, Willamette, and the Umatilla river basins, and in the Snake River upstream of Lower Granite Reservoir.

Section 10(a)(1) Permits. Permits, authorized under section 10(a)(1) of the Endangered Species Act, may be issued to carry out otherwise prohibited activities involving endangered and threatened wildlife under certain circumstances. Permits are available for scientific purposes to enhance the propagation or survival of a species and for incidental "take" (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a listed species) in connection with otherwise lawful activities. Private landowners seeking permits for incidental take offer a means of protecting bull trout habitat through the voluntary development of Habitat Conservation Plans and Safe Harbor Agreements.

Habitat Conservation Plans. Incidental take permits are required when non-Federal activities will result in "take" of threatened or endangered species. A habitat conservation plan must accompany an application for an incidental take permit. The purpose of the Habitat Conservation Planning process is to ensure there is adequate minimization and mitigation of effects from the authorized incidental take. The purpose of the incidental take permit is to authorize the incidental take of a listed species. For example, the Plum Creek Timber Company developed a Habitat Conservation Plan with the U.S. Fish and Wildlife Service addressing bull trout and other native salmonids occurring on over 688,500 hectares (1.7 million acres) of corporate lands, primarily in the Columbia River basin. The majority of the land under consideration occurs in Montana (87 percent) with the remainder in Idaho and Washington.

Because silvicultural activities, logging road construction and maintenance, and open range cattle grazing by the Plum Creek Timber Company may result in harm to bull trout, seven categories of conservation commitments were included in the Habitat Conservation Plan. The seven categories are: (1) road management, (2) riparian management, (3) livestock grazing, (4) land-use planning, (5) legacy management and other restoration opportunities, (6) administration and implementation measures, and (7) monitoring and adaptive management. The conservation benefits of activities in the seven categories include reducing sediment delivery to streams from roads and grazing, increasing canopy cover in riparian areas, restoring stream bank integrity and overall habitat complexity, and providing fish passage at road culverts and water diversion structures.

In Washington, the Washington Department of Natural Resources developed a Habitat Conservation Plan that was adopted on January 1, 1999. The plan covers the approximately 647,500 hectares (1.6 million acres) of forested State trust lands that lie within the range of the northern spotted owl. The Habitat Conservation Plan contains riparian conservation strategies that were designed to protect salmonid and riparian species for lands west of the Cascade Mountains crest. It includes a streamside no-harvest buffer strategy, a minimal-harvest area for ecosystem restoration, and a low-harvest area for selective removal of single trees or groups of trees and thinning and salvage operations. In addition to riparian buffers, road management standards were developed to ensure that mass-wasting (erosion and landslides) is not artificially accelerated and that sediment delivery remains near natural levels. The Habitat Conservation Plan also includes monitoring and adaptive management components. The minimization and mitigation actions of the plan will address habitat requirements of bull trout and cumulatively will reduce the adverse effects to bull trout in comparison to previous forest management practices (USFWS 1998d).

Safe Harbor Agreements. Safe Harbor Agreements between the U.S. Fish and Wildlife Service and non-Federal landowners are another voluntary mechanism to encourage conservation of listed species and authorize incidental take permits. In general, these agreements provide (1) conservation benefits for listed species that would otherwise not occur except for the agreement, and (2) Endangered Species Act regulatory assurances to the landowner through a section 10 permit. Safe Harbor Agreements are intended for landowners who have few or no listed species (or listed species' suitable habitat) on their property, but who would be willing to manage their property in such a way that listed species may increase on their lands, as long as they are able to conduct their intended land-use activities. An example of how Safe Harbor Agreements may be used to further bull trout conservation can be found with fish passage barriers in streams. If a landowner owns a stream with a fish passage barrier that prevents access to their property by bull trout, they may be unwilling to remove the barrier, and thereby allow access by bull trout, for fear of the "take" prohibitions under section 9 of the Endangered Species Act and potential restrictions on land-use activities. Under a Safe Harbor Agreement, the landowner would agree to removal of the barrier, allow bull trout access to their property, and the landowner and U.S. Fish and Wildlife Service would negotiate other conservation measures necessary to ensure suitable bull trout habitat conditions are maintained on the property while allowing the landowner's land-use activities to occur. The landowner would receive a section 10 permit authorizing incidental take of bull trout consistent with the agreed upon conservation measures in the Safe Harbor Agreement. Safe Harbor Agreements for bull trout may be developed in the future.

Clean Water Act. The Clean Water Act provides some regulatory mechanisms for protection and restoration of water quality in waters that support bull trout. Under sections 303 and 304, states or the Environmental Protection Agency set water quality standards, which combine designated beneficial uses and criteria established to protect uses. States or the Environmental Protection Agency designate water bodies that are failing water quality standards as water quality limited under section 303(d) (*e.g.*, MDHES 1994; USEPA 1994; ODEQ 1996), and are required to develop management plans. Management plans include total maximum daily loads with implementation plans that define site-specific actions and timelines for meeting water quality goals (65 FR 43586). The total maximum daily loads assess and allocate all the point and nonpoint sources of pollutants within a watershed. Best management practices are used with total maximum daily loads to address nonpoint sources of pollution, such as mining, forestry, and agriculture. Regulatory authority to enforce the best management practices, however, varies among the states. It is estimated that 10 percent of the total length of streams within the interior Columbia River basin and the Klamath River basin are listed as water quality limited, and this estimate may be below the true extent and distribution of streams with impaired water quality potentially affecting bull trout (USDA and USDI 1997). The U.S. Environmental Protection Agency requests that states give higher priority to polluted waters that are sources of drinking water or support listed species, when developing total maximum daily loads and implementation plans (65 FR 43586).

In accordance with section 319 of the Clean Water Act, states also develop programs to address nonpoint sources of pollution such as agriculture, forestry, and mining. The effectiveness of controlling water pollution from these activities has been mixed. The State of Washington monitored the effectiveness of riparian prescriptions under past forest practices regulations in meeting water quality temperature criteria for streams on forest lands and concluded that regulations for stream shading were inadequate to meet criteria (Sullivan *et al.* 1990).

Northwest Power Planning Council Fish and Wildlife Program. Congress, through the Pacific Northwest Electric Power Planning and Conservation Act of 1980, directed the Northwest Power Planning Council to develop a Fish and Wildlife Program. The program is intended to give the citizens of Idaho, Montana, Oregon, and Washington a stronger voice in the future of electricity generated by the Federal hydropower dams in the Columbia River basin and fish and wildlife affected by the dams and their operation.

One of the Northwest Power Planning Council's major responsibilities is to develop a program to protect and rebuild fish and wildlife populations affected by hydropower development in the Columbia River basin. State, Tribal, and local governments often work closely with the Northwest Power Planning Council as it develops power and fish and wildlife plans. The Bonneville Power Administration provides funding for implementation of the Council's Fish and Wildlife Program. In 2000, the Council amended its Fish and Wildlife Program to include development of subbasin plans. Subbasin planning, beginning in 2002, is a means for identifying projects that will be funded to protect, mitigate, and enhance the Columbia River basin’s fish and wildlife resources. These plans are viewed as crucial efforts for implementing the Endangered Species Act responsibilities of the Bonneville Power Administration, U.S. Corps of Engineers, and the Bureau of Reclamation in the Columbia River basin.

The primary objective of subbasin planning is to develop a unifying element for implementation of the Northwest Power Planning Council's Fish and Wildlife Program. It will also assist in the implementation of Endangered Species Act recovery activities. One of the goals of the subbasin planning process is to provide specific products that can be integrated directly into the Endangered Species Act recovery planning process. We will provide specific recovery unit chapters from the bull trout recovery plan to the applicable subbasin planning teams that have the responsibility for developing subbasin plans.

Federal Caucus Fish and Wildlife Plan. The Federal Caucus is a group of nine Federal agencies, formed as a result of the Federal Columbia Power System Biological Opinion, that have responsibilities for natural resources affecting species listed under the Endangered Species Act. The agencies are the National Marine

Fisheries Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, Bonneville Power Administration, U.S. Army Corps of Engineers, Bureau of Indian Affairs, Forest Service, Bureau of Land Management, and Environmental Protection Agency. The Federal Caucus has drafted a basin-wide recovery strategy for listed anadromous fish in the Columbia River basin which addresses management of habitat, hatcheries, harvest, and hydropower. This recovery strategy, titled 'The Conservation of Columbia River Basin Fish: Final Basin-Wide Recovery Strategy', will provide the framework for development of recovery plans for individual species and for effects determinations for actions under consultation. As recovery plans for individual species are developed following the basin-wide strategy, and measures to address biological needs of all stages of the life cycle are implemented, conditions for listed aquatic species are expected to improve sufficiently to provide for their survival and recovery. The Basin-Wide Salmon Recovery Strategy concludes that restoring tributary and estuary habitat is key to recovering listed fish. Actions focus on restoring tributary (both Federal and non-Federal), mainstem, and estuary habitat. The Salmon River basin would be a target for recovery efforts under this strategy.

For long-term actions, the Basin-Wide Salmon Recovery Strategy endorses the Northwest Power Planning Council strategy of conducting subbasin assessments and developing subbasin plans and prioritizing actions based on those plans. Once the assessments are complete, the Federal agencies will participate with State agencies, local governments, Tribes and stakeholders to develop subbasin plans. Draft subbasin summaries were used extensively in the preparation of bull trout recovery unit chapters.

While the salmon recovery framework has only recently been adopted, and thus the benefits of this recovery framework have not yet been realized, the U. S. Fish and Wildlife Service envisions significant improvements in habitat conditions for listed salmonids as recovery activities are implemented. Because bull trout often use the same areas, we expect bull trout to similarly benefit from improved habitat conditions.

U.S. Department of Agriculture. The U.S. Department of Agriculture offers landowners financial, technical, and educational assistance to implement conservation practices on privately owned land. Using this help, farmers and ranchers apply practices that reduce soil erosion, improve water quality, and enhance forest land, wetlands, grazing lands, and wildlife habitat. U.S. Department of Agriculture assistance also helps individuals and committees restore after floods, fires, or other natural disasters.

This assistance is provided to landowners via Farm Bill programs administered by the U.S. Department of Agriculture, Farm Service Agency and the Natural Resources Conservation Service. The implementation of practices associated with these programs may improve conditions for bull trout. In particular, the Conservation Reserve Enhancement Program is targeted to areas in Oregon and Washington where other listed fish occur and may provide direct benefits to bull trout.

The Conservation Reserve Easement Program is an addition to the Conservation Reserve Program. A Conservation Reserve Enhancement Program for the State of Oregon and the State of Washington was approved October 1998, in a Memorandum of Agreements between the United States Department of Agriculture, the Commodity Credit Corporation and the states of Oregon and Washington. The Conservation Reserve Easement Program is a partnership between Federal agencies, State agencies, and private landowners. Land enrolled in this program is removed from production and grazing, under 10 to 15 year contracts. In return, landowners receive annual rental, incentive, maintenance and cost share payments.

The Oregon Conservation Reserve Easement Program is a voluntary program offering annual payments to landowners for establishment of riparian buffers along streams and for restoration of wetlands. The Oregon Conservation Reserve Easement Program seeks to enroll up to 40,469 hectares (100,000 acres) located along streams inhabited (or once inhabited) by listed fish under Federal law as threatened or endangered. Up to 5,000 of these acres may be cropped wetlands which are either hydrologically connected to these streams or located in coastal estuaries.

In Washington, eligible stream designations were originally based on spawning habitat for stocks designated as critical or depressed under the 1993 Salmon and Steelhead Stock Inventory. Approximately 9,656 kilometers (6,000 miles) of eligible streams were included. Recent changes allow for the nomination of additional stream segments where riparian habitat is a significant limiting factor, and a new cap of 16,093 kilometers (10,000 miles) of eligible streams.

Other Farm Bill programs encourage farmers to convert highly erodible cropland or other environmentally sensitive acreage to native vegetative cover, provide incentives for landowners to restore function and value to degraded wetlands on a long-term or permanent basis, assist landowners with habitat restoration and management activities specifically targeting fish and wildlife (including threatened and endangered species), provide technical and financial assistance to farmers and ranchers that face threats to soil, water, and related natural resources, and support forest management practices on privately owned, nonindustrial forest lands.

Native American Tribal Activities

In Oregon, members of the Confederated Tribes of the Umatilla Reservation, Confederated Tribes of the Warm Springs Reservation, Burns Paiute Tribe, and Klamath Tribe all participate on bull trout working groups in their geographic areas of interest. The Confederated Tribes of the Warm Springs Reservation and the Burns Paiute Tribe both have projects funded through the Bonneville Power Administration focused on bull trout. The Confederated Tribes of the Umatilla Indian Reservation has multiple projects funded through the Bonneville Power Administration that address anadromous fish, but that also benefit bull trout, *e.g.*, habitat surveys, passage at dams and diversions, habitat improvement, and movement studies.

In Montana, the Confederated Salish and Kootenai Tribes were a full participant in the Montana Bull Trout Restoration Team and the Montana Bull Trout Scientific Group. They have been actively involved in recovery unit teams for the Clark Fork River Recovery Unit, including activities both on and off the Flathead Reservation. The Blackfeet Nation will be a pivotal player in the St. Mary-Belly River Recovery Unit Team. Much of the St. Mary River drainage in Montana occurs on Tribal lands.

In Idaho, the Coeur d'Alene Tribe, Kootenai Tribe of Idaho, Nez Perce Tribe, and Shoshone-Bannock Tribe are participating on various recovery unit teams.

The Spokane Tribe, Confederated Tribes of the Colville Reservation, and Kalispel Tribe participated in the Northeast Washington Recovery Unit Team. The Kalispel Tribe has projects funded through the Bonneville Power Administration, Salmon Recovery Funding Board, and Pend Oreille County Public Utility District that benefit bull trout (*e.g.*, habitat surveys and habitat improvement projects). The Yakama Nation participates on the Mid, Upper, and Lower Columbia recovery units teams. The Yakama Nation has many projects that address anadromous fish, but that also benefit bull trout (*e.g.*, habitat surveys, habitat improvement projects, and passage at dams and diversions). In western Washington, the Quinault Indian Nation and the Skokomish Tribe participate in the Olympic Peninsula Recovery Unit Team for the Coastal-Puget Sound population segment of bull trout. The Stillaguamish Tribe and Nooksack Tribe participate in the Puget Sound Recovery Unit Team. These Tribes as well as other Tribes within western Washington are currently involved in habitat restoration, watershed assessment, habitat and fisheries monitoring, and management forums focused on recovery and maintenance of anadromous salmon populations within the Puget Sound region and on the Washington Coast. Many of these efforts will also benefit bull trout.

Canadian Government Activities

Bull trout currently receive no legal protection in Canada, although legislation to protect wildlife species at risk has been introduced in the House of Commons. The provinces of Alberta (Berry 1994) and British Columbia (British Columbia Environment 1994) have both developed strategic plans for the recovery of bull trout. Both provinces have increased research and management efforts for the species in recent years and have implemented site-specific activities to improve bull trout habitat, increase migratory capabilities, and enforce stricter angling regulations. Alberta has adopted bull trout as the Provincial fish and has developed an extensive public relations campaign.