October 1997

STATUS OF OREGON'S BULL TROUT, DISTRIBUTION, LIFE HISTORY, LIMITING FACTORS, MANAGEMENT CONSIDERATIONS, AND STATUS

Technical Report 1997

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Dear Reader:

Thank you for purchasing the 1997 Status of Oregon's Bull Trout. Please note the following errata in the report:

Page 18 – Table 2 bottom of page: Odell Lake is included in the Deschutes River Basin, not the Hood River.

Page 66 – Last line in paragraph in right hand column: Should read, "Both working groups are drafting conservation strategies for bull trout in their respective basins."

Page 112 – Figure 41: The legends should be reversed; shaded for 1965 – 1971, clear for 1993 – 1996.

Page 155 – First sentence in second paragraph: Incorrect spelling of Kirk Schroeder's name.

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STATUS OF OREGON'S BULL TROUT

Distribution, Life History, Limiting Factors, Management Considerations, and Status

Oregon Department of Fish and Wildlife

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Cover photo by David Buchanan

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Status of Oregon's Bull Trout

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Silent Shadows

Roaring confluence of Canyon Creek and Metolius River
Another masterpiece from Mother Nature
Emerald green waters, dark and icy cold
A huge shadow moves like a ghost into Canyon Creek
Maybe just a vision or a hope
Maybe an adult bull trout
Returning to spawn, closing the cycle

Many miss the exhilaration of this moment
Only a handful of biologists understand the irony
Of a tentative population, newly rejuvenated
Providing promise and prospect

Our celebration is sparse and fleeting
Wrecked riparian and wiped out watersheds abound
Perishing populations of bull trout
Exist and persist throughout Oregon
But unlike some unfortunate souls
We have the understanding and the energy
To step forward and change the outcome

D. V. Buchanan
8/12/97

In memory of our friend and colleague, Greg Willmore, 1946 - 1995, fisheries biologist for the Wallowa-Whitman National Forest, His infectious enthusiasm for bull trout will be missed.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

PREFACE

The purpose of this document is to summarize the best scientific information presently available for bull trout (*Salvelinus confluentus*) throughout Oregon and to review their historical and current status.

What started out as a relatively simple exercise to review and update the status report by Ratliff and Howell (1992) based on recent data collection efforts, soon mushroomed into a more comprehensive treatment of all available data on bull trout populations in Oregon, Thus the foundation laid in Ratliff and Howell (1992) has been expanded for that section of the bull trout's range that includes Oregon.

A draft of this document received extensive review and additions from professionals within Oregon Department of Fish and Wildlife, U.S. Forest Service, Oregon Chapter of The American Fisheries Society, Portland General Electric Company, U.S. Fish and Wildlife Service, Plum Creek Timber Company, Confederated Tribes of the Warm Springs Reservation, Idaho, Department of Fish and Game, and Washington Department of Fish and Wildlife.

One of the reviewers wanted to see "more objective and numerical rating criteria" used to assess status. The authors agree that this is a useful "next" step and that work should begin on developing the necessary quantitative criteria to evaluate status. This is further addressed in the Recommendations section. Standards in Oregon's Wild Fish Management Policy and discussed in Kostow (1995), draft criteria developed by Washington Department of Fish and Wildlife and the USFS, and the body of bull trout research provide guidance in this effort Nevertheless, qualitative data can be useful and conclusive in assessing status when it is provided by a large number of professional experts. Throughout, the preparation of the document input was sought, from more than 100 fisheries biologists who had expertise or local knowledge of each basin.

Maps used in this document were created using Geographic Information System (GIS) technology. Map information pertaining to ownership, administrative boundaries, and physical features are from GIS layers readily available from the Oregon State GIS Service Center in Salem, Oregon. In some instances, features or names have been modified based on updated information or local knowledge of the area.

Mapping was done using the 1:100,000 U. S. Geological Survey (USGS) stream layer as base map. In some instances it was necessary to digitize additional streams from USGS 1:24,000 scale maps where this detail was missing on the 100,000 layer. River kilometers noted in the text were not mapped because of the difference in scale used in Oregon Water Resource Department (OWRD) basin maps, where these notations occur (as River Miles), and the scale used for bull trout distributions. River miles originally portrayed in OWRD maps were converted to River Kilometers for this report

Data on historic bull trout distribution were gathered from written historic records, Data on current bull trout distribution were based on knowledge provided by local biologists and survey reports provided by state, federal, private, and tribal entities.

Current distribution is presented in two categories: (1) spawning, juvenile rearing and resident adult bull trout, and (2) migratory habitat used by fluvial and adfluvial bull trout. Data are available and have been recorded since 1990 to verify these current distribution patterns. They are primarily derived from summer distribution patterns ofjuvenile or resident adult fish, however, when possible, fall distributions of adult spawning are also included. Verifiable reports of bull trout catches by steelhead anglers have also been used to define migratory corridors,

Historic distribution refers to distribution patterns for bull trout populations documented in the literature from 1854 to 1990, but which are now extirpated from these areas. The classification "probably extinct" refers to bull trout populations that existed historically (prior to 1990), or have not been found in numbers sufficient to be considered a population (such as an observation of a single bull trout or a single bull/brook hybrid). The upper and lower limits of historic distribution are less well documented than for the current distributions. In the classifications of statewide status in the text these two categories are lumped into one and referred to as "probably extinct."

Isolated sites where one or two bull trout have been observed outside of current or known distribution, or where a recent sighting has been recorded in historic range, are portrayed as individual dots.

The distributions portrayed should be viewed as conservative since we do not have a complete understanding of either the bull trout's current or historic distributions. They reflect the state of knowledge as of December 1996. As new information is obtained on the movements of bull trout and as additional historic information is uncovered, the distributions will be reviewed and updated. Even as this document goes to press, data collected during the 1997 field season shows extensions of bull trout distribution in Indian Creek (Grande Ronde Basin) and in Deming Creek and North Fork Sprague River below Boulder Creek (Klamath Basin). In addition, two reintroduction projects resulted in bull trout being returned to Wallowa Lake (Grande Ronde Basin) and to the Middle Fork Willamette River (Willamette Basin),

Metric units were used throughout the report. Where data-dited material were not portrayed in metric units, conversions were made. Likewise, temperature units were converted to Centigrade where they were portrayed originally in Fahrenheit.

We hope this information will be useful to present and future fishery managers, researchers, and bull trout enthusiasts.

David V. Buchanan
Mary L. Hanson
Robert M. Hooton
September 1997

EXECUTIVE SUMMARY

Limited historical references indicate that bull trout *Salvelinus confluentus* in Oregon were once widely spread throughout at least 12 basins in the Klamath River and Columbia River systems. No bull trout have been observed in Oregon's coastal systems. A total of 69 bull trout populations in 12 basins are currently identified in Oregon. A comparison of the 199 1 bull trout status (Ratliff and Howell 1992) to the revised 1996 status found that 7 populations were newly discovered and 1 population showed a positive or upgraded status while 22 populations showed a negative or downgraded status. The general downgrading of 32% of Oregon's bull trout populations appears largely due to increased survey efforts and increased survey accuracy rather than reduced numbers or distribution. However, three populations in the upper Klamath Basin, two in the Walla Walla Basin, and one in the Willamette Basin showed decreases in estimated population abundance or distribution.

Some Oregon river basins have bull trout populations at extreme risk of extinction. This statewide status review listed only 19% of the bull trout populations in Oregon with a "low risk of extinction" or "of special concern," Therefore, 81% of Oregon's bull trout populations are considered to be at a "moderate risk of extinction," "high risk of extinction," or "probably extinct." Populations in the Hood, Klamath, and Powder basins, as well as the Ode11 Lake population in the Deschutes basin, which contain only a few remaining bull trout, are examples of populations having a "moderate" or "high risk" of extinction.

Approximately 55% of current bull trout distribution occurs on lands managed by the U.S. Forest Service. A much smaller proportion occurs on Bureau of Land Management managed lands (2%). Only 16% of current bull trout distribution occurs within a protected area defined as Wilderness, Wild and Scenic River, or within a National Park The Northwest Forest Plan, Inland Native Fish Strategy, and Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California have provided increased protection for bull trout habitat depending on their scope and geographic areas affected, and the extent to which they are being effectively implemented in watersheds containing bull trout. Recent reduction in timber production on National Forests (up to 50% in western Oregon National Forests and over 30% in eastern Oregon National Forests) should help improve riparian and stream habitat conditions for bull trout. The remaining bull trout distribution occurs on private, state, or tribal owned lands.

A comparison of approximately 39 locations throughout the state with protective angling regulations on bull trout (in some areas more than one bull trout population is protected by one regulation) shows that all state managed areas were upgraded in a protective angling status or at least maintained in 1996 compared to 1989. Restrictive angling regulations prohibit angler harvest of all bul1 trout populations in Oregon except for one in the Deschutes Basin. Restrictive bull trout angling regulation changes (including the elimination of bull trout harvest in all spawning areas) may be the major reasons why the Metolius River/Lake Billy Chinook and mainstem McKenzie River populations have shown significant increases in abundance.

Statewide stocking of non-native brook trout, including the high lakes stocking program, has been discontinued in locations where managers believe brook trout could migrate downstream and potentially interact with native bull trout. Hatchery stocking of legal rainbow trout to promote recreational fisheries has been discontinued in most locations near bull trout populations to avoid incidental catch of bull trout.

The spatial and temporal distributions of bull trout reported for each river basin in this status report should be used as an accurate baseline for fisheries managers. Current distribution and relative change of distribution should be useful indicators of population health and status. The GIS maps in this report provide a template to add new layers of data such as critical spawning and juvenile rearing areas, or as a method to compare distribution changes through time.

Length frequency data are presented for most Oregon bull trout populations. This should provide estimates for the presence of multiple age classes and the percent of fluvial size life history component.

INTRODUCTION

The goal of Oregon's fish management is to prevent the serious depletion of any indigenous species through the protection of native ecological communities, the conservation of genetic resources, and the control of consumptive uses such that fish production is sustainable over the long term [OAR-635-07-510(l)]. Contrary to this, stated goal, bull trout *Salvelinus confluentus* is a native Oregon fish species in trouble. The existence of bull trout populations is being threatened in Oregon, in other Western states (Washington, Idaho, Montana, and Nevada), and in Canada (British Columbia, Yukon Territory, and Alberta).

The American Fisheries Society (AFS) first classified bull trout as a species "of special concern" in 1989 because of destruction of habitat, and hybridization, predation, and competition from non-native species (Williams et al. 1989). The Oregon Department of Fish and Wildlife (ODFW) listed bull trout as a sensitive/critical species in 1993. In October 1992, several Montana conservation groups petitioned the federal government to list all bull trout in the Western states as endangered under the Endangered Species Act (ESA). In January 1993, a second petition, requesting the listing of bull trout in the Klamath River Basin as endangered, was received by the U.S. Fish and Wildlife Service (LJSFWS) from the Oregon Chapter of AFS. The USFWS announced in June 1994 that listing the bull trout as a threatened or endangered species was warranted under the ESA, but was precluded by higher priority species and limited resources. Two of the petitioners, Friends of the Wild Swan and Alliance for the Wild Rockies, filed a lawsuit challenging the 1994 finding. In November 1996, the Oregon,Federal District Court granted the plaintiffs motion for summary judgement, directing the USFWS to reconsider the 1994 finding using only information available in 1994 and to respond to the court within four months. On June 10, 1997, in response to litigation, the USFWS proposed that Klamath Basin bull trout be proposed for endangered status, while the Columbia Basin bull trout be proposed for threatened status (USFWS 1997).

The geological record documents that species extinction is not a recent phenomenon. But it is the rapidly accelerating rate of extinction during this century, primarily as a result of human activities, that is a cause for deep concern. Meyers (1988) estimated that the world extinction rate may be over 1,000 species per year. Many of these species are undescribed plants, insects, and nematodes. The extinction rate of known birds and mammals is also increasing. For example, the extinction of 38 described birds and mammals was documented from 1600 to 1810 while 112 described birds and mammals have been extirpated from 18 10 to the present (Jane Lubchenco, Oregon State University (OSU), Corvallis, personal communication, November 1995).

The recent extinction of bull trout in California and that state's failed reintroduction efforts point out the difficulties of recovery efforts when the local population has been extirpated. Bull trout were historically found in the McCloud River, a 96 km tributary of the Sacramento River. The last reported capture of a bull trout there was in 1975. In 1980, the state of California designated bull trout of the McCloud River as an endangered species and developed a recovery plan. The plan included a reintroduction program using resident bull trout similar to populations found in Oregon's Klamath Basin. In 1989, over 60 resident adults from the Upper Klamath Basin were captured for broodstock for this recovery program. Unfortunately, heavy mortality occurred at the hatchery and only 270 fingerling bull trout were ultimately produced and transferred to California in 1990 for release (Howell and Buchanan 1992). This transfer and recovery program was only in effect one year because of the reduced distribution and abundance of the bull trout populations in the Upper ,Klamath Basin. In 1995, after five years of monitoring without success, the recovery program was listed as a failure and terminated (Mike Rode, California Department of Fish and Game, in conversation with Frank Shrier, PacifiCorp, Portland, Oregon, October 1995).

In Oregon, bull trout generally reside in restricted habitat primarily in the upper reaches of tributaries to the Columbia, Snake, and Klamath rivers (Ratjiff and Howell 1992). Most investigators believe Oregon's bull trout populations are depressed (Goetz 1989, Bond 1992, Buckman et al. 1992, Dambacher et al. 1992, Ratliff and Howell 1992,Ziller,l992). However, a recent review by Platts et al. (1995) has suggested that Oregon's populations are stable. This status report will attempt to resolve this controversy. The status report will include a general review of genetic and life history, patterns, habitat needs, potential limiting factors; and a statewide overview of historical distribution,current status, and management changes. Individual basin reports include an introduction, historical distribution, current distribution, life history, specific limiting factors, management considerations, and current status., Final sections include conclusions, research needs, and recommendations.

GENERAL REVIEW

Genetic Patterns

Leary et al. (1993) used starch gel electrophoretic techniques to analyze bull trout populations throughout the Columbia Basin and found little genetic variation within populations and significant genetic variation between populations. Their work suggests that preserving the genetic diversity of bull trout will require the continued existence of many populations throughout the region. Leary et al. (1993) also found that bull trout from the Columbia and Klamath basins would qualify genetically as a separate "species" under the ESA listing according to criteria established for anadromous salmonid fishes. Studies of Leary et al (1993) also note that fossil and geological evidence found that the Klamath and the Columbia River basins have been separated and isolated for at least 10,000 years., Williams et al. (1995) studied the same bull trout samples as Leary et al. (1993) using mitochondrial DNA analysis. They found bull trout populations could be separated into three distinct groups: Klamath Basin, lower Columbia Basin, and upper Columbia Basin. Like Leary et al. (1993) they found little variation within Columbia bull trout populations; however, their mitochondrial DNA also showed little variation between populations. Spruell and Allendorf (1997) used nuclear DNA extraction at four polymorphic microsatellite loci to characterize the genetic population structure of 52 bull trout populations, primarily found throughout Oregon (Hemmingsen et al. 1996). These studies were funded by the Bonneville Power Administration. Spruell and Allendorf s (1997) analyses support the existence of three major lineages of bull trout in Oregon. One lineage is composed of populations in western Oregon and,Washington including the Deschutes,, Hood, and Willamette basins. A second lineage includes the John Day River, tributaries to the Columbia River up to the mouth of the Snake River, and Snake River tributaries, The third lineage includes the populations found in the Klamath Basin as documented by protein electrophoresis (Leary et al. 1993).

Kostow (1995) designated seven "gene conservation units" (GCU) for bull trout throughout Oregon., These GCUs correspond roughly to the major drainages inhabited by bull trout. The genetic work initiated by Hemmingsen et al. (1996) and analyzed by Spruell and Allendorf (1997) will be used to support or revise the currently recognized GCUs.

Life History

Cavender (1978) first described the taxonomic charadteristics of bull trout and separated bull trout from Dolly Varden *S. malma*. The holotype specimen for bull trout was first collected .near Fort Dalles on the lower Columbia River in 1854 by George Suckley (Cavender 1978) The bull trout in Oregon have three life-history patterns represented by resident, fluvial, and adfluvial fish. Although anadromy is not found in Oregon, Bond (1992) believed that it was an important part of the life history and historical distribution patterns, and, may have acted as a mechanism for coastal distribution. Entry to salt water is common in chars in cold climates (Hubbs and Lagler 1958, Bond 1992). Resident juvenile bull trout are thought to generally confine their migrations to and within their natal stream. Fluvial populations generally migrate between smaller streams used for spawning and early juvenile rearing and larger rivers used for adult rearing. Fluvial populations can switch to adfluvial under some circumstances. Adfluvial populations generally migrate between smaller streams used for spawning and juvenile rearing and lakes or reservoirs used for adult rearing. Adfluvial individuals can attain sizes over 9 kg (20 pounds) in Oregon. Additional research is necessary to separate and understand these life-history forms within individual drainages.

Embryonic and Juvenile Life History

Since details of the early life history of resident bull trout are largely unreported, most of the life-history literature available is based on fluvial and adfluvial populations from Oregon and the Intermountain West, as summarized by Pratt 1992, Ratliff 1992, and Ratliff et al. 1996.

Bull trout eggs require approximately 350-440 temperature units (°C) to hatch (Weaver and White 1984, Gould 1987, Pratt 1992). Embryos require fewer temperature units to develop as incubation temperatures decline (Weaver and White 1985). Hatching is completed after 100-145 days (Pratt 1992). Bull trout alevins require at least 65-90 days after hatching to absorb their yolk sacs (Pratt 1992). They remain within the interstices of the streambed as fry for up to three weeks before reaching lengths of 25-28 mm, filling their air bladder, and emerging from the streambed in late April (McPhail and Murray 1979, Pratt 1992). In the McKenzie River Basin, bull trout fry emerge from late February through May (J. Capurso, U. S. Forest Service (USFS), personal communication, December 1996).

Juvenile bull trout are closely associated with the streambed and are found immediately above, on, or within the streambed (Griffith 1979, Oliver 1979, Pratt 1984, 1992). The highest observed densities of juvenile bull trout in the Flathead River basin were in stream reaches dominated by gravel or cobble substrate (Shepard et al. 1984). In the Metolius Basin, Oregon, young bull trout less than 100 mm were found most consistently in the coldest, spring-influenced tributaries (Ratliff 1992).

Juvenile bull trout were approximately 50-70 mm in fork length (FL) at Age 1, 100-120 mm at Age 2, and 150-170 mm at Age 3 in the Flathead River system (Pratt 1992). In the Metolius River system, bull trout were approximately 20-40 mm at Age 0+, 60-99 mm at Age 1+, 100-159 mm at Age 2+, and greater than 160 mm at Age 3+ (Ratliff et al. 1996). Bull trout less than 110 mm feed on aquatic insects, while those larger are primarily piscivorous (Horner 1978, Shepard et al. 1984). Fish identified in juvenile bull trout stomachs included sculpins, salmon fry, and other bull trout (Pratt 1992).

Juvenile bull trout migrated from the upper Flathead River tributaries primarily at Age 2 (49%) with 18% migrating at Age 1 and 32% migration at Age 3 (Pratt 1992). Oliver (1979) found that juveniles from the Kootenay River drainage migrated primarily at Age 2. Ratliff et al. (1996) found that most of the downstream migrants in tributaries of the Metolius River migrated at Age 2 (54%) with 19% migrating at Age 3 and older. Juvenile bull trout may migrate from natal areas during spring, summer, or fall (Pratt 1992). Shepard et al (1984) found migration continued from early May through the middle of July on the Flathead River system. Ratliff et al. (1996) observed downstream migration in May and June in the Metolius. They also noted that over 93% of the migration occurred nocturnally. Fies and Robart (1988) found that some juveniles migrated upstream upon entering the Metolius River from their natal streams, whereas Brumback (1993a) reported bull trout dispersing up warmer tributaries of the natal streams that had high abundance of small sculpins.

Adult Life History

Adfluvial bull trout feed primarily on fish and can exhibit extraordinary growth rates (Jeppson and Platts 1959, Rieman and Lukins 1979, Shepard et al. 1984, Pratt 1992). Length increased an average of 167 mm FL per year for adult bull trout rearing in Lake Billy Chinook (Ratliff 1992). Some adfluvial bull trout rearing in Lake Billy Chinook reach fork lengths over 800 mm (Ratliff et al. 1996). Fluvial bull trout tagged and recaptured in the Metolius River increased an average of 77 mm per year (Ratliff et al. 1996). Resident bull trout have much slower growth rates. For example, in the Klamath River Basin the largest bull trout captured in Deming Creek was 2 18 mm, while the largest bull trout captured from Long Creek was 234 mm (J. Dambacher, ODFW, personal communication, December 1996).

Adult bull trout rearing and migration patterns are not well documented in Oregon except for the Metolius River and Lake Billy Chinook system. In the Metolius River, of five fish recaptured after being tagged above Camp Sherman, three were recaptured near Camp Sherman after 4.5 years, one was recaptured 1.5 years later in Lake Billy Chinook Reservoir approximately 40 km downstream, and another was recaptured 5 years later while spawning in Jack Creek, a tributary of the Metolius River (Ratliff 1992). Maturing adult bull trout were captured staging at the head of the Metolius River arm of Lake Billy Chinook Reservoir beginning in May and continuing through August. Adult bull trout arrived at upstream traps located on Jack and Jefferson creeks (tributaries of the Metolius River) beginning in late July and continuing through the first week of October (Ratliff et al. 1996). Thiesfeld et al. (1996) implanted radio transmitters on maturing adfluvial bull trout captured where the Metolius River enters Lake Billy Chinook. They found after bull trout migration started in mid-July, that most fish moved quickly up the river and resided near the mouth of the intended spawning tributary Migration into the spawning tributary, spawning, and migration back to the mainstem Metolius River was usually accomplished within one month.

At Powerdale Dam trap, located on the lower Hood River near the Columbia River, some migrating adults as long as 570 mm FL are captured annually from id-May to mid-October. These fish are tagge and some recaptures have been observed the following year at Powerdale Dam; one was recaptured in the Columbia River near RK 261 or approximately 11 km downstream of the mouth of Hood River, and one was observed upstream in the Hood drainage at the Coe Branch Creek diversion (Pribyl et al. 1995). In the Grande Ronde River system, a 240 mm bull trout was tagged and released above the dam at Lookingglass Hatchery in September 1991: This fish was caught and released by a steelhead angler in March 1992 in the Grande Ronde River below LaGrande. The fish then was caught a second time by an angler in the Grande Rdnde River just below the mouth of Lookingglass Creek in September 1992. This one fish traveled a minimum of 160 km within one year (West and Zakel 1993).

Surveys in Oregon have documented bull trout spawning from late July through at least October. Most spawning occurs in cold headwaters or spring-fed streams. Adfluvial adults were found spawning in Metolius River tributaries in July through October. Spawning of adults and initial juvenile rearing is limited to very cold (approximately 4.5°C) spring-fed,tributaries to the Metolius River (Ratliff 1992). Resident bull trout were observed spawning in streams of the Klamath Basin in September and October (Klamath Basin Bull Trout Working Group, personal communication, August 1995). Annual and alternate year spawning has been documented for bull trout (Allan 1980, Shepard et al. 1984). Most of the adults in the Metolius River system spawn annually (Metolius Subbasin Bull Trout Working Group, personal communication, October 1995).

Habitat Needs

Rieman and McIntyre (1993) stated that bull trout appear to have more specific habitat requirements than other salmonids. They list channel stability, substrate composition, cover, temperature, and migratory corridors as all influencing bull trout distribution and abundance. Dambacher and Jones (1997) looked at 103 reaches from 32 Oregon streams for a comparison of possible bull trout habitat, They found that 59 reaches had juvenile bull trout present and 44 did not. Stream reaches supporting juvenile bull trout populations were compared, by multivariate analysis, to reaches without bull trout using 3 1 possible habitat variables. Dambacher and Jones (1997) found that seven habitat variables, were significant ($P < 0.0001$) descriptors of the presence ofjuvenile bull trout: (1) high levels of shade, (2) high levels of undercut banks, (3) large woody debris volume, (4) large woody debris pieces, (5) high levels of gravel in riffles, (6) low levels of tine sediment in riffles, and (7) low levels of bank erosion. They did not gather adequate data to test temperature or habitat requirements of fluvial fish. Fluvial fish require migratory corridors tying wintering, summering, or rearing areas to spawning areas and allowing the movement for interactions of local populations within possible metapopulations. Metapopulations as used in this text, refers to a set of local populations which interact via individuals moving among populations (Hanski and Gilpin 1991).

Bull trout are stenothermal, requiring a narrow range of cold temperature conditions to rear and reproduce (Buchanan and Gregory 1997). Water temperatures in excess of about 15°C are thought to limit bull trout distribution (Rieman and, McIntyre 1993). Many investigators have concluded that water temperatures represent a critical habitat characteristic for bull trout (McPhail and Murray 1979; Shepard et al. 1984; Fraley and Shepard 1989; Goetz 1989, 1994; Howell and Buchanan 1992; Rieman and McIntyre 1993). Buchanan and Gregory (1997) summarized temperature requirements for each life-history stage and each monthly time period for bull trout from field observations and laboratory studies found in the literature. Summer maximum temperatures are generally considered a limiting period for juvenile and adult bull trout. However, they suggested three additional temperature limiting periods such as fall spawning; fall, winter, and spring egg incubation; and spring fry growth (Figure 1).

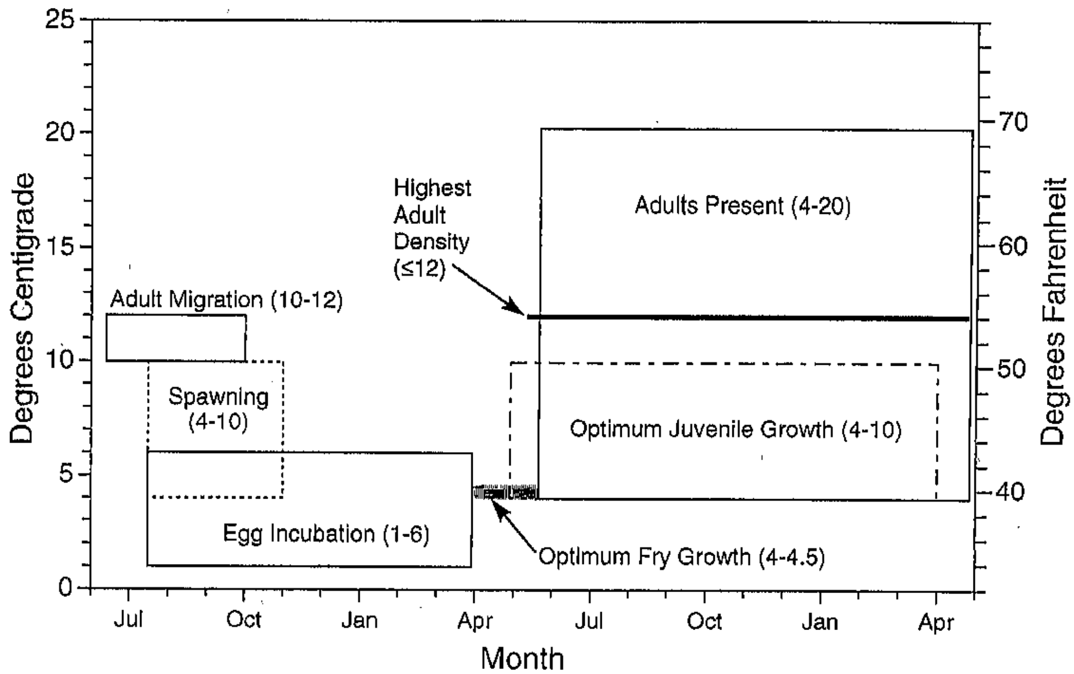


Figure 1. Bull trout temperature requirements for each life history stage and time period, as reported in the general literature (from Buchanan and Gregory 1997).

Potential Limiting Factors

Genetic and Random Risks

There is no clear basis for understanding the minimum amount of genetic diversity needed to ensure the persistence of bull trout, Soulé (1987) proposed that a closed population needs an effective population size of 50 breeding individuals to prevent excessive rates of inbreeding, and that 500 total individuals are needed to maintain genetic variation, Nelson and Soulé (1987) further concluded that for fish populations, an isolated population needs an effective population of 500 breeding individuals and 5,000 total individuals. ODFW's Wild Fish Management Policy, effective June 1992 [OARs 635-07-525 to 529], states that "the Department shall oppose habitat degradation, harvest strategies or any actions that allow mortality from competition, predation, or disease that causes a population to experience a decline in abundance that, if continued, would likely reduce the number of spawners to 300 breeding fish. In addition, the Department shall advocate the restoration of degraded habitat or other actions that has depressed a population to a level of 300 or fewer spawners."

Rieman and McIntyre (1993) estimated for bull trout that the probability of extinction will increase if there are substantially less than 100 redds or 2,000 total individuals. They also stated that changes such as habitat changes that eliminate or isolate segments of populations may increase the population's susceptibility to random processes such as natural death rates, sex ratios, or chronic or catastrophic environmental events because the number of individuals will be smaller and the population less diverse in structure or distribution. The loss of genetic diversity could reduce fitness and increase sensitivity to environmental variation. This agrees with the observations of Leary et al. (1993) and Spruell and Allendorf (1997) who indicate that persistence of many bull trout populations from throughout their range is necessary for the conservation of their genetic diversity.

The loss or isolation of local populations will increase the risk of extinction for most species. The presence of several subpopulations in a local area increases the probability that at least one will survive periods of risk or disturbance (Rieman and McIntyre 1993). In Levin's (1969) model, metapopulations are composed of geographically isolated genetic populations, Harrison (1993) notes that metapopulations can be seen as a collection of local populations in a fragile balance between extinction and refounding through dispersal. Li et al. (1995) stated that species persist because recolonization follows periodic extirpation of local populations, Therefore, each population of the metapopulation model may be evolutionarily significant because persistence may depend on any or all populations of the species. Li et al, (1995) also noted that for some aquatic species, a core-and-satellite pattern is possible. If local populations of core-and-satellite groups are suspected, then greater emphasis should be placed on protecting the core populations,

Overharvest

Throughout history, human overharvest of animals has been a factor in extirpation. For example, the passenger pigeon that once nested in great numbers in North American hardwood forests was harvested to extinction around 1914. Ratliff and Howell (199.2) noted that bull trout are aggressive by nature and readily take lures or bait, making them very susceptible to angling pressures. Bull trout up to 9 kg have historically provided a wide range of recreational angling opportunities throughout Oregon. However, recent protective management strategies by ODFW have included severe statewide angling restrictions **(see Management Changes,** p. 21).

The best Oregon example of overharvest as a potential limiting factor for bull trout is the Metolius River Basin. Most bull trout in the Metolius River system spawn in cold, relatively small tributaries that may increase their susceptibility to overharvest and poaching. Prior to 1980, the bull trout bag limit in the Metolius River system was 10 fish per day (Ratliff et al. 1996). However, fishery managers have enacted several protective angling regulations changes since 1980. All wild trout including bull trout have had to be released in the Metolius River since 1983, all Metolius River tributaries have been closed to angling during bull trout spawning periods since 1988, and the bull trout bag limit has been reduced in Lake Billy Chinook. These protective changes appear to have been very effective as spawning trends have increased over tenfold from 27 redds in 1986 to 330 redds in 1994 (Ratliff 1992, Ratliff et al. 1996).

Passage Barriers

Passage barriers or the elimination of migration corridors by dams can be a major limiting factor for some populations of bull trout. The location of a barrier relative to the spawning and juvenile rearing habitat may be important. For example, a small dam with no upstream passage immediately downstream of a spawning area may have a relatively higher impact in a system than a dam with a fish ladder located much lower in a system (Ratliff and Howell 1992).

Barriers can isolate bull trout populations and prevent genetic exchange. Migratory bull trout historically occurred in the Columbia River and its tributaries (Bond 1992). Donaldson and Cramer (1971) reported early fish wheels on the lower Columbia River near McCord Creek catching bull trout. Bull trout movement and migration were probably altered on the mainstem Columbia River after the construction of Bonneville Dam in 193 8 and on the lower Snake River after the construction of Brownlee Dam in 1958.

Non-native Salmonid Species

Bull trout have naturally coexisted and coevolved with rainbow trout, cutthroat trout, chinook and sockeye salmon, and many other native, aquatic species. However, the introduction of non-native salmonids to native bull trout habitat can be a limiting factor for some populations. Donald, and Alger (1992) documented that introduced lake trout can displace and eliminate native bull trout. Introductions of lake trout into Crescent and Ode11 lakes may explain why bull trout are extirpated in Crescent Lake and have a high risk of extinction in Ode11 Lake. Recent protective angling regulations for bull trout, while encouraging lake trout harvest, may help reduce the threat of extinction in Ode11 Lake. Moyle (1976) and Bond (1992) also suggested that introduced brown trout bave been associated with the decline of bull trout populations. Brown trout outcompeting bull trout may be a contributing reason for reduced bull trout distribution in the lower parts of Brownsworth and Leonard creeks in the Klamath Basin in 1995 (Jeff Dambacher, ODFW, unpublished data, September 1995).

Markle (1992) studied bull trout, brook trout, and resulting bull trout/brook trout hybrids in Oregon and found that some small populations of bull trout are seriously threatened by the presence of introduced brook trout. The encroachment of brook trout into bull trout waters is a serious threat in the Klamath Basin (Dambacher et al. 1992, Ziller 1992), in the Malheur River Basin (Buckman et al. 1992), and in other bull trout waters mentioned in this report, Brook trout were reported by Ratliff and Howell (1992) to be present in 3 1 of the 65 populations they listed in Oregon, while brook trout were found in 35 of 69 populations for this report

Leary et al. (1991.) believed that brook trout have a reproductive advantage over bull trout because they mature earlier. Moyle (1976) documented that male brook trout may spawn at the end of their first summer of life, while female brook trout can mature by the end of their second summer. It was more common for male brook trout to mature at their second or third year and female brook trout to mature in their third or fourth year. First spawning for resident bull trout occurred at Age 5+ to Age 6+ and first spawning for migratory bull trout was as late as 9 years in the Methow River system (Williams and Mullan 1992). Leary et al. (1993) stated that spawning begins at Age 5 or Age 6 for migratory bull trout. In the Metolius River system in Oregon, Pratt (199 1) found most adult bull trout with spawning checks had spawned for the first time at Age 5, although a few fish spawned as 4 year olds.

Habitat changes such as an increasing summer water temperatures may exacerbate the adverse effects of non-native species on bull trout (Rieman and McIntyre 1993). For example, Dambacher et al. (1992) found that bull trout and brobk trdut utilized similar habitat units and microhabitats in Sun Creek, but that bull trout were restricted to areas that contained heavy influxes of cold groundwater. USFS biologists studying adjacent tributaries of the Metolius River with no barriers or obstructions found that bull trout favored the colder waters (5 to 10°C), while brook trout favored the warmer waters (10 to 14°C) (M. Riehle, USFS, personal communication, June 1995). We hypothesize that additive factors such as increased temperature and toss of large, fluvial bull trout may contribute to or result in non-native brook trout domination over native bull trout populations.

Habitat Loss and Degradation

Bull trout were more widely distributed historically than currently, but it is unclear as to the effect of overall habitat degradation on their distribution, The prior section on habitat needs suggests that bull trout require high quality habitat to survive. Dambacher and Jones (1997) found juvenile bull trout only in areas of quality habitat characterized by high amounts of shade, undercut banks, large woody debris, gravel in riffles, and low levels of fine sediment and bank erosion. Weaver and Fraley (1991) found that any increase in fine sediment reduced survival of bull trout. Light et al. (1996) reported that major impacts on fish habitat in the larger tributaries and mainstem rivers of the Klamath Basin have occurred. Channelization, water withdrawals, removal of streamside vegetation, and other disturbances have altered the aquatic environment of the Klamath Basin by elevating water temperatures, reducing water quantity and quality, and increasing sedimentation. An example of the impacts of an elevated temperature can be found in the maximum 1994 summer temperatures measured in uppei Deining Creek (tributary of the Sprague River). Where bull trout were present, it was 17.4°C (63°F), while in a degraded section of lower Deming Creek, located only a few kilometers downstream, the maximum temperature increased to 29.3 °C (85 “F) and bull trout were not present (Buchanan et al. 1994).

Climatic Changes

Natural cyclic droughts and heat waves can adversely limit bull trout production. These stochastic events can be devastating to small, fragmented bull trout populations. Climatologists generally define “normal” as a 30-year arithmetic mean for a given parameter such as precipitation. Annual precipitation has been recorded for nearly 100 years at many of Oregon’s cities (Figure 2) (G. Taylor, Oregon Climate Service, unpublished data, 1996). The documented drought from 1985-1994 created a cumulative deficit of precipitation throughout Oregon, but this deficit was not necessarily uniform within each region. Recording stations at Corvallis and La Grande show a reduced cumulative precipitation Compared to Klamath Falls (Figure 3). Environmental catastrophic events such as an extended drought will continue to limit bull trout populations already pressured by other limiting factors.

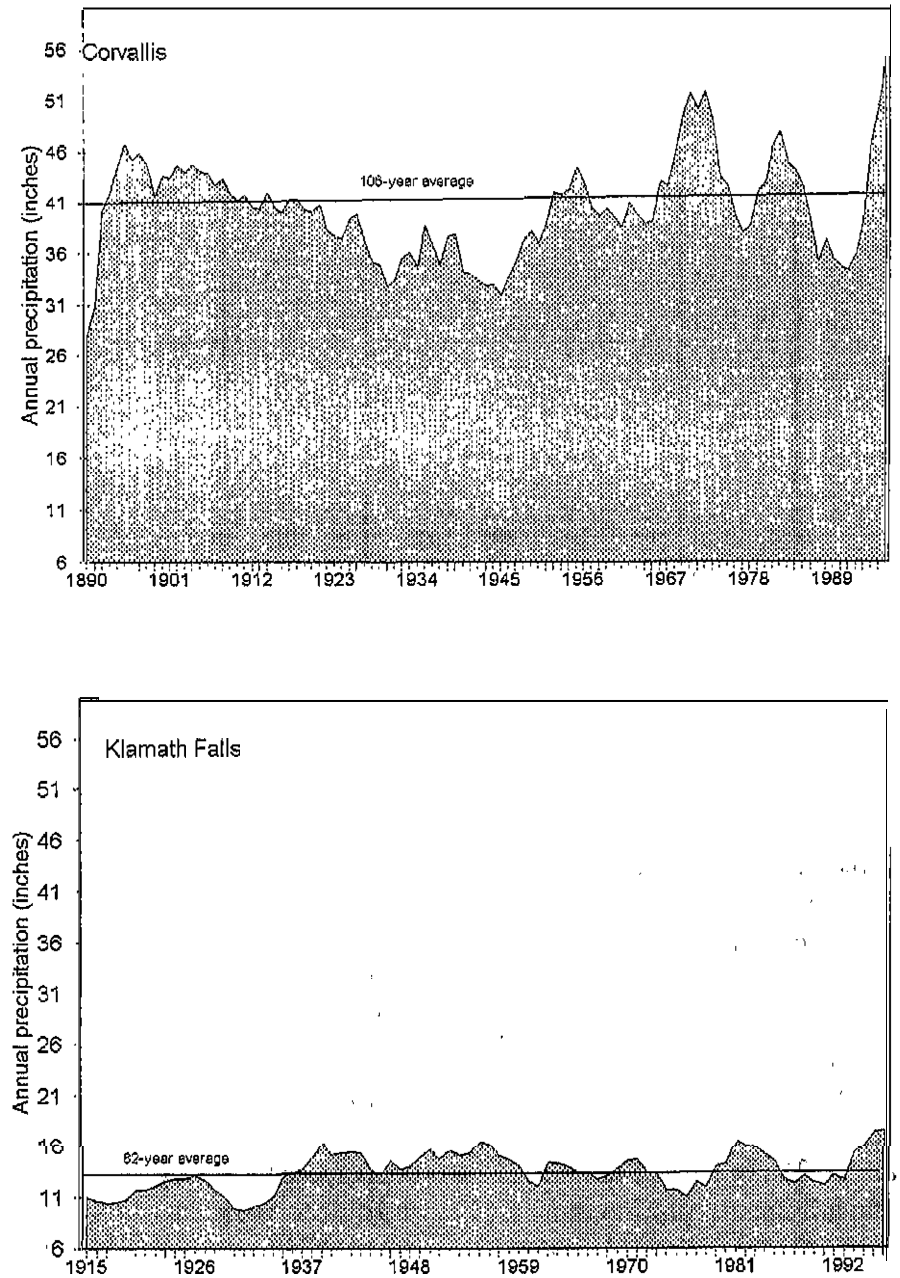


Figure 2. Long term annual precipitation records (5-year smoothing), for Corvallis (1890 - 1986) and Klamath Falls (1915 - 1996), Oregon (George Taylor, Oregon Climate Service, OSU, Corvallis, unpublished data).

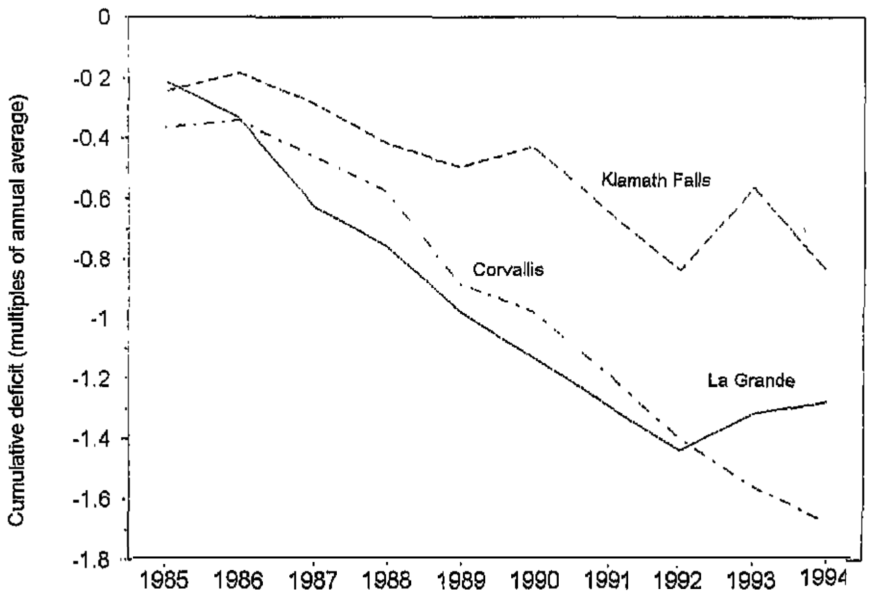


Figure 3. Cumulative precipitation deficit, Corvallis, La Grande and Klamath Falls, 1985-94 (George Taylor, Oregon Climate Service, OSU, Corvallis, Unpublished data).

Recent concerns over global warming underscore the threats to bull trout survival especially near the margins of their historical range. Most global climate models predict air temperature increases of 1 °C to 5°C for North America over the next century (National Research Council (NRC) 1987; Schneider et al. 1990, Wigley and Raper 1990, Neitzel et al. 1991, Bella et al. 1992, Schneider et al. 1992). In December 1995, the Intergovernmental Panel on Climate Change, sponsored by the United Nations, forecasted a rise of 1 °C to 3.5 °C by 2100 (Newsweek, January 22, 1996). Rieman and McIntyre (1993) reported several models of climate change that concluded mean air temperatures in the Pacific Northwest may increase by 2°C to 3 °C in the next 50 to 100 years. Such warming would likely reduce the range and/or cause extinctions of some current bull trout populations.

Ecosystem Change

Ecosystems supporting bull trout are the product of the geologic history of the basin, the erosional history of the watershed and its surrounding land forms, the evolutionary history of the biotic community, and the cultural history of human economics that exploited and altered the ecosystem (Lichatowich et al. 1995). Large-scale anthropogenic change on landscapes may be difficult to visualize or document as to its direct effect on present bull trout populations, but these changes throughout the entire ecosystem may render complete basinwide protection and recovery efforts impossible. Populations of bull trout have adapted to local habitats and environmental conditions. Restoring the productive capacity of the basin or ecosystem requires an understanding of the historical nature of the stream habitats to which the native bull trout populations have adapted over a wide time span (Sedell and Luchessa 1981, Lichatowich et al. 1995).

The cultural history of anthropogenic changes in Oregon's river basins containing bull trout has been documented by a variety of workers (Oregon's Meat Animals and Wool 1947, Oregon Historical Society 1963, Wilkinson 1992, Henjum et al. 1994, McIntosh et al. 1994, Wissmar et al. 1994). Shortly before his violent death in 1847, Marcus Whitman reported that "The interior of Oregon is unrivaled probably by any country for grazing of stock of which sheep are the best." Sheepman took his words to heart and by 1900 Pendleton was the chief primary wool market in the United States (Oregon Historical Society 1963). Oregon produced an average of 2.0-2.5 million sheep from 1890 to 1937, but production dropped to less than 1 million by 1946. Only 164,000 sheep are currently grazing Oregon's rangelands (R. Williams, USFS, letter, June 1997). The average number of cattle produced in Oregon ranged from 600,000 in the 1890s to approximately 850,000 in the 1930s (Oregon's Meat Animals and Wool 1947). The number of cattle grazing on Oregon's open rangeland has been maintained since the 1940s (317,000 in 1940 and 390,000 in 1995) (R. Williams, USFS, letter, June 1997). These early high numbers of livestock grazers were clearly not sustainable in Oregon. For example, 97% of the Malheur National Forest is open to livestock grazing, but the current Malheur Forest plan notes that unsatisfactory habitat conditions for fish occur on all 104 grazing allotments within the forest, particularly in eight riparian zones (Henjum et al. 1994). The practice of season-long grazing used in the 1940s has changed to rest/rotation and other systems. The USFS is presently working with permittees to improve range and riparian conditions, but the restoration of ecological function and healthy systems has been admittedly slow (R. Williams, USFS, letter, June 1997). Unsatisfactory rangeland conditions are not unique to Oregon, but a general condition of the West. The 1973 Bureau of Land Management (BLM) Budget Justification estimated that only 16% of the BLM-managed grazing land was in good or excellent condition while 84% was in fair, poor, or bad condition (Wilkinson 1992).

Although small scale logging and sawmills were first established in Oregon during the mid-1800s, logging did not begin significantly altering watersheds containing Oregon's bull trout until the 1940s. A 1936 survey of forestry resources in Oregon and Washington east of the, Cascade Mountains found that original old growth of all forest types made up 89% of sawlog-sized stands or 73% of all commercial forestlands (Henjum et al. 1994). Wilkinson (1992) reports that 80% of all logging in national forests has occurred in the past 25 years, and that clearcutting replaced selective cutting as a management tool in many of the national forests. The annual cut from all national forests jumped from the historical average of 1 billion board feet (bbf) to 3.3 bbf in 1944 and gradually increased to 4.4 bbf in 1954. Then timber production jumped to 12.1 bbf in 1966 and remained relatively steady at 10- 11 bbf through the 1970s and 1980s (Wilkinson 1992). McIntosh et al. (1994) showed that increased timber production in 1979 created sharp increases in logging road construction in the Wallowa-Whitman National Forest (Figure 4).

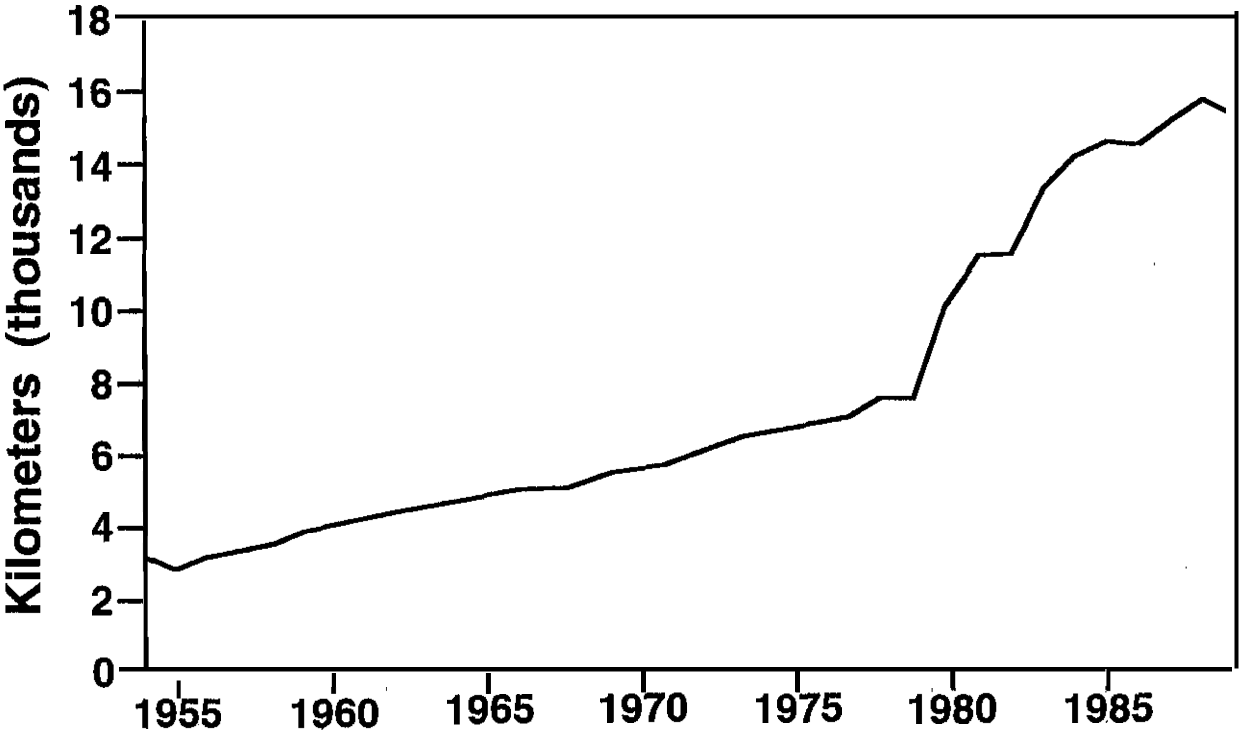


Figure 4. Road mileage (in KM) on the Wallowa-Whitman National Forest, 1954 to 1990 (from McIntosh et al. 1994).

Major hydrological changes have occurred in many basins containing bull trout due to the construction of Columbia River and tributary dams for hydroelectric power, water storage, or diversions for agricultural purposes. The Malheur, Powder, Pine Creek, and Klamath basins are all basins with depressed resident populations of bull trout. In addition to the loss of migration corridors, these basins have lost all native salmon and steelhead production due to impassable barrier dams in the Columbia, Snake, or Klamath rivers. Loss or significant reduction of salmon and steelhead as prey species for bull trout could effect growth and reproductive potential for surviving bull trout populations, especially when alternate prey species aren't readily available. Linkage to the Columbia or Snake rivers may have been important to the life history of many bull trout populations. A remnant population of fluvial bull trout using the Columbia River still remains in the Hood River system.

Anthropogenic changes such as mining, chemical poisoning projects, and non-point pollution and sedimentation have altered Oregon's watersheds and rendered large aquatic areas unsuitable for bull trout.

OVERVIEW OF STATEWIDE STATUS

Historical Distribution

Bull trout are endemic to western North America. The distribution of bull trout extends from about 41 °N latitude to about 60°N latitude--from the McCloud River, where bull trout are recently extinct, to the headwaters of the Yukon River (Bond 1992). In Oregon, limited historical references indicate that bull trout were once widely spread throughout 12 basins in the Klamath and Columbia River systems (Figure 5). Cavender (1978) and others suggested that bull trout originated in the Columbia River system and extended and constricted its range according to climatic changes. Range extensions occurred mainly through headwater transfers, crossovers, and captures (McPhail and Lindsey 1970, Behnke 1992, Bond 1992). Known historical and current distribution documented in Oregon's early records will be discussed for each basin.

Current Status

Ratliff and Howell (1992) first reviewed the status of bull trout populations for Oregon in 1991. The populations they reviewed were considered to be reproductively isolated primarily on the basis of geographic separation of spawning and juvenile rearing areas. They rated populations in one of five status categories ranging from "low risk of extinction" to "probably extinct." Their status categories were similar to those used by Nehlsen et al. (1991) for Pacific salmonid stocks. The status of each bull trout population was subjectively determined on the basis of relative abundance; the severity of factors suppressing the population, such as habitat conditions and the presence of non-native brook trout; and the potential of the population to recover to a healthy condition. The status review of Ratliff and Howell (1992) was developed in consultation with local biologists in each basin.

This 1996 status review of bull trout populations in Oregon was first presented at the annual Oregon Chapter meeting of the American Fisheries Society by D. Ratliff, P. Howell, and D. Buchanan in February 1995, and was updated throughout 1995 and 1996 as additional data were available. This review was developed with information and consultation from a broad base of local and regional fishery biologists from ODFW; USFS; USFWS; the Warm Springs, Umatilla, and Klamath tribes; Portland General Electric (PGE); PacifiCorp; Weyerhaeuser; U.S. Timberlands, Inc.; BLM; and the National Park Service (NPS). ODFW's Habitat Inventory Study, Native Trout Study, and the various ODFW and USFS district biologists also have gathered much new survey and distribution data on bull trout since 1991, For consistency, we used the same five status categories of Ratliff and Howell (1992) as was suggested for anadromous salmonids in Nehlsen et al 1991 (Table 1). The status of each population was subjectively determined on the same basis as Ratliff and Howell (1992), except that the severity of factors suppressing the population such as the presence of brook trout was changed to include non-native lake, brown, and brook trout and the probably extinct category was revised after extensive biological surveys to include sightings of a single bull trout or a single bull/brook hybrid. We also added life history stage and population distribution as additional criteria suggested by Rieman and McIntyre (1993).

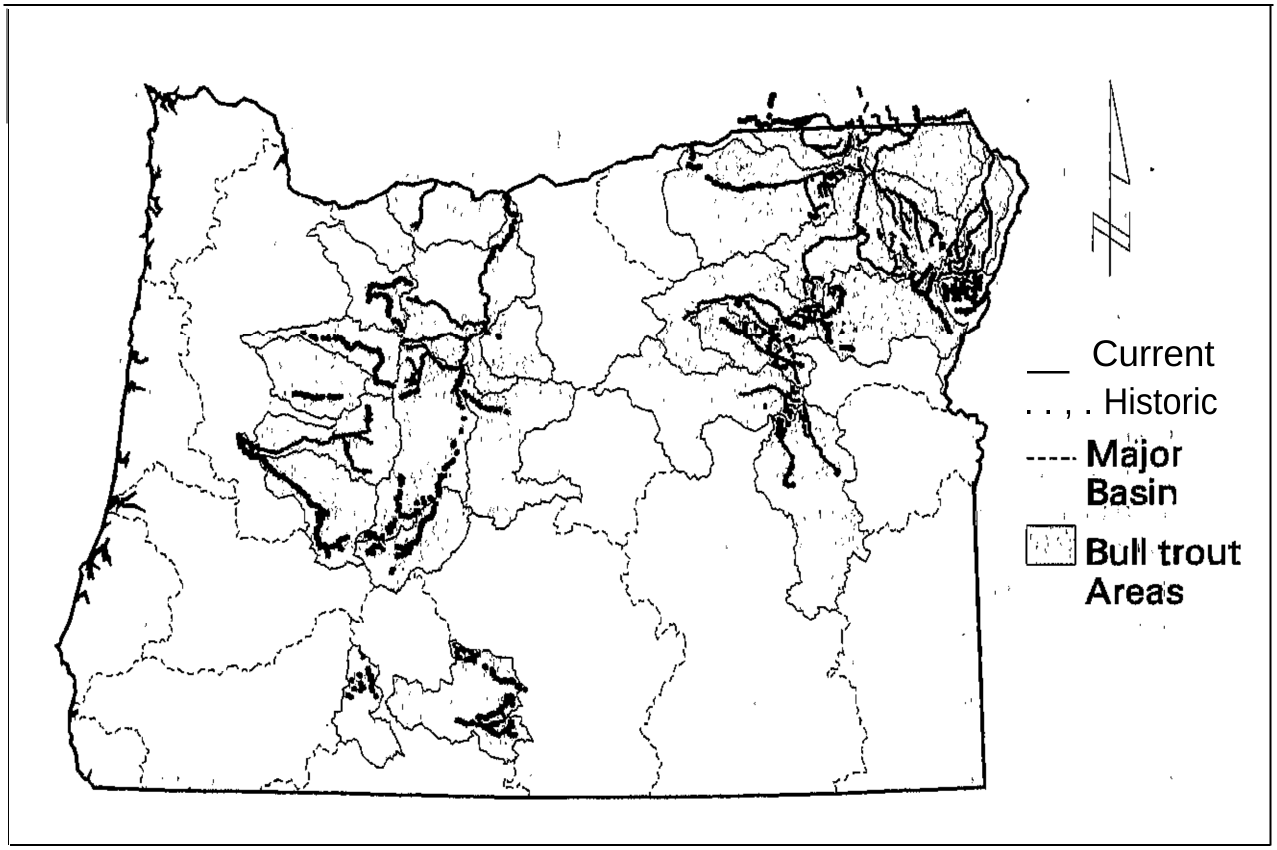


Figure 5. Current and historic distribution of bull trout in Oregon

A total of 69 bull trout populations in 12 basins are identified in Table 2. This includes seven newly discovered populations that contained juvenile or resident adult bull trout. Ratliff and Howell (1992) listed bull trout, that were probably extinct from Carmen Reservoir in the McKenzie River subbasin, the West Fork Hood River, and the Burnt River Basin. Since no clear historical reference or documentation has been found for these populations, they are omitted as historical populations from this status report

A comparison of the 1991 bull trout status to the revised 1996 status found that seven populations were newly discovered (Table 2). Six of the seven new pobulations were listed as "high risk of extinction~and one population was listed as "of special concern," One population showed a positive or upgraded status (Anderson Creek/ mainstem McKenzie River). In 1991, 34% of Oregon's bull trout populations were placed in the two lowest risk categories ("low risk of extinction" and "of special concern"). This 1996 status review listed only 19% of the bull trout populations in the,two lowest risk categories; therefor& 81% of Oregon's bull trout are considered to have at least a" "moderate risk" of extinction (Figure 6).

Table 1. Status criteria for bull trout (modified from Ratliff and Howell 1992).

Category	Life history stage[a]	Abundance	Distribution	Habitat	Non-native trout[c]	Recovery potential
Low risk of extinction	Large size	High	Dispersed	Excellent	None	--
Of special concern	↕	↕	↕	↕	↕	↕
Moderate risk of extinction						
High risk of extinction	Small size	Very low	Isolated and fragmented	Poor	High	Major effort required
Probably extinct		No reports since 1990[d]				

[a] Large fish size assumes migratory fluvial or adfluvial bull trout while small fish size assumes resident bull trout
[b] Present and projected
[c] Non-native trout includes lake, brown, and brook trout.
[d] Includes sightings of a single bull trout or bull/brook hybrid.

The general downgrading of 22 Oregon bull trout populations since 1991 appears largely due to increased survey efforts and survey accuracy rather than from a further declining trend in abundance or distribution when compared over a short 5-year period. For example, Shitike Creek, tributary of the Deschutes River, was listed as a "low risk of extinction" status in 1991. This status has been downgraded because recent biological surveys found previously unrecorded brook trout and logging activities in parts of the Shitike Creek watershed (A. Hemmingsen and B. Lampman, ODFW and Confederated Tribes of the Warm Springs Reservation (CTWSR), respectively, personal communication, Corvallis, August 1995).

Three bull trout populations in the upper Klamath Basin showed actual decreases in estimated population number or distribution. Brook trout invaded the upper 2.8 km of Long Creek that was thought to be a sanctuary for allopatric bull trout. Population estimates of bull trout in this area showed a 50% reduction in estimated population number (J. Dambacher, ODFW, unpublished data, Corvallis, 1995). Detailed bull trout distribution surveys in 1995 in Brownsworth and Leonard creeks reported a net loss of one-third of their total summer distribution (J. Dambacher, unpublished data, ODFW, Corvallis, 1995). Two additional bull trout populations in the Walla Walla Basin (Mill Creek and North Fork Walla Walla River)

Table 2. Population status of bull trout in Oregon river basins (updated from Ratliff and Howell 1992; first revised 4/95 through:9/95 by P. Howell, D. Ratliff, and D. Buchanan, unpublished data, then revised through 12/96 by this report).

Basin	Subbasiiopulation	1991 status	1996 status	Status Change
KlanthRiver	Sprague R.			
	Boulder and Dixon Crs.	High Risk	High Risk	None
	Deming Cr.	Moderate Risk	Moderate Risk	None
	Brownsworth Cr.	Moderate Risk	High Risk	
	Leonard Cr.	Moderate Risk	High Risk	-[a]
	Sycan R.			
	Long Cr.	Moderate Risk	High Risk	-[a]
	Coyote Cr.	High Risk	Probably Extinct[b]	-[a]
	Upper Sycan R	Probably Extinct	Probably Extinct	None
	Upper Klamath Lake			
	Sevenmile Cr.	Probably Extinct	Probably Extinct	None
	Threemile Cr.		High Risk	New pop. (+)
	Cherry Cr.	High Risk	Probably Extinct	-[a]
	Sun Cr.	High Risk	High Risk	None
Willamette River	M.F. Willamette River	High Risk	Probably Extinct	-[a]
	McKenzie River			
	S.F. McKenzie R.	Moderate Risk	High Risk	-[a]
	Anderson Cr./mainstem McKenzie R	Moderate Risk	Of Special Concern	+[a]
	Trailbridge Reservoir	High Risk	High Risk	None
	Santiam R.			
	North Santiam R.	Probably Extinct	Probably Extinct	None
	South Santiam R.	Probably Extinct	Probably Extinct	None
	Clackamas R.	Probably Extinct	Probably Extinct	None
Hood River	Middle Fork Hood R.			
	Clear Branch	High Risk	High Risk	None
	Compass Cr.	--	High Risk	New pop (+)
	Odell Lake	High Risk	High Risk	None

Table 2. Continued.

Basin	Subbasin/Population	1991 status	1996 status	Status Change
Deschutes River	Upper Deschutes R.	Probably Extinct	Probably Extinct	None
	Crescent Lake	Probably Extinct	Probably Extinct	None
	Metolius R.	Low Risk	Low Risk	None
	Shitike Cr.	Low Risk	Moderate Risk	-[a]
	Warm Springs R.	Moderate Risk	Moderate Risk	None
John Day River	Upper John Day River	Moderate Risk	Moderate Risk	None
	Middle Fork			
	Upper Middle Fork	Probably Extinct	Probably Extinct	None
	Granite Boulder Cr.	High Risk	High Risk	None
	Big Cr.	High Risk	High Risk	None
	Clear Cr.	--	High Risk	New pop. (+)
	North Fork	Of Special Concern	Moderate Risk	-[a]
Umatilla River	North Fork Umatilla R.	Low Risk	Of Special Concern	-[a]
	South Fork Umatilla R.	Of Special Concern	High Risk	-[a]
	Meacham Cr.	--	High Risk	New pop. (+)
Walla Walla River	North Fork Walla Walla R.	Of Special Concern	High Risk	-[a]
	South Fork Walla Walla R.	Low Risk	Low Risk	None
	Mill Cr.	Low Risk	Of Special Concern	-[a]
Grande Ronde River	Upper Grande Ronde R.			
	Clear Cr.	Moderate Risk	Moderate Risk	None
	Limberjim	Moderate Risk	Moderate Risk	None
	Indiana cr.	Moderate Risk	Moderate Risk	None
	Catherine cr.	Of Special Concern	Moderate Risk	-[a]
	Indian cr.	Moderate Risk	Moderate Risk	None
	Lookingglass Cr.	Of Special Concern	Moderate Risk	-[a]
	Minam R.	Low Risk	Low Risk	None
	Little Minam R.	Low Risk	Low Risk	None
	Wallowa R.			
	Lostine R.	Moderate Risk	Moderate Risk	None

Table 2. Continued.

Basin	Subbasin/Population	1991 status	1996 status	Status Change
Grande Ronde River (cont)	Deer Cr.	--	Of Special Concern	New pop (+)
	Bear Cr.	Of Special Concern	Of Special Concern	None
	Hurricane Cr,	Of Special Concern	Moderate Risk	-[a]
	Wallowa Lake	Probably Extinct	Probably Extinct	None
	Wenaha R.	Low Risk	Low Risk	None
Imnaha River	Imnaha R.	Low Risk	Of Special Concern	None
	Big Sheep Cr.	Of Special Concern	High Risk	None
	Little Sheep Cr.	Of Special Concern	Moderate Risk	-[a]
	McCully Cr.	Of Special Concern		-[a]
Pine Cr.	North Pine Cr.			
	Elk Cr.	Moderate Risk	Moderate Risk	None
	East Pine Cr.	Of Special Concern	Moderate Risk	-[a]
	Meadow Cr.	Moderate Risk	Moderate Risk	None
	Upper Pine Cr.	Of Special Concern	Moderate Risk	-[a]
Powder River	Upper Powder R.			
	Silver Cr.	Moderate Risk	Moderate Risk	None
	Little Cracker Cr	Moderate Risk	Moderate Risk	None
	Lake Cr.	Moderate Risk	Moderate Risk	None
	Big Muddy Cr.	--	High Risk	New pop.(+)
	North Powder R.	--	High Risk	New pop.(+)
	Indian and Anthony Cr.	Moderate Risk	High Risk	-[a]
	Eagle Cr.	High Risk	Probably Extinct	-[a]
Malheur R.	North Fork Malheur R.	Of Special Concern	Of Special Concern	None
	Middle Fork Malheur R.	High Risk	High Risk	None

[a] *This status change is due to additional monitoring and/or field surveys of bull trout distribution or abundance.*
[b] *This category refers to basins with historic populations, but may include those where, after extensive biological surveys, sightings of a single bull trout or a single hybrid have occurred.*

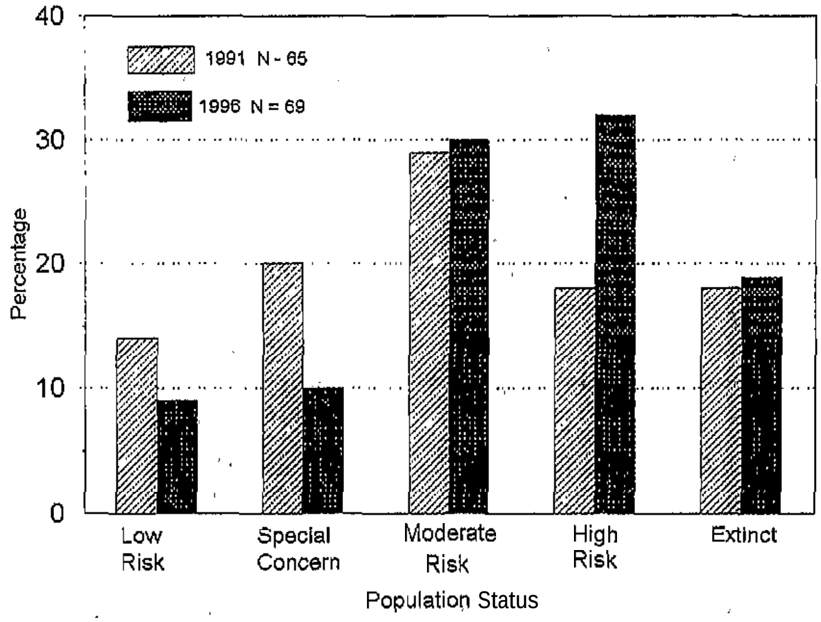


Figure 6. Oregon's 1991 bull trout status (from Ratliff and Howell 1992) compared to the 1996 bull trout status.

were downgraded when they showed major decreases in redd counts for the last three years. One additional bull trout population in the Willamette Basin (South Fork of the McKenzie River) was downgraded when only 1,2, and 0 redds were recorded in 1994, 1995, and 1996, respectively.

Management Changes

Approximately 55% of current bull trout distribution occurs on lands managed by the USFS. A much smaller proportion occurs on BLM managed lands (2%) and on NPS lands (0.2%). The remaining bull trout distribution occurs on private, state, or tribal lands. Recent policies instituted on federal lands, e.g., The Northwest Forest Plan, Inland Native Fish Strategy (INFISH), and Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH) have provided increased protection for bull trout habitat depending on their scope and geographic areas,affected and the extent to which they are being effectively implemented in watersheds containing bull trout. Recent reductions in timber production up to 50% in western Oregon National Forests and over 30% in eastern Oregon National Forests should help improve riparian and stream habitat conditions for bull trout (R. Williams, USFS, letter, June 1997).

Only 16% of current bull trout distribution occurs within a protected area defined as Wilderness, Wild and Scenic River, or within Crater Lake National Park. Wild and Scenic River designated river segments are federally managed based on the three levels of designations: "Scenic" (free of impoundments, with shorelines or watersheds still largely primitive and shorelines largelv undeveloped, but accessible in places by . roads), "Recreation" (readily accessible by road or railroad that may have undergone some development along their shorelines, and that may have undergone some impoundment or diversion in the past), and "Wild" (free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted).

Less stringent protective standards apply to private lands where bull trout occur. Recent amendments the Oregon Forest Practices Act may benefit bull trout on private forest lands.

Oregon fishery managers for many years actively managed against bull trout. Bull trout were intentionally trapped from Wallowa Lake during the 1930s and 1940s (Ratliff and Howell 1992) and at many hatchery-operated facilities. From 1940 to 1970, a number of Oregon streams were chemically poisoned with rotenone to remove fish thought to compete with or prey on salmon or rainbow trout including bull trout and other native species. Construction of many dams in the 1950s and 1960s was followed with extensive rotenone poisoning projects to control "rough fish" infestations in the new reservoirs, There was little concern in these early times for bull trout, which were mainly considered to be just predators of trout and salmon (Ratliff and Howell 1992). Through the 1960s to the mid-1980s, bull trout were further ignored with liberal bag limits of 10 trout per day statewide, regardless of species.

Only a few protective angling regulations for Oregon's bull trout were in place in 1989. Sun Creek, tributary of the Wood River in the Klamath Basin, was closed to all take by the Crater Lake National Park. ODFW protected Metolius River bull trout by requiring the release of all wild trout in 1983. However, by 1996, restrictive angling regulations protected most bull trout populations throughout the state (Table 3). A comparison of approximately 39 angling regulation locations (some regulation locations protected more than one bull trout population) shows that all state managed areas were upgraded or at least maintained in a protective status in 1996 compared to 1989. For waters managed by ODFW, restrictive angling regulations prohibit angler harvest of all bull trout populations in Oregon except for one in the Deschutes Basin. Harvest on this population is restricted to one fish per day with a 610 mm (24 inch) minimum size limit. The CTWSR allows some harvest in Shitike Creek and Warm Springs River.

Statewide stocking of non-native brook trout, including the high lakes stocking program, has been discontinued in locations where ODFW managers believe they could migrate downstream and potentially interact with native bull trout. Beginning in 1997, there are no bag limits and no size limits on non-native brook trout in any Oregon stream where bull trout are present. Also, hatchery stocking of legal-sized rainbow trout for recreational fisheries has been discontinued by ODFW managers in most locationsnear bull trout populations to reduce the incidental catch of bull trout.

Table 3. Status of protective angling regulations by Oregon Department of Fish and Wildlife, Crater Lake National Park Service, and Warm Springs and Umatilla Tribes for bull trout populations in Oregon rivers basins.

Basin	Location	1989 status	1996 status	Protective status change
Klamath	Upper Sprague R.	5 trout per day	Bull trout take prohibited	+
	Upper Sycan R.	5 trout per day	Bull trout take prohibited	+
	Sun Cr.[a]	Closed to all take	Closed to all take	None[b]
	Three Mile Cr.	5 trout per day	Bull trout take prohibited	+
Willamette	M.F. Willamette River	5 trout per day	Bull trout take prohibited	+
	McKenzie R. & Tribs.	5 trout per day	Bull trout take prohibited	•
Hood	Clear Branch	5 trout per day	Closed to all angling	+
	Lawrence Lake	10 trout per day	Bull trout take prohibited throughout Hood R.	+
Deschutes	Odell Lake	10 trout per day	Bull trout take prohibited	+
	Metolius R.	All wild trout must be released	All wild trout must be released	None[b]
	Metolius R. tributaries	5 trout per day	Closed to all angling	+
	Lake Billy Chinook	5 trout per day	1 bull trout per day	+
	Deschutes R. From Lake Billy Chinook to Bend	2 trout per day	1 bull trout per day	+
	Warm Springs R.	5 trout per day	5 trout per day	None
	Shitike Cr.[c]	No non-tribal take	No non-tribal take	None[b]
John Day	Upper John Day	5 trout per day	Bull trout take prohibited	+
	M.F. John Day	5 trout per day	Bull trout take prohibited	+
	N.F. John Day	5 trout per day	Bull trout take prohibited	+
Umatilla	Upper Umatilla R.[d]	5 trout per day	Bull trout take prohibited	+
Walla Walla	N.F. Walla Walla R.	5 trout per day	Bull trout take prohibited	+
	S.F. Walla Walla R.	5 trout per day	Bull trout take prohibited	+
	Mill Cr.	5 trout per day	Bull trout take prohibited	+

Table 3. Continued

Basin	Location	1989 status	1996 status	Protective status change
Grande Ronde	Upper Grande R.	5 trout per day	Bull trout take prohibited	+
	Catherine Cr.	5 trout per day	Bull trout take prohibited	+
	Indian Cr.	5 trout per day	Bull trout take prohibited	+
	Lookingglass Cr.	5 trout per day	Bull trout take prohibited	+
	Minam R.	5 trout per day	Bull trout take prohibited	+
	Wallowa R.	5 trout per day	Bull trout take prohibited	+
	Wenaha R.	5 trout per day	Bull trout take prohibited	+
Imnaha	Upper Imnaha R.	5 trout per day	Bull trout take prohibited	+
	Sheep Cr.	5 trout per day	Bull trout take prohibited	+
	McCully Cr.	5 trout per day	Bull trout take prohibited	+
Pine	N.F. Pine Cr.	5 trout per day	Bull trout take prohibited	+
	E.F. Pine Cr.	5 trout per day	Bull trout take prohibited	+
	Upper Pine Cr.	5 trout per day	Bull trout take prohibited	+
Powder	Upper Powder R.	5 trout per day	Bull trout take prohibited	+
	N.F. Powder R.	5 trout per day	Bull trout take prohibited	+
Malheur	N.F. Malheur R.	5 trout per day	Bull trout take prohibited	+
	M.F. Malheur R.	5 trout per day	Bull trout take prohibited	+

[a]*Regulations controlled by Crater Lake National Park*
[b]*some protective regulations were already in effect.*
[c]*Regulations controlled by the CTWSR.*
[d] *Regulations controlled by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR).*

BASIN STATUS REPORTS

Introduction

ODFW began development of strategies in November 1992 to recover populations of bull trout throughout Oregon, This process included establishment of working groups within Oregon's major river basins containing bull trout. These working groups are composed of biologists and local experts from ODFW, USFS, USFWS, Tribes, utilities, BLM, landowners, commodity and recreational interests, and other interested parties who meet to share information on the status of bull trout and develop site specific conservation strategies. Strategies address limiting factors, goals and objectives for conservation, rationale, implementation, monitoring, and funding needs.

Bull trout working groups have been formed for most of the basins. Some groups, such as the Metolius-Lake Billy Chinook Working Group, have worked jointly since the mid-1980's, whereas in other basins bull trout working groups have begun more recently. The Klamath Basin Bull Trout Working Group recently completed work on a conservation strategy for bull trout populations in the Upper Klamath Basin. Work has begun on conservation strategies in the Hood, Deschutes, and upper Willamette basins with the help of a statewide bull trout coordinator hired in July 1995. In the river basins of northeastern Oregon, technical working groups, made up primarily of fishery professionals from state and federal agencies and the tribes, have been meeting to coordinate field work and share data on bull trout populations. Much of the population status information within this report was developed in cooperation with the various bull trout working groups.

Upper Klamath River Basin

Introduction

The following is a summary of existing information on bull trout in the Upper Klamath River Basin (hereafter called Klamath Basin). It updates and builds on the Klamath Basin Bull Trout Conservation Strategy report produced by.the Klamath Basin Working Group with principal authors J. Light, L. Herger, and M. Robinson (Light et al. 1996). This report also cites important information obtained from Howell and Buchanan (1992) and Buktenica (1997) and a draft report of ODFW's Klamath River Basin Fish Management Plan (Fortune and Smith 1996).

The Klamath River Basin is situated in southcentral Oregon, The Klamath, River begins in Upper Klamath.Lake at river kilometer (RK) 402 and flows south and west for 67 km to the state line and on through northern California to the Pacific Ocean. Major rivers that flow into Upper Klamath Lake and contribute their flow to the Klamath River include the Wood, Williamson, and Sprague rivers.

Elevations in the basin vary from 870 m in Klamath River canyon at the state line to 2,894 m on Mt. McLaughlin in the Cascades and 2,549 m on Gearhart Mt. at the eastern edge of the basin. Most of the drainage tributaries funnel through Upper Klamath Lake, elevation 1,262 m, before spilling into the Klamath River (Fortune and Smith 1996).

Since the late 1800s, land uses in the basin have been dominated by timber harvest, livestock grazing and irrigation farming (Fortune and Smith 1996). Ownership of lands in the Klamath Basin that support bull trout habitat mainly include USFS and private lands (was Weyerhaeuser, now U.S. Timberlands Inc.). The Klamath Tribes have ceded lands throughout the basin.

Historical Distribution

Resident and fluvial bull trout were probably found throughout much of the Oregon portion of the,Klamath Basin. Cope (1879) reported bulltrout in ,Sevenmile Creek which enters klamath Lake from the northwest. Gilbert (1897) referred to Cope later finding bull trout in the Williamson River. Chinook salmon and large rainbow trout also prevailed throughout the Klamath Basin, Historical evidence of fluvial bull trout is limited. A photo of a 2.7 kilogram (6 pound) bull trout caught in the Wood River in 1927 was found in,the historical files of the Klamath District ODFW office (R. Smith, ODFW, personal communication, October 1994). Also Dambacher et al. (1992) reported that a 380 mm bull trout was caught in the Wood River in 1938. A 1953 creel census on Long Creek, a tributary of the Sycan River, reported angler catch of several large bull trout up to 355 mm. Finally, there is a 330 mm mummified specimen in the Smithsonian Institute captured in 1876 from Fort Creek, tributary of the Wood River. Because of their size, these fish likely exhibited a fluvial life history. No adfluvial bull trout have been recorded from Upper Klamath or Agency lakes.

Current Distribution

Extensive distribution surveys of bull trout were conducted in the Klamath Basin from 1989 to 1991 (Dambacher et al. 1992.

Ratliff and Howell 1992, Ziller 1992). Of the 10 Klamath Basin populations listed by Ratliff and Howell (1992), 60% were rated as being at a "high risk of extinction" or as being already extinct. The Oregon Chapter of AFS (OCAFS), in its ESA petition and review of the Klamath Basin bull trout status in 1993, reported that almost 40% of the known populations had gone extinct in the last 30 years. USFS personnel found a new bull trout population in Threemile Creek in 1992; however, only 1.6 km of Threemile Creek contained bull trout. Because of large numbers of brook trout and habitat degradation, Threemile Creek was classified by the OCAFS petition as having a "high risk" of extinction. Of the 11 populations listed by OCAFS in 1993, 7 (64%) were rated as being at a "high risk" of extinction or as being already extinct. Their data further reported that fewer than 5,000 fish remained among 7 fragmented populations. The Klamath Basin Working Group conducted detailed bull trout distribution studies throughout the basin in 1993 to 1995. These distributions were reported and mapped by Light et al. (1996).

This status report lists only 7 fragmented populations of small, resident bull trout residing in a total of 34.1 km (21 miles) in the Klamath Basin (Table 4). Figures 7 and 8 show bull trout distribution in the Klamath Lake and Sprague River subbasins, respectively. Of this total, only 15.7 km (less than 10 miles) of stream distribution contained native bull trout without non-native brook and brown trout competition (Table 4).

Table 4. Current summer distribution of bull trout and non-native brown or brook trout in the Klamath Basin.

Stream	Kilometers of bull trout only	Kilometers of bull and brook trout	Kilometers of bull and brown trout	Total kilometers
Sun Creek	0.0	6.2	0.0	6.2
Threemile Creek	1.1	0.3	0.0	1.4
Long Creek	1.3[a]	3.7	0.0	5.0
Boulder/Dixon Creek	1.6	0.0	7.4	9.0
Deming Creek	6.4	0.0	0.0	6.4
Leonard Creek	2.2	0.0	0.5[b]	2.1
Brownsworth Creek	3.1	0.0	0.3[c]	3.4
Totals	15.7	10.2	8.2	34.1

[a] *There were 2.8 km of pure bull trout in Long Creek in 1991. An invasion of brook trout recorded in 1994 reduced this distance to only 1.3 km.*

[b] *There were 1.9 km of bull trout plus brown trout distribution estimated in Leonard Creek in 1994; however, this distribution was reduced to OS km in the summer of 1995 because only brown trout were found in the lower 1.4 km.*

[c] *There were 2.3 km of bull trout plus brown trout distribution estimated in Brownsworth Creek in 1994: however, this distribution was reduced to 0.3 km in the summer of 1995 because only brown trout were found in the lower 2.0 km.*

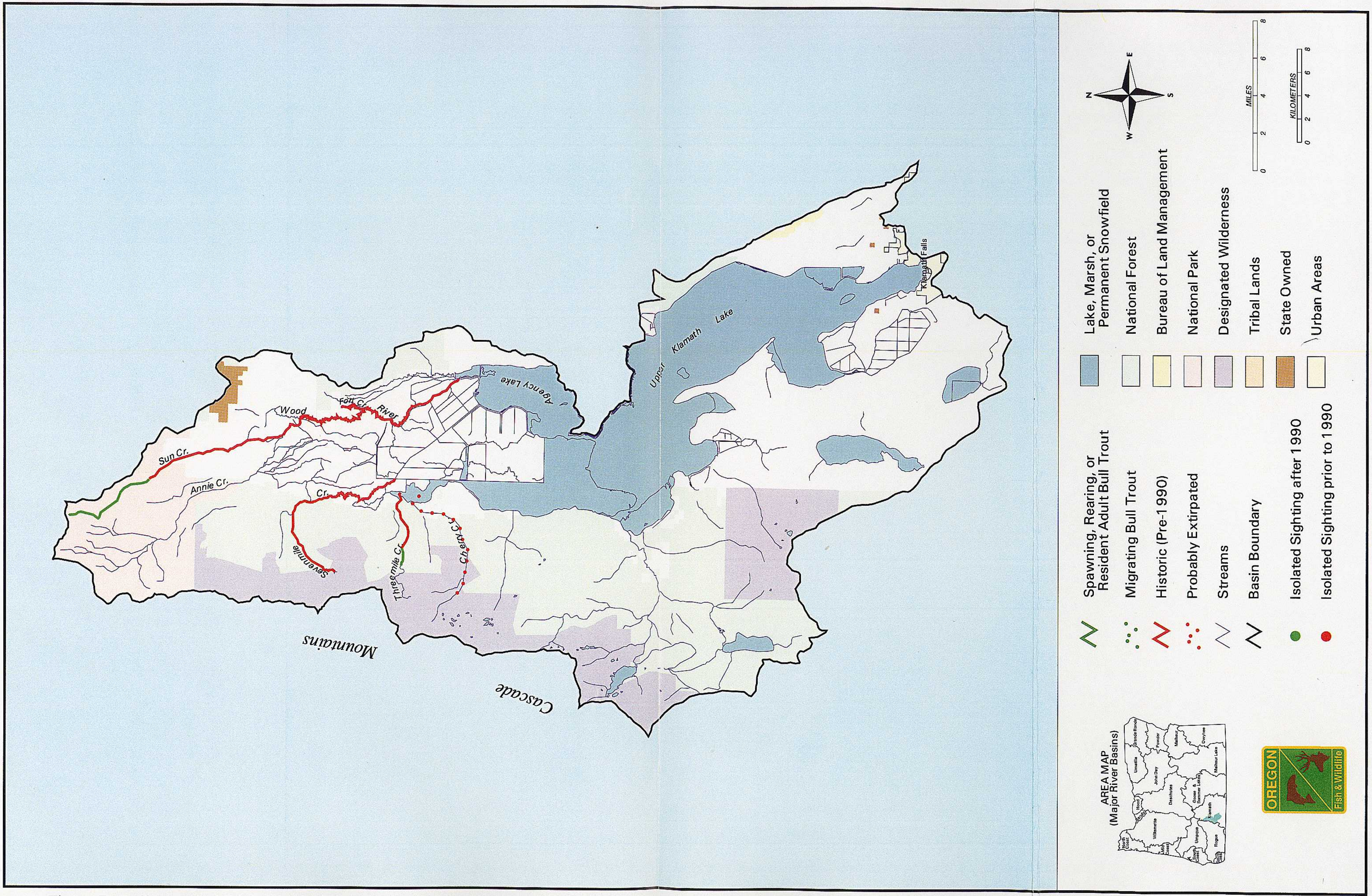


Figure 7. Bull trout distribution in the Klamath Lake Subbasin, Oregon.

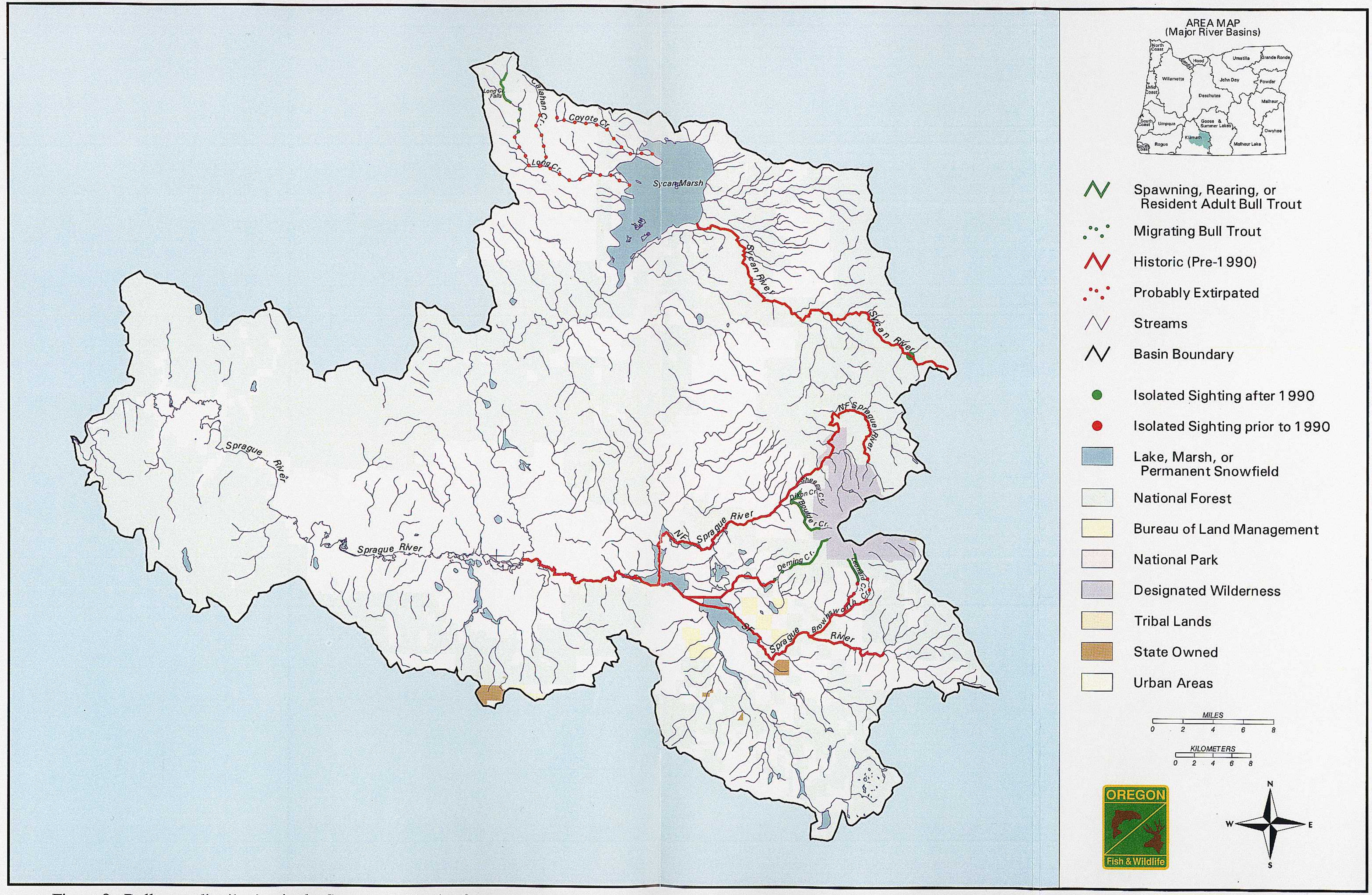


Figure 8. Bull trout distribution in the Sprague Subbasin, Oregon.

Life History

Only resident forms of bull trout are believed to be currently found in the Klamath Basin. Ziller (1992) reports the largest bull trout captured in Deming Creek was 218 mm whereas bull trout captured in Brownsw,orth, Leonard and Boulder/Dixon creeks were all less than 190 mm. The largest bull trout captured in Long Creek in 1994 was 234 mm (Jeff Dambacher, ODFW, Corvallis, OR unpublished data). A length frequency and age class relationship was developed using 133 bull trout sampled from Long Creek in summer 199 1 (Figure 9). Long Creek bull,. trout were also sampled in 1994 and a fork length-to-age relationship was developed using scale analysis (Figure 10) (Lisa Borgerson, ODFW, Corvallis, OR, unpublished data).

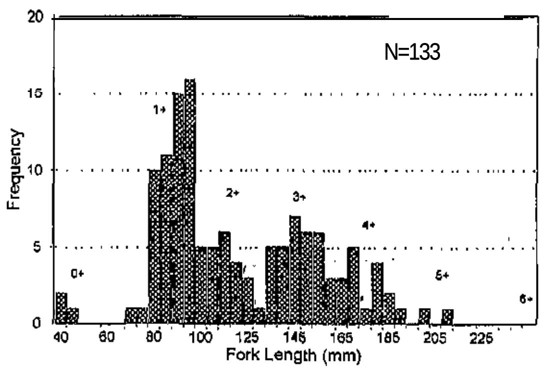


Figure 9. Fork lengths and estimated age class of bull trout captured in Long Creek in summer 1991 (from J. Dambacher, ODFW, unpublished data).

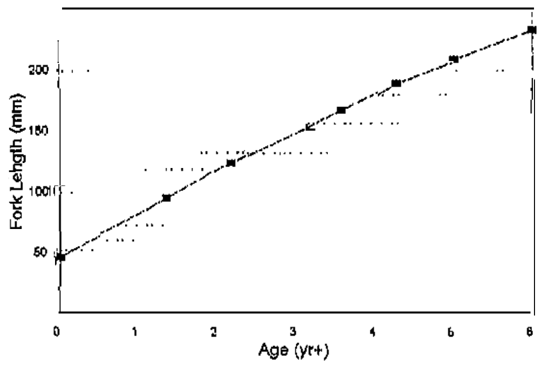


Figure 10. A fork length-to-age relationship developed from scales-taken from Long Creek bull trout in August 1994 (from L. Borgersan, ODFW, Corvallis, OR, unpublished data).

Rode (1990) collected spawning adult bull trout from Deming and Leonard creeks, He found sex ratios favored males, which made up 54% to 67% of the sample. He also found the length of spawners to be 140 mm or greater. Because of the small size of the 16 female spawners (average length of females was 175 mm), these bull trout only averaged 170 eggs per female. The average fecundity of resident bull trout collected in Sun Creek in 1947 was 249 eggs per female and these females had an average length of 18 1 mm (OCAFS 1993). These data suggest that resident Klamath Basin bull trout. have a low reproductive potential.

In 1993, ,OCAFS calculated effective population size for bull trout in the six Klamath Basin streams (Table 5).

Table 5. Estimated abundance of bull trout, spawners, female spawners, and effective population size in six Klamath Basin streams.

Stream	Total abundance[b]	Percent >140 mm[c]	Spawner abundance (N)	Percent females	Female spawner abundance	Effective ,population size (N_e)
Boulder	219	64	140	30	42	14-46
Brownsworth	964	46	443	30	133	44-146
Deming	1,293	47	608	46	280	61-201
Leonard	834	25	208	33	69	21-69
Long	842	43	362	50	181	36-l 19
Sun	133	--[f]	105[f]	50	52	11-35

[a] *The data source is the Oregon Chapter of AFS 1993 bull trout petition.*

[b] *From Ziller 1992, Dambacher et al. 1992, ODFW 1991 and 1992. No estimate was available for Threemile Creek, but USFS surveys found just 9 bull trout (2.6 fish/100 ft) in 2 sites compared to 63 brook trout (18.1 fish/100 ft) in 2 sites immediately downstream within the same reach.*

[c] *Length of spawners assumed to be 140 mm or greater (Rode 1990) may overestimate spawners because length of spawners in Sun Creek in 1947 was 160-184 mm (Wallis 1948). Percentage of length samples ≥140 mm was estimated from Ziller 1992 and ODFW 1991 and 1992 for Long Creek*

[d] *Based on sex ratios in Rode 1990. An average sex ratio was used for Boulder and Brownsworth creeks and an estimated sex ratio of 1:1 was used for Sun and Long creeks.*

[e] *N_e was calculated by assuming that N_e/N ranges from 10%-33% (Nelson and Soulé 1987; Thompson 1991) and that spawner abundance was an approximation of adult population size.*

[f] *Because length frequency data were was not available, bull trout >100 mm were assumed to be spawners, although this likely overestimates spawners,*

These abundance estimates ranged from 133 to 1,293 bull trout, The estimated number of spawners based on length frequencies were from 105 fish to 608 fish. Finally, OCAFS calculated an effective population size ranging from 11 to 201 fish. These abundance estimates of Klamath Basin bull trout primarily originated from Ziller (1992) and Dambacher et al. (1992). The data were gathered in 1989 except for bull trout in Long Creek which was completed in 1991, Recent studies conducted by the Klamath Basin Working Croup and ODFW indicate these abundance levels may have been only maintained at best. An abundance of 855 bull trout was estimated in 1994 on upper Long Creek by the Klamath Basin Working Group. However, in 1995 an estimated subsection showed a 50% reduction in bull trout abundance (Memos by J. Dambacher and D. Buchanan, ODFW, Corvallis, OR 1994 and 1995). In 1992, the Park Service estimated that bull trout abundance in Sun Creek was approximately 200 fish (M. Buktenica, NPS, Crater Lake, Unpublished data, 1992).

Bull trout have been observed spawning in the Klamath Basin from mid- September to mid-November. For example, spawning bull trout and freshly constructed redds were found in upper Long Creek on 21 September 1994, and 9 new redds were observed in a

0.4 km section of Three Mile Creek on 20 November 1995 (D. Buchanan, ODFW, personal communication, February 1995; Smith and Messmer 1996).

Leary et al. (1993) used protein electrophoresis to document that bull trout in the Klamath Basin were a separate major lineage from Columbia River bull trout, and Williams et al. (1995) used mitochotidrial DNA to separate Klamath River bull trout from Lower Columbia River and Upper Columbia River bull trout. However, Spruell and Allendorf (1997), using microsatellite DNA analysis, failed to find unique microsatellite alleles when comparing Klamath bull trout to western Oregon bull trout. All investigators detected extremely low levels of variation in Klamath bull trout, suggesting that the Klamath Basin was either founded by a few individuals or that the bull trout populations have been held at low numbers for the past several generations (Spruell and Allendorf 1997)

Specific Limiting Factors

Interactions with non-native trout threatens 6 of the 7 bull trout populations remaining in the Klamath Basin. The current status of bull trout in Long, Brownsworth, and Leonard creeks has been downgraded, primarily because of obvious interactions with non-native trout. In August 1991, the upper 2.8 km of Long Creek above a small (1.2 m) natural falls was thought to be a sanctuary for a pure bull trout population with no significant competition or hybridization with non-native brook trout. At that time, ODFW estimated the population of age 1+ and greater bull trout to be 871 fish (±25%, 95% C.I.). Only a single 1+ age brook was observed above the falls in 1991 (J. Dambacher, ODFW, unpublished data, 1992). In July 1994, Klamath tribal biologists observed by snorkel diving that brook trout constituted approximately 20% of the 1+ and greater fish above the Long Creek falls. In August 1994, 86 age 0+ brook trout, 79 age 1+ and greater brook trout, and 10 1 bull/brook hybrids were removed by electrotishing from the bull trout sanctuary area (J. Dambacher and D. Buchanan, ODFW, August 1994 memo).

In August 1995, the Fremont National Forest increased the height of the natural falls from 1.2 m to 2.1 m, and the Klamath Basin Working Group removed an additional 62 age 1+ and greater brook trout and approximately 42 bull/brook hybrids from the sanctuary area of Long Creek. (J. Dambacher and D. Buchanan, ODFW, September 1995 memo). A two-pass population estimate of 1+ and older bull trout of 394 and 202 was estimated from a comparable section of the Long Creek sanctuary in 1994 and 1995, respectively. The 1995 bull trout population estimate was approximately one-half of the 1994 population estimate.

Weyerhaeuser Company funded a detailed fish distribution study in Brownsworth and Leonard creeks in the summer 1995, This study reported a loss of 1.4 km and 2.0 km in bull trout distribution at Leonard and Brownsworth creeks, respectively (J. Dambacher, ODFW, unpublished data, September 1995). These figures represent a net loss of one-third of the total summer distribution previously repoited for bull trout in these two systems and represents an approximate 10% reduction for bull trout distribution in the total Klamath Basin (Table 6). Non-native brown trout residing in these sections may have contributed to this reduction.

The abundance of many of the Klamath bull trout populations is extremely low compared to the effective population size recommended by Nelson and Soulé (1987). These populations are highly susceptible to random processes such as an increase in natural deaths or catastrophic environmental events such as wildfires. A natural wildfire occurred in Deming Creek in the early 1960's, but no recent wildfires have occurred in current bull trout distribution areas within the basin. Angling harvest of bull trout is not presently considered an issue in the Klamath Basin. The taking of bull trout is prohibited throughout the Klamath Basin, although none of the bull trout streams are closed to fishing for the other trout species present (Light et al. 1996). Oregon State Police observe only occasional angler use in the area of the Klamath Basin where bull trout occur.

The impacts of historical land use on fish habitat in the larger tributaries and mainstem rivers of the Klamath Basin have been profound. Channelization, water withdrawals, removal of streamside vegetation, and other disturbances have altered the aquatic environment by elevating water temperatures, reducing water quantity and quality, and increasing sedimentation (Light et al. 1996). Water diversions are present in four of the seven headwater drainages that have bull trout populations (Light et al. 1996). The maximum summer temperatures in upper Deming Creek where bull trout are present was 17.4°C, while in a degraded section of Deming Creek located only a few kilometers downstream where bull trout were absent, the maximum temperatures increased to 29.3°C (Buchanan et al. 1994).

Because the geology of the basin has highly erodible soils; fine sediment is present to some degree in most of the basin's bull trout streams. For example, Sun Creek in Crater Lake National Park has high quantities of naturally occurring tine sediment throughout its bull trout distribution areas (Dambacher et al. 1992).

Livestock grazing in riparian areas has resulted in localized areas of decreased bank stability, increased sediment loadings, and removal of the vegetative cover that provides shade for most of the bull trout streams in the basin (Dambacher 1995, Light et al. 1996). The meadows in upper Long Creek show examples of bank stability loss and diminished availability of undercut banks caused by livestock hoof action. Historical Bureau of Indian Affairs (BIA) and USFS grazing records for parts of the Klamath Basin (near and including the present Winema U.S. Forest) show heavy livestock grazing from 1911 to the 1950s (Figure 11). Livestock trend data from the Fremont National Forest shows a similar heavy livestock use from 1915 to the 1950s (Scott Peets, USFS, personal communication, September 1995). Livestock use has been removed on bull trout streams on U.S. Timberlands Inc. and in bull trout sensitive areas in USFS lands, However, documented cattle trespass in Long Creek in 1995 and Deming Creek in 1996 indicates that livestock are still a threat to bull trout in the basin.

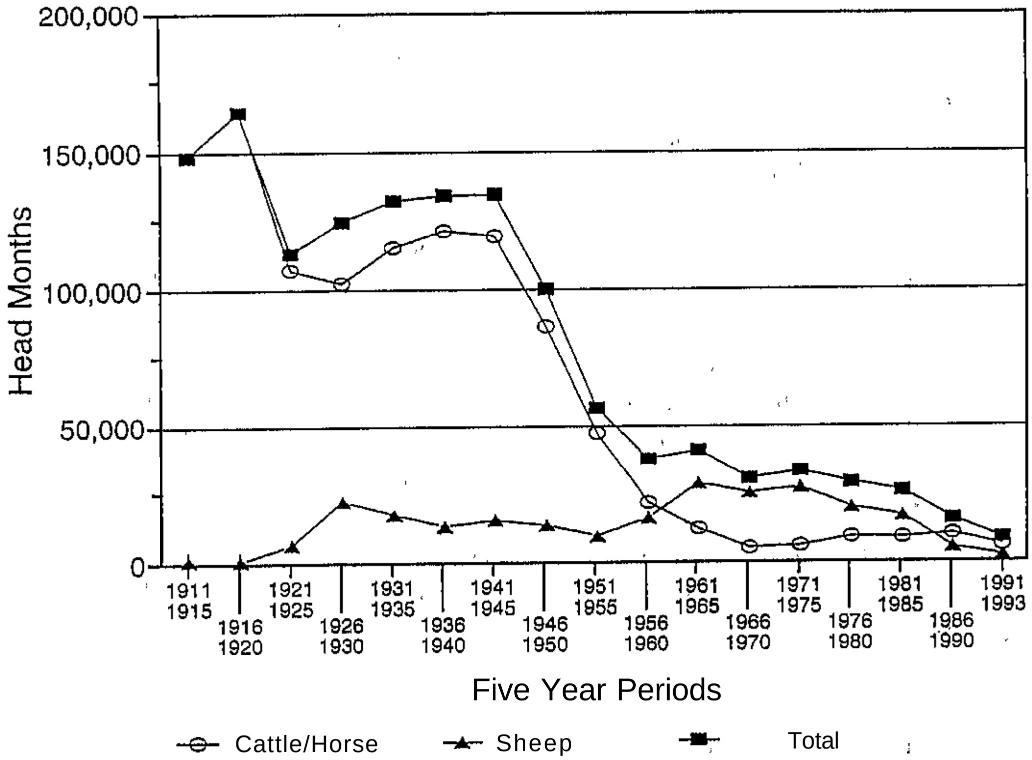


Figure 11. Historical livestock grazing use for parts of the Klamath Basin from 1911 to 1993 (from BIA and USFS records, Brent Frazier).

Past timber harvesting practices have removed large trees from riparian zones outside of USFS Wilderness and U.S. National Park boundaries, thus decreasing shade and the availability of large woody debris (LWD) that could provide components of high quality fish habitat (Light et al. 1996).

Streamside roads associated with timber harvest deliver fine sediment to multiple locations along parts of Boulder, Deming, Threemile, Brownsworth, and Leonard creeks. Levels of fine sediment were found to be moderate to high in several locations in Brownsworth Creek (Dambacher 1995, Light et al. 1996). Stream surveys in Brownsworth Creek found some pool volume was being lost by filling with fine sediments (Weyerhaeuser unpublished data; Light et al. 1996). Boulder Creek has a high percentage of fines (approximately 30%) in some stream reaches within the bull trout distribution area (Weyerhaeuser 1994; Dambacher 1995, Light et al. 1996).

Increasing stream temperatures from localized droughts, global climatic warming, natural southern exposures, and anthropogenic land uses are a major limiting factor for Klamath Basin bull trout. An earlier discussion on potential limiting factors suggest a strong correlation between increased temperatures and the adverse effects of non-native brook trout. A 10-year drought (1985 to 1994) in the Klamath Basin may have been limiting to bull trout. However, this drought was not as strong as localized Klamath Basin droughts in 1915-

1921 or 1930-1935 (*See* Figure *2, page* II), and the cumulative precipitation deficit of other regions in the state such as near La Grande or Corvallis were much greater than near Klamath Falls (See Figure 3, page 12). Because Klamath Basin bull trout are near the southern edge of the species range, any general warming trends of stream temperature could be harmful.

Riparian shade, cold water springs, or cold headwater streams are all essential to maintain cold water habitat for stenothermal bull trout. For example, maximum summer temperatures of 17°C were measured in areas of upper Long Creek inhabited by bull trout. However, inflow from a cold water spring cooled upper Long Creek to 15°C below the confluence of the spring. Downstream of the spring, where upper Long Creek flows through an open meadow approximately 2.0 km in length, water temperature warmed to 21 °C at a monitoring site immediately below the open meadow (Light et al. 1996). Reduced shade resulting from timber harvest and close proximity of roads is found in sites along Dixon, Boulder, and Threemile creeks (Dambacher 1995, Light et al. 1996).

Management Considerations

The Klamath Basin Working Group comprised of representatives from ODFW, Fremont National Forest, Winema National Forest, USFWS, Crater Lake National Park, Klamath Tribes, OCAFS, PacifiCorp, Bureau of Reclamation, Sprague River Water Assoc., Klamath Basin Water Users Protective Assoc. and U.S. Timberlands Inc. is in the process of implementing a conservation strategy for bull trout in the Klamath Basin (Light et al. 1996). Their goal is to protect and enhance bull trout throughout the basin.

The Klamath Basin Bull Trout Conservation Strategy recommends the following phased approach to conserving bull trout:

Phase I focuses on the seven small drainages in the Klamath Basin where bull trout populations exist today. It identifies the most immediate and solvable threat as the continued presence of non-native trout within bull trout populations and suggests an approach to isolate bull trout populations above barriers followed by eradication of brook and brown trout within each isolated stream reach. Localized areas of habitat degradation and alteration are an additional serious concern, Habitat enhancement is considered generally feasible, particularly in areas where roads or livestock are the issues.

The intent of Phase II is to refound bull trout populations in headwater streams that now support brook trout only (Calahan Creek and Cherry Creek). Expanding historical bull trout range could serve to expand the number of populations or subpopulations and may increase the overall size of metapopulations.

U.S. Timberlands, Inc. is the major private timberland owner in several bull trout drainages and is an active partner in the Klamath Basin Working Group. Their conservation and stewardship measures and those of the previous private owners (Weyerhaeuser, Inc.) for bull trout have included: excluding cattle from stream riparian zones, funding bull trout population and habitat surveys, obliterating roads near bull trout streams, altering forest practices to protect riparian shade and possible sediment inputs near bull trout habitat, and supporting bull trout conservation throughout the Klamath Basin, The Working Group and

ODFW are optimistic that U.S. Timberlands Inc. will continue these conservation and stewardship measures. In a recent harvest area immediately downstream of bull trout habitat in upper Long Creek, U.S. Timberlands Inc. have left a no-cut protective riparian area ranging from 30 to 183 m.

Three restoration projects under the review of the Klamath Working Group are currently focusing on reduction or eradication of non-native brook trout in native bull trout habitats within the basin (see phase 1). The NPS began a restoration plan in 1991 to reduce and potentially eradicate brook trout from a high risk bull trout population in Sun Creek in Crater Lake National Park (Buktenica 1997). After extensive planning and monitoring, the NPS used electrofishing, antimycin chemical removal, and construction of two barriers in the National Park to limit the distribution of non-native brook trout, The Winema National Forest, ODFW, and the Klamath Tribe are leading a similar reductionand eradication plan for brook trout in Threemile Creek. They plan to electroshock the lower reaches of Threemile Creek that contain populations of pure brook trout. Moving into the mixed zone of brook trout and bull trout, they plan to use snorkelers to remove individual brook trout by electroshocking or spearing (L. Dunsmoor, Klamath Tribe, personal communication, December 1996). The Fremont National Forest is leading an effort to rehabilitate Long and Calahan creeks by removing brook trout. They plan to complete data analysis and write an Environmental Assessment in the winter of 1997/1998 and publish a Decision Notice in spring of 1998 (C. Speas, USFS, personal communication, December 1996).

Instream water rights have been issued for 16 stream reaches in the Klamath Basin by the OWRD. Instream water rights will be junior in priority to existing rights. Streams with water rights that may effect bull trout include Annie, Brownsworth, Long creeks, and several reaches of the upper Sycan River. An additional 20 streams in the basin have had applications submitted for instream water rights but the proposals have been contested by present water users.

Current Status

The status of bull trout in the Klamath Basin was first assessed in 1991 by Ratliff and Howell (1992). They listed 10 populations with Upper Sycan River and Seven Mile Creek as "probably extinct;" and Boulder/Dixon, Coyote, Cherry and Sun creeks as having a "high risk" of extinction; and Deming, Brownsworth, Leonard, and Long creeks as having a "moderate risk" of extinction. This status report lists 11 populations in the basin with the upper Sycan River and Sevenmile, Coyote, and Cherry creeks as "probably extinct;" and Boulder/Dixon, Brownsworth, Leonard, Long, and Sun creek as having a "high risk" of extinction. A new population found in Threemile Creek is listed as having a "high risk" of extinction. Five populations in this basin have been downgraded in status, Coyote and Cherry creeks were downgraded after increased survey efforts found no bull trout. Brownsworth, Leonard, and Long Creek were downgraded due to actual decreases in estimated population number and/or distribution. The only population of bull trout listed as having a "moderate risk" of extinction is that in Deming Creek.

Willamette River Basin

Introduction

The following is a summary of existing information on bull trout in the Willamette River Basin. Most information presented is from ODFW and USFS unpublished reports.

The Willamette River Basin, situated in northwestern Oregon, is a major tributary of the Columbia River entering at about RK 140. It drains an area of approximately 19,380 sq km in Oregon. It is bounded on the north by the Columbia River, and on the east, south and west by the summits of the Cascade Range, the Calapooia Mountains, and the Coast Range, respectively. The north-south length of the basin is about 240 km and its average east-west width is about 120 km. Principal streams of the basin head at elevations of 1,830 m and higher in the bordering Cascades. In higher elevations of the Cascade Range where bull trout occur, precipitation ranges from 229 to 356 cm and snowfall is heavy with considerable snowpack accumulation. Major tributaries of the Willamette River include Clackamas (RK 40), Tualatin (RK 45), Molalla (RK 58), Yamhill (RK 88), Santiam (RK 175), Calapooia (RK 193), Mary's (RK 2 12), Long Tom (RK 241), McKenzie (RK 282), Middle Fork Willamette (RK 301), and Coast Fork Willamette (RK 301).

Historic Distribution

Bull trout were probably found historically throughout much of the Willamette Basin; however, available documentation of bull trout is limited. John Gill (1914) reported catching huge Dolly Varden (bull trout) in the upper McKenzie River near McKenzie Bridge. Frank Smith (19 18) recalled a fishing trip on the upper Middle Fork of the Willamette 20 miles north of Oakridge (This could be the North Fork of the Middle Fork Willamette.). They landed many rainbow trout and at least two large Dollys (bull trout). Goetz (1989) portrayed a historical bull trout distribution for the Willamette Basin based on a review of ODFW and Oregon State University records. He reported that bull trout were last observed in 1945, 1953, and 1960 in the North Santiam River, South Santiam River, and Clackamas River, respectively (Figure 12). Ratliff and Howell (1992) listed bull trout as "probably extinct" for these three river systems. Goetz (1989) reported that one bull trout was last found in the Long Tom River in 1962. Goetz (1989) also reported several bull trout in the McKenzie tributaries and the Middle and North forks of the Willamette during the 1960s (Figure 13). Ziller (1996), in a presentation to the *Salvelinus confluentus* Curiosity Society, reported that three bull trout were caught in the Middle Fork Willamette in 1969. Moring (1976) reported an estimated 13 bull trout were caught by anglers participating in a catchable rainbow trout fishery in the Middle Fork Willamette River above Hills Creek Reservoir in 1976. However, no bull trout were reported in a similar creel survey conducted in 1975 (Moring 1975).

Current Distribution

Recent extensive surveys have not found bull trout in the Middle Fork Willamette River. More than 14 person months have been expended searching for bull trout in the Middle Fork Willamette River using day/night snorkel methods and electrofishing (J. Ziller, ODFW, personal communication,

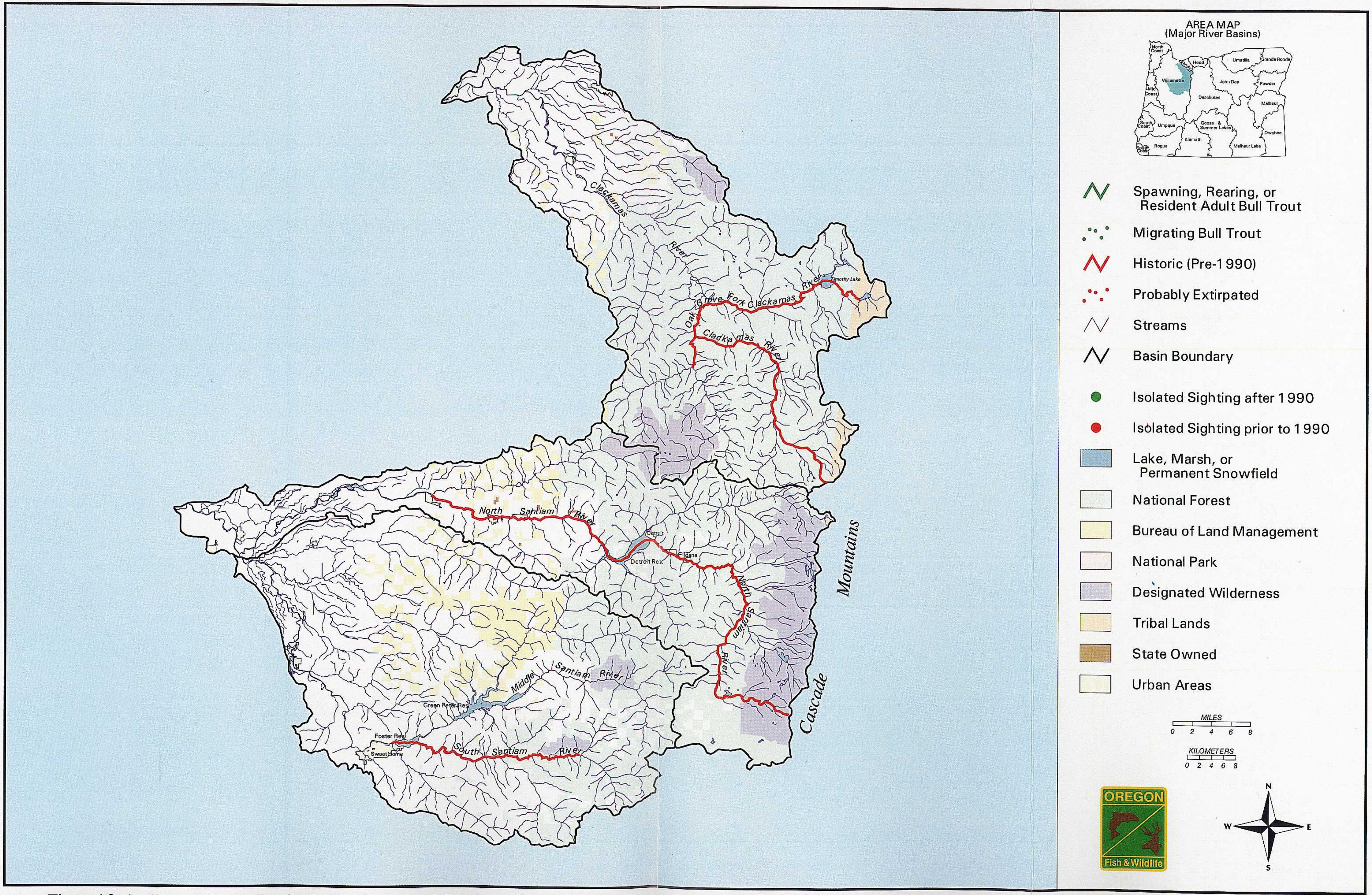


Figure 12. Bull trout distribution in the Clackamas and Santiam subbasins, Oregon.

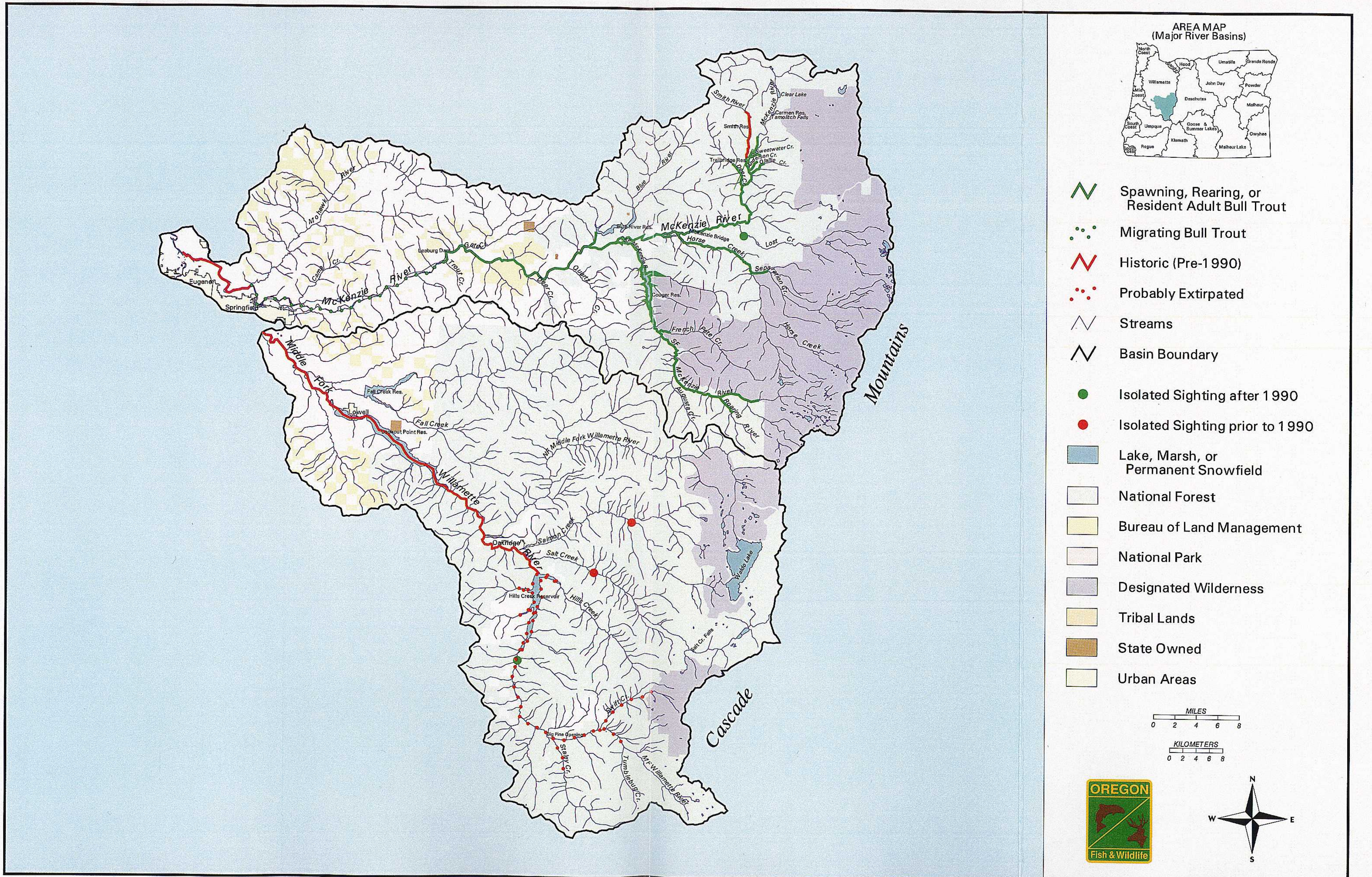


Figure 13. Bull trout distribution in the McKenzie and Middle Fork Willamette subbasins, Oregon.

October 1996). However, a verified photograph of a bull trout was taken in 1990 at the head of the Middle Fork arm of Hills Creek Reservoir (J. Ziller, ODFW, personal communication, October 1996). Also Ambrosier et al. (1995) noted two unconfirmed 1990s sightings of bull trout in the Middle Fork near Big Pine Opening and in the lower reaches of Swift Creek. The current assessment for bull trout in Middle Fork Willamette River is "probably extinct;" however, ODFW and USFS biologists will continue to look for a possible viable population.

The McKenzie River probably had one or two fluvial populations distributed from the mouth upstream to Tamolitch Falls, a natural barrier. With the construction of Trail Bridge and Cougar reservoirs in 1963, there are now essentially three isolated populations in the McKenzie System: (1) the Mainstem population with bull trout found from Leaburg Dam upstream including parts of the lower South Fork, Blue River, Horse Creek, Separation Creek, Deer Creek, Olallie Creek, and Anderson Creek; (2) the South Fork population above Cougar Reservoir including parts of Roaring River; and (3) the Mainstem above Trail Bridge Dam and below Tamolitch Falls including Sweetwater Creek that flows directly into Trail Bridge Reservoir (Figure 13). There are no other documented populations throughout the rest of the Willamette Basin.

Life History

Spawning surveys for bull trout were first initiated in Anderson Creek, tributary of the upper Mainstem McKenzie, in the fall of 1989 and have continued through 1996. For the first 5 years, a spawning index area of 2.6 km in the lower part of Anderson Creek was surveyed by USFS. Since 1994, 3.9 km of Anderson Creek up to a barrier has been surveyed for bull trout spawners each fall (Table 6). Bull trout spawning streams and potential spawning streams include Anderson, Olallie, Sweetwater, upper McKenzie River below Trail Bridge Reservoir, McKenzie River above Trial, Bridge Reservoir, Horse, Separation, and Roaring River creeks (J. Ziller, ODFW, personal communication, October 1996). Bull trout spawning in the McKenzie River system usually occurs from early September to early October in cold, stable, spring-fed creeks. Most bull trout spawning occurred between 5 and 8°C. Most bull trout redds were found in sites with small to medium sized gravel in water depths of 17 to 45 cm, and average water velocities at the head, end of the redd of 30 cm/second. The average velocity at the tailspill was 49 cm/second (J. Ziller, ODFW, personal communication, October 1996).

A trend towards increasing redd counts is seen in Anderson Creek from 1989 to 1996 (See Table 6). Female abundance may be inferred from the estimated number of redds. To reduce possible bias with identification of redds associated with physical stream parameters, algal colonization, and individual observer diffrences, redd counts were conducted on a weekly basis (M. Wade, ODFW, personal communication, June 1997).

In 1995, upstream passage for bull trout was re-established in upper Olalhie Creek, a cold-water tributary of the McKenzie River located immediately downstream of Anderson Creek. Previous spawning surveys in 1994 found only 3 redds below the Highway 126 culvert barrier. Construction and placement of a new culvert with upstream fish passage

Table 6. Summary of bull trout spawning surveys from Anderson Creek, tributary of the Mainstem McKenzie River, 1989-1996.

Year	Redd count in USFS index area	Redds/ km	Redd count in total stream	Redds/km
1989	7	2.7	--	
1990	9	3.5	--	
1991	7	2.7	--	
1992	13	5.0	--	
1993	15	5.8	--	
1994	22	8.5	30	7.7
1995	30	11.5	74	19.0
1996	26	10.0	82	21.0

in Olallie Creek upstream of Highway 126 may have increased bull trout spawning as 9 and 8 redds were found above Highway 126 in 1995 and 1996, respectively (D. Bickford, USFS, personal communication, June 1997). Separation and Lost creeks were also surveyed in 1995 and 1996 for possible bull trout redds, but none were identified.

Bull, trout populations above Trail Bridge and Cougar dams are severely limited by lack of spawning habitat. Bull trout are apparently spawning in the Mainstem McKenzie River above Trail Bridge Reservoir, as evidenced by seven redds observed in 1996 (C. Rose, ODFW, personal communication, November 1996). No redds have yet been observed in Sweetwater Creek, however, recent re-establishment of fish passage, placement of a new culvert, and stocking of bull trout fry should help establish future spawning. No redds were observed in the South Fork McKenzie River above Cougar Dam in 1996, and only three redds have been counted in South Fork McKenzie River since 1994. A downstream migrant screw trap located in Anderson Creek captured both fry and older juvenile bull trout in late winter and spring, J994 to 1996 (Table 7) (Ambrosier et al. 1995, Hope and Rose 1996).

Juvenile bull trout studies in Anderson Creek have found an age 0+ and 2+ migration occurring from April through June. An occasional age 3+ bull trout (>I20 mm) is also captured in the downstream trap. Length frequency data from the Anderson Creek trap found age 1+ fish ranged from 45 to 70 mm and age 2+ fish ranged from 70 to 120 mm (D. Bickford, USFS, personal communication, June 1997). A length frequency histogram has been completed for bull trout captured or observed in the Mainstem McKenzie River below Trail Bridge Dam since 1978 (Figure 14). Fluvial adult fish up to 840 mm have been captured or observed in this section of the McKenzie River (J. Ziller, ODFW, personal communication, October 1996).

Adult bull trout rear in large pools in the McKenzie River from below Leaburg Dam up to Trail Bridge Reservoir and then stage in the Mainstem McKenzie River in July, August, and early September (J. Ziller, ODFW, personal communication, October 1996). Snorkeling crews monitoring eight standard adult holding pools on the McKenzie River below Trail Bridge Dam in 1994, 1995, and 1996 found large numbers of bull trout staging in these pools before spawning (Figure 15). Adult numbers decrease in these pools when spawning begins. The increasing trend in redd counts in Anderson Creek, the high numbers of fry migrating out of Anderson Creek, and the increasing snorkel counts of staging adult bull trout all suggest that bull trout numbers in the Mainstem McKenzie River are improving (J. Ziller, ODFW, personal communication, October 1996).

Samples for genetic analysis were taken in 1995 from the South Fork McKenzie above Cougar Reservoir and Anderson Creek (Hemmingsen et al. 1996). Analysis of microsatellite nuclear DNA from these data showed that bull trout populations from the McKenzie, Hood, and Deschutes basins and western Washington comprised a major genetic lineage (Spruell and Allendorf, 1997).

Specific Limiting Factors

Throughout the Willamette Basin bull trout have been adversely affected by habitat alterations, especially impassable dams and culverts (Wevers et al. 1992). Ratliff and Howell (1992) list habitat degradation, passage barriers, overharvest, chemical treatment projects, and hybridization and competition with non-native brook trout as possible suppressing factors for bull trout populations in the Willamette Basin. The construction of Hills Creek Reservoir in 1961 and a chemical treatment project to remove non-game fish from the stream tributaries above the dam site have no doubt harmed bull trout in the Middle Fork Willamette River (Ambrosier et al. 1995). Also, habitat alteration from timber harvest and associated road construction, loss of wild juvenile spring chinook as a major food source, and overharvest from anglers participating in catchable trout fisheries have contributed to the decline in the Middle Fork Willamette River bull trout population (Ambrosier et al. 1995).

Table 7. Number of bull trout fry and juveniles age 1+ and older caught in a downstream trap on Anderson Creek 1994-96.

Date	Number of fry		Number of juveniles age 1+ and older	
	Captured	Estimated potential[a]	Captured	Estimated potential[a]
Feb. 15 - April 26, 1994	1,808	3,185	129	242
Feb. 15 - May 31, 1995	1,877	3,597	261	471
Feb. 19 - May 31, 1996	1,995	3,420	179	330

[a] *The estimated potential is a calculated estimate which includes an estimate for the days that the trap was not in operation.*

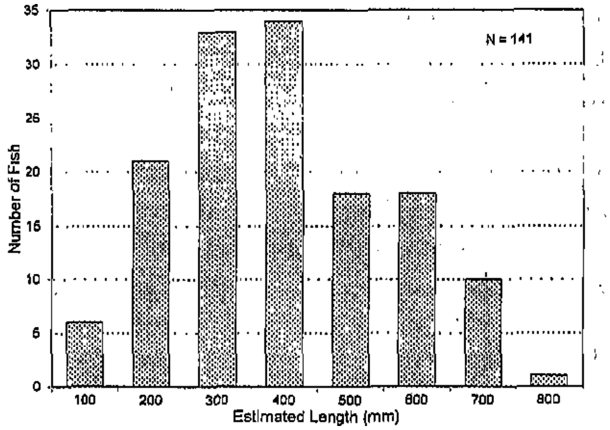


Figure 14. A length frequency distribution for bull trout in the Mainstem McKenzie River below Trail Bridge Dam based on angler reports from 1978 to 1996 (from J. Ziller, unpublished data, ODFW).

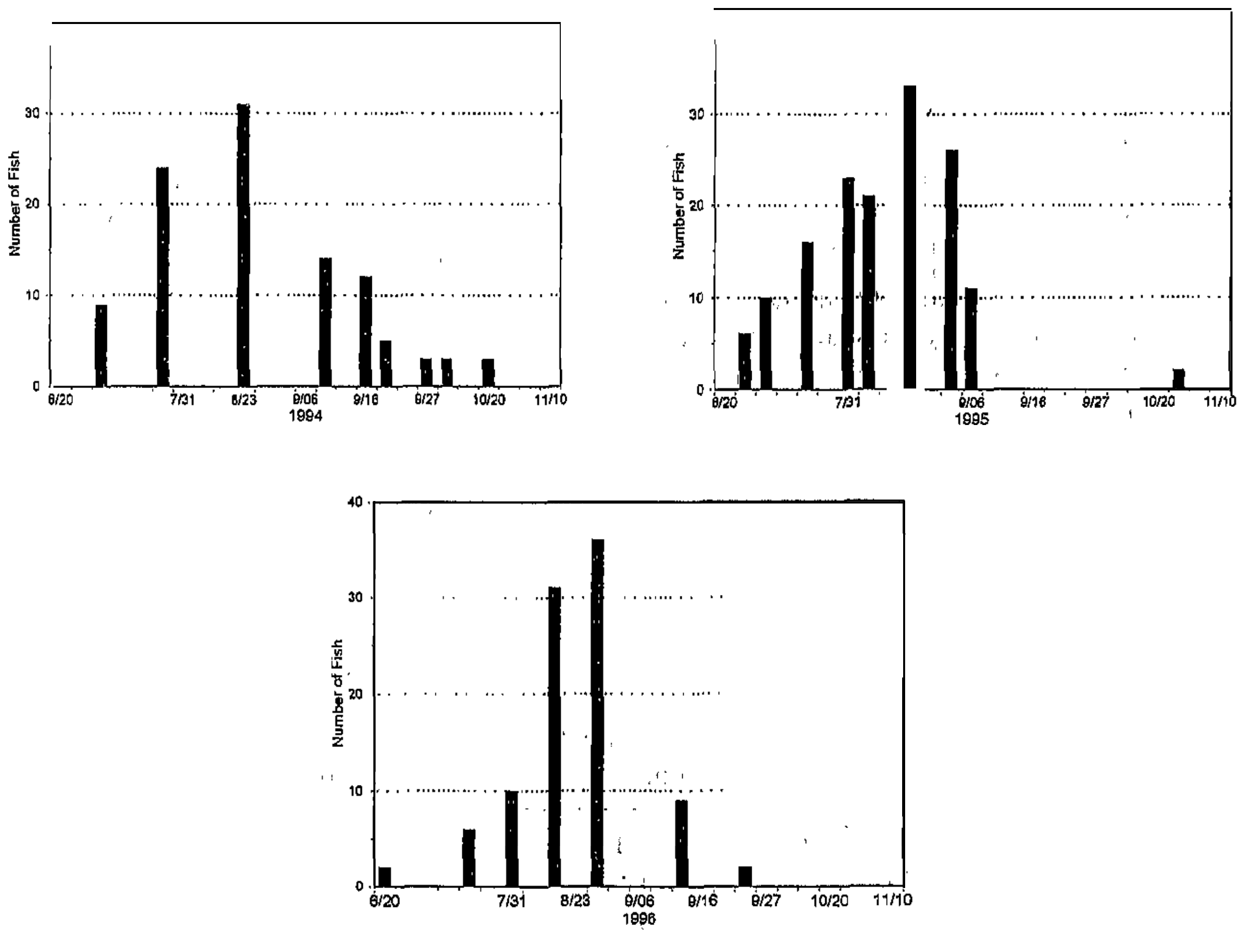


Figure 15. Counts of adult bull trout in eight standard pools on the McKenzie River, 1994 - 1996 (from J. Ziller, unpublished data, ODFW).

Overharvest and stocking programs may have limited bull trout production. Before-1990, anglers fishing in the McKenzie River and its tributaries could legally catch and keep 5 trout per day (native rainbow trout, native bull trout, stocked catchable rainbow trout, or non-native brook trout were all listed as trout in the McKenzie River system.). New angling regulations and changes in stocking of catchable trout on the McKenzie River have not been fully evaluated for their effectiveness in protecting bull trout.

The McKenzie River is a high elevation, snow melt and cold spring fed system with water temperatures that can remain under 15°C. However, human alterations to riparian and upland habitats potentially may have warmed the water temperatures of the basin. For example, prior logging in Augusta Creek (tributary of the South Fork McKenzie River) and Deer, Anderson, and Olallie creeks (tributaries of the Mainstem McKenzie River) may have adversely effected bull trout habitat. Presently, Willamette NF lands are protected by the Northwest Forest Plan that has designated the McKenzie River area as a key watershed. Water quality and riparian function will be maintained or restored under the Aquatic Conservation Strategy Objectives (D. Bickford, USFS, personal communication, June 1997).

Management Considerations

A working group comprised of representatives from ODFW, USFS, USFWS, BLM, Oregon Dept. of Transportation, U.S. Army Corps of Engineers, Eugene Water and Electric Board, Weyerhaeuser, National Fish and Wildlife Foundation, Oregon Council of the Federation of Fly Fishers, Trout Unlimited, and other affected interests has been formed to coordinate work on bull trout and, to draft a conservation strategy for bull trout in the Willamette Basin. This working group has completed several restoration projects for bull trout. In November 1992, a migration barrier at the mouth of Sweetwater Creek where the creek passes under Highway 126 (Figure 16) was corrected by placing a passable culvert (pre-fit with weirs) next to the existing culvert, nearly doubling the amount of spawning and rearing habitat available to the bull trout population in Trail Bridge Reservoir (Capurso 1995).

Some bull trout fry from nearby Anderson Creek have been transferred and released into Sweetwater Creek to help establish a viable bull trout population in the stream above Trail Bridge Reservoir. A total of 308, 507, 589, and 894 fry was transferred in 1993, 1994, 1995, and 1996, respectively (USFS 1993-1996). In 1993, 12 age 0+ bull trout from the Anderson Creek transfer, were observed in Sweetwater Creek by USFS personnel using snorkel surveys. In 1994, 18 bull trout were observed within 50 m of the release site. In June 1995, USFS snorkel surveys identified 2 1 age 0+, 12 age 1+, and 7 age 2+ bull trout. The older, larger juveniles were mainly found in the lower portion of the stream and the younger fish were usually found higher in the stream (Ziller and Wade 1996). Habitat in Sweetwater Creek is protected from land use impacts associated with logging and road construction. It is within a designated key watershed contained in the Forest Plan for Habitat within the Range of the Northern Spotted Owl.

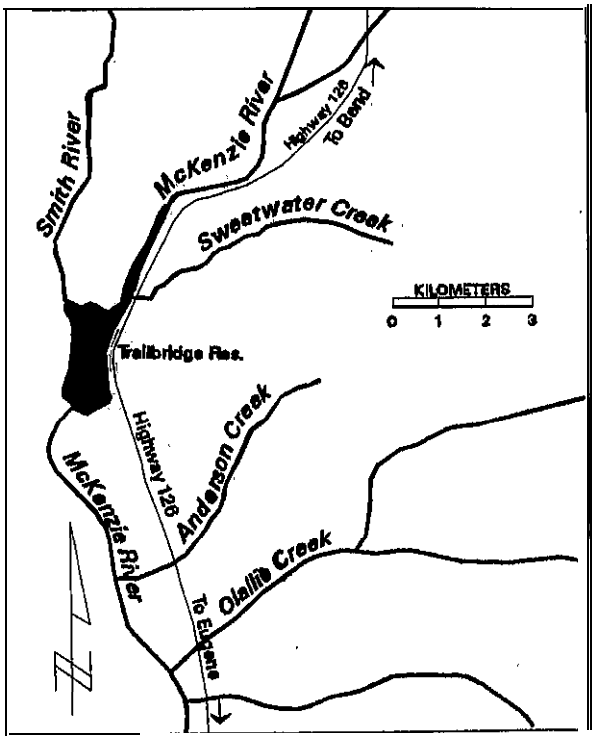


Figure 16. Upper McKenzie River including Sweetwater Creek, Anderson Creek, and Olallie Creek.

A second restoration project for bull trout was completed in August 1995, when upstream passage for migrating fish was restored under Highway 126 in Olallie Creek. Fish, including bull trout and cutthroat trout, migrating upstream from the McKenzie River into Olallie Creek were blocked from nearly 3.2 km of quality rearing and spawning habitat when Highway 126 was constructed in 1959 (USFS 1993-1996). The self-cleaning passage culvert was pre-fit with weirs, or steps and placed parallel to the old culvert. Juvenile bull trout were transferred from nearby Anderson Creek to Olallie Creek in 1994 and 1995 to speed colonization of habitat in Olallie Creek above Highway 126. A total of 245 and 3 13 fry were transferred in 1994 and 1995, respectively. In 1994, three redds were counted in Olallie Creek from the mouth to the passage barrier at Highway 126. In 1995, one month after placement of the passage facility, 10 redds were observed in Olallie Creek. One was located below the previous passage barrier at Highway 126, and the other nine, including six in the North Fork of Olallie Creek, were found upstream (Ziller and Wade 1996). Eight redds were counted in Olallie Creek in 1996. Due to the rapid recolonization of Olallie Creek above Highway 126 by spawning bull trout, no additional transplants of bull trout fry from Anderson Creek into upper Olallie Creek are anticipated.

Changes in angling regulations to protect bull trout include those adopted in 1990 requiring release of bull trout. Others adopted in 1992 require release of all wild trout and use of barbless flies and lures upstream from Paradise Campground (Ambrosier et al. 1995). The elimination of hatchery releases of catchable rainbow trout in bull trout rearing areas on the upper McKenzie River and South Fork McKenzie River should also reduce angling pressure. A USFS/ODFW "Please Release Me" bull trout interpretive poster has helped convey the message that bull trout can be threatened by angler overharvest and competition and hybridization with brook trout (Capurso 1995). This poster has been posted throughout the McKenzie and Middle Fork Willamette subbasins. Some illegal angler harvest of adult bull trout is suspected on the South Fork McKenzie River (J. Ziller, ODFW, personal communication, June 1997).

Instream water rights have been issued for 35 stream reaches in the Willamette Basin. Streams with water rights that may be beneficial to bull trout include Olallie, Scott, Gate, Lost, and Horse creeks in the McKenzie Subbasin; and Gold and Coal creeks in the Middle Fork Willamette Subbasin.

Future plans for the working group consist of completion of a conservation strategy, continued life history studies, continued inventory studies, possible reintroduction efforts in the Middle Fork Willamette River, further definition of important spawning and rearing areas in the basin, and a continuation of the various restoration projects to protect populations and their habitats, thus improving the status of the bull trout populations.

Current Status

The status of bull trout in the Willamette Basin was first assessed by Ratliff and Howell (1992). They listed bull trout as "probably extinct" from Carmen Reservoir and above. However, since no clear historical reference or recent documentation have been found for this population, it is omitted from this status report, They listed the North Santiam, South Santiam, and Clackamas populations as "probably extinct." These populations remain "probably extinct." They further list the Middle Fork, Willamette population at "high risk" of extinction, With the recent failure to identify a viable population of bull trout in this system, this status has been downgraded to "probably extinct." The South Fork McKenzie River population above Cougar Reservoir has been downgraded from "moderate risk," to a "high risk" of extinction. The bull trout population above Trail Bridge Reservoir also remains at "high risk" of extinction. The South Fork McKenzie was downgraded to a "high risk" because only 1, 2, and.0 redds were observed by spawning surveyors in 1994, 1995, and 1996, respectively. Illegal angler harvest of pre-spawning adults is also suspected. However, the Anderson Creek/Mainstem McKenzie River population has been upgraded from "moderate risk" to "of special concern" because of (1) recent changes in angling regulations, (2) increased redd counts, (3) large numbers of migrating fry in Anderson Creek, and (4) increased numbers of staging adults counted in the Mainstem McKenzie River.

Hood River Basin

Introduction

Much of the current status and trends reported for the Hood River Basin bull trout is a review from information provided by an unpublished 1995 report by Steve Pribyl, ODFW; Chuti Ridgley, USFS; and Jim Newton, ODFW (Pribyl et al. 1995). Also, members of the Hood River Basin Bull Trout Working Croup contributed data and information.

The Hood Basin consists of the mainstem Hood River, West Fork, East Fork, and Middle Fork. The Middle and East forks head from permanent glaciers on the northern and eastern slopes of Mount Hood (Figure 17). The basin is located in north central Oregon, and the Hood River enters the Columbia River at approximately RK 272. Two large dams impede or block upstream passage of migratory fish in the Hood River system. Powerdale Dam, located on the lower mainstem Hood River at RK 7.2, is a concrete structure approximately 6.7 m high. It is owned by PacifiCorp and operated for hydroelectric power generation. Clear Branch Dam, that created Laurance Lake, is located on Clear Branch Creek, a tributary of the Middle Fork. This dam was constructed in 1969 for irrigation storage and modified for hydroelectric power production in the early 1980s (Pribyl et al. 1995).

Historical Distribution

Recorded historical information of bull trout in the Hood Basin is very limited. Construction of the Hines Lumber Company Dam on the mainstem Hood River at Dee (RK 21) in the early 1900's likely interrupted upstream migration (Pribyl et al. 1995). This dam, which was removed in the early 1960s, had a wooden fish ladder that was probably inoperative at high water levels. Bull trout were captured in small numbers at the upstream ladder and trap at Powerdale Dam from 1962 to 1971, indicating that a small migratory or fluvial population of bull trout has existed in the mainstem Hood River for many years (Pribyl et al. 1995).

A single bull trout was captured in the lower part of the West Fork Hood River in 1963 at a natural barrier (Punchbowl Falls at RK 0.5) that historically impeded upstream passage of migratory fishes during low flows. It is not known whether this fish originated from a bull trout population in the West Fork or if this fish was from the mainstem Hood River. No bull trout have been observed in the West Fork since this single observation (Pribyl et al. 1995). We are not aware of any historic records of bull trout upstream of Punchbowl Falls.

Sighting of a bull trout in Evans Creek, tributary to East Fork Hood River, was reported in the early 1990s during the spring (W. Stanley, Middle Fork Irrigation District, personal communication, July 1997). Investigation of the area by fishery biologists did not locate any bull trout.

The Columbia River probably provided important historical rearing habitat for migratory bull trout from the Hood River system. Bull trout were first collected near Fort Dallas (now called The Dalles) in 1854 (Cavender 1978).

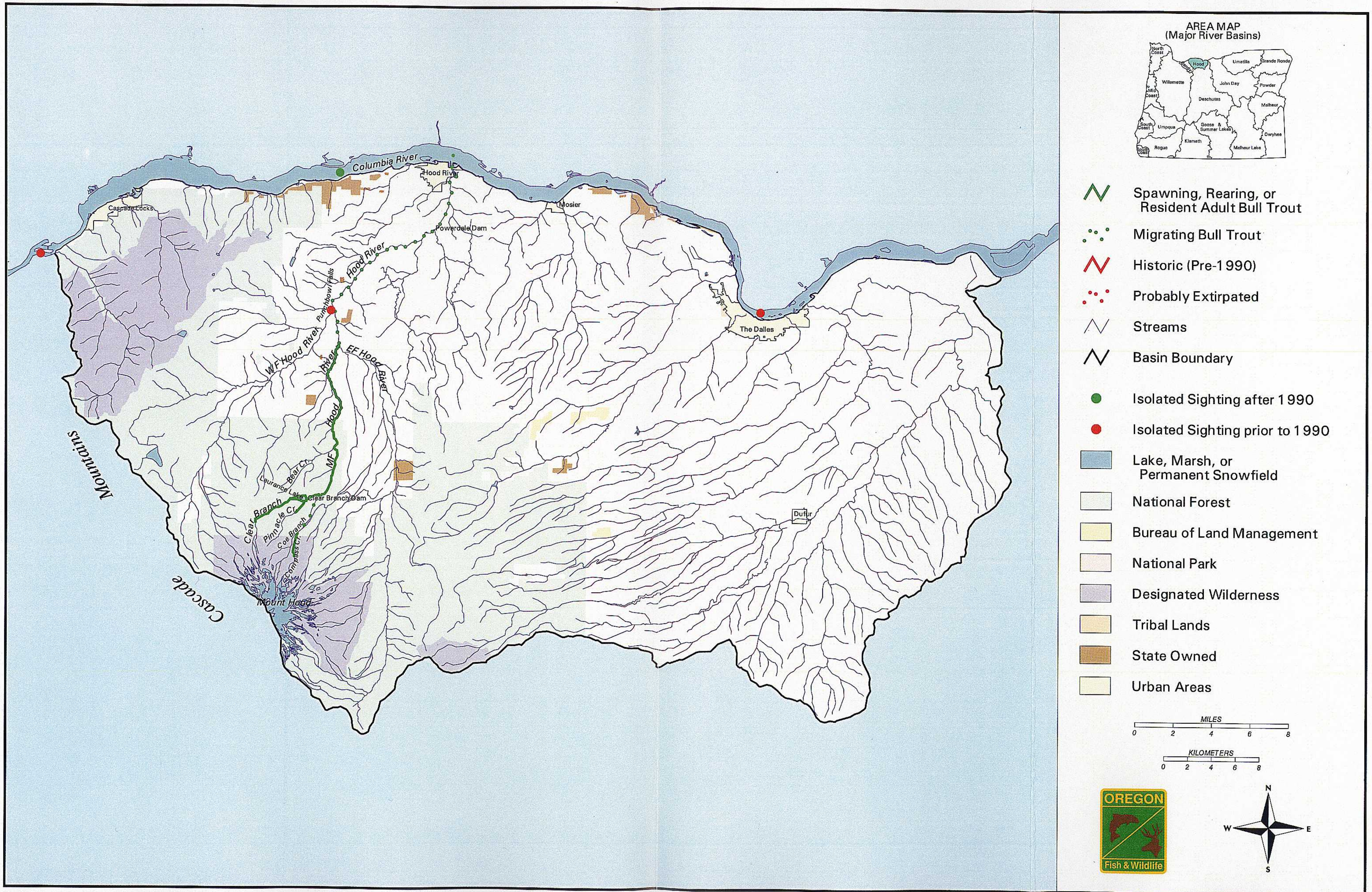


Figure 17. Bull trout distribution in the Hood Basin, Oregon.

Current Distribution

Prior to 1994, known bull trout distribution in the upper basin was comprised of a small population in Laurance Lake and the Clear Branch system above Clear Branch Dam (Figure 17). A single bull trout was also observed downstream of Clear Branch Dam in Bear Creek near the confluence with the Middle Fork in 1990, but actual distribution in Bear Creek has not been substantiated. Some fluvial individuals were also captured and tagged with Floy tags at Powerdale Dam trap on the lower Hood River (Table 8). Tag recaptures document in-stream movement from Powerdale Dam to immediately below Clear Branch Dam, or near the Coe Branch Diversion that is operated by the Middle Fork Irrigation District. One bull trout tagged at Powerdale trap in 1994 was recaptured in 1995 in the Columbia River near RK 261 or approximately 11 km downstream of the mouth of Hood River. An untagged bull trout was captured in the Columbia River immediately below Bonneville Dam near Ives Island in 199 1. These two Columbia River captures and the large size of some fluvial bull trout captured at Powerdale Dam suggest that the lower Columbia River is still an important habitat for Hood River bull trout.

In 1994, ODFW biologists documented bull trout in Pinnacle Creek, a small tributary of Laurance Lake, and in 1995 found rearing bull trout in Coe Branch Creek and Compass Creek, a tributary of Coe Branch Creek. Most of the streams in the basin thought to contain bull trout habitat and appropriate temperature regimes have been surveyed for the presence of bull trout and none have been found (Pribyl et al. 1995)

Life History

Data presented by Pribyl et al. 1995 suggests that bull trout of the Hood Basin contain resident, fluvial, and adfluvial life history forms. The adfluvial life history is the result of historically fluvial fish being trapped in Laurance Lake by the construction of Clear Branch Dam. Fish estimated up to 600 mm FL have been observed by snorkel surveys in the Clear Branch Creek above Laurance,Lake (Figure 18). Snorkel surveys were usually conducted weekly between mid-August to mid-October in 1992, from early July to early October in 1993, and from early May to mid-October in 1994. Members of the basin working group used 203 mm (8 inches) as an approximate length to distinguish between adult and juvenile bull trout based on a dead sexually mature 203 mm male found during the 1992 survey. A 254 mm dead female was also found in Clear Branch Creek. She was on her second spawning migration as determinedby the presence of retained first spawning eggs (Pribyl et al. 1995).

Fluvial bull trout captured at Powerdale Dam trap ranged in fork length from 243 to 570 mm (Table 8). Some growth data are available for these fluvial bull trout released above the dam and recaptured the following years at Powerdale trap. Six bull trout were recaptured approximately 1 year later and their growth ranged from 30 to 1.05 mm in length. One bull trout that was captured on 22 May 1994 had grown 115 mm when it was recaptured over 2 years later on October 1996.

Table 8. Powerdale Dam trap capture data and recapture information for bull trout throughout the Hood River system 1992 to 1996.

Capture date	Capture fork length (mm)	Recapture date,	Recapture fork length (mm)	Recapture location
05/08/92	--			
05/10/92	--		--	
05/19/92	515	05/17/93	555	Powerdale Dam trap
05/26/92	560			
05/26/92	452			
06/06/92	565	08126192	--	Observed below Clear Branch Dam
06/01/93	480	05/23/94	530	Powerdale Dam trap
05/13/94	555			
05/22/94	43s	10/05/96	550	Powerdale Dam trap
06/02/94	375			
06/13/94	3 7 0			
06/14/94	243	not recorded		Angler capture and release above Powerdale trap
06/24/94	335			
06126194	410	05/02/95	--	Angler capture Hood River below Powerdale Dam trap
06/30/94	410	07/28/95	515	Powerdale Dam trap
07/20/94	375	05/02/95	--	Captured in Columbia River
07/25/94	355			
06/02/95	515			
06/07/95	460	06/01/96	500	Powerdale Dam trap
06/10/95	480			
06/23/95	510		—	Old tag scar present
07/03/95	460	06/02/96	535	Powerdale Dam trap
07/08/95	505	09/14/95	--	Observed at Coe Branch Creek diversion
07/27/95	390			
08/06/95	460			
08/24/95	430			
10/04/95	470	06/28/96	500	Powerdale Dam trap
05/12/96	500			
05/14/96	485			
06/02/96	495			

Table 8. Continued,

capture date	Capture fork length (mm)	Recapture date	Recapture fork length (mm)	Recapture location
06/02/96	500			
06/03/96	530			
06/04/96	550			
06/08/96	490			
06/08/96	500			
06/11/96	570			
06/11/96	510			
06/12/96	500			
06/15/96	555			
06/26/96	505			
07/07/96	495			

No bull trout age or growth data From scale analysis are yet available from the basin; however, scales have been collected at the Powerdale trap and from Compass Creek and Clear Branch Creek by the research team collecting genetic samples in 1995. Spawning ground surveys in Clear Branch Creek upstream from Laurance Lake began in 1991. Bull trout redds were found to be very difficult to identify. Redds were only apparent when spawning adults were actively using them and only had a visible life of a few days after their construction. Members of the basin working group believe that the total adult population may be less than 300 individuals (Pribyl et al. 1995).

Samples for genetic analysis were taken in 1995 from Clear Branch and Compass creeks (Hemmingsen et al. 1996). Analysis of microsatellite nuclear DNA from. these data showed that bull trout populations from western Oregon and western Washington, the Hood and Deschutes basins all comprised a similar major genetic lineage. However, the Hood Basin fish were genetically differentiated from the other populations in this lineage group (Spruell and Allendorf 1997).

Specific Limiting Factors

Because the total adult population; of bull trout is believed to be less than 300 individuals, there, is a high risk of.extinction. This population is highly susceptible to, random processes such as increased natural death rates or catastrophic environmental events such as droughts, fires or volcanic activity. Any further loss of genetic diversity could also reduce fitness. It is unknown whether separate genetic or life history differences exist. Recent, length frequency data suggest life history differences between the Compass Creek and Clear Branch Creek groups, but more study is necessary to verify this hypothesis (Figure 19).

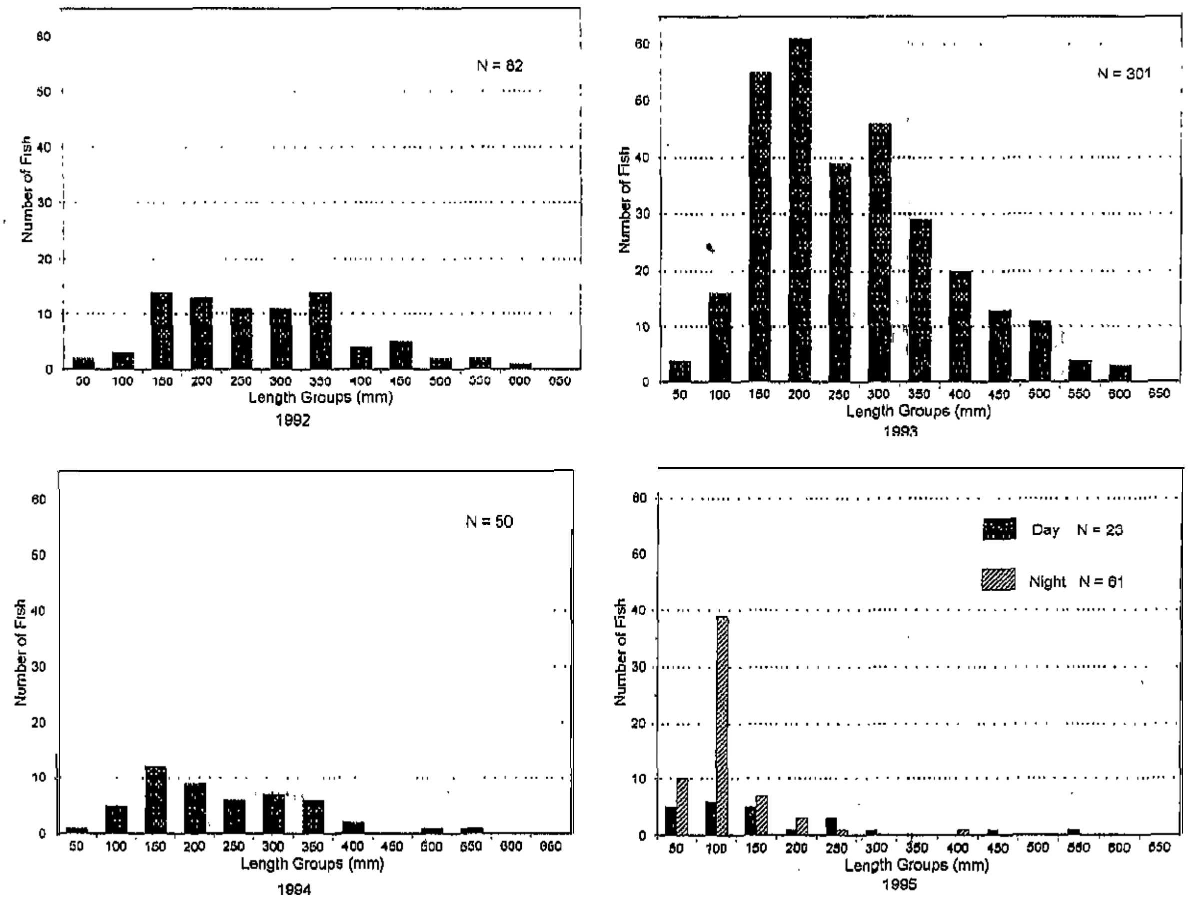


Figure 18. Bull trout length-frequency distributions observed in snorkel surveys from Clear Branch Creek from the Hood River system in 1992-94 (from Pribyl et al. 1995).

Overharvest of bull trout in Laurance Lake was potentially an important limiting factor for bull trout in the Hood Basin. A liberal bag limit (10 trout, including bull trout) was in effect prior to 1991. Catchable rainbow trout are still released in Laurance Lake to provide a recreational fishery and these fish may provide a forage base for bull trout. (Pribyl et al. 1995). All catchable trout have their adipose fins removed at release and only adipose tin marked fish are legal for harvest.

Passage barriers are a major limiting factor for bull trout in the Hood River basin. Powerdale Dam has adequate upstream passage for bull trout except during brief periods of high flows. Juvenile fish are screened from the Powerdale Diversion by traveling vertical screens. The efficiency of these screens is inadequate. Clear Branch Dam is believed to be a major obstacle to bull trout recovery (Pribyl et al. 1995). This dam is located immediately downstream of prime spawning and rearing habitat; and it had no upstream fish passage facilities until an upstream migrant trap was completed in fall 1996.

Bull trout above the dam in Laurance Lake, in 3.2 km of Clear Branch Creek, and in 1.6 km of Pinnacle Creek would be isolated unless they utilized an occasional spill flow for downstream passage. It is suspected that downstream migrating juvenile bull trout are lost at screened and unscreened diversions in the system. Clear Branch Dam has no downstream fish passage facilities other than the potential for juveniles to migrate from the reservoir via limited surface spill. Surface spill is not an annual event and the concrete spillways are long and steep. Survival of juvenile bull trout passing out of Laurance Lake is unknown (Pribyl et al. 1995).

Laurance Lake creates a heat sump that significantly warms the upper basin below the dam. Temperature monitoring during the summer and fall of 1995 recorded increases caused by the reservoir (Figure 20) These increases occur during the critical summer rearing and fall spawning times. Temperature can be a critical limiting factor to adult spawning, egg survival, and juvenile rearing (Buchanan and Gregory 1997). The authors of this status report hypothesize that adult bull trout unable to pass above Clear Branch Dam would not spawn successfully immediately below the dam.

Bull trout spawning habitat is limited in the basin. Glacial sand and silt occur naturally in Coe Branch Creek and are carried into the Middle Fork Hood River beyond the confluence. The sand and silt flows peak near the bull trout spawning period. Adult bull trout must migrate through the sand and silt flows to reach Compass Creek; however, it is unknown if bull trout can successfully spawn in these conditions (Pribyl et al. 1995).

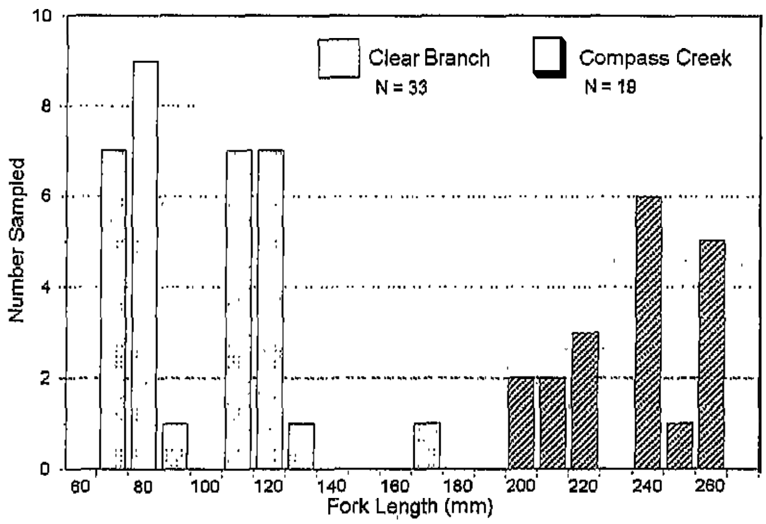
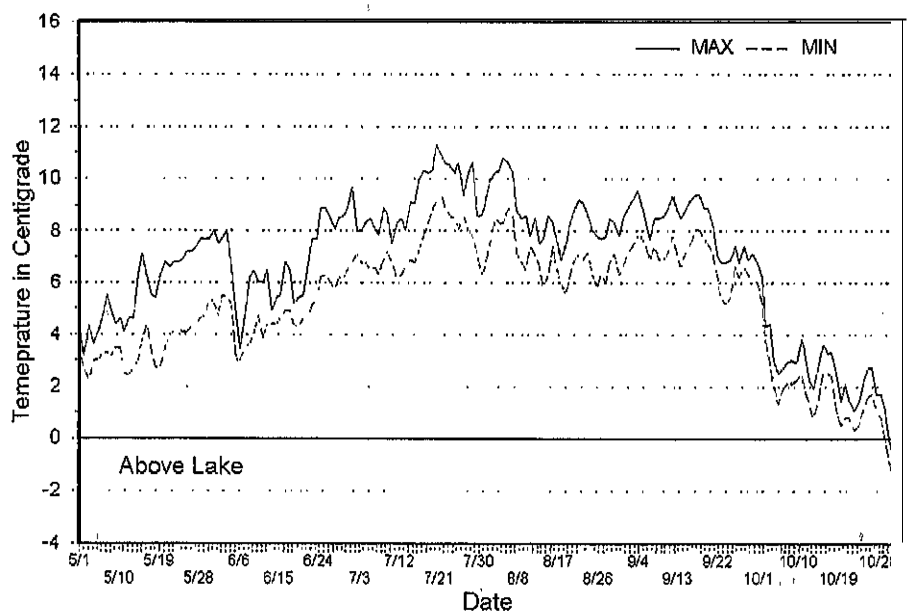


Figure 19. Bull trout length frequency comparisons between Clear Branch Creek and Compass Creek, tributaries of the Hood River (A. Hemmingsen and R. French, ODFW, unpublished data, November 1995).



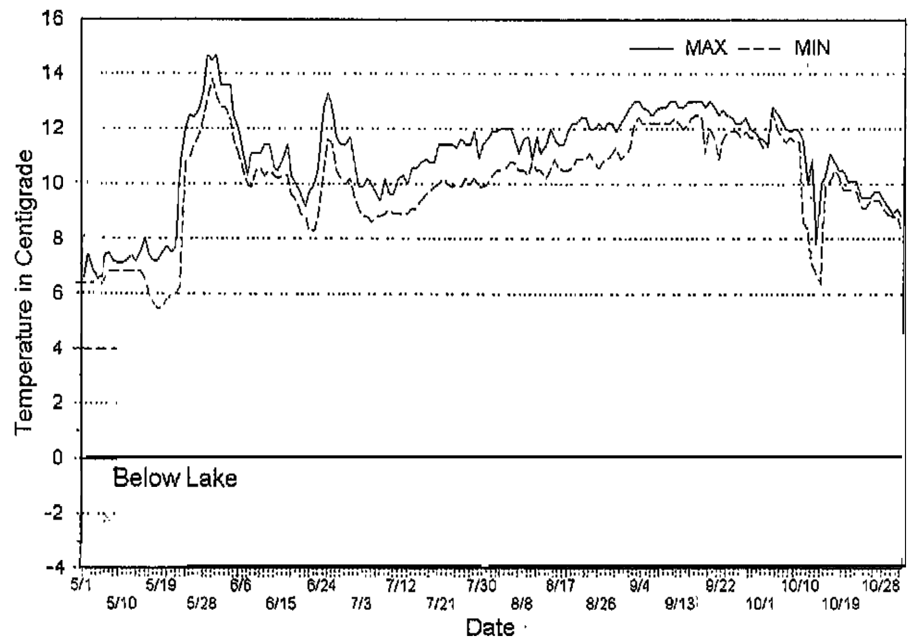


Figure 20. Temperature data from immediately above and below Laurance Lake Reservoir at Clear Branch Creek from the Hood River system in 1995 (from Pribyl et al. 1995).

Major spawning areas in this drainage have yet to be identified. The Clear Branch watershed was heavily logged prior to dam construction in 1969 resulting in a lack of large woody debris and a reduction in riparian corridors. Also, Clear Branch Dam halts downstream movement of gravel and sediment, resulting in limited spawning gravel in the reach immediately below the dam (G. Asbridge, USFS, letter, April 1997).

No non-native trout are presently found in parts of the Hood Basin where bull trout occur. Brook trout have been widely stocked in parts of the basin, but not in the Middle Fork subbasin. ODFW has no plans to stock brook trout in the Middle Fork subbasin. However, hatchery releases of spring chinook and winter steelhead will soon be stocked into the Middle Fork subbasin where temporal and spatial overlap of spawning may occur.

Management Considerations

The Hood Basin Bull Trout Working Group comprised of representatives from ODFW, USFS, USFWS, CTWSR, PacifiCorp, Oregon Natural Heritage Program, Middle Fork Hood River Irrigation District, and other affected interests has been formed to coordinate work on bull trout and to draft a conservation strategy for bull trout in the basin. The working group has identified numerous actions to improve bull trout habitat including two culvert replacements in Pinnacle Creek near Laurance Lake, upstream fish passage improvements at Middle Fork Irrigation District's Coe Branch Diversion, improving screening at several diversions, and improving water temperature below Laurance Lake during spawning.

Construction of an upstream trapping facility at the base of Clear Branch Dam by the USFS was completed in 1996 and coordinated through the working group. It is currently unknown if migratory adult bull trout that arrive immediately below Clear Branch Dam are all from the Clear Branch system upstream of Clear Branch Dam. Some may be from the Coe Branch (Compass Creek) system. Bull trout caught in the trap will be measured, weighed and tagged (if untagged), and scale samples taken; Tagged bull trout that are caught in the trap three times will be moved over the dam to Laurance Lake. It will be assumed that they are trying to return to the lake.

The spillway at Clear Branch Dam was enlarged and modified in 1991-1992 to better accommodate downstream passage when water is being spilled. To test survival of salmonids passing over the spillway, approximately 50+ each of marked hatchery chinook, steelhead, and rainbow were released in 1996 into the uppermost section of the spillway and subsequently monitored using a screw trap located approximately 100 yards downstream from the spillway stilling basin. No injuries were noted on fish captured. An estimated 80% of the test chinook, 32% of the test steelhead, and 132% of the rainbow trout were recovered. The high number of rainbow captured may have resulted from additional rainbow trout stocked in the lake exiting via the spillway. Efficiency of the trap was not determined, but is believed to be fairly high.

Habitat improvement work by the USFS has included installing artificial structures including large woody debris and root wads, and conducting riparian planting to enhance upper Clear Branch Creek both above and below the dam. The Middle Fork Hood

River Irrigation District is planning to add spawning-sized gravel below Clear Branch Dam.

Future plans for the working group consist of completion of the conservation strategy, continued life history studies, continued inventories to further define important spawning and rearing areas in the basin, and continuation of the various restoration projects to protect populations and their habitats, thus improving the status of the population.

The entire Hood Basin including Laurance Lake was closed to the taking of bull trout in 1991. Angling at Laurance Lake is further restricted to barbless artificial flies and lures since 1992 (Pribyl et al. 1995). It is unknown if illegal harvesting of bull trout is continuing to occur at Laurance Lake. Angler education efforts include bull trout identification posters, brochures in Spanish and English, and a planned kiosk at Laurance Lake where educational materials can be displayed.

Instream water rights on four streams in the Hood River Basin have been applied for, but have been protested by local users. No instream water rights have been issued for streams in the Hood River Basin to date.

Current Status

The status of bull trout in the Hood River Basin was first assessed by Ratliff and Howell (1992). They listed a Clear Branch population as having a "high risk" of extinction and a West Fork Hood River population as "probably extinct." The Clear Branch population remains at the same status in this report. A possible new population in Compass/Coe Branch Watershed is also listed as having a "high risk" of extinction. No historical reference for bull trout above Punchbowl Falls on the West Fork Hood River has been found and it is therefore omitted from this status report.

Deschutes River Basin

Introduction

This is a summary of existing information on bull trout in the Deschutes River Basin. It updates the published information by Ratliff (1992), Ratliff and Howell (1992), Thiesfeld et al. (1996) Ratliff et al. (1996) and Stuart et al. (1997). Some additional published and unpublished reports are also cited.

The Deschutes River flows north through central Oregon and is a major tributary to the Columbia River entering at about RK 327. The Deschutes Basin drains an area of approximately 27,195 sq km. The mainstem Deschutes River begins at its source at Little Lava Lake and travels approximately 405 km to its confluence with.the Columbia River. Major tributaries to the Deschutes River include White River (RK 75), Warm Springs River (RK 135), Trout Creek (RK 140), Shitike Creek (RK 15l), Metolius River (RK 179) Crooked River (RK 183), and Little Deschutes River (RK310). The Deschutes River,Basin drains much of the east side of the Cascade Mountains, and ranges in elevation of 49 m at its mouth to over 3,200 m in the high Cascades.

Ode11 and Davis lakes are included in this report of the Deschutes Basin, although they have been physically isolated from the upper Deschutes Basin for about 4,000 to 6,000 years by a lava flow that impounded Odell Creek and formed Davis Lake (Johnson et al. 1985). Water from Ode11 Lake flows via Odell Creek into Davis Lake.

Lands in the Deschutes Basin that support bull trout habitat are owned or managed by the USFS, BLM, CTWSR, and private timber companies and individuals.

Historic Distribution

Bull trout were historically found throughout most of the Deschutes Basin (Ratliff.et al. 1996). A major Native American and Euro-American pioneer fishery occurred on bull trout in the upper Deschutes River at Pringle Falls (Ratliff and Fies 1989). Many historical photos of large bull trout are recorded, near Bend and from the Metolius River, Bull trout populations upstream of a natural falls (Big Falls at RK 212) were apparently reproductively isolated, from populations in the, lower river. Historical, adfluvial populations of bull trout were also present in the Blue/suttle lake complex Crescent Lake, and Davis Lake.

Isolation of upper Deschutes Basin bull trout populations probably occurred upon completion of upper basin irrigation storage dams. The completion of Crane Prairie Dam in 1922, Crescent Lake in 1928, and Wickiup Dam in 1947, all without fish passage facilities, blocked access for adult bull trout migrating to upper Deschutes River spawning areas. Increased water temperatures, altered streamflow regimes, inundation of some juvenile rearing areas, blockage of adult spawning areas, competition with non-native trout, and overharvest apparenty eliminated remnant bull trout populations in the Deschutes River above Big Falls during the 1950s (Stuart et al. i997). The last bull trout were observed in Crane Prairie Reservoir in 1955, in Wickiup Reservoir in 1957,: and in Crescent Lake in 1959. The last bull trout was observed in the Deschutes River above Bend in 1954 (Ratliff et al. 1996). Ratliff and Howell (1992) listed two bull trout populations, upper Deschutes River and Crescent Lake, as “probably extinct.” There may have been separate populations in Fall River and Tumalo Creek, but spawning was not documented in these systems, and bull trout can no longer be found there (Ratliff et al. 1996).

Constructed dams have further isolated populations of bull trout in the lower Deschutes Basin. Round Butte Dam, constructed in 1964, and the subsequent abandonment of downstream passage facilities in 1968, isolated the Metolius River bull trout populations from those in Shitike Creek and Warm Springs River downstream (Ratliff et al. 1996). Bull trout are no longer found in Trout Creek, although they were reported there in 1960 (Goetz 1989). Fluvial subpopulations in Shitike Creek and Warm Springs River contributed and still contribute bull trout into the lower Deschutes River (Newton and Pribyl 1994).

The Blue Lake-Link Creek-Suttle Lake bull trout group (Metolius subbasin) has been extirpated, possibly due to overharvest. The last bull trout observed in Suttle Lake was in 1961. Abbot Creek was historically a bull trout spawning and rearing stream but recent surveys in this stream found no spawning bull trout (Ratliff et al. 1996). However, recent night diving in Abbot Creek found juvenile bull trout (M. Riehle, USFS, personal communication, June 1997).

The first extensive fish surveys in the Crooked River subbasin were conducted in the 1950s. By this time, the basin was degraded due to severe water withdrawal and radically altered riparian areas (Nehlsen 1995). Wandering subadult and adult bull trout, likely from the Metolius system, were occasionally caught in the Crooked River as far up as the city-of Prineville (RR 77) through the early 1980s (Ratliff et al. 1996). The 1983 enlargement of the Opal Springs Diversion Darn on the lower Crooked River created an upstream barrier to bull trout and other fish species.

Current Distributions

Current and historic distribution of bull trout in the Deschutes Basin based on documented reports is portrayed in Figure 21 (lower Deschutes River Subbasin) and Figure 22 (upper Deschutes River Subbasin). Of the historical adfluvial bull trout populations in Oregon, only the Odell Lake population continues to produce bull trout. The abundance of the Odell population remains unknown. However, angler observations of bull trout incidentally caught in the kokanee fishery have been increasing since the harvest of bull trout was prohibited after I990 (Smith and Messmer 1996). Resort owners and creel surveyors recorded 12 bull trout caught and released by anglers in 1996. No bull trout were caught in trapnet sets in the fall of 1995. One 460 mm adult female bull trout and 5 juvenile bull trout were observed in Trapper Creek, a tributary to Odell Lake in 1995 (Smith and Messmer 1996), but no adults or juveniles were observed in nearby Crystal Creek by USFS personnel in 1995. Also, the USFS surveyors did not observe bull trout in nearby Quita and Fire creeks. In 1996, biologists from the USFS observed 23 juvenile bull trout from several age classes by snorkeling in a 0.8 km section of Trapper Creek (R. Messmer, ODFW, personal communication, October 1996).

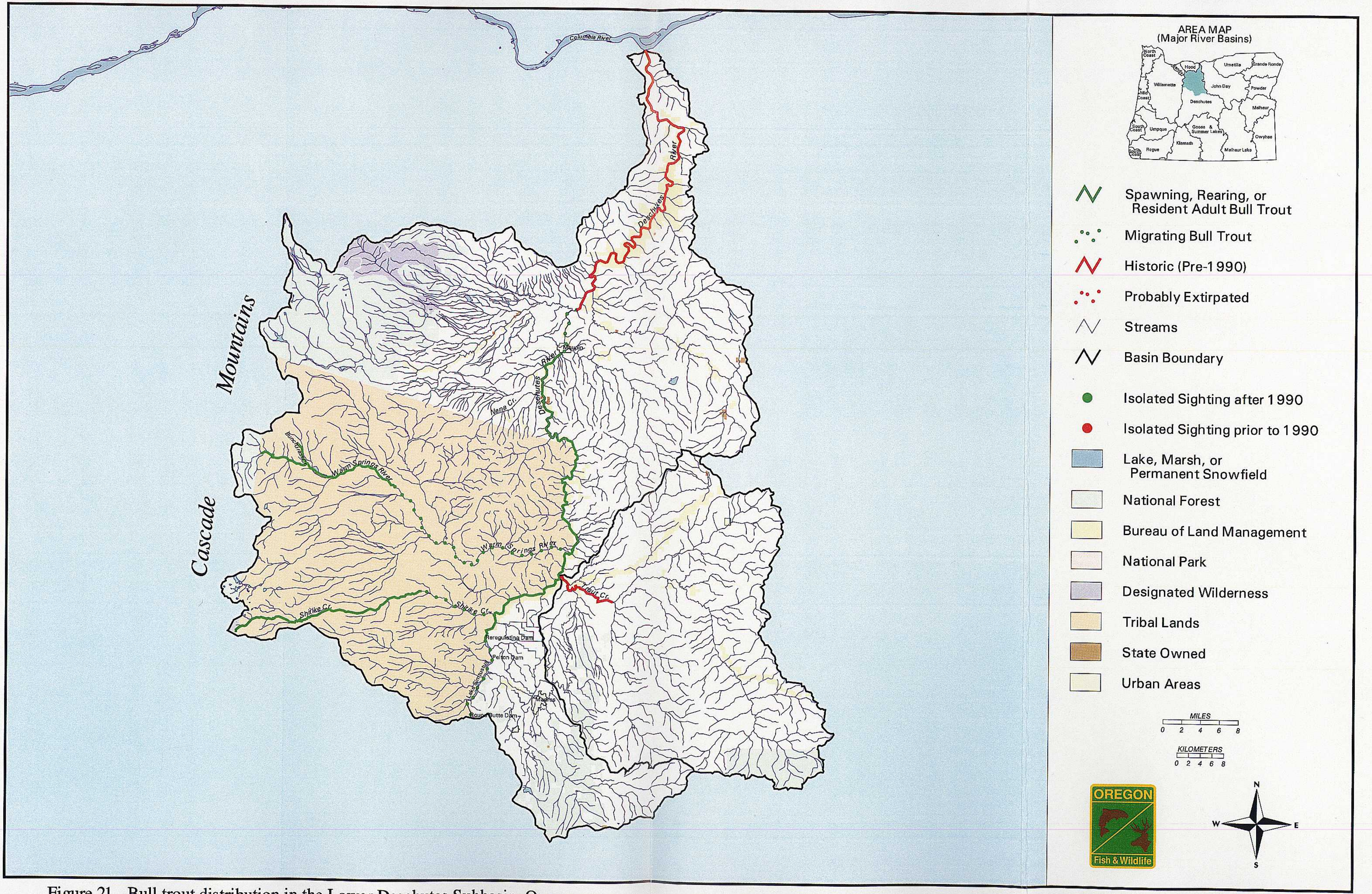


Figure 21. Bull trout distribution in the Lower Deschutes Subbasin, Oregon.

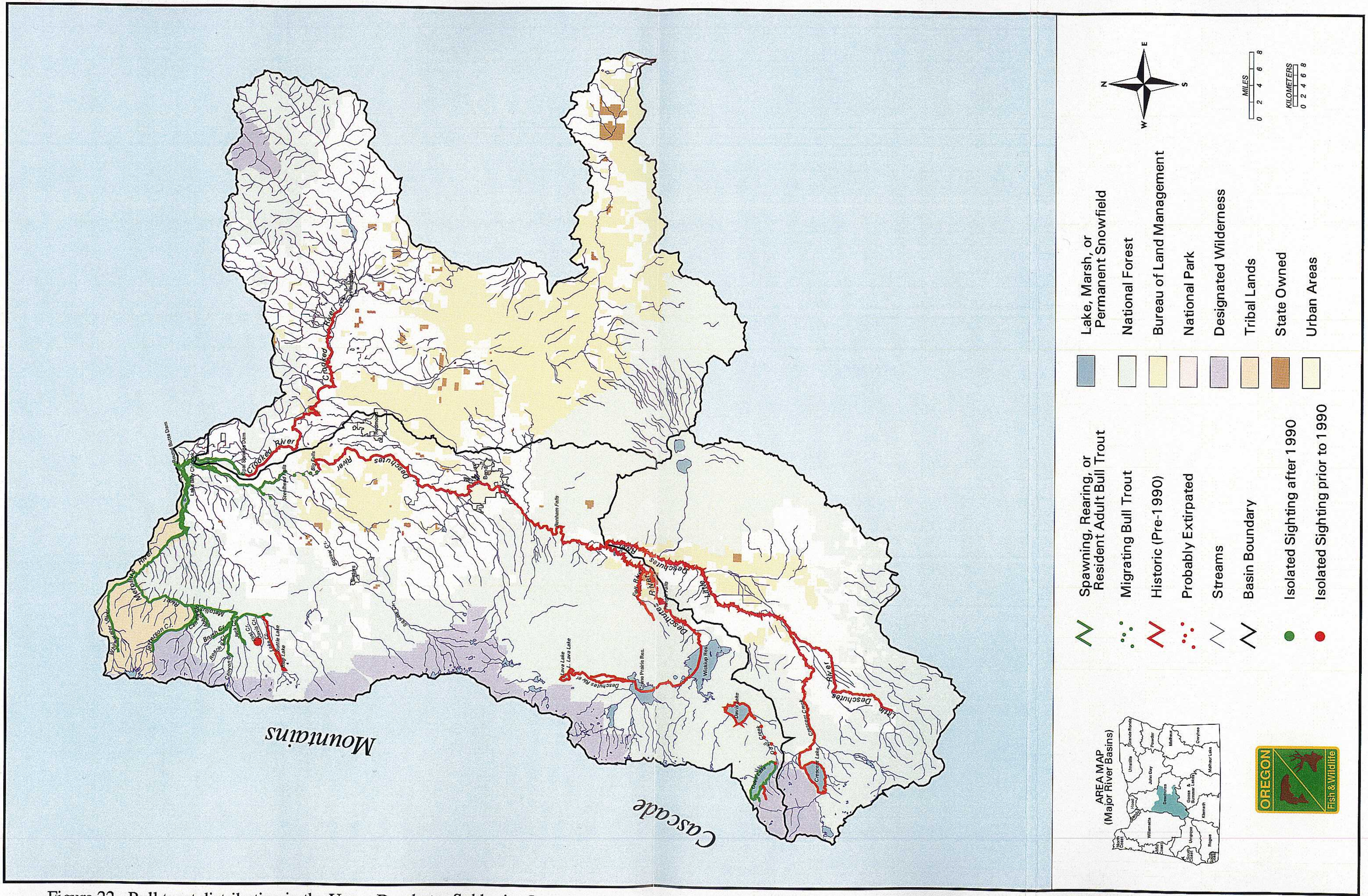


Figure 22. Bull trout distribution in the Upper Deschutes Subbasin, Oregon.

Bull trout currently inhabit most riverine habitats of the Metolius Subbasin except Lake Creek, Link Creek, and Suttle and Blue lakes. This includes First, Jack, Canyon, Roaring, Brush, Abbot, Candle, and Jefferson creeks; and Whitewater River. Some juvenile bull trout apparently recolonized Abbot Creek in 1994; as they were not observed in an earlier study (Ratliff and Fies 1989). The Metolius River, Lake Billy Chinook Reservoir (LBC), the Deschutes River above LBC upstream to Steelhead Falls, and the lower part of Crooked River up tb the Opal Springs Dam also support bull trout. Subadult bull trout also use lower Squaw Creek, a tributary to the Deschutes River 4.8 km above LBC.

Bull trout are found in the lower Deschutes River above Sherars Falls, Shitike Creek, and,Warm Springs River (Figure 21). Abundance of bull trout has not been estimated in these areas but appears to be low (Newton and Pribyl 1995): One or two adult bull trout are caught in the Pelton Dam trap each year. In 19 years of operation of a steeppass trap at Sherars Falls, no bull trout havk been captured (S. Pribyl, ODFW, personal communication, January 1996).

Life History

Little life history information can be gleaned from rare populations such as the Odell Lake population. Some data from 6 adult bull trout caught on 13 October 1992 by trapnets set in Odell Lake suggests that 5 were mature or maturing females. These bull trout were captured at a time and place in the lake that suggests they would spawn in late October or into November (John Fortune, ODFW, personal communication, February 1993).

Some excellent life history information is available for bull trout in the Metolius River and LBC subbasin developed by multi agency, tribal, and private industry biologists working in the subbasin since 1983 (Ratliff et al. 1996). Most bull trout in the Metolius River And tributaries spawn between 15 August and early October with some individual spawner's found between July through late October (Ratliff 1992). It appears that the extremely cold (4 to 8°C.) Metolius River tributaries, including Jack, Canyon, Roaring, Candle, and Jefferson creeks, and Whitewater River, provide the critical spawning and juvenile rearing habitats that support the Metolius River bull trout population (Ratliff et al. 1996).

Juvenile bull trout typically rear in their natal streams for two to three years before migrating downstream to LBC Although migrating juveniles were observed in all months, most migration peaked in May and June Figure 23). Many of these fish appeared to migrate directly to LBC when about 200 mm long. Subadult bull trout tagged in LBC at the head of the Metolius River arm mdved into all available waters. After.two to three years in the reservoir (Age 5-6), they migrated b&k up the Metolius River during April-July. Maturing adult bull trout were captured at the head of the Metolius River arm of LBC beginning in April and continuing through August (Pratt 1991, Ratliff et al. 1996).

Most maturing bull trout remained in the lower Metolius River until mid-July when they initiated their upstream migration. After migration commenced, most fish quickly moved up the Metolius River and resided near the mouth of the intended spawning tributary (Thiesfeld et al. 1996). Adult bull trout entered tributary streams beginning in late July and continuing through the last week of September (Figure 24). Migration into the spawning tributary, spawning, and migration back to the Metolius River usually took place within two weeks (Thiesfeld et al. 1996). Most bull trout appeared to return to the same stream and spawn each year. Bull trout spawning in Whitewater River migrated upstream faster and earlier than fish spawning in other tributary streams (Thiesfeld et al. 1996). Most post-spawning bull trout moved back down to LBC within four weeks of spawning, demonstrating an adfluvial life history pattern. However, some bull trout appeared to demonstrate a fluvial life history pattern and remained in the upper Metolius River (A. Hemmingsen, ODFW, personal communication, October, 1995).

The number of bull trout redds counted in the Metolius River and tributaries has generally increased from a low of 27 in 1986 to a high of 330 in 1994, These counts may represent 50-70% of the spawning that occurs in the system (Ratliff et al, 1996). The number of spawning adults per redd ranged from 2.1 to 5.4 during a 4 year period where migrating adults were counted at Jack Creek trap and redds were counted upstream. The number of adults per redd ranged from 2.3 to 4.3 during a 2 year period where migrating adults were counted at Jefferson Creek trap and redds were counted upstream. The estimated adult population in the monitored spawning areas increased from 348 fish in 1990 to 759 fish in 1994, while the entire spawning population was estimated to be 818 adults in 1993 and 1,895 adults in 1994 (Ratliff et al. 1996). The number of bull trout counted in the Metolius River Basin suggest that this population is fit and robust enough to prevent excessive inbreeding.

Growth rates of Metolius River Basin bull trout were similar to those reported for bull trout in other locations through Age 4, but much faster after Age 4. Mean fork lengths during April for juvenile bull trout Ages 0+, 1+, and 2+ sampled in the Metolius River tributaries were 33 mm, 70 mm, 107 mm, respectively. Spawning bull trout ranged from 230 mm to 824 mm long, with most adults between 450 mm and 650 mm. Length of bull trout rearing in LBC increased an average of 167 mm per 12 months (Ratliff et al. 1996).

Metolius River tributaries had some of the highest juvenile bull trout density estimates recorded in the literature (Ratliff et al. 1996). Late summer densities of Age 1 through Age 3 bull trout in pool and glide habitats in Jack, Roaring, Brush, Canyon, and Candle creeks were estimated to range from 2.0 to 20.6 fish/100 sq.m.

As identified from USFS surveys, rearing tributaries for juvenile bull trout are dominated by riffle and run habitats (Riehle 1993). Pools make up less than 12% of the habitat in bull trout streams in the basin. Cover, most frequently undercut banks, and overhanging and aquatic vegetation, comprises from 1 to 10% of the habitat area in the tributaries. Wood also provides cover and densities range from 20 to 480 pieces/km in streams with bull trout. Cobble embeddedness is 28-56% in the tributaries, and this probably reduces the ability of juvenile bull trout to enter interstitial spaces in the substrate for cover. The amount of tine sediment (<6.4 mm diameter) in spawning areas was 22% in Canyon Creek, 22-33% in Roaring Creek, 24% in Jefferson Creek, and 32% in Jack Creek. However, recent monitoring after the 1996 flood has

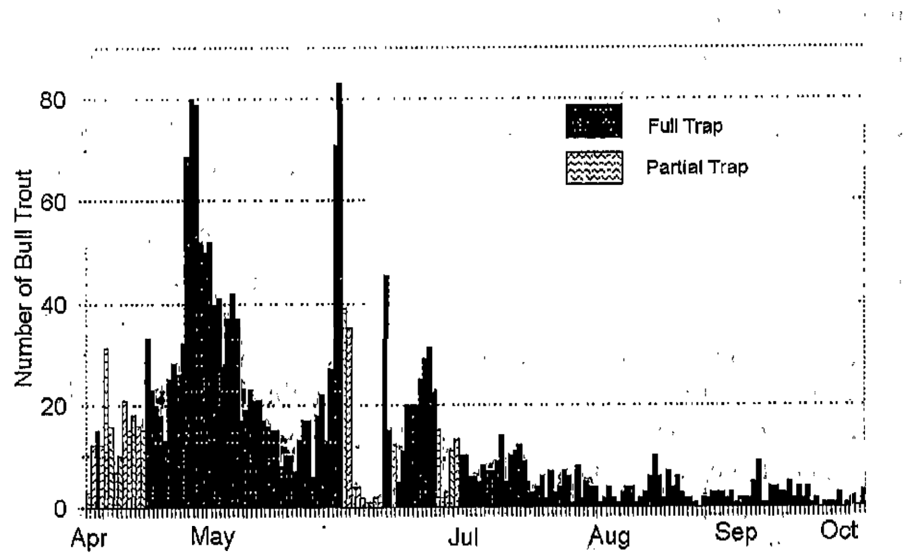


Figure 23. Timing of bull trout downstream migrations from Jack Creek, Metolius River Basin, Oregon, 1990 (from Ratliff et al. 1996).

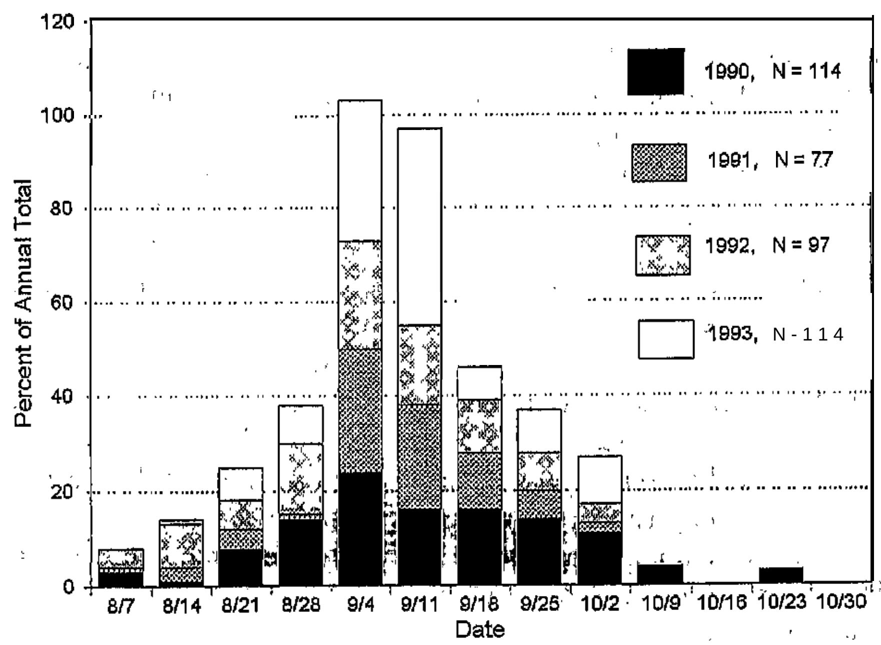


Figure 24. Timing of upstream migrating adult bull trout into the Jack Creek trap, Metolius River Basin, Oregon 1990-93 (from Ratliff et al. 1996).

shown reduced levels of fine sediment in bull trout spawning areas (M. Riehle, USFS, unpublished data, June 1997). Summer water temperature in the streams used by bull trout for spawning and rearing was strongly influenced by cold springs. Roaring and Candle creeks were the coldest streams and had summer temperatures than ranged from 4 to 6°C. In all spawning streams, temperatures fell below 9°C before spawning began (Ratliff et al. 1996). Macroinvertebrate monitoring indicated a moderate to high relative abundance of sediment-tolerant organisms in most streams sampled. There have been only slight changes in summer water temperature, peak flow and macroinvertebrate abundance and diversity in juvenile bull trout rearing streams during recent years (Ratliff et al. 1996).

Most bull trout spawning in the lower Deschutes Basin is believed to occur in the upper parts of Warm Springs River and Shitike Creek. Estimated redd counts ranged from a high of 18 redds in 1989 to lows of six redds in 1992 and 1994 and only one redd in 1995 in upper Shitike Creek (C. Brun, CTWSR, personal communication, November 1996). An occasional adult bull trout is captured at the Warm Springs National Fish Hatchery upstream trap and at the Pelton Dam upstream trap.

Samples for genetic analysis were taken in 1995 from Jack, Whitewater, and Jefferson creeks (Metolius Subbasin) and from Shitike Creek and Warm Springs River (Hemmingsen et al. 1996). Analysis of micrasatellite nuclear DNA from these data show that bull trout populations from western Oregon, Hood Basin, and the Deschutes Basin all comprise a similar major genetic lineage (Spruell and Allendorf 1997).

Specific Limiting Factors

Some bull trout habitat in the Metolius River Subbasin has been impacted by past and present logging and road building activities. These impacts may have increased local water temperatures and sedimentation in spawning and juvenile rearing habitats (Ratliff et al. 1996). Stringent controls are now in place to protect bull trout habitat in the Metolius Subbasin (USFS 1990a). Much of the western half of the upper Metolius subbasin has been adversely affected by a spruce budworm outbreak that has caused high mortality in stands of white fir and Douglas fir. Some thinning and salvage logging is occurring in the subbasin (M. Riehle, USFS, personal communication, July 1996).

Brook and brown trout have been introduced in the Metolius subbasin. Brook trout are currently found in Abbot, Brush, and Canyon creeks (Brumback 1993b). Brook trout are no longer stocked in Metolius Basin high lakes that overflow or can potentially flow into tributaries of the Metolius River. Brook trout appear to be relatively more tolerant of warmer stream temperatures than bull trout. M. Riehle (USFS, personal communication, June 1995) compared juvenile bull trout habitat use in two Metolius River tributaries: Roaring and Canyon creeks. Using snorkel surveys, he found that there were consistently more bull trout in the colder parts of the streams sampled, a fact he attributed to their temperature preferences (Table 9). He also noted that there were no barriers or obstructions to movement between the study streams and that Roaring Creek is a cold water tributary that separated upper and lower Canyon Creek.

Table 9. Relative abundance of three salmonid species in adjacent tributaries without barriers in the Metolius River, Oregon.

Location	Maximum summer temperature	Native bull trout	Native rainbow trout	Non-native brook trout
Upper Canyon Creek	14°C	2%	27%	71%
Roaring Creek	8°C	88%	12%	0
Lower Canyon Creek	10°C	81%	18%	1%

The only harvest allowed on bull trout in Oregon occurs in LBC and the Deschutes upstream of the reservoir. Harvest is, closely monitored and is not believed to. be limiting bull trout at this time. A discussion of the fishery on LBC occurs later in this report.

Introduction of non-native lake trout into Odell Lake may explain why bull trout in this lake are at a "high risk" of extinction. Donald and Alger (1992) documented that introduced lake trout can displace and eliminate native bull trout. The presence of a public campground on Trapper Creek in the only identified bull trout spawning area in the Odell subbasin may put spawning bull trout at risk from illegal harvest.

Warm Spring River and Shitike Creek provide most of the known spawning areas for bull trout found in the lower Deschutes Subbasin. Logging, road construction, and intensive livestock grazing on the Warm Springs Reservation may have impacted bull trout habitat (Newton and Pribyl 1994). The presence of brook trout in both Warm Springs River and Shitike Creek is a concern for the lower Deschutes subbasin bull trout populations.

Management Considerations

Prior to 1980, the bull trout bag limit was 10 fish per day in the Metolius subbasin (Ratliff et al. 1996). Since then fishery managers have enacted several protective regulation changes (Table 10). A regulation change in 1994 prohibited the taking of bull trout in the lower Deschutes River. This change should provide some additional population protection.

Statistical creel surveys have been conducted on LBC since 1990 during March and April, the months that many anglers key on bull trout, Angler effort directed toward bull trout ranged from 40 to 65% of the total angler effort in March. Total angler effort in March and April, 1995 was 26,369 hours, while angler effort directed towards bull trout was 12,687 hours (Figure 25). In March and April 1995, an estimated 321 bull trout were harvested, while an estimated 1,958 bull trout were released. The number of bull trout harvested in the March and April fishery has remained relatively stable since 1990, while the number released has increased dramatically (Figure 26). Bull trout harvest in March and April has shifted to larger fish in recent years, probably due to educational efforts and the one bull trout per day bag limit (Stuart and Thiesfeld 1996, Stuart et al 1997). The combined harvest of bull trout during the bull trout and kokanee fisheries from March through October has increased since 1990. In 1996, an estimated 2,105 bull trout were harvested and an estimated 5,719 bull trout were released (A. Stuart, ODFW, personal communication, December 1996). Some illegal adult harvest is suspected in the Metolius River (Stuart and Thiesfeld 1996, Thiesfeld et al. 1996). Efforts are currently underway to determine the long-term carrying capacity of the Metolius-Lake Billy Chinook system for bull trout given their ecological role as the top-level aquatic predator (D. Ratliff, PGE, personal communication, April 1997).

The Metolius Bull Trout Working Group comprised of representatives from ODFW, USFS, CTWSR, and PGE began efforts to protect and enhance bull trout in the Metolius subbasin in 1983. The group has been expanded to include the entire Deschutes Basin and additional representatives from the USFWS, BLM, Central Oregon Flyfishers, Trout Unlimited, Oregon Department of Forestry, and Oregon State Parks and Recreation Department. Another working group has been formed to work on bull trout issues in the Odell Lake Basin. This group includes representatives from the USFS, ODFW and resort owners around the lake. Both working groups are drafting conservation strategies for bull in their respective basins.

Table 10. A chronology of state angling regulation changes enacted in the Metolius River/Lake Billy Chinook system to prevent over-harvest of native bull trout (from Ratliff et al. 1996).

Year	Location	Regulation change
1980	Ail Oregon streams	Trout bag limit reduced from 10/day to 5/day
1983	Metolius River	All wild trout including bull trout must be released unharmed
1988	LBC	Trout bag limit reduced from 10/day to 5/day
1988	Metolius River tributaries	Closed to angling from 15 August through 3rd Saturday in April
1992	LBC	Trout bag limit reduced to 5/day of which only one may be a bull trout
1994	Metolius River tributaries	All tributaries below Lake Creek closed to angling
1997	LBC	Trout bag limit S/day of which only one bull trout over 610 mm (24 inches) in length

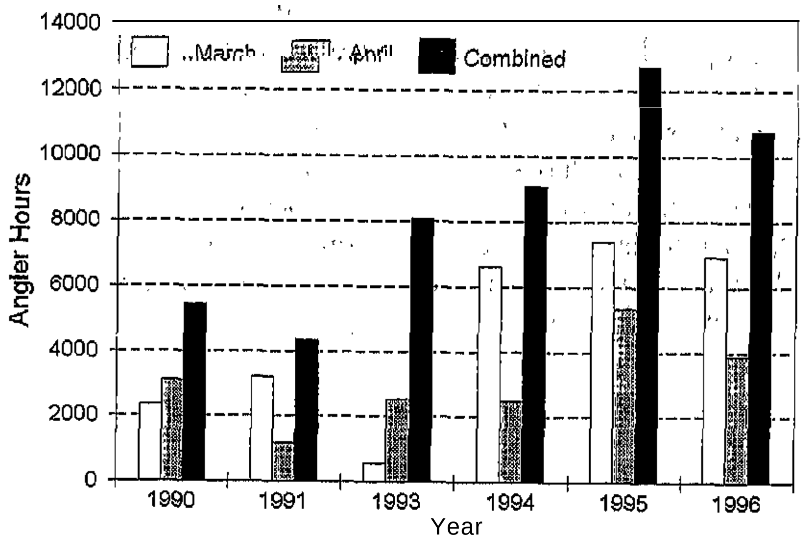


Figure 25. Angler effort directed at bull trout on Lake Billy Chinook during March and April, 1990-91 and 1993-96 (from Stuart and Thiesfeld 1996 and Stuart et al. 1997).

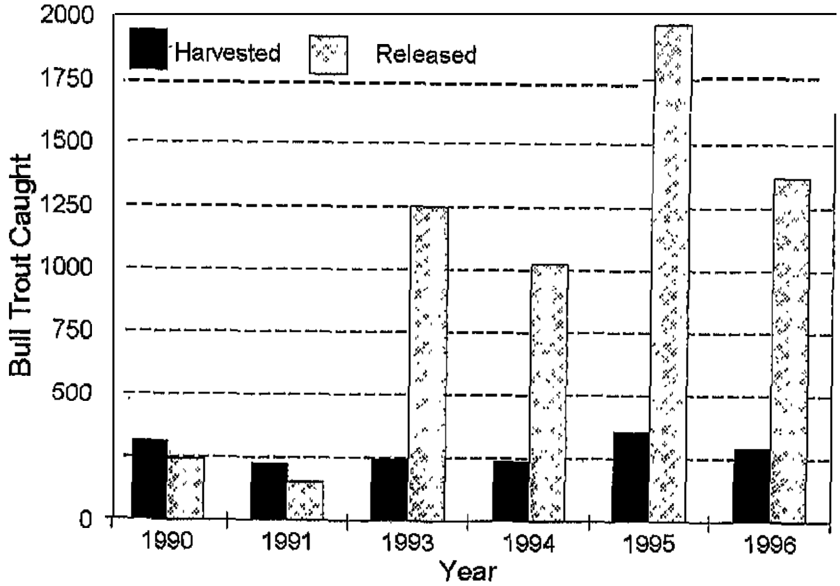


Figure 26. The number of bull trout caught during March and April at Lake Billy Chinook (from Stuart and Thiesfeld 1996 and Stuart et al. 1997).

Current Status

The status of bull trout in the Deschutes Basin was first reported by Ratliff and Howell (1992). They listed six populations with the upper Deschutes River and Crescent Lake populations as "probably extinct." The Odell Lake population was listed as "high risk" of extinction and the Warm Springs River was listed as having a "moderate risk." Both the Metolius River and Shitike Creek populations were listed as having only a "low risk" of extinction.

This status report lists the same six populations for the basin. There is no status change for the Upper Deschutes River, Crescent Lake, Odell Lake, Warm Springs River and Metolius River. However, Shitike Creek has been downgraded to a "moderate risk" because recent biological surveys found previously unrecorded brook trout in the system and recent bull trout redd counts are low.

John Day River Basin

Introduction

The following is a summary of existing information on bull trout in the John Day River Basin. Most information presented is from ODFW unpublished reports and data provided by USFS, Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and The Nature Conservancy.

The John Day Basin, situated in northeastern Oregon, drains nearly 13,033 sq km of an extensive interior plateau lying between the Cascade Range and the Blue Mountains. It is the fourth largest basin in the state and the third largest basin east of the Cascade Range. Elevations range from about 6 1 m at the confluence of the John Day River with the Columbia River up to 2,745 m in the Strawberry Range (Oregon Water Resources Department (OWRD) 1986).

Coniferous forests and meadows are prevalent above 1,220 m. Some irrigated agriculture is practiced in the canyon bottoms, but dryland farming and livestock grazing are the most prevalent agricultural activities in the basin.

Most of the John Day Basin is part of lands ceded to the Confederated Tribes of the Warm Springs Reservation (CTWSR). However, part of the North Fork John Day Subbasin is land ceded to the CTUIR.

Historical Distribution

Bull trout were historically found throughout much of the upper John Day Basin. CTUIR (1941) was able to document many of the usual and accustomed fishing sites of the Native American tribes using the John Day Basin. Unfortunately, CTUIR (1941) only separated the species harvested into trout, salmon, and whitefish. In the John Day Basin, "trout" could refer to rainbow, steelhead, bull and cutthroat trout. Large, fluvial, late fall spawning bull trout were undoubtedly a fresh protein source caught before the impending harsh winters. The fishing sites in the mainstem John Day River and tributaries are listed in Table 11. None of these sites were actively used by the tribes by 194 1. The fishing sites in the Middle Fork of the John Day River are listed in Table 12. The only site still active in 1941 was a site near Ragged Creek (RK 88). The fishing sites in the North Fork John Day River and tributaries are listed in Table 13. Of the 19 trout fishing sites listed in the North Fork system, 13 were still actively used by the tribes in 1941. This fishing site activity suggests that in 194 1 the North Fork system was producing catchable-sized bull and other trout.

Claire and Gray (1993) report that local anglers caught bull trout in the Middle Fork John Day River and tributaries from Indian, Butte, Vinegar, Big Boulder creeks and the Middle Fork itself from Big Creek to Phipps Meadow. Also old-time anglers report larger bull trout up to a meter long caught throughout the North Fork John Day. A review of data summarizing fish collected at water diversions in tributaries to the upper mainstem of the John Day River found references to bull trout captured in Pine, Dixie, Dad's, Beech, and Laycock creeks in the late 1950s and throughout the 1960s (E. Claire, ODFW, personal communication, November 1995). A single bull trout was trapped in a diversion trap in Canyon Creek in July 1985. Diversion traps are still active in Canyon, Beech, and Laycock creeks, but

Table 11. Usual and accustomed fishing sites of the Confederated Tribes of the Umatilla Indian Reservation in the mainstem John Day River and tributaries (CTUIR 1941).

Stream	Location	Indian name	Species	Tribes[a]	Fishing method[b]	Active site[c]
Rock Creek	Confluence of Tupper and Chapin Cr.	Kutske-pa	Trout	UM, CR	Hooks	No
Beech Creek	Near mouth of E. Fk.	Pow-wa-sackt	Trout	UM, RC, CR	Hooks	No
Upper mainstem John Dav River	RK 447-near Call Cr.	I-tie-meene-pa	Trout	UM, CR	Hooks	No

[a] *Tribes which use fishing sites: UM = Confederated Tribes of the Umatilla Indian Reservation; RC = Rock Creek; CR = Columbia River.*
[b] *Fishing methods before 1941; present methods include grab hooks and hook and line only.*
[c] Refers *to site activity as of 1941. No sites used historically are used today (Claire and Gray 1993).*

Table 12. Usual and accustomed fishing of the Confederated Tribes of the Umatilla Indian Reservation in the Middle Fork John Day River (CTUIR 1941).

Stream	Location	Indian name	Species	Tribes[a]	Fishing method[b]	Active site[c]
M Fk John Day R	M Fk-N FK Confl.	Pow-wa-chakt	Salmon	UM, CR	Weirs	No
M Fk John Day R.	RK 48-near Paradise Canyon	Ya-we-shin-ma	Salmon	UM	Weirs	No
M Fk John Day R.	RK 88-near Ragged Cr	Nook-simnos-saw-us	Trout, Salmon	UM, RC	Hook and nets	Yes
M Fk John Day R.	RK 101-near Caribou Cr.	Tum-sque-pa	Trout, Salmon	UM, RC	Hook and nets	No
M Fk John Day R	near Bates, OR	We-wa-nite	Trout	UM, RC	Hooks	No

[a] *Tribes which use fishing sites: UM = Confederated Tribes of the Umatilla Indian Reservation; RC = Rock Creek; CR = Columbia River.*
[b] *Fishing methods before 1941; present methods include grab hooks and hook and line only.*
[c] Refers *to site activity as of 1941. No sites used historical& are used today (Claire and Gray 1993).*

Table 13. Usual and accustomed fishing sites of the Confederated Tribes of the Umatilla Indian Reservation in the North Fork John Day River tributaries (CTUIR 1941).

Stream	Location	Indian name	Species	Tribes[a]	Fishing method[b]	Active site[c]
Camas Creek	Near mouth of Wm. Spr. Cr.	Tucg-kupin-was	Trout	UM	Hooks	No
Camas Creek	5 km below Cable Cr.	Couse-shets-pa	Trout, Whitefish	UM	Water diversion	No
N Fk Cable Creek	Near mouth of Neeves	Tipas	Trout	UM	Water diversion	Yes
N Fk Cable Creek	Headwater area	Kolk-tie	Trout	UM	Hooks	Yes
Camas Creek	Near Ukiah, OR	Tack-en-pala	Trout	UM	Hooks	Yes
Camas Creek	Camas George	Wy-na-nets-pa	Trout, Whitefish	UM	Hooks	Yes
Owens Creek	4 km north of Ukiah	Ukiahs	Trout	UM	Hook and Spear	No
Snipe Creek	Near mouth	Wrap-neet-pa	Trout	UM	Hook and Spear	No
Trail Creek	Near mouth	O-yel-pa-wa-coas	Trout	UM	Hook and Spear	Yes
Bull Run Creek	Near boundary G.S.	Kuts-kutsapa Tacken	Trout, Salmon	UM	Hook and Spear	Yes
Granite and Boulder Cr.	Near confluence	Pe-sown-e-a	Trout, Salmon	UM	Hook and Spear	No
Big Creek	Big Creek Meadow	Tuna-pull-tia-pa	Trout	UM	Horn Hooks	Yes
Winom Creek	Near Winom Meadows	Winomp-smoot	Trout	UM	Hooks	Yes
N Fk Desolation Creek	Desolation Meadows	Tsopp-pa	Trout	UM, CR, RC, WS	Hooks	Yes
Wall Creek	Near Walls Cr. Forks	Wa-hoe-tanine-spa	Trout	UM, CR	Hooks	Yes
Little Wall Creek	5 km up from mouth	Neinelpa	Trout	UM, CR	Hooks	Yes
Big Wall Creek	8 km up from mouth	Shnups-pa	Trout	UM, CR	Hooks	Yes
Ditch Creek	15 km up from mouth	Soo-la-yakt	Trout	UM, CR	Hooks	Yes
Smith & Dunning Creek	Near Fox, OR	A-my-yee	Trout	UM, CR, RC, WS	Hook and Spear	No

[a] *Tribes which use fishing sites: UM = Confederated Tribes of the Umatilla Indian Reservation; RC = Rock Creek; CR = Columbia River; WS = Warm Springs.*
[b]*Fishing methods before 1941; present methods include grab hooks and hook and line only.*
[c]*Refers to site activity as of 1941; most sites used then are occasionally used today (Claire and Gray 1993).*

no bull trout have been captured at these sites since the listed dates. In May 1980, Errol Claire and Steve Sasser from the Oregon State Police checked two angler-caught bull trout approximately 460 to 480 mm in length near Oriental Creek (RR 117) on the North Fork John Day River (E. Claire, ODFW, personal communication, November 1995).

Current Distribution

Current and historic distribution of bull trout in the John Day River Basin listed in documented reports is portrayed in Figure 27. The John Day River is the largest Columbia River tributary that has no major dams or reservoirs in the basin to act as passage barriers for migrating bull trout. However, loss of riparian habitat and resulting high water temperatures in much of the mainstem and larger tributaries act as thermal passage barriers during most summer and early fall months. Distribution and habitat surveys conducted by ODFW's Aquatic Inventory Research crews in 1990 through 1992 found actual summer distribution for bull trout at about 25 percent of the suspected distribution as 104 km contained bull trout out of 428 km of habitat previously estimated to contain bull trout (Unterwegner and Gray 1995).

Small bull trout populations are currently found in the upper mainstem John Day and in Indian, Deardorff, Reynolds, Rail, Roberts, and Call creeks. Streams inventoried during the summer of 1990 revealed limited amounts of summer habitat in the mainstem John Day and tributaries (Table 14). Water diversion traps operated by the John Day Screen Program in 1990, 1991, and 1992 captured 39, 26, and 52 bull trout, respectively, in the Roberts Creek bypass trap. Survey crews were unable to find bull trout in Roberts Creek in 1990 and 1995; however, they captured juvenile and adult resident bull trout in 1996.

In the Middle Fork John Day Subbasin, small populations of bull trout have also been found scattered in upper Clear Creek above Highway 26, Big Creek, and Granite Boulder Creek. Bull trout migration from these headwater streams into the lower Middle Fork John Day River during summer months is unlikely due to serious temperature increases, poor habitat conditions, and irrigation withdrawals (Claire and Gray 1993).

Bull trout distribution in the North Fork John Day Subbasin, as inventoried by ODFW in 1990, found bull trout in Clear, Crane, Desolation, and South Fork of Desolation creeks (Table 15). Claire and Gray (1993) also list Big Creek, North Fork John Day River above Gutridge, Baldy Creek, and Trail Creek as tributaries within the subbasin that contain bull trout. Recent surveys conducted by ODFW biologists and volunteers in the North Fork Subbasin in summer 1996 found bull trout in Crayfish, Cunningham, Onion, and Boulder creeks (T. Unterwegner, ODFW, personal communication, November, 1996).

Life History

Very little is known about the life history of John Day River bulltrout. Limited data collected to date suggests that populations of bull trout in the John Day Basin are fragmented with extremely low numbers. In the early 1980s, spawning surveys in the upper North Fork John Day River between Baldy Creek and Peavy Cabin found

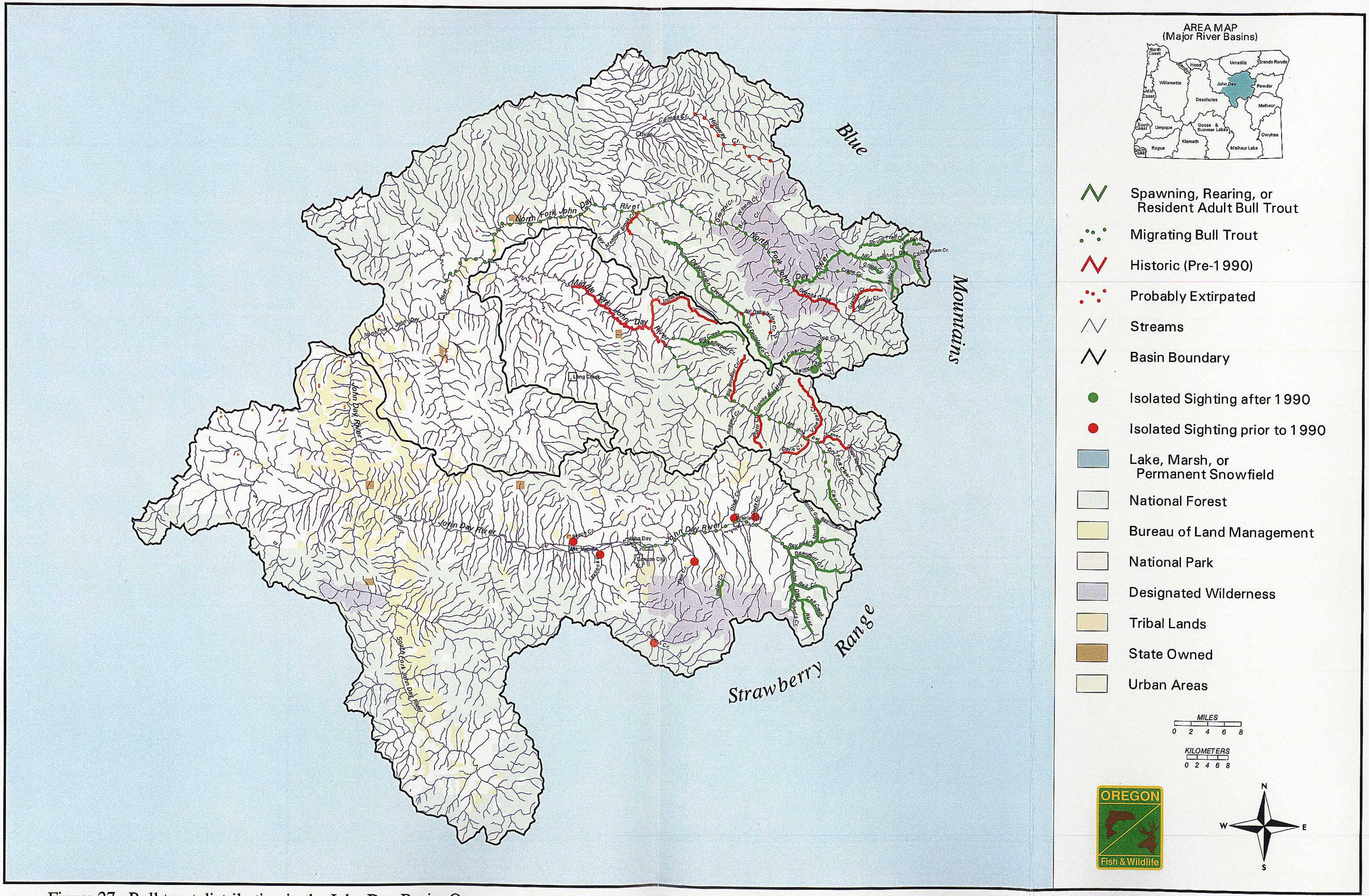


Figure 27. Bull trout distribution in the John Day Basin, Oregon.

Table 14. Summary of bull trout populations in streams of the mainstem John Day River and tributaries. Streams inventoried by ODFW's Aquatic Inventory Project during summer 1990.

Stream	Total kilometers distribution	Kilometers electrofished in distribution	No. <15 cm	No. >15 cm
Main John Day River	10.5	0.28	3	8
Deardorff Creek	9.3	0.59	15	7
Reynolds Creek				
Main Stem	4.4	0.06	13	0
North Fork	0.8	0.11	0	2
Mossy Gulch	0.0	--	0	0
Rail Creek	6.0	0.19	10	10
Roberts Creek	0.0	--	0	0
Call Creek	4.4	0.04	2	6
Cottonwood Creek (West Dayville)	0	--	0	0
Cottonwood Creek (Mount Vernon)	0	--	0	0
Birch Creek				
Main Stem	0	--	0	0
West Fork	0	--	0	0
Middle Fork	0	--	0	0
Fields Creek	0	--	0	0
Buck Cabin Creek	0	--	0	0
McClellan Creek	0	--	0	0
Laycock Creek	0	--	0	0

[a]*Juvenile bull trout were found in diversion traps at Roberts Creek indicating the continued presence of bull trout in the system. Also survey crews found bull trout in Roberts Creek in summer of 1996.*

Table 15. Summary of bull trout populations in streams of the North Fork John Day River Subbasin. Streams inventoried by ODFW's Aquatic Inventory Project during summer 1990.

Stream	Total kilometers distribution	Kilometers electrofished in distribution	No. <15 cm	No. >15 cm
Clear Creek	3.2	0.09	7	1
Granite Creek	0.0	--	0	0
Crane Creek	2.0	0.06	3	3
Desolation Creek	2.8	0.06	0	1
S. Fk. Desolation Cr.	9.7	0.31	7	7
Lost Creek	0	--	0	0
Lower Lake Creek	0	--	0	0
Upper Lake Creek	0	--	0	0

approximately 18 bull trout redds in a 5 km section with some spawning bull trout over 500 mm seen. In August or September 1985, a pair of spawning bull trout (approximately 460 mm and 530 mm) were observed on a redd in the North Fork John Day between Baldy Creek and Peavy Cabin (E. Claire, ODFW, personal communication, September, 1985). Snorkel and streamside spawning surveys conducted in October 1993 by USFS biologists from the Wallowa-Whitman National Forest found some bull trout redds in the North Fork below Baldy Creek but no redds or spawners were observed in much of the best spawning habitats (G. Willmore, USFS, personal communication, October 1993). Spawning surveys were also conducted in South Fork of Desolation Creek in 1993, but no bull trout redds were found. ODFW and USFS personnel conducted spawning surveys in October of 1995 and found two redds and one bull trout in the section between Baldy and Peavy creeks (T. Unterwegner, ODFW, personal communication, December 1996).

Length-frequency data from 102 bull trout collected in 1990-1991 by ODFW Aquatic Inventory surveys from the mainstem John Day Subbasin showed sizes from 60 mm to 5 10 mm. Most of these fish ranged from 60 mm to 210 mm as only three bull trout were in the 260 mm to 5 10 mm size range. Length-frequency data from 60 bull trout collected in the 1990-1991 Aquatic Inventory surveys from the Middle Fork John Day Subbasin showed a range in size from 60 mm to 360 mm. Most of these fish were small (from 60 mm to 210 mm) as only one bull trout was 260 mm and another was 360 mm. ODFW has gathered over 250 scales from bull trout sampled throughout the John Day Basin. These scales will be analyzed for age and growth in summer 1997.

Sampling for genetic analysis was conducted in 1995 in the mainstem John Day, Middle Fork, and North Fork subbasins (Hemmingsen et al. 1996). Analysis of microsatellite nuclear DNA from these data suggest that bull trout populations from the John Day Basin and other basins throughout northeastern Oregon comprise a similar major genetic lineage (Spruell and Allendorf 1997). This data suggests there has been limited migration of bull trout between the John Day and Deschutes basins despite their proximity (Spruell and Allendorf 1997). Some alleles found in the John Day Basin are not found in the Grande Ronde River and other northeastern Oregon rivers. This suggests that although bull trout may have conducted historic headwater transfers between the John Day and Grande Ronde basins, this exchange is not presently occurring (Spruell and Allendorf 1997).

Specific Limiting Factors

Basins east of the Cascade Mountains like the John Day Basin naturally experience relatively higher stream and river temperatures as a result of arid climate and many clear sunny days. Changes in riparian vegetation, channel widening, or channel shallowing as a result of land and water use activities will increase the amount of sun hitting the water surface and resulting in further increasing water temperatures (B. Beschta, personal communication, October 1996). Any anthropogenic warming of rivers or streams above natural conditions in the John Day Basin will likely result in further reductions in critical bull trout habitat.

Livestock grazing on private land and allotments on public lands can reduce riparian vegetation and bank stability, increase sediment and raise water temperatures in all three of the major subbasins within the John Day Basin (Claire and Gray 1993). Many areas in the basin are currently unsuitable for bull trout due to anthropogenic land and water activities. To illustrate this point, maximum daily temperatures were taken during 1992 from the Middle Fork John Day River and nearby Big Boulder and Coyote creeks on a 494 hectare ranch owned by The Nature Conservancy. Water temperatures in the Middle Fork exceeded 20°C for over 75 days in June, July, and August (Figure 28) (Claire and Gray 1993). Clearly, these summertime temperatures exceed the conditions that bull trout need. Big Boulder Creek, a historical site for bull trout, along with Coyote Creek also showed maximum daily temperatures over 20°C in 1992.

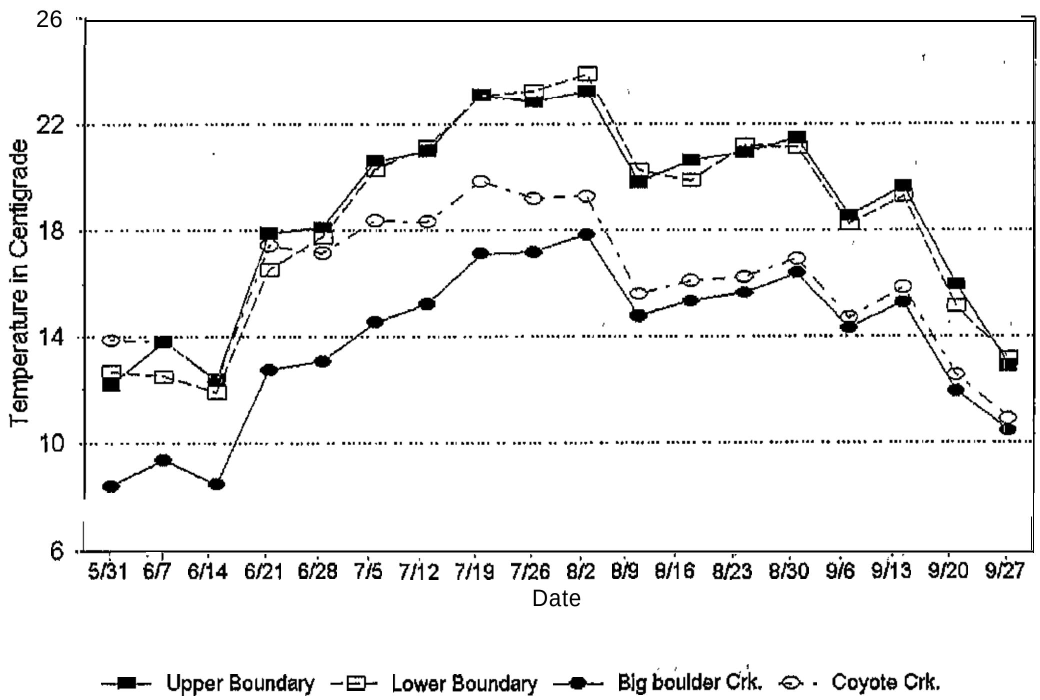


Figure 28. Weekly averages of the daily maximum water temperatures for the Middle Fork John Day River at the upper and lower edges of a nature preserve owned by The Nature Conservancy and nearby tributaries (Big Boulder and Coyote creeks) from 3 1 May to 2.7 September 1995.

Claire and Gray (1993) report that the bull trout habitat, in most of the mainstem and Middle Fork John Day River subbasins is not located in wilderness areas. Habitat in private ownership and USFS management categories other than Wilderness or other protective designation could be logged for salvage activities to improve "Forest Health." They list bull trout spawning and rearing habitat in these subbasins as extremely vulnerable due to potential water temperature increases, riparian habitat loss, loss of instream structure, and increased sediment inputs. Other limiting factors listed for the mainstem and Middle Fork subbasins by Claire and Gray (1993) include: (1) reduction in anadromous fish populations that may reduce possible prey species for bull trout; (2) irrigation diversion dams with associated upstream and downstream passage delays, and water withdrawal (no unscreened diversions were identified); (3) past opportunities for overharvest and poaching; (4) hybridization and competition with introduced brook trout; and (5) possible impacts from historic chemical rehabilitation projects (no evidence of bull trout mortalities were ever found in any of the treatment evaluations).

Claire and Gray (1993) report that the North Fork has the most bull trout habitat of the three John Day River subbasins, but many areas are still affected by mining, logging, grazing and road building, They list bull trout spawning and rearing habitat in the North Fork as highly vulnerable due to water temperature increases from destruction of cold water springs, riparian habitat loss, and loss of instream structure and gravel. Other limiting factors include: (1) chemical mine waste, (2) reduction in anadromous fish populations, (3) past opportunities for overharvest and poaching, and (4) hybridization and competition with brook trout. An estimated 295 bull trout were killed by an accidental hydrochloric acid spill in February 1990 at the mouth of Camas Creek.

Recent cooperative studies by ODFW's Native Trout Project and USFS are studying distribution interactions between bull trout and brook trout in several North Fork streams (Table 16). Brook trout were found in the Upper North Fork and in Baldy, Crayfish, Crane, and Cunningham creeks. In some streams such as Crayfish and Crane creeks, brook trout appear to be more widely distributed than bull trout. ODFW and USFS are studying habitat conditions and temperature in relation to bull trout and brook trout distribution patterns to better understand the effects of hybridization and competition between brook trout on bull trout.

Natural limiting factors for the North Fork Subbasin include barrier falls on East Meadowbrook, Big, Baldy, and upper Cunningham creeks that limit upstream passage. Large lightning storms caused wildfires in 1996 that burned about 80,000 acres in the North Fork and Middle Fork subbasins, and directly affected bull trout habitat in the Desolation, Cunningham, Big, Baldy, and Winom drainages and in the upper mainstem of the North Fork John Day River.

Table 16. Summary of ODFW and USFS surveys of bull trout distribution on the North Fork John Day River drainage in 1996.

Stream	Total length (km)	Length of bull trout distribution (km)	Length of brook trout distribution (km)	Mean number of bull trout captured in 100m section[a]	Comments
Baldy Creek	8.0	5.5	1.5	7.5	Brook trout in upper end, 2 bull trout >400 mm captured.
Crawfish Creek	5.5	1.0	4.5	5.0	Bull trout in lower end; brook trout distribution overlaps bull trout.
Crane Creek	13.8	1.0	12.2	4	Brook trout distribution overlaps bull trout.
Cunningham Creek[b]	1.8	0.5	0.0	1	1 hybrid
Upper North Fork John Day	6 (survey length)	6.0	2.5 (to upper limit of Brook trout distribution)	5.9	Upper and lower end of bull trout distribution not determined.

[a] *Based on 1-pass electrofishing.*
[b] *This stream was in a high intensity zone of a forest fire in the first week of September 1996 (a week after the distribution survey), there were reports of a large fish kill.*

Management Considerations

New protective angling regulations prohibiting harvest of bull trout are in effect throughout the basin since 1994. Oregon State Police officers report no incidence of non-compliance with these new regulations. Bull trout identification signs that prohibit harvest of bull trout have been placed near bull trout spawning and rearing areas. In addition, fish identification cards created by USFS and ODFW are handed out at local district offices and sporting goods stores to aid anglers in identification of sensitive trout species in the basin. Stocking of catchable rainbow trout has been discontinued in the Middle Fork John Day River and Desolation Creek to prevent incidental catch of bull trout.

In 1990, The Nature Conservancy acquired a ranch on the Middle Fork of the John Day River. They plan to restore the cold water aquatic and riverine ecosystem on their property to the most natural condition and function possible. A Preserve Management Committee including members of The Nature Conservancy, ODFW, USFS, CTUIR, and Oregon Trout has drafted a monitoring agenda for the preserve. Water quality, and flood plain hydrology are among the critical elements. An essential objective identified by this committee was to reduce the daily summer water temperatures on the Middle Fork John Day River and Big Boulder Creek (Claire and Gray 1993). This could result in the expansion of seasonal distribution of bull trout.

Instream water rights have been issued for 24 streams or stream reaches in the John Day Basin. Streams with water rights that may be beneficial to bull trout include Indian, Crane, Trail, and Desolation creeks and reaches of the North Fork John Day River. Applications for instream water rights for an additional 18 stream or stream reaches have been submitted, but have been contested by other water users. Streams that have been contested and that may be beneficial to bull trout include Reynolds, Deardorff, Rail, Roberts, and Pine creeks in the mainstem John Day Subbasin; Granite Boulder, Indian, Big Boulder, and Big creeks in the Middle Fork Subbasin, as well as reaches in the mainstem John Day River.

Portions of the upper North Fork John Day Subbasin are within the North Fork John Day Wilderness and the Vinegar Hill Scenic Area. Headwaters of several important bull trout tributaries to the mainstem John Day River are located within the Strawberry Mountain Wilderness.

Much of the management direction in the early 1990s was surveying distribution and habitat needs of bull trout within the basin. The USFS is currently writing proposed standards more stringent than those of PACFISH (USFS/BLM 1995) to be included in the 1994 Forest Plan Amendment. However, proposed salvage timber sales in 1997 on upper Big, Coyote; Beaver, Deep, Big Boulder, and Elk creeki (all Middle Fork John Day tributaries in the Malheur National Forest) are proposing to protect only riparian trees within 7.6 m (25 feet) of the stream. These salvage sales may have negative impacts on bull trout habitat in Big Creek and may affect water quality in the Middle Fork John Day River (T. Unterwegner, ODFW, personal communication, December 1996). New grazing permits of USFS allotments in the Desolation Creek drainage prohibit livestock use in the upper watershed, and require riparian exclosures in the other areas

(P. Howell, USFS, personal communication, June 1997).

A working group comprised of representatives from ODFW, USFS, USFWS, CTWSR, CTUIR, local Soil and Water Conservation Districts, and interested citizens has been formed to share information and coordinate field activities relating to bull trout in the John Day and Malheur basins.

Current Status

The status of bull trout in the John Day Basin was first reported by Ratliff and Howell (1992). They list the upper mainstem John Day River population as having a "moderate risk of extinction." This status has not changed. They list bull trout populations in Middle Fork Subbasin as "probably extinct" for the upper Middle Fork John Day and "high risk" for Granite Boulder Creek and Big Creek. These assessments remain the same except a new "high risk" population has recently been found in Clear Creek and is added to this status report. Populations of bull trout in the North Fork John Day River have been downgraded from "of special concern" to a "moderate risk" of extinction. Snorkeling surveys conducted by ODFW and the Umatilla National Forest in 1993 found only two bull trout sighted in a 32 km section of the North Fork system from the mouth of Camas Creek to above Granite Creek. These sightings were far below expectations (P. Howell, USFS, personal communication, January 1994). Very few redds have been identified in recent spawning surveys. Recent documentation of interactions and hybridization between non-native brook trout and native bull trout in the North Fork system also contributed to the change in status.

Umatilla River Basin

Introduction

The following is a summary of existing information on bull trout in the Umatilla River basin. Most information presented is from ODFW unpublished reports and data provided by CTUIR and USFS.

The Umatilla River, situated in northeastern Oregon, is a tributary to the Columbia River entering at about RK 440. It drains an area of approximately 6,592 sq km, and is approximately 143 km in length from its mouth to where it divides into the North and South Fork Umatilla River, each fork adding another 16 km of length. Major tributaries include North and South Forks, Meacham Creek, Birch Creek, Butter Creek, and Wildlhorse Creek. The Umatilla River originates in the Blue Mountains at elevations up to 1,289 m and descends to an elevation of about 82 m at the confluence with the Columbia River.

Agricultural activities dominate the landuse pattern in the basin with timber harvest occurring in forested areas and dryland and irrigated farming in lower elevations. Tribal reservation lands of the CTUIR are located in the basin, but the entire Umatilla Basin is part of the area ceded to the tribe by treaty.

Historic Distribution

Bull trout would have had access to the Columbia River and its tributaries historically as did anadromous salmonids; however, we do not have documentation to support this. Earliest known documentation of bull trout in the Umatilla basin is from ODFW creel reports dating from 1963. Bull trout were still being caught occasionally near Pendleton as late as 1988. Bull trout likely existed in Woodward, Bear, Bobsled, and Squaw creeks, as well as the McKay and Birch creek drainages. This is based on presence of available habitat at suitable elevations in these drainages, compared to areas where bull trout are currently found.

Irrigation and hydroelectric development and overharvest have been cited in the decline of anadromous fish populations (OWRD 1988). Three Mile Falls Dam, constructed in 19 14, eliminated spring chinook from the Umatilla Basin. Access to McKay Creek above RK 9.7 was closed in 1927 with construction of the McKay Creek Dam. Construction of these dams would have been upstream barriers to bull trout as well, preventing access from the Columbia for most of the year. Construction of mainstem Columbia dams would have further inhibited interchange with other nearby bull trout populations in the Columbia basin, e.g., bull trout of the Walla Walla Basin.

The mainstem Umatilla River is artificially confined for much of its length between high terraces constructed for roads, railroads, and dikes (Contor et al. 1995). The lower 4.8 km of the South Fork Umatilla River is constrained by a road in the floodplain. Straightening of the channel has reduced the ability of the river to dissipate energy during high flow events resulting in increased scouring of the streambed. Meacham Creek was channelized after the 1964 flood (J. Phelps, ODFW, personal communication, May 1996).

The Umatilla River below Meacham Creek and the lower 16 km of Meacham Creek were chemically treated to control non-game fish during the summer of 1967 (Smith 1973). However, no bull trout were observed during this treatment project (D. Heckeroth, ODFW Retired, personal communication, June 1996), nor during chemical treatment in the Umatilla River (from about 2 km downstream of Meacham Creek to Threemile Dam) in 1974 (J. Phelps, ODFW, personal communication, May 1996). The habitat most likely was inhospitable for bull trout prior to the treatment projects.

Current Distribution

Bull trout are found in the mainstem Umatilla River and several tributaries upstream from Thorn Hollow (RR 110) at elevations above 500 m. Current and historic distribution of bull trout based on documented reports are portrayed in Figure 29. Spawning and rearing occurs in the North and South forks of the Umatilla River, and in North Fork Meacham Creek. Suitable spawning and rearing habitat occurs in East Fork Meacham Creek, but bull trout have not been observed there. Rearing and migration activities occur in Squaw Creek, Ryan Creek, North Fork Umatilla River, Coyote Creek, Shimmiehorn Creek, and Meacham Creek (Germond et al. 1996a).

Since 1994, ODFW, USFS, and CTUIR have cooperated to coordinate annual comprehensive spawning surveys throughout the known or suspected areas of bull trout distribution in the Umatilla Basin. Results to date indicate the majority of redds are in the North Fork Umatilla River between Coyote and Woodward creeks.

One adult bull trout (>305 mm fork length) was observed in North Fork Meacham Creek during the summer of 1995 by CTUIR personnel during spring chinook surveys, and one by ODFW personnel conducting snorkel surveys. This was the first verified sighting of bull trout in the North Fork Meacham Creek, and expands the known distribution of bull trout summer rearing habitat in the Umatilla basin (Germond et al. 1996a). A 305 mm bull trout was captured at Threemile Dam adult fish trapping facility, on mainstem Umatilla River at about RK 6, on 26 June 1996. This is the first recorded capture of a bull trout at that facility since at least 1973. Sightings of bull trout in this area prior to 1973 have not been documented (ODFW 1996b).

Life History

In 1995, an index reach on North Fork Umatilla River between Coyote and Woodward creeks, a distance of approximately 5 km, was selected and surveyed on a biweekly basis from early September through October to determine peak time of spawning. In 1993, spawning was already underway on 13 September. Data from the 1993 survey and the 1995 index reach survey indicate that peak spawning occurred between 25 September and 4 October over at least a two month period (ODFW 1995a). Data from 1996 suggest the peak spawning occurred between mid-September and early October, although the peak is not overly pronounced (ODFW 1996b). Figure 30 shows results of the index reach surveys in 1995 and 1996.

Bull trout spawning surveys were initiated in 1993 by ODFW. Five redds were found in the lower four miles of the North Fork Umatilla River on 1 September 1993. Results of the spawning ground survey for 1994 through 1996 are shown in Table 17.

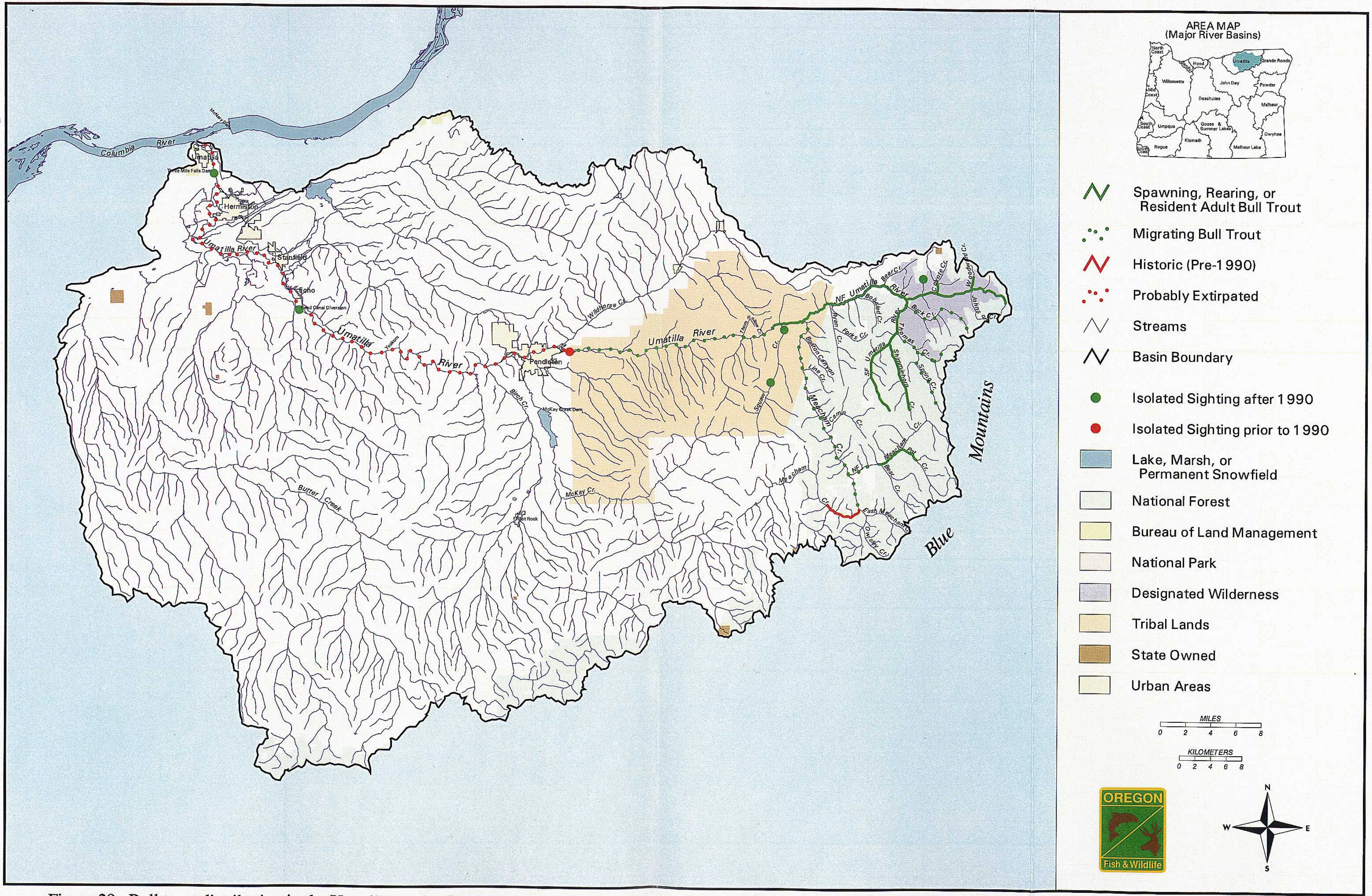


Figure 29. Bull trout distribution in the Umatilla Basin, Oregon.

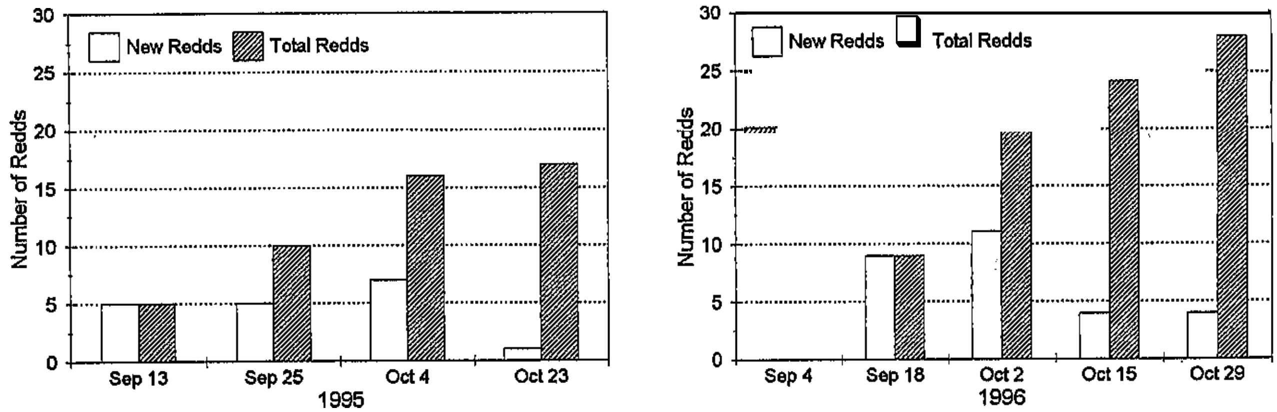


Figure 30. Redd counts and timing from bull trout spawning ground surveys conducted on the North Fork of the Umatilla River, 1995 and 1996.

Table 17. Umatilla Basin bull trout spawning ground survey results, 1994-1996 (adapted from Germond et al. 1996a and ODFW 1996b).

Stream	Year	Kilometers Surveyed	Redds			
						Per
Umatilla River	1994	11.81	7	32	39	3.3
	1995	7.46	5	17	22	2.9
	1996	27.40	N/A	N/A	37	1.4
Meacham Creek	1994	6.21	0	3	3	0.5
	1995	5.90	0	1	1	0.2
	1996	10.90	N/A	N/A	0	0

Redd sizes measured in 1995 and 1996 are shown in Table 18. By comparison, redd size in the South Fork Walla Walla River in 1995 averaged 1.3 m in length, 0.7 m in width, and 0.3 m in depth (ODFW 1996b). Similar redd size could indicate similar size distribution in fish. Bull trout redds observed in the Tucannon River in southeast Washington in 1990 averaged 1.62 m in length and 1.05 m in width and in 1991 they averaged 1.90 m in length and 0.87 m in width (Martin et al. 1992).

Table 18. Bull trout redd sizes from spawning surveys in the Umatilla Basin in 1995 and 1996 (Germond et al. 1996a and ODFW 1996b).

		Length (m)		Width (m)	
Year	Number	Average	Range	Average	Range
1995	19	1.1	2.0 - 0.6	0.6	1.1 - 0.3
1996	32	1.0	2.0 - 0.4	0.6	1.5 - 0.3

Martin et al. (1992) reported that the minimum fork length of any observed spawning bull trout was 250 mm in three southeast Washington streams and ranged up to 600 mm in size. In the Umatilla Basin, most of the fish collected at the CTUIR screw traps greater than 250 mm in length showed signs of eroded caudal fins indicating previous spawning activity (Germond et al. 1996a). The size of bull trout observed during the ODFW spawning surveys ranged from 250 mm to 508 mm, with an average of about 432 mm (J. Germond, ODFW, personal communication, February 1996).

Thermographs recorded a range of temperatures at the peak spawning from 6 to 10" C at the mouth of Coyote Creek and a range of 7 to 10" C at the mouth of Woodward Creek in 1995 (Figure 3 1). In 1996, during the period when spawning began and peaked (12 September - 25 September), the daily average water temperature at Coyote Creek declined from 10.3° C to 6.4° C (ODFW 1996b) (Figure 32).

Some information on migration timing and movements of bull trout in the Umatilla Basin is available from trap data collected by CTUIR. Fisheries Program personnel operated two rotary screw traps in the Umatilla Basin during 1993 and 1994. One trap was located in the niainstem Umatilla River at RK 127.9 (0.8 km upstream from the confluence with Meacham Creek), and was operated for 145 days during the period 15 October 1993 to 19 July 1994. The other trap, located in Meacham Creek at RK 2.4, was operated for 183 days during the period 15 December 1993 to 22 June 1994 (Contor et al. 1995). The majority of bull trout (142) were captured in the Umatilla rotary screw trap, while two were trapped in the Meacham Creek trap. The majority of bull trout were trapped during April, May and October. The trap at RK 127.9 in the Umatilla River captured only 10 bull trout between September and November of 1995. Figure 33 shows a time-frequency histogram of bull trout trapped by month.

Two pipe traps operated in Squaw Creek (RK 0.8) captured two bull trout in June of 1994. One of these fish was a recapture from the Umatilla River rotary screw trap.

Most bull trout trapped in the spring ranged in size between 100 and 200 mm fork length, while those trapped in the fall ranged in size between 200 mm and 300 mm. Figure 34 shows length frequency histogram of bull trout captured by rotary screw traps and electrofished in 1993 and 1994 at selected sites in the Umatilla River basin.

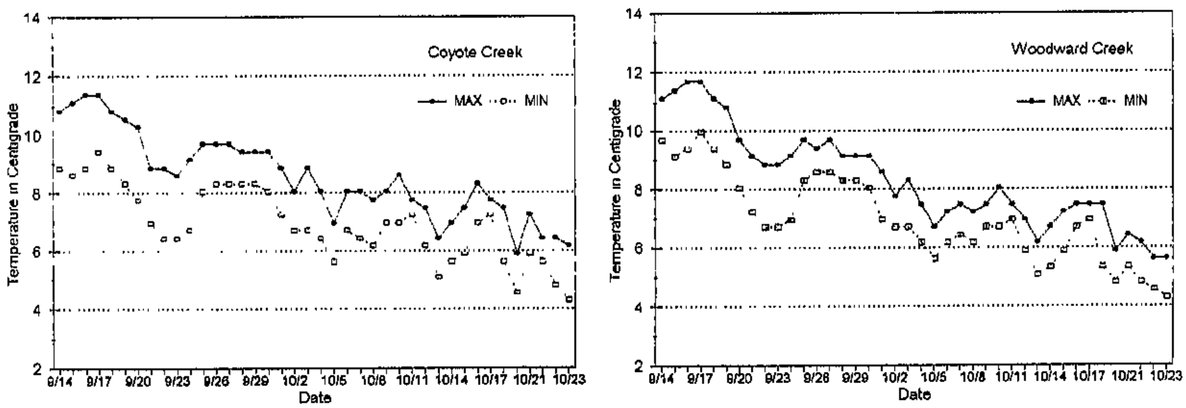


Figure 31. Daily average maximum and minimum stream temperatures recorded in the North Fork Umatilla River at Coyote and Woodward creeks, 14 September to 23 October, 1995.

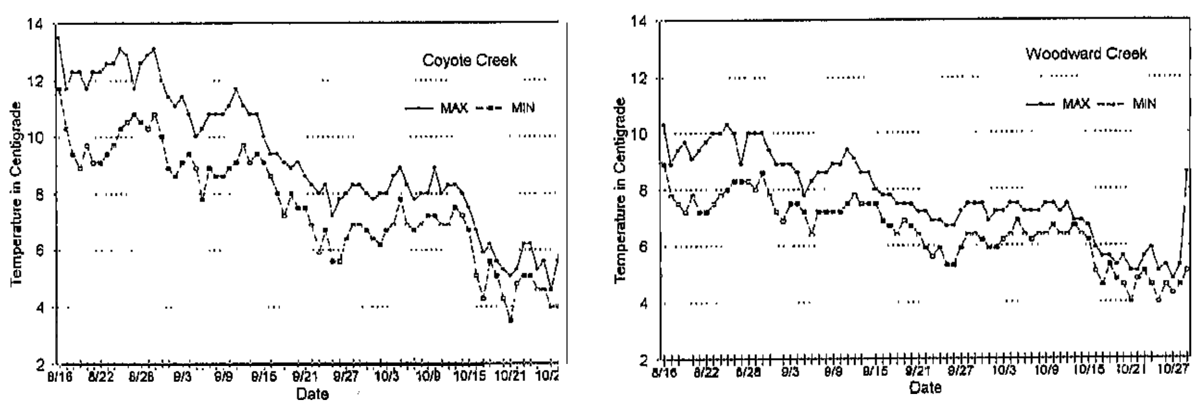


Figure 32. Daily average maximum and minimum stream temperatures recorded in the North Fork Umatilla River at Coyote and Woodward creeks, 16 August to 29 October, 1996.

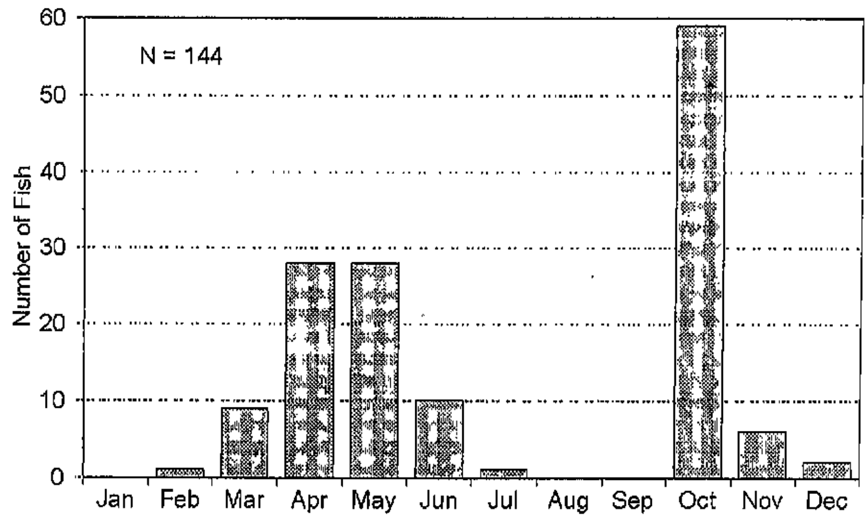


Figure.33. Time frequency histogram of bull trout trapped in CTUIR screw traps in the Umatilla River (RK 127.9) and Meacham Creek (RK 2.4) during 1993 and 1994. Traps were not operational during August and September.

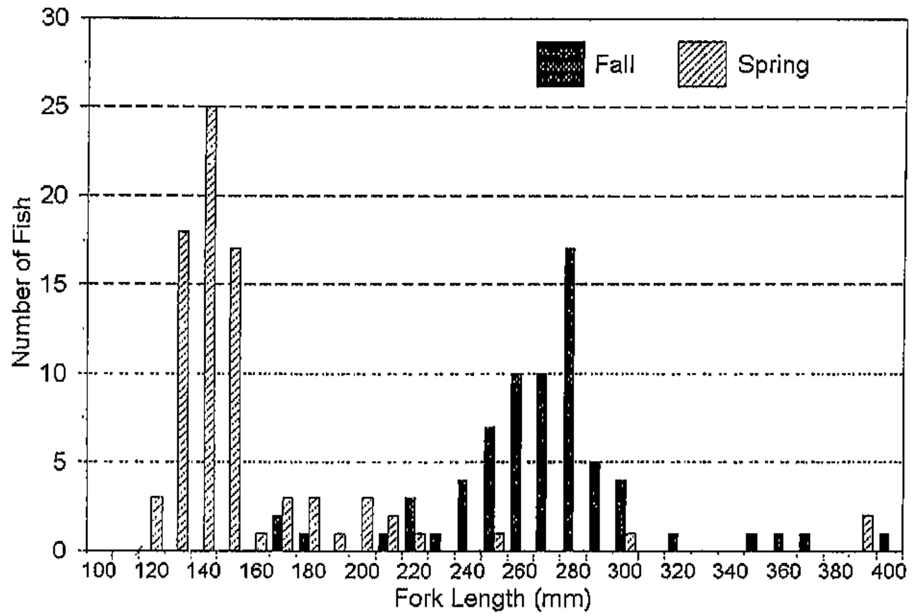


Figure 34. Fork lengths of bull trout captured by screw traps or electrofished in the Umatilla River (RR 127.9) North Fork Umatilla River (RK 2.4), and Meacham Creek (RK 2.4) during the fall and spring months of 1993 and 1994.

Bull trout in the Umatilla River basin show fluvial and resident, life history patterns, though most are believed to be resident fish. A few juvenile fish, have been sampled during spring months in recent years by CTUIR biologists at the Westland smolt trapping facility on the mainstem Umatilla River at RK 44.

Samples for genetic analysis were taken in 1995 from the North Fork, Umatilla River and ranged from 41 mm to 153 mm in fork length (Hemmingson et al. 1996). Analysis of microsatellite nuclear DNA suggests that bull trout populations from the John Day River basin and northeastern Oregon (including the Umatilla River basin) comprise a major genetic lineage (Spruell and Allendorf 1997).

In 1995, CTUIR collected scales from 16 bull trout and analysis showed 10 to be age 3+ (165 to 290 mm) and 6 to be age 4+ (225 to 320 mm) (Contor et al. 1996). One 390 mm bull trout captured during CTUIR trapping activities in the Umatilla River in 1994 was determined by scale and otolith analysis to be 4+ years of age (Contor et al. 1995). Age versus length derived from analysis of otoliths of dull trout collected from three neighboring, streams in Washington is shown in Table 19 (Martin et al. 1992).

A population estimate for the Umatilla Basin bull trout is not available at this time. Daytime and nighttime snorkel surveys were conducted on a total of 0.8 km of the North Fork Umatilla and 2 km of the North Fork Meacham Creek in July of 1995 to determine the feasibility and logistics of collecting juvenile abundance data and identifying potential index sites. The surveyors observed only one bull trout less than 76 mm in total length on the North Fork Umatilla River survey during the day, and none at night. Larger bull trout were readily observed during both day and night in the North Fork Umatilla River primarily in pools containing concentrations of woody debris. Very few bull trout of any size were observed in areas without some wood component. The North Fork Meacham Creek was surveyed only during the day, and only one bull trout was observed. No electrofishing was conducted in conjunction with the snorkel surveys (Germond et al. 1996a).

Table 19. Mean fork length (mm) and range of fork lengths for each age class of bull trout in three southeast Washington streams for 1990 and 1991 (Martin et al. 1992)

Stream/River	Age 0+	Age 1+	Age 2+	Age 3+
Mill Creek"	55 (30-70)	110 (90-130)	160 (135-190)	235 (199-270)
Wolf Fork	55 (35-80)	105 (85-115)	155 (120-185)	170 (165-175)
Tucannon River	45 (30-65)	90 (70-l 10)	145 (115-175)	195 (168-225)

[a] *A portion of the study area was located in Oregon*

Native fish species found in association with bull trout during genetic sampling in the North Fork Umatilla River include redband trout and sculpins (Hemmingson et al. 1996). Other species trapped along with bull trout by CTUIR rotary screw traps included chinook salmon, shiners, suckers, dace, sculpins, and squawfish (CTUIR 1994).

Specifid Limiting Factors

Historic land uses affecting bull trout habitat in the Umatilla River include timber harvest, grazing, and irrigated agriculture. Channel modifications for flood control have occurred. Overharvest and competition with stocked hatchery rainbow trout have also affected bull trout populations. Loss of habitat from water withdrawal, increased water temperatures, lack of large wood, and sedimentation continue to impact bull trout in the Umatilla Basin.

Stream surveys of the Umatilla River and Meacham Creek stream systems were conducted by USFS personnel between 1989 and 1995 on USFS managed land, and by ODFW and CTUIR on private land (primarily in the Meacham Creek drainage) between 1991 and 1994. Much of this information is summarized in the watershed assessment conducted for the upper Umatilla River and Meacham Creek watersheds (Crabtree 1996). The assessment found the best remaining fish and aquatic habitat to occur in subwatersheds of the upper and lower North Fork Umatilla River; Coyote, Ryan, and Bear creeks; upper North Fork Meacham Creek; and Pot Creek. Subwatersheds where aquatic habitat was considered fair to good with potential for restoration include Buck, Shimmiehorn, Camp, and Owsley creeks. Habitat in Spring Creek, the lower reaches of the South Fork and mainstem Umatilla River, and all but a few tributaries in the Meacham Creek system was in poor condition. The assessment concluded that temperature is probably the most limiting factor in the majority of the streams analyzed. Other contributing factors cited included streamsedimentation and low frequency of canopy cover, pools, and wood (Crabtree 1996).

Temperatures in excess of about 15°C are thought to limit bull trout distribution, while temperatures colder than 10°C are required for successful spawning and early rearing (Reiman and McIntyre 1993, Buchanan and Gregory 1997). Temperatures recorded throughout the Umatilla Basin during 1992 showed maximum temperatures above 15°C during the summer and fall at RK l04.6 and RK 127 in the mainstem Umatilla River and at three sites between RK 3.2 and RK 20.9 on Meacham Creek. Minimum temperatures at the these sites exceeded 10°C for most of the period between July and October. Temperatures were more amenable to bull trout in the North Fork Umatilla River where maximum temperatures averaged well below 15° C from May through August, 1993 (CTUIR 1994). Yearly maxima of seven-day moving average maximum temperatures for streams in the upper Umatilla River and Meacham Creek watersheds are shown in Table 20.

Loss of shade and riparian habitat is a concern in the Umatilla Basin because of its impact on stream temperature and cover. Results of habitat surveys by CTUIR indicate that canopy cover and shade are poor in the mainstem Umatilla River, Meacham Creek, and tributaries of Meacham, Boston Canyon, and Line creeks (CTUIR 1994, Contor et al. 1995 and 1996).

Table 20. Summary of stream temperatures (° C) for upper Umatilla River and Meacham Creek watersheds from 1992-1995 (modified from Crabtree 1996).

Stream and Location	Year					
	1990	1991	1992	1993	1994	1995
Upper Umatilla Watershed:						
Umatilla River, RK 122 (below Meacham Cr.)			23.4	21.9	23.2	23.5
Umatilla River, RK 127 (above Meacham Cr.)		21.8	22.3	20.7	22.5	
Umatilla River, RK 131 (USGS gage)		21.8	23.3	21.1	22.8	21.3
Umatilla River, RK 144 (Corporation)		17.6	18.3	17.3	17.3	17.8
NF Umatilla River (USFS gage near mouth)			15.6	14.6	15.3	14
SF Umatilla River (USFS gage above NF Umatilla)			20.5	19.8	20.9	19
SF Umatilla River (above Shimmiehorn Cr.)			18.2	16.1	19.4	
Spring Creek			18			
Shimmiehorn Creek (at mouth)	17.5	18.5	17	15.4	17.1	
Ryan Creek, RK 2				17.7		
Bobsled Creek				18.3		
Buck Creek (at mouth)				14.3		
Meacham Creek Watershed:						
Meacham Cr., RK 3 (USGS gage)			25.8	23.5	25.5	23.8
Meacham Cr. (reservation/NF boundary)			26.3	23.7	25.4	24.6
Meacham Cr., RK 21 (above NF boundary)				22.5[b]		
Camp Creek					18.6[b]	
NF Meacham (NF boundary)			19.8	18.5	21.9	
East Meacham Cr.				18.0[b]		17.8[b]
Butcher Cr.				13.8[b]		14.6[b]

[a] *Seven-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive seven-day period,*
[b]*Sites where monitoring was discontinued in late July. Seven-day maximum temperature may not have been reached.*

Much of the instream habitat surveyed is lacking in wood size and volume. This could limit juvenile bull trout production, as it is a preferred habitat component (Dambacher and Jones, 1997). Very few bull trout of any size were observed in areas without some wood component during snorkel surveys in 1995 in the North Fork Umatilla River and North

Fork of Meacham Creek (Germond et al. 1996a).

North Fork Umatilla River habitat is fairly complex with low levels of bedload movement, moderate levels of large organic debris, and relatively minimal flow events. All the bull trout habitat is in the North Fork Umatilla Wilderness except the upper headwaters, which are still within the Umatilla National Forest.

There is no grazing in the Wilderness where much of the critical bull trout spawning habitat exists, but loss of riparian vegetation is still a problem downstream, primarily on private land. Grazing and logging activities occur in the North Fork Umatilla River headwaters above the Wilderness boundary on National Forest lands.

The South Fork Umatilla River system lacks large woody material and adequate spawning gravel. The annual bedload movement is high due to the flashy nature of the watershed (J. Germond, ODFW, personal communication, February 1996).

Flooding during the winter of 1996 may have had a major impact on habitat in the Umatilla Basin, although the effects have not been evaluated fully by biologists. Loss of flows associated with irrigation diversions in the mainstem Umatilla River downstream of Pendleton restrict movement of bull trout to and from the Columbia River. Irrigation water rights from both surface and groundwater sources account for slightly less than 83% of the total rights in the basin (including the Walla Walla basin), and streamflow during the summer months does not meet existing demands in the lower Umatilla River (OWRD 1988). Six major screened diversions occur downstream of Yoakum, about RK 59.5 (OWRD 1988).

The Umatilla Basin Project, designed to improve passage flows downstream from Pendleton for juvenile and adult anadromous fish, will augment flows during the period September through the end of June when fully implemented. This would improve winter habitat for bull trout below Pendleton, but low flows would. still limit movement upstream of Pendleton for most of the year.

Riprap and gravel push-up dams for irrigation diversions below Pendleton pose passage problems for fish in this reach. Several irrigators have converted to screened pumps and other conversions are planned. The fish ladder at the U.S. Feed Canal diversion dam (RK 45.4) collects gravel which must be scooped out periodically. A solution is still being sought for this problem (J. Germond, ODFW, personal communication, February1996). Blockage exists seasonally in the upper mainstem above Pendleton from gravel berms used to divert water for irrigation and rock berms used to create swimming holes (Germond et al. 1996a).

Competition with introduced species does not appear to be a problem in the basin at this time. Extensive population sampling by CTUIR in lower Meacham Creek in 1993 and in the mainstem Umatilla River above and below Meacham Creek in 1994 and 1995 failed to find any brook trout. Likewise, ODFW crews surveying the Meacham Creek watershed in 1992 and 1993 found no brook trout.

Management Considerations

Until 1994, hatchery rainbow trout were released in two groups (in late May and late June) into the upper mainstem Umatilla River and lower three miles of the South Fork Umatilla River in locations easily accessible to anglers. Some incidental harvest of bull trout may have occurred during this fishery. Stocking locations were moved downstream in 1994 to Pendleton and lower McKay Creek to reduce hatchery rainbow trout competition and potential overharvest of bull trout, redband trout, and juvenile steelhead trout in preferred bull trout habitat (Germond et al. 1996a).

Harvest on bull trout has been closed in the Umatilla Basin since 1994. Tribal angling regulations allow the harvest of some bull trout. However, since the statewide regulation has been in effect, most tribal members release bull trout (David Wolf, CTUIR Enforcement Officer, personal communication, June 1996).

A multi-agency effort [ODFW, CTUIR, USFS, Bureau of Reclamation (BOR), and Department of Environmental Quality (DEQ)] to collect temperature data throughout the Umatilla Basin is ongoing. Data gathered will be used to determine the summer thermal regime and its relationship to the distribution of bull trout in the basin (Germond et al. 1996a).

Instream water rights have been issued for seventeen streams or stream reaches in the Umatilla Basin. Streams with bull trout for which instream water rights were issued include North Fork Meacham Creek, Thomas Creek, Meacham Creek, Ryan Creek, South Fork Umatilla River, North Fork Umatilla River, and Squaw Creek.

Biologists from state, federal, tribal agencies and private interests whose jurisdictions include bull trout habitat within the Blue Mountain Province have initiated meetings to set priorities, coordinate field work, and compare information concerning bull trout. Highest priorities for action include spawning ground surveys on the mainstem Umatilla River and tributaries, the North and South forks Umatilla River and their tributaries, and North Fork Meacham Creek and tributaries; and bull trout presence/absence inventory for the North Fork of Meacham Creek and tributaries. Additional work activities include collecting bull trout scales, continuing to collect migration and life history data from CTUIR and ODFW screw trap and radio tagging operations, completing habitat and fish population surveys for the mainstem Umatilla River (CTUIR 1994), assessing the impacts of catch and release angling in spawning areas at time of spawning, and pursuing options for acquisition of water rights to benefit fish habitat.

Current Status

The status of bull trout in the Umatilla Basin was reported by Ratliff and Howell (1992). Two populations were recognized in the Umatilla Basin: the North Fork Umatilla River rated at “low risk of extinction” based on data available at the time, and the South Fork Umatilla River rated “of special concern” due to habitat degradation. The status of these two populations have been downgraded to “of special concern” for the North Fork Umatilla River and to “high risk” for the South Fork Umatilla River based on additional field studies discussed in this section The Meacham Creek population has been added to the table and rated at “high risk” based on available data.

Walla Walla River Basin

Introduction

The following is a summary of existing information on bull trout in the Walla Walla River Basin. Most of the information presented is from published and unpublished reports by Oregon and Washington departments of fish and wildlife in consultation with state, tribal, and federal fishery professionals.

The Walla Walla River, situated in northeastern Oregon and southeastern Washington, is a tributary to the Columbia River entering about 6 km north of the Oregon border. It drains an area of approximately 1,015 **sq** km in Oregon. The mainstem flows for about 16 km in Oregon before dividing into the North Fork Walla Walla River, 29 km in length, and the South Fork Walla Walla River, 43 km in length. The forks of the Walla Walla River originate at elevations of 1,500-1,700 m in the Blue Mountains. The mouth of the Walla Walla River is at an elevation of about' 100 m at its confluence with the Columbia River. Mill Creek dips south into Oregon from its headwaters then reenters Washington to join the Walla Walla River about 10 km downstream of the city of **Walla** Walla.

Bull trout in the Oregon portion of the Walla Walla Basin are divided into three populations: the North Fork Walla Walla River, South Fork Walla Walla River, and Mill Creek. Another population occurs in the Touchet River, which enters the Walla Walla River about 19 km upstream of the Columbia River in Washington.

Historical Distribution

Bull trout would have easily had access to the Columbia River and its tributaries historically as did anadromous salmonids; however, we do not have documentation to support these migrations. Dam construction and associated manipulations of streamflow within the Walla Walla Basin and in the mainstem Columbia River would have inhibited interchange with other nearby bull trout populations in the Columbia Basin, such as bull trout of the Umatilla Basin.

Earliest documentation of bull trout in the Walla Walla Basin in Oregon is from ODFW creel reports dating from 1963 to 1985. Ray Hughes, an 83 year old retired stockman, recalled that Dolly Varden (bull trout) were in most of the streams southeast of Walla Walla (ODFW interdepartmental memo from Warren Aney, July 6, 1989). Similar to the history of the Umatilla Basin, the decline of anadromous fish in the Walla Walla Basin is attributed to irrigation, hydroelectric development, and overharvest. Spring chinook salmon were eliminated from the Oregon portion of the Walla Walla River by about 1925 (OWRD 1988).

Historic land uses affecting bull trout habitat in the Walla Walla Basin include timber harvest, livestock grazing, and irrigated agriculture. The mainstem Walla Walla River was diked below the forks in 1965 and is managed for flood control. Several diversion dams have been constructed on the mainstem Walla Walla River and tributaries. The combination of degraded habitat and operation of irrigation diversions has limited the potential interchange between bull trout populations in the Walla Walla Basin from late spring through fall.

The upper Mill Creek watershed provides municipal water to the city of Walla Walla and human entrance into the watershed, except for big game hunting and administrative uses, has been prohibited since the early 1900s. Anadromous fish passage past the water intake dam (RK 22.2) was blocked until 1985, when an adult fish ladder was installed (Martin et al. 1992).

Current Distribution

Current and historic distribution of bull trout in the Oregon portion of the Walla Walla Basin, based on documented reports, is portrayed in Figure 35. Other tributary streams where bull trout may occur, but where their presence/absence has yet to be confirmed, include Cottonwood Creek (mainstem tributary), Little Meadows Canyon and Big Meadows Canyon (North Fork Walla Walla River tributaries).

Spawning occurs mainly in the South Fork between Table Creek and the second major tributary above Reser Creek (RR 24.6 - 34.9), the lower 1.6 km of Skiphorton, and lower 0.8 km of Reser creeks. No spawning has been documented in the North Fork Walla Walla River. Spawning in Mill Creek has been documented upstream of the Forest boundary with the largest concentration of redds found upstream of Paradise Creek in Washington.

Life History

Spawning surveys in the basin were initiated in 1993 and are continuing. A summary of the results is presented in Table 21.

In 1995, an index reach was selected in the South Fork Walla Walla River between Skiphorton and Reser creeks. It was surveyed three times between 11 September and 17 October in 1995 (Figure 36). A thermograph was placed just above the mouth of Skiphorton Creek during the 19 September survey and recovered at the end of October. Stream temperatures recorded during this survey period ranged from a maximum of 7.5 °C at the beginning to a minimum of 4.5 °C at the end of the period (Figure 37). Weather and logistical problems prevented survey crews from completing the index survey enough times to determine peak spawning timing, or to accurately correlate onset of spawning with changes in stream temperature in 1995 (Germond et al. 1996b). In 1996, thermographs were placed at the mouth of Skiphorton Creek on 8 August and removed on 29 October. A distinct drop in the average daily water temperature occurred between 20 August and 6 September (Figure 37). Spawning was underway on 10 September when this reach was surveyed (ODFW 1996b). Schill et al. (1994) reported active spawning activity among Rapid River (Idaho) bull trout within a week after average water temperatures dropped from 10 °C to 6.5 °C. Maximum daily stream temperature measured in Mill Creek in 199 1 did not drop below 10 °C until mid-September and bull trout redds were not observed until 20 September of that year (Martin et al. 1992).

Martin et al. (1992) reported that the minimum fork length of any observed spawning bull trout was 250 mm in three

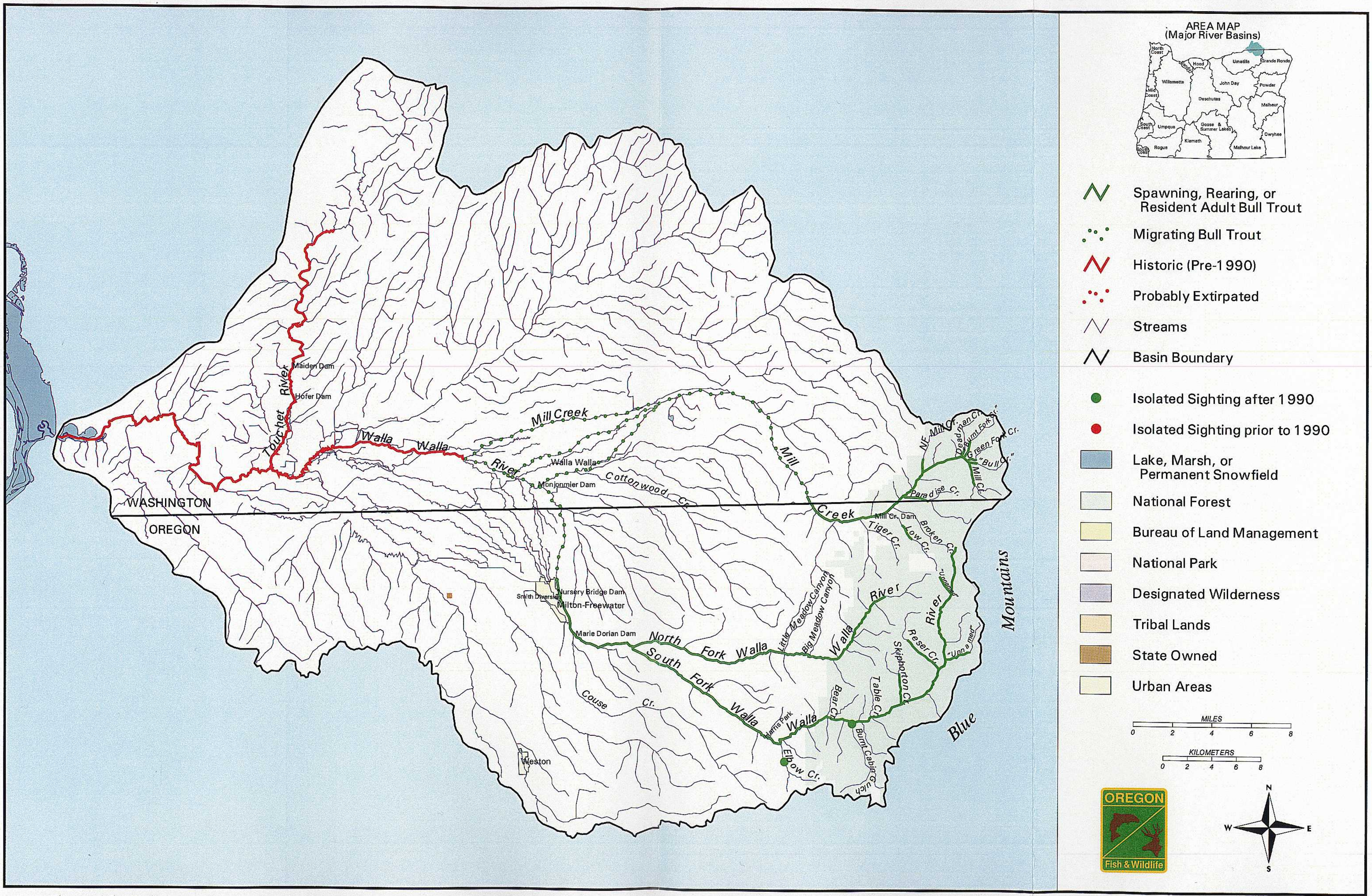


Figure 35. Bull trout distribution in the Walla Walla Basin, Oregon.

Table 21. Summary of bull trout spawning ground surveys from the North and South Forks Walla Walla River in Oregon and from Mill Creek on National Forest lands in Oregon and Washington, 1993 - 1995 (adapted from Germond et al. 1996b).

Stream/River	Year	Kilometers Surveyed	Number of Redds	Redds/ kilometer
South Fork Walla Walla	1993	12.07	103	8.5
	1994	28.56	143	5.4
	1995	20.51	114	5.3
	1996	20.5	177	8.6
North Fork Walla Walla	1994	8.05	0	0
	1995	7.24	0	0
	1996	7.2	0	0
Mill Creek	1994	25.26	191	7.6
	1995	24.26	165	6.8
	1996	27.7	134	4.8

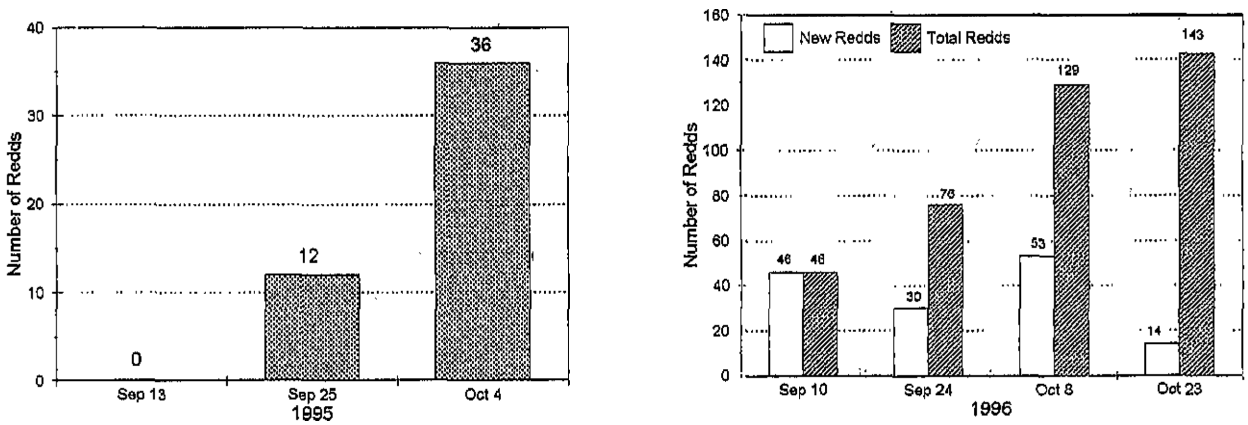


Figure 36. Redd counts from bull trout spawning ground surveys in the index reach in the South Fork Walla Walla River, 1995 and 1996.

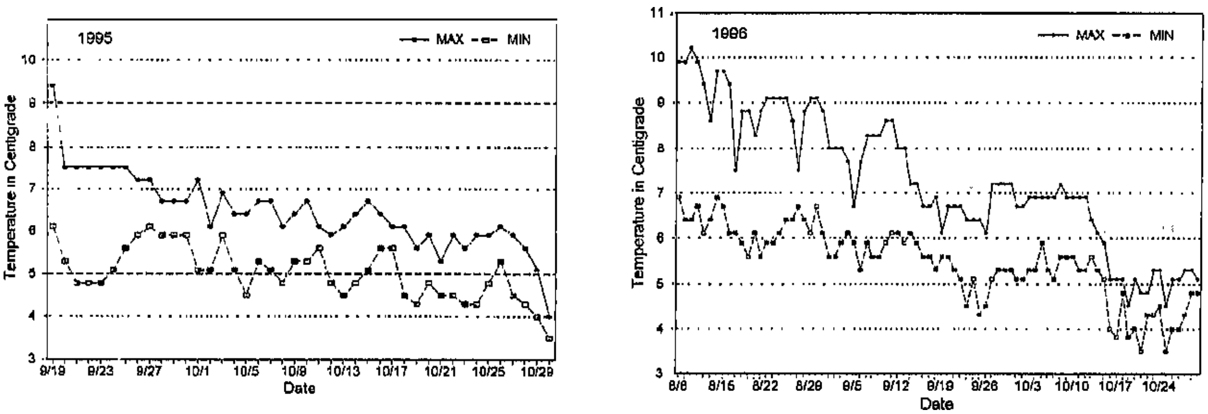


Figure 37. Stream temperature in the South Fork Walla Walla River at Skiphorton Creek, from 19 September to 30 October 1995, and from 8 August to 29 October, 1996.

southeast Washington streams, including Mill Creek, and ranged up to 600 mm in size. Size of bull trout observed during ODFW spawning ground surveys in the South Fork Walla Walla River in 1995 ranged in size from approximately 200 mm to >610 mm (Germond et al. 1996b).

Redd sizes measured in 1995 and 1996 are shown in Table 22. Redds measured in the Walla Walla Basin are similar in size to those measured in the Umatilla Basin (ODFW 1996b). Bull trout redds observed in the Tucannon River in southeast Washington in 1990 averaged 1.62 m in length and 1.05 m in width, and in 1991 they averaged 1.90 m in length and 0.87 m in width (Martin et al. 1992).

Bull trout in the Walla Walla Basin show both fluvial and resident life history patterns. Five to eight bull trout from 330 mm and 430 mm have been captured annually in the steelhead trap (upstream adult migrants) at Nursery Bridge Dam on the mainstem Walla Walla River (Germond et al. 1996b). The trap is fished whenever flows permit, usually from December into June Bull trout captured in the trap could be fluvial migrants returning to the upper Walla Walla Basin, Anglers report catching bull trout 607 mm - 711 mm in length downstream of the trap during the steelhead fishery. It is believed that these larger bull trout are able to negotiate the dam and bull trout smaller than 330 mm would be able to swim through the bars in the trap unimpeded, but there are no data to confirm this (J. Germond, ODFW, personal communication, August 1996).

Samples for genetic analysis were taken in 1995 from upper Mill Creek, the South Fork Walla Walla River, and the North Fork Touchet River (Washington). Bull trout collected ranged from 41 mm to 460 mm in fork length with 84% sampled less than 190 mm in fork length (Hemmingsen et al. 1996). Analysis of microsatellite nuclear DNA suggests that bull trout populations from the John Day River basin and throughout northeastern Oregon (including the Walla Walla Basin) comprise a major genetic lineage (Spruell and Allendorf 1997).

Age versus length derived from analysis of otoliths of bull trout collected from three neighboring streams in Washington (including Mill Creek) is shown in Table 23 (Martin et al. 1992). Bull trout in the 200 mm size range were between 3 and 4 years old. Bull trout surveyed during snorkel surveys between Bear Creek and Skiphorton creeks in the South Fork Walla Walla River in 1995 ranged from young of the year to about 6 10 mm in fork length. Creel records showed bull trout landed ranged from size group 150 to 200 mm up to +500 mm size group (Germond et al. 1996b) (Table 24).

Table 22. Bull trout redd sizes from spawning surveys in the Walla Walla Basin in 1995 and 1996 (Germond et al. 1996b and ODFW 1996b).

		Length (m)		Width (m)	
Year	Number	Average.	Range	Average	Range
1995	114'	1.3	0.6 - 4.0	0.7	0.2 - 2.0
1996	151	1.1	0.4 - 2.5	0.6	0.2 - 2.0

Table 23. Mean fork length (mm) and range of fork lengths for each age class of bull trout in three southeast Washington streams for 1990 and 1991 (Martin et al. 1992)

Stream	Mean Fork Length (Range)			
	Age 0+	Age 1+	Age 2+	Age 3+
Mill Creek[a]	55 (30-70)	110 (90-130)	160 (135-190)	235 (199-270)
Wolf Fork	55 (35-80)	105 (85-115)	155 (120-185)	170 (165-175)
Tucannon River	45 (30-65)	90 (70-l 10)	145 (115-175)	195 (168-225)

[a] A portion of *the study area was located in Oregon.*

Table 24. Creel census summary data for bull trout by year for the Walla Walla Basin 1963-1985.

Year	Number of bull trout by size group (mm)								
	150-200	200-250	250-300	300-350	350-400	400-450	450-500	500+	Total Fish Landed
1963									4
1964									24
1965									14
1966									23
1967									35
1968	3	10	9	4	3				29
1969	11	3	2	1		4	1		22
1970	1	4	2	1					8
1971									
1972	2	16	17	7	7	4	1		54
1973		2	1	1	2	1			7
1974	1	1							2
1975		12	1	5		2		1	21
1977			5	1					6
1978			2				2		4
1979		6	5	8					19
1981		9	12	4	2	2	2		31
1982		3	4	1	1				9
1983		2		1	1				4
1984			1						1
1985		1	1						2

An estimate for the Walla Walla bull trout population is not available. However, Martin (1992) estimated there were 4,071 bull trout in Mill Creek in 4.1 RK of stream surveyed, based on spawning surveys, Martin et al. (1992) estimated 1,754 young-of-year bull trout and 2,171 juvenile bull trout in Mill Creek in 1991, Juvenile bull trout densities were highest in plunge pools with woody debris (8.7 fish/100 sq m) or turbulence and next highest in run habitat with woody debris (8.4 fish/100 sq m). Young of year bull trout densities were highest in riffle (8.8 fish/100 sq m) and cascade (8.8 fish /100 sq m) habitat types where turbulence and boulder substrate were the most common type of instream cover. Young-of-year bull trout densities were on an average higher in turbulent water and lower in placid water for all three streams surveyed (Martin et al. 1992).

Fish species associated with bull trout in Mill Creek include steelhead and redband trout, whitefish, river lamprey, and sculpin (Martin et al. 1992). Interspecific competition for habitat between juvenile bull trout and steelhead/rainbow did not occur in Mill Creek because of minimal habitat overlap. Bull trout and steelhead ate similar taxa of invertebrates in each of the study streams, but food was not limiting, and the authors concluded that interspecies competition for food in the study reach of the study streams was minimal (Martin et al. 1992).

Specific Limiting Factors

Upper Mill Creek is considered pristine and has protected status as a municipal watershed (Martin et al. 1992). Habitat units surveyed in 1991 by Martin et al. had a high percentage of overhead cover, and substrate embeddedness was low to moderate with slight increases at downstream sites. Temperatures recorded in Mill Creek between June and September of 1991 showed daily maximums did not exceed 13 °C during the period. Highest daily maximums were recorded during August, but dropped considerably toward the end of August. Maximums below 10 °C were recorded until early July and again in early September (Martin et al. 1992). The lower sections of Mill Creek are degraded from water diversions, removal of riparian habitat, construction of roads, housing developments, and instream erosion.

The South Fork Walla Walla River above Bear Creek is protected from logging and considered in nearly pristine condition. Habitat from Bear Creek downstream to Harris Park (approximately RK 11) is also excellent (Germond et al. 1996b).

Habitat in the North Fork Walla Walla River is in need of restoration and protection. Historic grazing and timber harvest have impacted riparian areas and contributed to heavy soil loss throughout the North Fork Walla Walla drainage. Loss of riparian shade continues to be a problem on private lands along the North Fork Walla Walla River (Germond et al 1996b). Lack of large wood is also a major problem in the North Fork Walla Walla drainage as is heavy grazing by livestock (T. Bailey, ODFW, personal communication, January 1997).

Surveyors doing fish presence surveys in 1990 noted that large wood levels were low on private lands in both forks of the Walla Walla River (Germond et al. 1996b). Large wood (as defined by USFS Region 6 protocol) is considered low on federal lands in the basin. For example, 48 pieces of wood per km was calculated for the 49 km surveyed in SouthFork Walla Walla River, North Touchet River, and TigerCreek (tributary of Mill Creek), with 8 pieces per km over 5 1 cm in diameter. The average across the Walla Walla Ranger District, which includes streams in the Umatilla and lower Grande Ronde basins, as well as the Walla Walla Basin is 64 pieces per km, 13 pieces per km over 51 cm in diameter. Most of the streams surveyed in the Walla Walla River on the Ranger District are in roadless areas so the wood component may reflect natural conditions in the drainage (M. Northrop, Umatilla National Forest, personal communication, September 1996).

Shade does not appear to be a problem on the South Fork Walla Walla River, where large cottonwoods provide most of the stream shade at lower elevations. However, private landowners have been logging some of the cottonwoods in both forks of the Walla Walla River, which may impact stream shading and future large wood recruitment (J. Germond, ODFW, personal communication, August 1996). Downstream of the forks the dikes are routinely cleared of vegetation with trunks or stems larger than 100 mm in order to maintain the flood control function of the dikes (Germond et al. 1996b).

Flooding during the winter of 1996 may have had a major impact on habitat in the Walla Walla Basin, although the effects have not been evaluated fully by biologists, Preliminary observations by stream survey crews indicate dramatic changes in channel configurations and large inputs of woody material.

Mill Creek experienced heavy bedload movement and bank erosion upstream of Walla Walla, Washington, during the flooding. Biologists have not assessed, habitat condition in the upper watershed since the flood (M. Schuck, Washington Department of Fish and Wildlife (WDFW), personal communication, September 1996). Operation of heavy equipment in Mill Creek on private land to repair flood damage during the summer of 1,996 may have caused mortalities or interrupted bull trout migration, and substantially altered habitat and negated possible positive effects of the flood (ODFW 1996b; P. Howell, USFS, personal communication, June 1997).

Fish habitat in the mainstem below the forks has been simplified with loss of a functioning flood plain as a result of the dike work. Several of the dikes were breached during flooding in 1996 and immediately rebuilt even higher than before. The use of large riprap rock which absorbs energy from the sun, and systematic removal of riparian vegetation from the dikes prevents any temperature amelioration that would be provided in a more naturally functioning system. These areas could become potential thermal barriers to bull trout.

Passage barriers in the Walla Walla system are believed to prevent interchange between populations in Mill Creek, the Touchet River, and upper Walla Walla Basin populations. Until recently, there were two diversion dams in Oregon on the mainstem Walla Walla: Marie Dorion Dam at RK 78 and Nursery Bridge Dam at RK 73. Nursery Bridge Dam is laddered, but is a barrier at low flows, Marie Dorion Dam was removed during the spring of 1996. It was not laddered and blocked upstream adult passage at most flows and upstream juvenile passage at all flows. A plan for passage improvements at Nursery Bridge Dam is being considered by the appropriate agencies (U.S. Army Corps of Engineers, CTUIR, and Bonneville Power Administration) and could be implemented as early as 1999 (Germond et al 1996b). There are three dams in Washington: one on the mainstem just downstream from the Oregon-Washington border, and two (Hofel and Maiden dams) in the lower Touchet River.

Mojonmier Dam (south of the city of Walla Walla) has an old ladder that is not functional at low flows, The ladder at Hofer Dam on the Touchet River near the mouth was damaged this spring and will be evaluated for passage this fall. Maiden Dam, 3 km above Hofer Dam, is not considered a major problem as it must pass water downstream to meet the Hofer water right, which has seniority. However, it can present a barrier to fish at very low flows (M. Schuck, WDFW, personal communication, September 1996).

Barriers to fish movement are also caused by lack of streamflow during the irrigation season. The Walla Walla River is dry downstream from the Nursery Bridge Dam each summer due to irrigation withdrawals. For many years ODFW (with assistance from CTUIR in last 3 years) has conducted an annual rescue effort in the plunge pool below the dam. In each of the last six years (1990-1995), between 10 and 30 bull trout ranging in size from approximately 75 mm to 430 mm were salvaged along with hundreds to thousands of redband/steelhead trout. Restoration of flows is not likely in the near future. Studies in the Walla Walla Basin have shown that structural storage for flow augmentation is not cost-effective. Purchase or lease of water rights is a possibility if willing water right holders can be identified (Germond et al. 1996b).

Gravel pushup dams for irrigation diversions are used throughout private lands on the mainstem and both forks of the Walla Walla River. These occasionally block upstream passage (J. Germond, ODFW, personal communication, August 1996).

Two diversions in Oregon remain unscreened: Smith Ditch (<1 cfs) located in Milton-Freewater and Hudson Bay Frost Control (>30 cfs) located just upstream of Nursery Bridge Dam at the fish ladder. The latter diversion is used only in the spring for frost control; however, bull trout may be present at this time of moderate water temperature. The irrigation district that controls these diversions and others in the area is considering consolidation of five diversions into one. Smith Ditch and Frost Control diversions would be included in the project, and the need for several individual screens would be reduced to one for the single diversion.

Numerous irrigation diversion dams on the mainstem Walla Walla River in Washington were viewed on a multi-agency tour (ODFW, WDFW, CTUIR, and the National Marine Fisheries Service) in 1996. Fish bypass pipes on these dams were designed to pass steelhead smolts and may not be sufficient to pass adult fish. Some pipes have collapsed and WDFW biologists are working with irrigators to change these systems (M. Schuck, WDFW, personal communication, September 1996). Five screens on the mainstem in Washington have been identified as problems and are scheduled for improvement during 1997 (M. Schuck, WDFW, personal communication, September 1996).

Salmon were historically part of the Walla Walla bull trout's prey base, but have been absent in the basin for decades. It is not known how their absence has affected bull trout populations. Reintroduction of spring chinook, currently being considered by ODFW and CTUIR, would restore this traditional food source for bull trout.

Management Considerations

Harvest of bull trout in the Walla Walla Basin in Oregon and Washington has been prohibited since 1994. Prior to this, angling occurred from the late trout opener (Memorial Day weekend in May) through October 3 1. Bull trout were also targeted on their spawning grounds in September and October by a small group of anglers (Germond "et al. 1996b). Entry to the upper Mill Creek watershed is prohibited by law (Martin et al. 1992).

Hatchery rainbow trout releases occurred annually within bull trout habitat during mid-May, June, and July in the mainstem Walla Walla River near Couse Creek (RK 77.5) and in the South Fork Walla Walla River upstream to Elbow Creek (RR 15.7) until 1991. At this time, South Fork Walla Walla River was closed to vehicle traffic upstream of the gauging station at RK 13.7 effectively limiting stocking upstream of Harris Park (RR 11). Oregon State Police (OSP) special patrols in the South Fork Walla Walla River in 1991 and 1992 reported high compliance with angling regulations. They also reported a slight increase in catch of bull trout, and decreased redband trout catch between Elbow Creek and Bear Creek, due mostly to the absence of hatchery rainbow trout. In 1994, releases of hatchery rainbow trout were eliminated in the Oregon portion of the Walla Walla River (Germond et al. 1992).

Twelve temperature data loggers were placed in the Walla Walla River by CTUIR, ODFW, and USFS personnel several years ago in a cooperative monitoring effort. The information will be used to determine the thermal regime in the basin and its relationship to distribution of bull trout (Germond et al. 1992).

Instream water rights were certificated for Couse Creek from the mouth to headwaters, the portion of Mill Creek in Oregon, the North Fork Walla Walla River from headwaters to its confluence with the South Fork Walla Walla River, and the South Fork Walla Walla River from Reser Creek to the confluence with the North Fork Walla Walla River. Unfortunately, instream water rights are junior to most existing out-of-stream water rights and will not be effective in restoring streamflows unless senior rights are returned to instream flows.

Biologists from state, federal, and tribal agencies and private interests whose jurisdictions include bull trout habitat within the Blue Mountain Province have initiated meetings to set priorities, coordinate field work, and compare information concerning bull trout. Highest priorities for action in the Walla Walla Basin include habitat protection and improvement (including improved passage at the Nursery Bridge Dam, and riparian restoration), bull trout life history studies (including snorkel surveys with some limited electrofishing to determine presence/absence and abundance and telemetry work to determine movement patterns), and continuation of spawning ground surveys.

Current Status

The status of bull trout in Oregon was reported by Ratliff and Howell (1992). They designated bull trout in the North Fork Walla Walla River as a population "of special concern" based on habitat degradation and recent inventory information that indicates numbers are very low. Populations in the South Fork Walla Walla River and in Mill Creek were rated at, "low risk" by Ratliff and Howell (1992). The isolation of populations in the upper Walla Walla Basin from the Mill Creek population remains a concern. The 1996 status of Walla Walla Basin bull trout is unchanged in the South Fork Walla Walla River. However, the North Fork Walla Walla River has been downgraded to a "high risk" of extinction because no redds have been found in the last three years. Mill Creek was also downgraded from "low risk" to "of special concern" because of an apparent downward count in spawning redds in the last 3 years and the habitat disruption that occurred in the summer of 1996.

Grande Ronde River Basin

Introduction

The Grande Ronde River Basin, situated in northeastern Oregon and a small corner in southeastern Washington, drains approximately 6,350 sq km (Anonymous, 1990). The mainstem Grande Ronde River extends 341 km from its headwaters in the Blue Mountains to its confluence with the Snake River in southeastern Washington. This confluence is located 271 km above the confluence of the Snake and Columbia rivers and 793 km above the confluence of the Columbia with the Pacific Ocean. Major tributaries within the basin with bull trout include upper Grande Ronde River, Catherine Creek, Lookingglass Creek, Minam River, Wallowa River, and Wenaha River. This basin is located upstream of eight mainstem dams in the Columbia River system. For purposes of this report, the Grand Ronde Basin is divided into the Upper Grande Ronde Subbasin, the Lower Grande Ronde Subbasin, and the Wallowa Subbasin.

The Grande Ronde Basin is dominated by the rugged Blue Mountains, which border the drainage to the west and the northwest, and the taller Wallowa Mountains, located to the southeast. Peaks in the Blue Mountains reach 2,347 m and in the Wallowa Mountains reach as high as 3,050 m (Anonymous, 1990).

Agriculture and logging are the most important economic enterprises in the basin. The Grande Ronde River upstream of Lookingglass Creek is part of lands ceded to the CTUIR, while their usual and accustomed use areas extend into the lower Grande Ronde River and Wallowa subbasins. The Nez Perce Tribe's usual and accustomed use areas include the lower Grande Ronde River downstream of Lookingglass Creek and the Wallowa River Subbasin.

Historical Distribution

Bull trout were historically found throughout most of the Grande Ronde Basin. Complete distribution is undocumented, but seasonal connection with the Snake River was likely. Much of the historical distribution is also suggested by the current bull trout distribution shown in Figures 38 (Upper Grande Ronde Subbasin), 39 (Wallowa Subbasin), and 40 (Lower Grande Ronde Subbasin). Limited information is available on historical distribution for bull trout in the Upper Grande Ronde Subbasin, but it is suspected that bull trout occurred throughout all major tributary streams (West and Zakel 1993). Ben Brown, an early freighter and settler, recorded catching 18 "mountain trout" averaging over 4.5 kilograms (10 pounds) in September 1860 in the Grande Ronde River near Hilgard Park (West and Zakel 1993). Electrofishing surveys in 1955 indicated bull trout in Fly Creek and East Chicken Creek. Angelo (1866) noted in his book "Sketches of Travel in Oregon and Idaho" that Catherine Creek was full of "speckled trout" near the present town of Union. We speculate that "speckled trout" may have been bull trout.

A catchable rainbow trout creel survey conducted on the Lostine River in summer and early fall of 1976 documented angler catches of wild bull trout. Approximately 10,000 hatchery rainbow trout were planted from July to middle August 1976 to increase recreational angling on the Lostine River. Unfortunately, anglers also caught and retained an estimated 346 bull trout (Anderson 1982). The extirpation of a

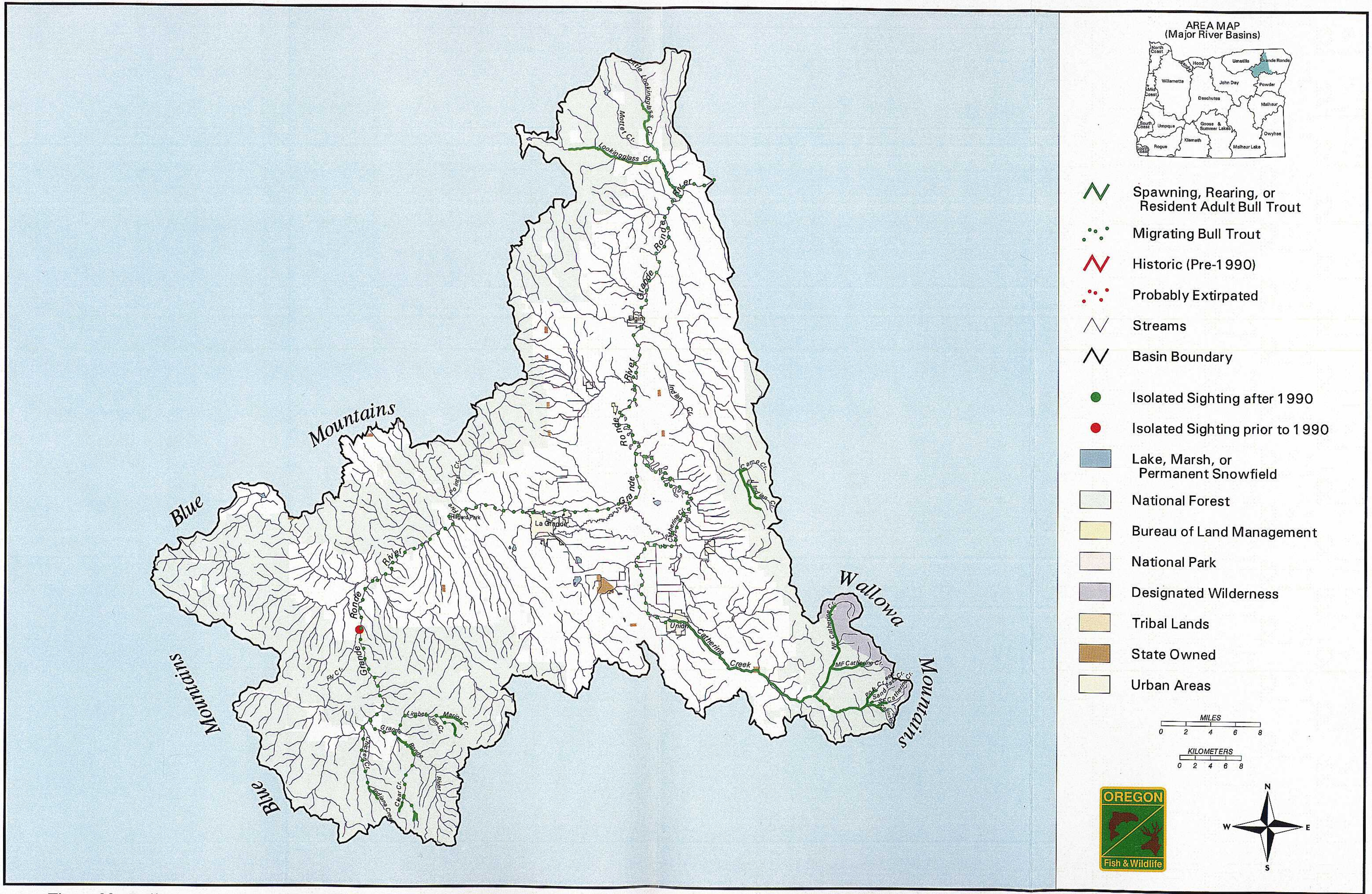


Figure 38. Bull trout distribution in the Upper Grande Ronde Subbasin, Oregon.

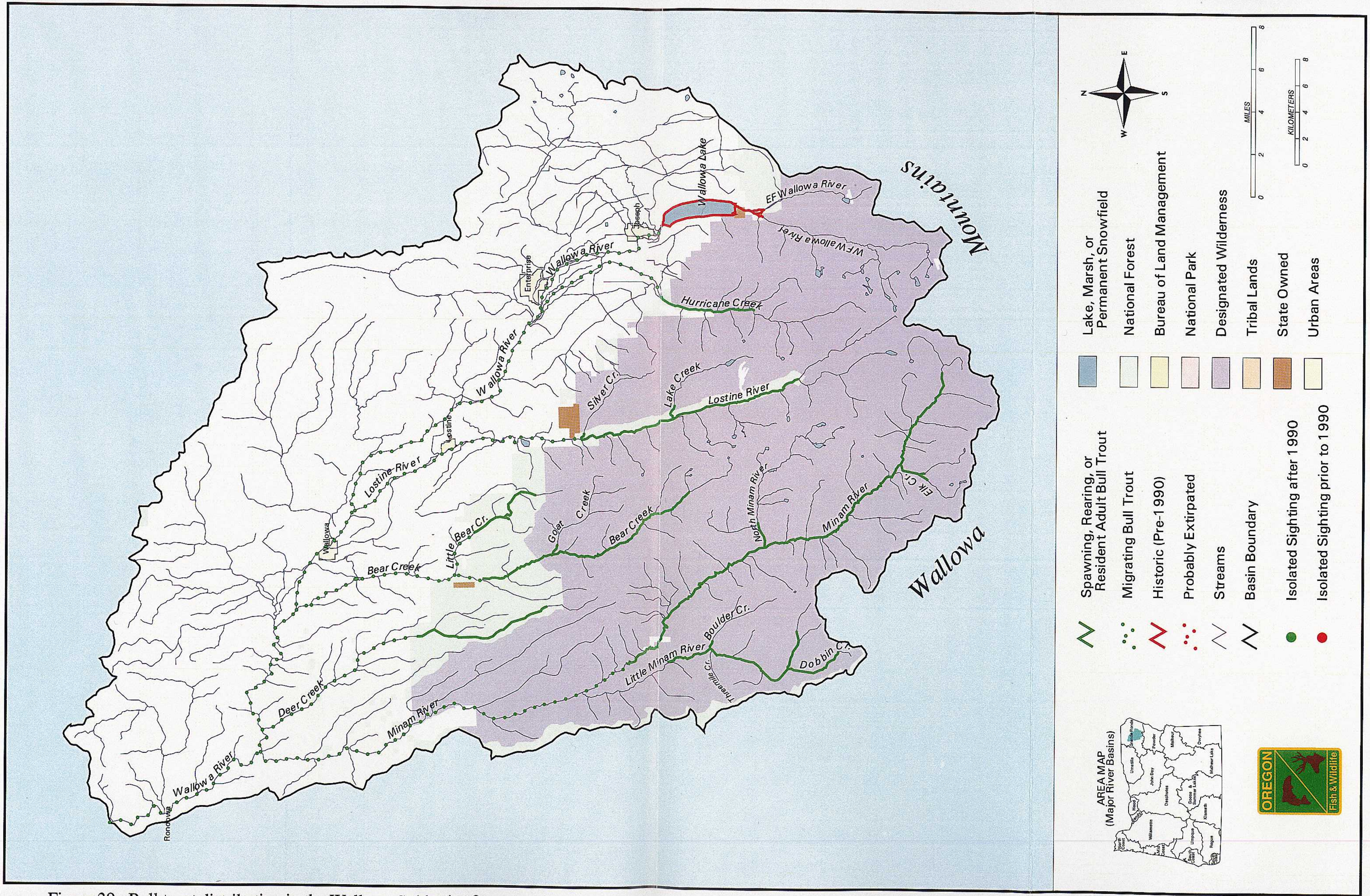


Figure 39. Bull trout distribution in the Wallowa Subbasin, Oregon.

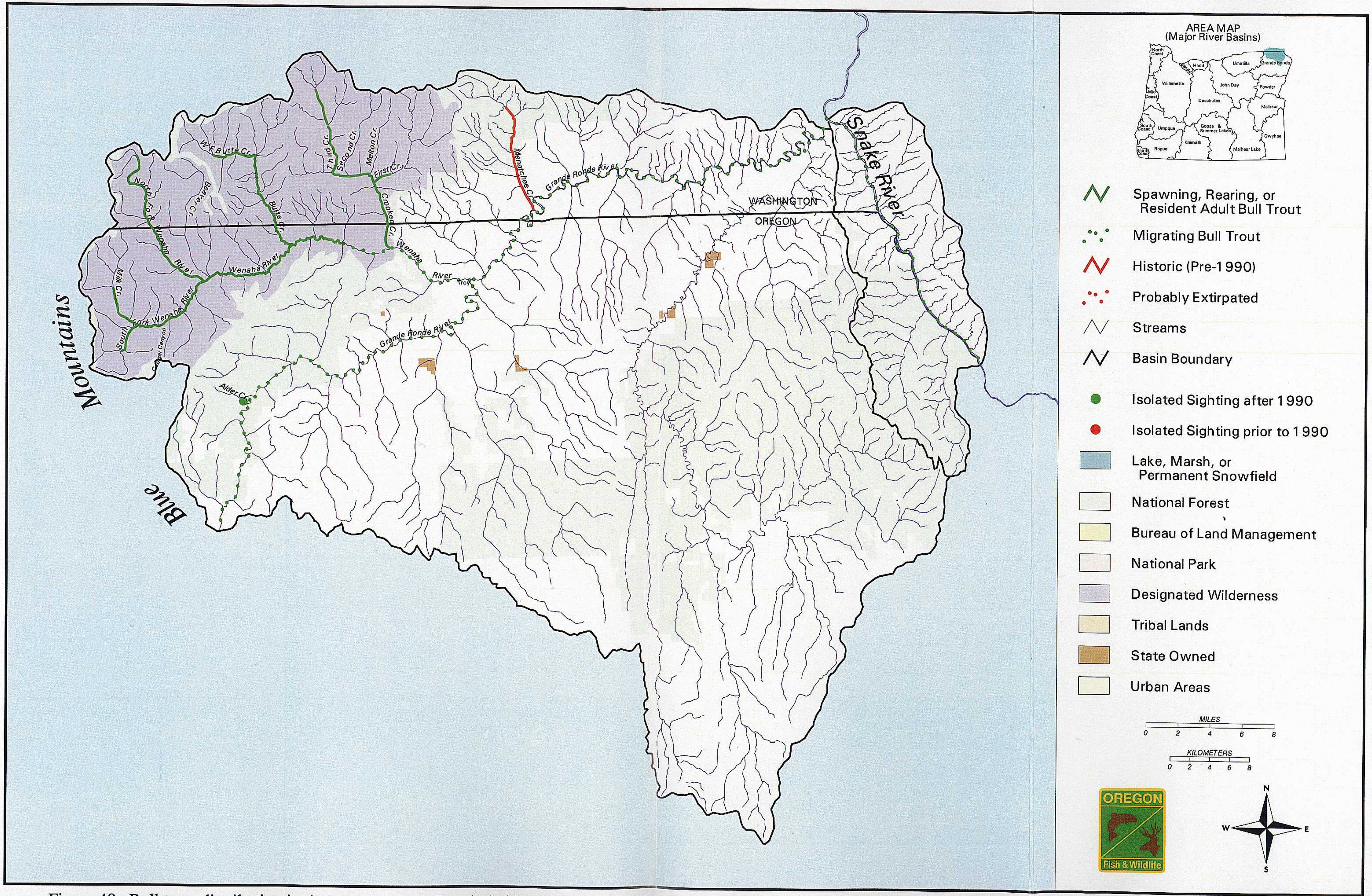


Figure 40. Bull trout distribution in the Lower Grande Ronde Subbasin, Oregon.

large-sized, adfluvial population of bull trout (up to 740 mm in length) in Wallowa Lake and its upstream tributaries is a historical example of misguided fishery management. Adult bull trout were intentionally trapped and removed from Wallowa Lake beginning in the early 1930s (Ratliff and Howell 1992). A dam and series of weirs were used to eliminate bull trout migration into Wallowa Lake in an effort to reduce predation on rainbow trout. Most wild bull trout were believed to be extirpated from Wallowa Lake in the late 1950s (Smith and Knox 1993; Kostow 1995).

Wallowa Lake Controversy

A recent draft report by Platts et al. (1995) reviewed trends of bull trout, abundance in Idaho, Montana, Oregon, and Washington. This widely circulated report was prepared for the Intermountain Forest Industry Association. The conclusion section of Platts et al. (1995), states that bull trout populations presently appear stable over most of their range in the four states studied. They further conclude that a minimum of 10 years, and preferably more, of consistent data is needed to identify time-related bull trout population trends. Using this logic, they reviewed only seven bull trout populations in Oregon. They found that Oregon bull trout populations are generally stable and are in no jeopardy of declining to endangered levels. Platts et al. (1995) further argue that the conventional wisdom that bull trout populations have gone through drastic declines could not be supported by a consensus of the data available in Oregon or other states. However, four state chapters of the AFS independently reviewed this report and identified several serious problems with their overall analysis including: use of unreliable creel data to draw conclusions about trends, use of outdated data (9 -18 years old), and use of percent of bull trout in total creel without reference to angler effort or effects of abundance of other species (e.g., hatchery fish) (W.J. Paradis, Idaho Chapter AFS President, Letter to C. Lobdell and W.S. Platts, June 1995).

Platts et al. (1995) used the Wallowa Lake bull trout population as an example that a 24-year trend of angler catch data from 1954 to 1977 showed a slow increase in bull trout population, and concluded that there are no trends in the Wallowa Lake data that indicated bull trout populations were not stable. On the other hand, ODFW fishery managers Smith and Knox (1993), concluded that wild bull trout in Wallowa Lake were believed to be extirpated in the late 1950s. A review of the angler catch estimates for Wallowa Lake from 1954 to 1996 will help clarify this controversy (Table 25). Platts et al. (1995) used an estimated bull trout catch of 482 in 1976 and 1903 in 1977 to show a dramatic increase in angler catch. If the authors had contacted ODFW Wallowa managers they would have found that local extinction of bull trout was the reason for a 1968 reintroduction project in Wallowa Lake. This reintroduction project was primarily comprised of hatchery releases of bull trout and an Alaskan stock of Dolly Varden trout (Table 26). The reintroduction program failed and was discontinued after 1978. No bull trout or Dolly Varden have been caught by anglers or captured in Wallowa Lake since 1979 (B. Smith, ODFW, personal communication, May 1995).

It is unclear why Pfatts et al. (1995) analyzed the angler catch of bull trout beginning in 1954, then ended their analysis in 1977, even though additional data were

Table 25, A comparison of angler catch estimates, Wallowa Lake, 1954- 1996.

Year	Estimated angler hours[a]	Total angler catch[a]	Rainbow trout	Kokanee salmon	Lake trout	Dolly Varden/ bull trout[b]
1954	44,800	42,770	39,200	3,145	0	425
1955	44,018	27,417	23,347	3,695	0	37s
1956	42,494	46,020	32,356	13,190	0	474
1958	48,236	42,862	32,263	9,843	756	0
1959	33,899	30,259	25,770	3,821	504	200
1961	19,758	16,501	15,282	934	285	0
1963	18,984	11,800	10,795	303	654	48
1965	38,840	24,461	19,030	5,190	241	0
1966	57,326	41,111	27,797	13,223	45	46
1961	53,399	46,056	28,277	18,000	0	0
1988	35,405	30,973	15.775	15,198	0	0
1969	31,869	32,629	14:182	18,423	0	24
1970	50,810	46,321	32,307	14,014	0	0
1971	47,214	35,697	28,802	6,895	0	0'
1972	44,973	45,387	25,520	19,867	0	0
1973	22,385	29,780	,9,712	20,068	0	0
1974	27,706	38,629	1,473	31,136	20	0
1975	22,241	26,442	9,165	17,277	0	0
1976	49,684	49,792	16,448	32,862	0	482
1977	52,695	49,021	23,724	23,394	0	1,093
1978	48,868	35,969	23,075	12,280	0	614
1979	28,269	36,719	8,622	27,966	0	131
1980	18,505	24,510	5,542	18,942	26	0
1981	12,764	13,920	4,617	9,270	33	0
1982	23,618	37,142	6,519	30,623	0	0
1983	15,361	27,665	6,252	21,413	0	0
1984	30,303	42,667	11,315	31,331	21	0
1985	---------No Survey Conducted---------					
1986	22,920	30,418	5,544	24,856	18	0
1987	39,424	30,984	8,747	22,215	6	0
1988	39,302	33,483	17,982	15,385	19	0
1989	34,099	30,753	11,128	19,618	I	0
1990	37,003	26,856	14,541	12,285	30	0
1991	18,286	18,745'	8,835	9,907	3	0
1992	18,8?5	24,627	7,724	16,896	7	0
1993	16,570	19,652	9,719	9,873	0	0
I994	18,114	20,221[a]	7,223	12,998	O	0
1995	22,940	24,332	12,607	11,702	23	0
1996	16,707	16,171	5,976	10,179	16	0

[a]For many years estimated angler hours and angler catch was reduced because sampling effort was reduced due to budget reasons.
[b] Catch in the 1950s were wild bull trout; while catch in the '1960s may have been misidentified lake trout or a few wild bull trout and catch in 1970s were primarily from hatchery released of introduced Dolly Varden or bull trout.

Table 26. Introductions of bull trout and Dolly Varden trout in Wallowa Lake from 1968 to 1978.

Year	Number	Size	Stock
1968	1,897	Fingerling	Unknown[a]
1973	26	Legal	Imnaha River bull trout
1974	19,500	Fingerling	Alaskan Dolly Varden[b]
1975	4,312	Legal	Alaskan Dolly Varden[b]
	13,089	Fingerling	Alaskan Dolly Varden[b]
1976	18,750	Fingerling	Alaskan Dolly Varden[b]
	7,304	Legal	Alaskan Dolly Varden[b]
1977	13,300	Fingerling	Alaskan Dolly Varden[b]
	5,000	Legal	Alaskan Dolly Varden[b]
1978	6,560	Legal	Alaskan Dolly Varden[b]
	11,520	Fingerling	Alaskan Dolly Varden[b]

[a] *These bull trout or Dolly Varden trout came from Saratoga National Hatchery in Wyoming.*
[b] *These fish were probably Alaskan Dolly Varden trout that originatedfrom Clark Fork Hatchery*

available. A large number of legal-sized Dolly Varden trout were released into the lake in 1976 and 1977. These hatchery fish were the reason angler catch increased up to 1903 fish in 1977. Inclusion of available data after 1977 would have shown a downward trend beginning in 1978 and then zero harvest from 1980 through 1996 for bull trout/Dolly Varden in the angler catch (Table 25). We agree with the local fishery managers that the bull trout population in Wallowa Lake is extinct. Thus, conclusions in Platts et al. (1995) are not accurate and should be reanalyzed.

Current Distribution

In the Upper Grande Ronde subbasin (Figure 38), small populations of bull trout are present in the headwater parts of Limber Jim, Indiana, and Clear creeks. The actual summer distribution is less than 5 km for each of these creeks. Most Catherine Creek bull trout summer holding and rearing areas are found above RK 50 (Zakel 1995). Occasionally, a bull trout is captured near the town of Union. Streams with bull trout in the Catherine Creek system include: North Fork, South Fork, Middle Fork, Sand Pass Creek, Collins Creek, and Pole Creek. All known bull trout summer holding and rearing areas in Indian Creek are found only in the extreme headwaters of the drainage. Bull trout in the Lookingglass Creek drainage are seasonally connected to the Grand Ronde River and possibly the Snake River since some fluvial migration has been documented (Zakel 1995). An isolated bull trout sighting was made in lower Five Points Creek, a small tributary of the Lower Grande Ronde River on U.S. Forest Service lands. This is the first documentation of bull trout in this stream (Zakel 1995).

Much of the Wallowa River subbasin is protected wilderness area. Most of the remaining spawning, rearing, and summer resident areas are on USFS-managed lands. Populations of bull trout are currently found in Minam River, Elk Creek, Little Minam River, Deer Creek, Bear Creek, Little Bear Creek, Lostine River, and Hurricane Creek (Figure 39).

Distribution in the Lower Grande Ronde River subbasin is presented in Figure 40. The Wenaha River may contain one of Oregon's healthiest bull trout populations with its extensive wilderness areas and a current distribution comparable to probable historic distributions. Distribution extends into the mainstem Wenaha River and headwaters of all major tributaries including: North Fork, South Fork, Milk Creek, Beaver Creek, Butte Creek, and Crooked Creek (B. Smith and B. Knox, ODFW, personal communication, November 1996). Fluvial bull trout from the Grande Ronde Basin may still utilize the Snake River. Some bull trout are still found in the Snake River. One bull trout was captured in Little Goose Reservoir in the Snake River near Central Ferry State Park in 1991, while another bull trout was captured in the Snake River near the mouth of the Tucannon River in 1992 (D. Ward, ODFW, personal communication, January 1995).

Life History

Limited life history data is available from the Grande Ronde River Basin, ODFW's Native Trout Project and the USFS have gathered over 300 scales from bull trout sampled throughout the basin. These scales will be analyzed for age and growth in 1997. Extensive samples for genetic analysis were taken in 1995 from 11 sites within the basin and compared to bull trout throughout Oregon and parts of Washington (Hemmingsen et al. 1996). Analysis from these data show that populations from the John Day Basin and Northeastern Oregon (including the Grande Ronde Basin) comprise a major genetic lineage (Spruell and Allendorf 1997).

Unpublished length frequency data were obtained from W. Burck, (retired ODFW, personal communication, October 1995) who captured 348 downstream migrating bull trout in lower Lookingglass Creek in 1965 through 1971. These historical data were compared to 205 recent downstream migrating bull trout captured in lower Lookingglass Creek from 1993 through 1996 (P. Lofy and B. Bellerud, ODFW, unpublished data, December 1996). Migrants in 1993 to 1996 were significantly smaller than migrants from 1965 to 1971 (Figure 41). Although no population estimates have been made in the Lookingglass Creek drainage, presence/absence surveys and spawning ground surveys indicate that abundance was low (West and Zakel 1993).

Movement of a 240 mm bull trout has been observed after it was tagged at Lookingglass Hatchery in Lookingglass Creek in September 1991. This fish was later caught in the Grande Ronde River near LaGrande (72 km upstream) on March 1992. Then on September 1992, this same fish was caught and retained by an angler in the Grande Ronde River immediately below the confluence of Lookingglass Creek (West and Zakel 1993). In one year, this bull trout had migrated almost 160 km (100 miles). Migration studies are currently underway in the Grande Ronde basin under the Native Trout Research Study funded by BPA.

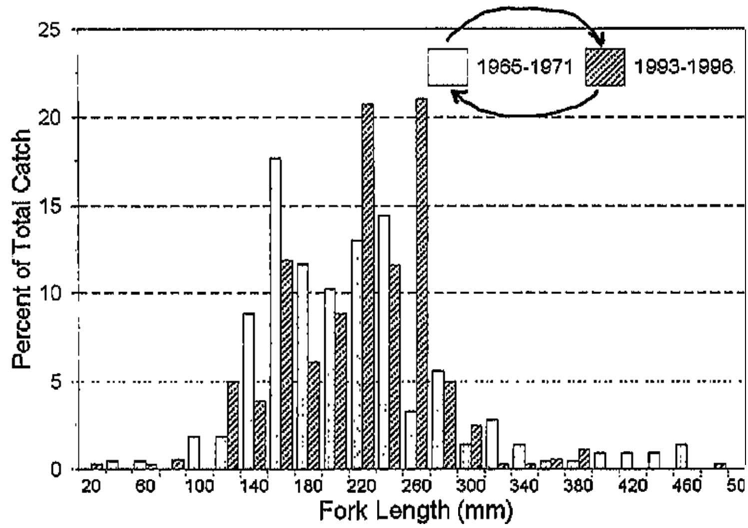


Figure 4 1. A comparison of length frequencies from downstream migrating bull trout trapped in 1965 to 1971 and in 1993 to 1996 in lower Lookingglass Creek (W. Burck, P. Lofy, and B. Bellerud, ODFW, unpublished data, 1995 and 1996).

No population estimates have been conducted in the Catherine Creek drainage, but presence/absence surveys suggest that numbers were extremely low (West and Zakel 1993). A downstream migrant trap located in Catherine Creek near the town of Union from 1994 through 1996 captured 43 small bull trout that ranged from 121 mm to 255 mm. Peak movement was in September and October (M. Keefe and B. Bellerud, ODFW, unpublished data, December 1996). Also, 29 bull trout ranging from 133 mm to 298 mm were captured in a downstream migrant trap in the lower Grande Ronde River near the town of Elgin from 1993 to 1996.

In 1968, biologists surveyed the North Fork of Catherine Creek for spawning bull trout in Catherine Creek Meadows (RK 13). They found 18 bull trout redds and 36 adult bull trout in the immediate area (J. Zakel, ODFW, personal communication, November 1996). In 1994 and 1995, USFS biologists surveyed the Lookingglass Creek drainage and found 15 and 16 redds, respectively. In 1996, biologists surveyed Lookingglass Creek and found 3 occupied bull trout redds and 26 unoccupied bull trout redds in approximately 15.7 km of stream (B. Bellerud, ODFW, unpublished data, December 1996).

The Native Trout Research Study surveyed the Little Minam River in fall of 1996 from the confluence of Boulder Creek to the headwaters. They found no redds or spawners downstream of Three Mile Creek. All spawning bull trout observed were relatively small fish (200 ± 50 mm in length) and probably represented a resident population. Their first survey was conducted on 11 and 12 September and they found 10 new redds. Another survey was conducted on 2 and 3 October and 23 additional bull trout redds were found: A final survey was conducted on 23 October and no new redds were found; however only the two reaches where the most redds had been previously recorded were surveyed due to snow conditions. An additional six redds were found in Dobbin Creek (B. Bellerud, ODFW; personal communication, December 1996).

A cooperative bull trout spawning survey was conducted on the Wenaha River system in 1996 by the ODFW Wallowa District, USFS Umatilla National Forest and the Native Trout Project (Table 27). This was the first year a comprehensive bull trout survey was conducted. A total of 60 redds were recorded; however, this survey represents an incomplete sample as each reach was only counted once and some spawning areas such as upper Butte Creek were not surveyed (B. Smith and B. Knox, ODFW unpublished data, December 1996).

Specific Limiting Factors

Some Grande Ronde Basin streams, such as the Minam, Little Minam, and Wenaha rivers, contain large amounts of designated wilderness areas in their watersheds and have limited habitat impacts (Figure 38 and 40). Other basin streams such as the Upper Grande Ronde, Catherine Creek, and Lookingglass Creek contain public and private lands where habitat alteration can occur from timber harvest and road building. Timber harvest and agriculture are important economic enterprises in the Grande Ronde Basin. Streamflow diversions provide irrigation water for an estimated 29,826 hectares (73,700 acres) in the Grande Ronde and Wallowa valleys (ODFW 1990). Private agricultural and timber land make up large proportions of some subbasins. For example, 39% of the Catherine Creek drainage is private agricultural/grazing lands and another 3 1% of the drainage is private timber/grazing lands (Sims 1994).

Water rights on the Wallowa River, Grande Ronde River above Rondowa, and Catherine Creek are all over-appropriated (Anonymous, 1990). The management of livestock grazing, timber salvage harvest, and cropland production on private land have caused loss of riparian shade, which has increased the warming rate of water temperatures. These uses have also caused loss of bank stability and channel changes. Sedimentation from these impacts has reduced large pool depth (West and Zakel 1993).

Brook trout were introduced into streams and alpine lakes in the basin in the 1920s or earlier (B. Smith and B. Knox, ODFW, personal communication, November, 1996). In some basin streams, such as Hurricane Creek and Bear Creek, brook trout may be a limiting factor with their successful reproduction, high population numbers, and resulting low bull trout populations. In other nearby basin streams, such as the Minam River, only limited numbers of brook trout are present and they appear not to be adversely interacting with bull trout.

Overharvest of bull trout was probably a limiting factor for many of the basin streams where hatchery produced, catchable-sized rainbow trout were planted. Overharvest may have occurred in Catherine, South Fork Catherine, and North Fork Catherine creeks because of their accessibility and popularity for camping (West and Zakel 1993). Over 13,000 catchable-sized rainbow trout were released into the Catherine Creek drainage annually prior to 1990 to promote a

Table 27. Summary of redd count and fish observation data from bull trout spawning surveys conducted in the Wenaba River system, Fall 1996.

Stream reach	Redds					Fish (mm)		
	Kilo-meters	Occ.	Unocc.	Total	/mi	<250	250-510	>510
South Fdrk								
Milk Cr.-upstream	3.2	5	12	17	8.5	7	4	1
Milk Cr.-Cougar Cyn.	3.5	3	9	12	5.4	0	0	2
Cougar Cyn. Fks	6.0	0	0	0	0.0	1	0	1
North Fork								
Mth. upstream	5.2	5	10	15	4.7	1	4	1
Milk Creek								
Mth upstream	4.0	0	0	0	0.0	0	0	0
Wenaha River								
Forks-Beaver Cr.	0.8	0	0	0	0.0	1	0	0
Beaver Creek								
Mth. upstream	1.6	0	1	1	1.0	2	0’	0
Butte Creek								
Mth. upstream	6.0	0	6	6	1.6	0	2.	0
Crooked Creek								
Mth.-First Cr.	8.0	0	0	0	0.0	<a	0	0
First Cr.-Melton Cr.	0.8	0	0	0	0.0	<a	0	0
Melton Cr.-Cherry Cr.	0.8	0	0	0	0.0	<a	0	0
Cherry Cr.-Second Cr	1.6	1	3	4	4.0	<a	5	0
Second Cr.-Third Cr.	1.6	0	1	1	1.0	<a	0	0
First Cr.								
Mth.-Willow Cr.	2.4	1	2	3	2.0	<a	1	0
Third Cr.								
Mth.-Trout Cr.	4.8	0	1	1	0.3	<a	0	0
TOTAL	50.3	15	45	60	1.9	12	16	5

<a = not reported

recreational trout fishery in the area (J. Zakel, ODFW, personal communication, July 1995). A creel survey on the Lostine River documented that catchable trout anglers incidentally catch wild bull trout if unregulated.

Management Considerations

A creel survey on Catherine Creek and the upper Grande Roncle River in the summer of 1966 documented some incidental bull trout catch by anglers fishing for hatchery rainbow trout. The number of hatchery stocking locations is being reduced and modified to reduce incidental catch of bull trout. Stocking of catchable rainbow trout has been discontinued in the Wallowa and Lostine rivers, and Bear Creek.

Protective catch and release angling regulations for bull trout have been in effect throughout the basin since 1994. Presently, the taking or keeping of bull trout is prohibited in the Grande Ronde Basin and throughout most of the state.

Instream water rights have been issued for 42 streams or stream reaches in the Grande Ronde Basin. Streams with water rights that may be beneficial to bull trout include Catherine, South Fork Catherine, North Fork Catherine, Lookingglass, Limber Jim, Clear, Indian, and Hurricane creeks, and parts of the Wallowa and Wenaha rivers. Some of the stream reaches that have instream rights are already over-appropriated to senior users.

ODFW's Wallowa district office is studying a proposal to reintroduce bull trout into Wallowa Lake and its upstream tributaries. An earlier reintroduction program failed in 1978 however, most of those introductory releases were an Alaskan stock of Dolly Varden. This proposal would utilize wild-reared bull trout from the Big Sheep Creek drainage (Imnaha Basin). A hydroelectric diversion in the big Sheep Creek drainage will be closed and its channel dried up in 1997. Biologists believe that several hundred wild bull trout could be salvaged and transferred to the nearby Wallowa subbasin if disease and genetic considerations are found to be neutral. (B. Smith, ODFW, personal communication, December 1996).

The National Marine Fisheries Service listed the Snake River spring/summer chinook salmon as a threatened species under the Endangered Species Act in May 1992. This listing was upgraded to endangered in August 1994. Because endangered spring chinook are found in areas shared by migrating bull trout, bull trout should receive better protection from an ecological perspective as a result of the listing., Snake River steelhead have recently been proposed for listing as a threatened species. Any future Snake River steelhead listing may more directly benefit bull trout because their juvenile rearing areas overlap. However, continued timber harvest is planned for many of the subbasins in the Grande Ronde system. For example, the Lookingglass Creek watershed is approximately 24,605 hectares in size; the U.S. Forest Service manages 19,102 hectares (78% of the subbasin), while the rest of the subbasin (22%) is in private ownership. Northrop and Westlund (1994) estimate that 21% of the U.S. Forest Service lands have been logged. They further report that a total of 16,552 hectares (87% of all U.S. Forest, Service lands). are scheduled for eventual timber harvest by the Umatilla Forest Plan.

Henjum et al. (1994) suggest a refuge or preserve concept for the remaining, important aquatic diversity areas (ADA) throughout the eastside of Oregon and Washington. Their ADAs are defined as (1) locations where native aquatic species are at risk of extinction and vulnerable to future disturbance, (2) whole watersheds exemplifying native aquatic ecosystems, or (3) essential corridors linking habitats required to support fish populations at critical times in their life cycles. Henjum et al. (1994) list ADA's in Lookingglass Creek, Minam River, upper Wallowa River, Wenaha River, and parts of the lower Grande Ronde

River. The ODFW LaGrande district biologist has suggested that implementation of ADA's in the Grande Ronde Basin would be a workable, ecological approach to aquatic protection for bull trout, salmon, steelhead, and other aquatic species in this basin (J. Zakel, ODFW, personal communication, December 1996).

Informal coordination takes place on an ongoing basis between representatives from the LaGrande and Wallowa district offices of ODFW, the Umatilla and Wallowa-Whitman National Forests, and the Umatilla and Nez Perce tribes to protect and enhance bull trout throughout the Grande Ronde Basin.

Current Status

The status of bull trout in the Grande Ronde Basin was first reported by Ratliff and Howell (1992). They list the Upper Grande Ronde subbasin and upper tributary populations (Clear, Limberjim, and Indiana creeks) as having a "moderate risk" of extinction. This status has not changed. Catherine Creek has been downgraded from "of special concern" to a "moderate risk" of extinction. Approximately 70% of the Catherine Creek drainage is private lands with high agricultural, grazing and timber use (Sims 1994). Only. those tributary streams upstream from RK 50 on Catherine Creek appear to maintain temperatures low enough to allow bull trout spawning (West and Zakel 1993). The status of Indian Creek has not changed.

Lookingglass Creek has also been downgraded from "of special concern" to a "moderate risk" of extinction. Presence/absence and spawning surveys indicate that bull trout abundance is low in the Lookingglass system (West and Zakel 1993). Size comparison between downstream migrating bull trout found that migrants from the 1990s were significantly, smaller than migrants from 1965 to 1971 (P. Lofy and B. Bellerud, ODFW, unpublished data, December 1996). Most of the subbasin is in U.S. Forest Service lands, and 87% of these lands are scheduled for eventual timber harvest (Northrop and Westlund 1994). The large amount of proposed timber harvest on U.S. Forest Service lands could adversely impact bull trout in the subbasin (Northrop and Westlund 1994).

A new, previously unreported population, of bull trout has been found in Deer Creek, a tributary of the Wallowa River. This population is present in the upper parts of Deer Creek on U.S. Fdrest Service lands. Its status is listed as "of special concern."

The status assessments for the remaining bull trout populations throughout the Grande Ronde Basin remain the same as listed by Ratliff and Howell (1992). Populations in the Minam River, Little Minam River, and Wenaha River are protected by roadless, wilderness areas and are all listed as havmg a "low risk" of extinction.

Imnaha River Basin

Introduction

Information for this narrative was gathered from published and unpublished reports and data provided by fishery biologists at the ODFW District office in Enterprise, Oregon, and the USDA Forest Service, Wallowa-Whitman National Forest,

The Imnaha River, situated in northeastern Oregon, is a tributary to the Snake River entering at about RK 309. It drains an area of approximately 2,266 sq km, or 2,849 sq km if the tributaries draining the left bank of the Snake River from the confluence of the Imnaha to Nelson Creek are included in the basin, The Imnaha River is approximately 124 stream km in length from its headwaters to its confluence with the Snake River (USFS 1994a). Big Sheep Creek at 64 km in length and Little Sheep Creek at 48 km are the longest tributaries (Oregon Water Resources Board (OWRB) 1960) and their combined watersheds comprise a major portion of the total Imnaha basin.

The Imnaha flows northerly from its origin in the Wallowa Mountains at 2,949 m in elevation to the confluence with the Snake River at 292 m of elevation, Almost 90 percent of the total area is classified as mountainous and stream gradients are generally steep (OWRB 1960).

Bull trout are found from the headwaters to the mouth in the mainstem Imnaha River and in numerous tributaries. Spawning and early life history rearing habitat occurs in the upper reaches. Imnaha bull trout have access to the Snake River and may use this habitat at various times during the year.

The USFS manages 87% of the land in the Imnaha mainstem subwatershed, as defined by USFS (1994a). Private lands make up 12%, and less than 1% is managed by the BLM and DOF. Designated wilderness areas include the Eagle Cap Wilderness area in the headwaters of the Imnaha drainage and Hells Canyon Wilderness in the portion of the basin draining to the Snake River. Together they account for 14,857 hectares (USFS 1994a). Landownership in Big Sheep Creek subwatershed is 53% private, 46% national forest, and BLM and DOF administer approximately 1% (1,157 hectares). Total wilderness areas consist of approximately 6,079 hectares of the national forest land. The Imnaha basin is within the usual and accustomed use area of the Nez Perce Tribe.

Historical Distribution

Documentation on the historical distribution of bull trout in the Imnaha River drainage is limited. Anecdotal reports from anglers who fished the Imnaha River in the 1940s indicate that large bull trout were, easily caught. Good populations of native "Dolly Varden" (bull trout) were reported in Big Sheep and Lick creeks and the Imnaha River. The Imnaha River was considered "a good Dolly Varden stream" with no early limits on number or size.

Creel survey data was collected in 1978 on the mainstem Imnaha River between approximately RK 90 - RK 105, at sites where legal rainbow trout were stocked. In addition to rainbow trout and whitefish, anglers caught 68 bull trout, which comprised approximately 2% of the total catch (ODFW

Fingerling rainbow are released in some lakes that do not drain into the Imnaha River system. Steelhead smolts are released in Little Sheep Creek downstream of spawning, rearing, and resident adult bull trout habitat.

Current Distribution

Current and historic distribution of bull trout based on documented reports is portrayed in Figure 42. Current distribution is based on data collected between 1990 and 1996 during fish and stream habitat surveys, on reports of bull trout caught in irrigation diversion screen traps, and at upstream trapping facilities for adult chinook and steelhead. Bull trout habitat in the Imnaha Basin is characterized by streams dominated by cascades and rapids with gradients of 4% to 11% at elevations of 1,524 to 2,134 m (ODFW 1996a).

Presence/absence surveys in 1991 found bull trout in Little Sheep Creek above and below the Wallowa Valley Improvement Canal (Canal), in Cabin and Redmont creeks (tributaries to Little Sheep Creek), and in Big Sheep Creek and its tributaries (Salt Creek and the South Fork Big Creek). Bull trout were also found in McCully Creek from RK 5 to 14 and in the Canal as far downstream as Kinney Lake (in the Wallowa River subbasin), but have not been documented in Kinney Lake. Sampling in 1993 found bull trout in Little Sheep Creek drainage, South Fork Imnaha River, and Cliff Creek. Surveys completed in 1996 found bull trout in the lower reaches of Bear, Blue, and Soldier creeks, all tributaries of the South Fork Imnaha River.

Surveys in 1995 in the North and Middle Forks of the Imnaha River in the Eagle Cap Wilderness established the upper distribution in the North Fork near the headwaters, while distribution in the Middle Fork Imnaha River ended at a major falls approximately 2 km from the confluence with the North Fork Imnaha River. A falls at RK 117 on the Imnaha River may be a partial barrier to bull trout.

Data from trap boxes at screen sites collected between 1974 and 1992, showed bull trout captured in the mainstem Imnaha River at RK 47 and RK 75, in Grouse Creek 2 km upstream from its confluence with the Imnaha River, Summit Creek 0.3 km upstream of its mouth (enters Imnaha River at RK 72), and at the mouth of Camp Creek, approximately 3 km above confluence of Big Sheep Creek and Imnaha River. The trap boxes were installed early spring and were pulled in early August or when water was low and water temperatures approached 16° C. Use of the trap boxes was discontinued after 1994.

Bull trout have been captured routinely at the adult steelhead capture facility on Little Sheep Creek (about RK 8) during its operation from March to mid-June, and at the adult chinook capture facility on the mainstem Imnaha River (about RK 87) between June and September.

Bull trout are known to occur in the Snake River between the mouth of the Imnaha River and Hells Canyon Dam. Idaho Fish and Game personnel have observed bull trout in Idaho streams entering this reach of the Snake River at the mouth of Sheep, Granite, Deep, and Wolf creeks (T. Cochanaur, Idaho Fish and Game, personal communication, November 1995). Bull trout have also been observed in Sheep and Granite creeks by Forest Service personnel. In the summer of 1993, ODFW survey crews

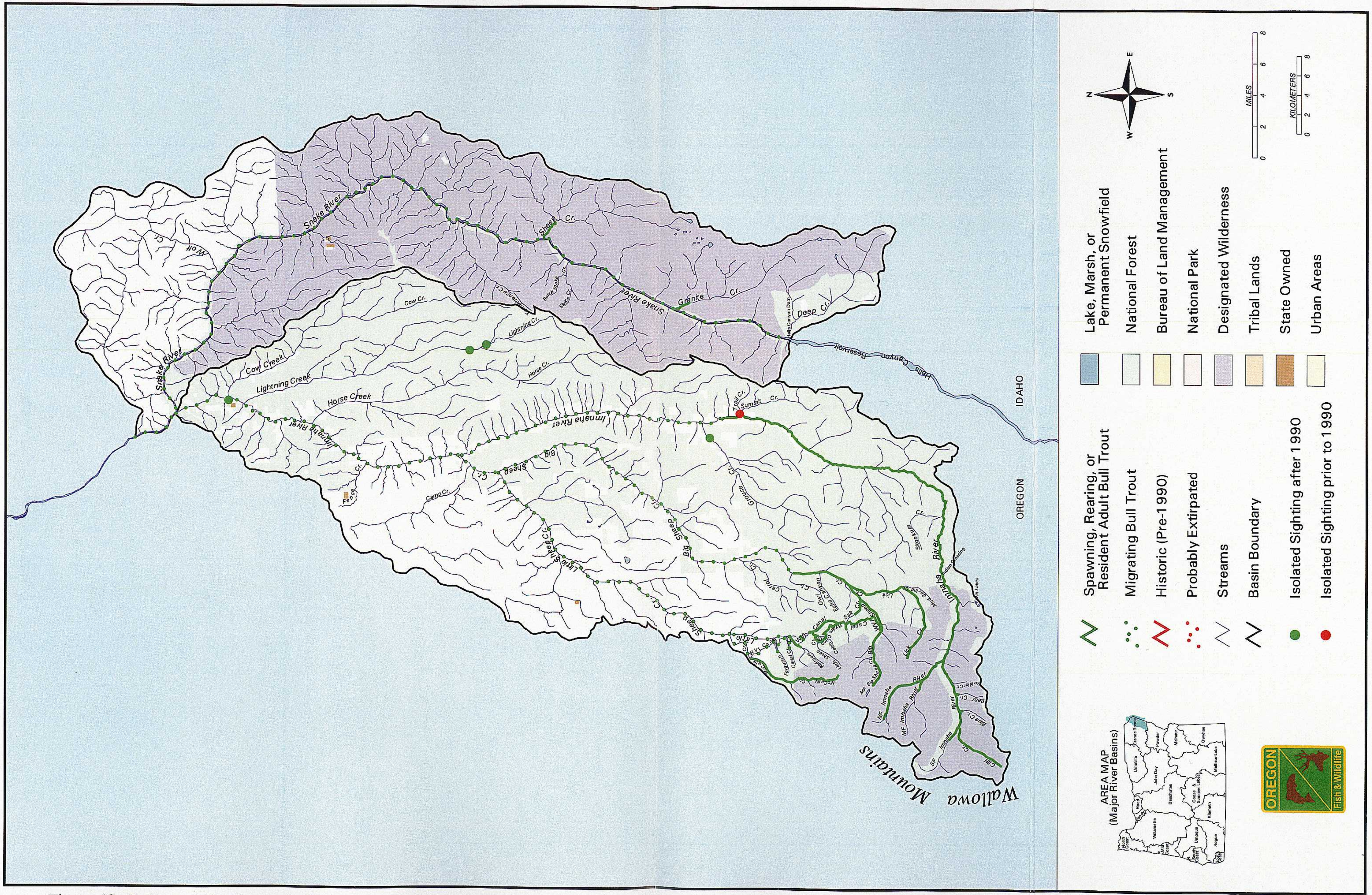


Figure 42. Bull trout distribution in the Imnaha Basin, Oregon.

sampled Temperance, Sluice, and Rattlesnake creeks, Snake River tributaries on the Oregon side, but did not find bull trout.

Life History

Bull trout have been observed spawning below the falls on the mainstem Imnaha River (RR 117), also in the South Fork Imnaha River above the forks at the end of August. Spawning surveys of bull trout in the Imnaha Basin have not been initiated as yet. Presence of 0+ age fish in Big Sheep Creek and its tributaries (Lick and Salt creeks), McCully Creek, Cliff Creek, and the South Fork Imnaha River indicate that these streams are used for spawning.

Resident and fluvial life forms of bull trout occur in the Imnaha River system based on the sizes of fish sampled and the existence of some barriers to migration. Bull trout in upper McCully and upper Big Sheep creeks are considered resident because of the barriers to upstream migration imposed by the Canal diversions. Fluvial forms occur in Little Sheep Creek and the mainstem Imnaha River as evidenced by the large fish trapped at the weirs, but these systems may have the resident form as well. The presence of fluvial fish in Little Sheep Creek suggests they may also occur in Big Sheep Creek, although no trapping has been done to verify this.

Bull trout sampled in 1992 and 1993, and fish incidentally captured at screen trap boxes and at adult collection weirs ranged in size from 50 mm to 400 mm. Length frequencies of bull trout from Little Sheep creek and its tributaries sampled in 1993 are shown in Figure 43. Length frequency graphs of bull trout from Big Sheep Creek in 1992 and from the upper Imnaha River drainage in 1993 are shown in Figures 44 and 45, respectively.

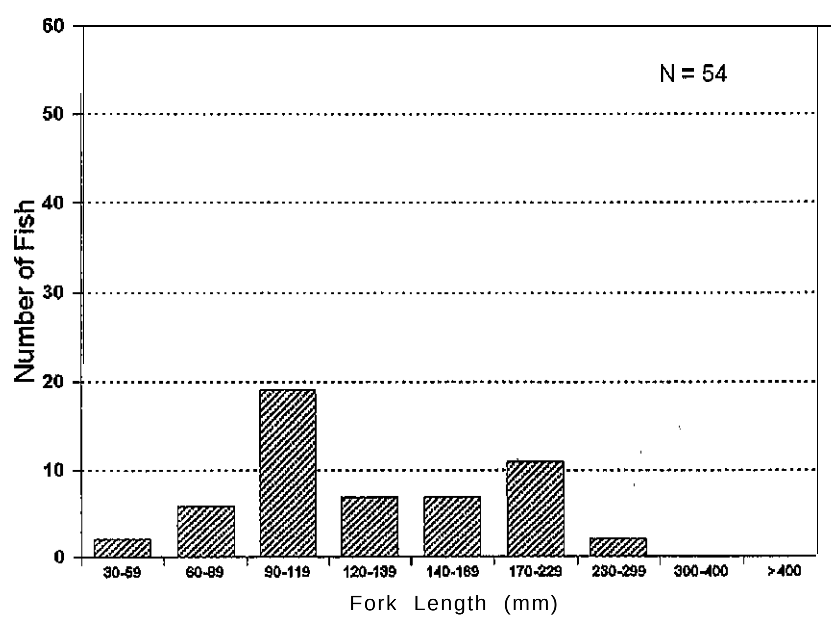


Figure 43. Length/frequency distribution of bull trout sampled in Little Sheep Creek and several tributaries in 1993.

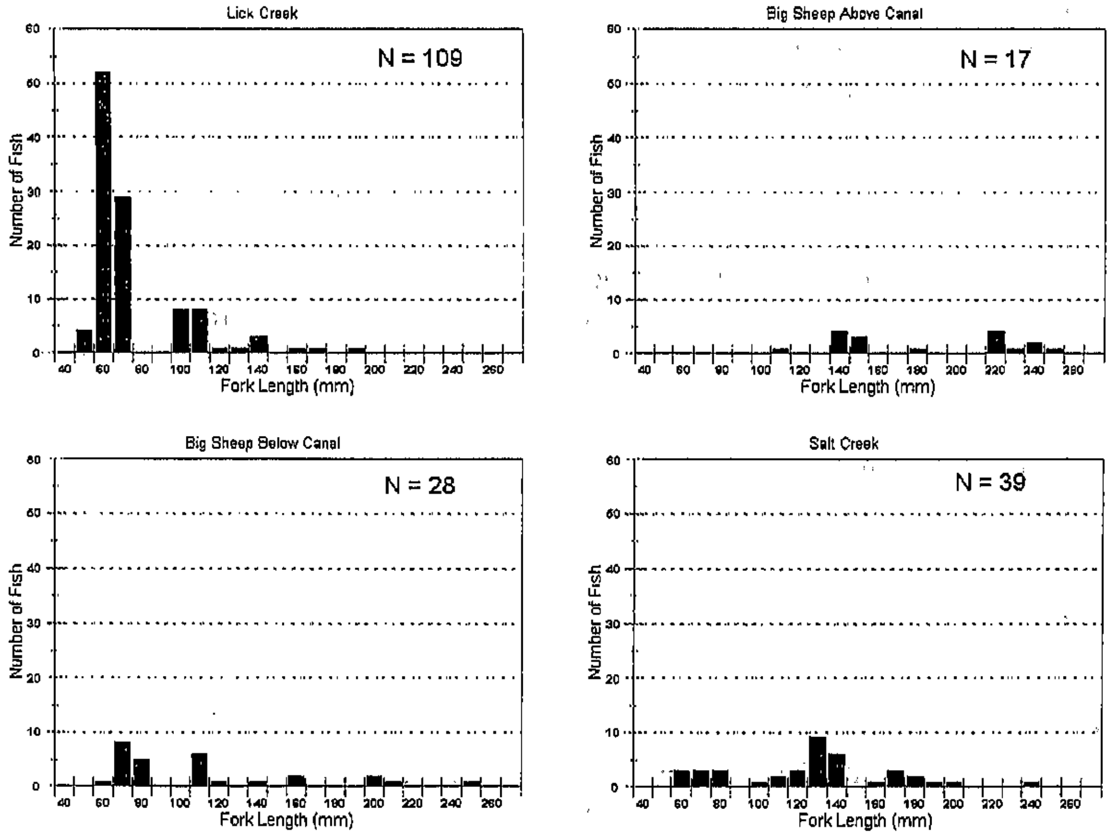


Figure 44. Length/frequency distribution of bull trout sampled in Big Sheep Creek, including Lick and Salt creeks in 1992.

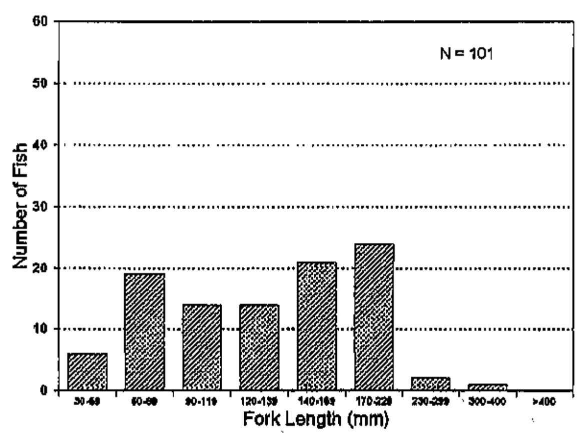


Figure 45. Combined length/frequency distribution of bull trout sampled in the upper Imnaha River drainage (South Fork Imnaha River and Cliff Creek) in 1993.

Bull trout 100 mm to 140 mm were observed in screen trap boxes between 1974 and 1992 on the mainstem Imnaha River and Camp, Grouse, and Summit creeks. The size of fish entering the trap were limited by the trap orifice which measured about 50 mm in diameter.

Several large (406 mm) bull trout were sampled at Little Sheep Creek weir in 1993, which is operated from early March to the end of May. Nineteen 406 to 660 mm bull trout appeared in the Imnaha River trap when it was installed in 1992 to capture spring chinook, and a 533 mm bull trout was captured in 1996. This trap is operated in the summer when the water is low until the chinook salmon run is over in September.

Resident bull trout were found to mature at 160 mm based on a sample of 11 fish from Big Sheep, Salt, Lick, and McCully creeks in 1992. Sizes of fish sampled ranged from 125 to 245 mm in length (Smith and Knox 1992).

Samples for genetic analysis were taken in 1995 from the North Fork Imnaha River, McCully Creek, and Lick Creek, and compared to bull trout throughout Oregon, Washington, and elsewhere in the Columbia Basin. Analysis from these data show that populations from the John Day Basin and Northeastern Oregon (including the Imnaha River basin) comprise a major genetic lineage (Spruell and Allendorf 1997). Scale samples from these fish were taken, but have not been analyzed yet.

Aquatic Inventory crews sampling for presence and absence of bull trout during 1991 in Little Sheep Creek observed bull trout above and below the Canal, but at low densities. No fish were sampled in Little Sheep Creek during surveys in 1992. Subsequent sampling in 1992 captured only 54 fish in Little Sheep Creek suggesting this population persists, but at low densities.

Observations of USFS habitat survey crews, ODFW biologists, and the creel study, suggest that the upper reaches of the Imnaha River contain moderate to high densities of smaller bull trout while lower reaches contain low to moderate densities of small bull trout and low densities of larger bull trout. Table 28 shows estimated densities for two size classes of bull trout sampled in September of 1992 in Big Sheep, Salt, Lick, Little Sheep, and McCully creeks.

Smith and Knox (1992) concluded that substantial spawning populations ($\geq$ 300 fish) were present in the Big Sheep Creek (above and below the diversion and including Lick and Salt Creeks) and McCully Creek bull trout populations based on the size of sampled areas relative to the remainder of bull trout habitat within streams and number of bull trout $\geq$ 160 mm present. Using information from the habitat surveys that indicated uniform habitat in McCully Creek, they estimated a total population of 2,500 bull trout for McCully Creek. Population estimates for the other creeks were not possible with the available habitat information.

Specific Limiting Factors

Historic land uses affecting bull trout habitat in the Imnaha Basin include timber harvest, road building, mining, grazing, irrigation development, and recreation. Most of these landuses continue to take place, although in some cases not to the same extent or in the same manner as in the past.

Table 28. Estimated density of bull trout in selected streams in the Imnaha basin sampled in 1992 (Smith&Knox 1992).

Stream	Site number	Estimated density (fish/100 sq m) by size class"	
		1 to 75 mm	76 to 300 mm
Big Sheep Creek	1	0	0
	2		
	3	18.32 0	5.61 7.4
Salt Creek		5.87	18.77
	1		0
Lick Creek	1	50.[illegible]	15.76
Little Sheep Creek	2	0	0
			0
McCully Creek	1	1.74	7.84
	2	0.57	7.35
	3	0	5 79

[a]*Size Class 1 to 75 mm considered to be 0+ age, while fish 76 IO 300 mm are considered to be older than 0+ age.*

Since 1987, timber harvest has focused on insect-killed and fire-killed (salvage) trees. Some harvest activity on these trees is expected to occur in the Sheep Creek portion of the watershed over the next several years (USFS 1994b). Riparian reserves (no-activity buffers) designated under consultation with NMFS for ESA listed spring chinook should help protect bull trout habitat from logging; however, there is very limited overlap between chinook salmon and bull trout in Sheep Creek (Dambacher and Jones 1997). Buffer widths vary from 91 m buffers each side of the stream in designated critical habitat and in fish bearing streams, to 46 m each side in streams without fish, and 30 m each side of intermittent streams (USFS 1994a & 1994b). Harvest has also changed in the last two decades from skidding downhill to skyline and helicopter logging, and reducing road densities to decrease sediment input. In 1992, clearcutting was eliminated as a harvest method on the Wallowa-Whitman National Forest (USFS 1994a & 1994b).

Channel morphology has been altered as a result of road construction in the floodplain and bank stabilization work. Roads established along the mainstem Imnaha River, Big Sheep and Little Sheep creeks during early settlement remain in use today, although they have been improved. From the late 1970s to 1985, the kilometers of roads constructed on the Wallowa-Whitman National Forest doubled from 7,000 km to over 14,000 km (McIntosh et al. 1994). Recently, road densities are being reduced on the Wallowa-Whitman National Forest (USFS 1994a & 1994b).

Sinuosity of streams in the Imnaha River is low because of the geology and in localized areas because of riprap and bank stabilization associated with road construction. In the mid-1970s, flood repair work in the mainstem and stream stabilization projects in the lower 8 km of Big Sheep Creek constricted the channel (USFS 1994a & 1994b).

Livestock grazing has been an historic use since the Nez Perce used the valleys to pasture horses as early as the 1730s. Early settlers historically grazed sheep, cattle, and horses year round. The level of use has been reduced since the early 1900s with cattle being the,primary domestic grazing stock. However, new data shows a recent increase in livestock grazing in the Imnaha Watershed (B. McIntosh, Oregon State University, personal communication, July 1997). Past and present grazing has resulted in streambank disturbance, soil compaction, and a reduction in the amount and variety of upland and streamside vegetation.

The Canal, constructed in the late 1800s, transfers water from the Imnaha Basin to the Wallowa Basin. The Canal picks up water from Big Sheep Creek, Little Sheep Creek and several of its tributaries (Salt, Redmont, Cabin, Canal, and Ferguson), and exits the drainage shortly after picking up water from McCully Creek. The diversion dam on Big Sheep Creek prevents upstream migration and effectively separates bull trout in upper Big Sheep Creek from the population in lower Big Sheep Creek during operation of the Canal. Diversions along the Canal are not screened. Screening of the diversion on Big Sheep Creek was considered by ODFW but rejected because the risks (e.g., icing up of the screen in winter at a remote site and potential spill problems) were considered to outweigh the benefits. The diversions on Big Sheep and McCully creeks prevent upstream migration of bull trout. to reaches above the diversions, Irrigation ditches in lower Big Sheep Creek are screened as are those on the mainstem Imnaha River.

Hydroelectric development in 1983 resulted in construction of three small facilities along the Canal that divert water via penstocks from the Canal to an associated powerhouse and then return it to the Canal. A hydropower ditch (Ditch) was constructed which takes water from the Canal downstream of Salt Creek and transports it to the penstock on Little Sheep Creek. From here the water is returned to the Canal where it passes through two more hydro facilities located on Canal Creek and South of McCully Creek along the Canal route. Most of the water goes down the Ditch year round leaving a minimum flow in the Canal for fish needs. Spillways from the Canal to Little Sheep Creek and from the Canal to McCully Creek allow for flows in excess of irrigation needs to spill to the creeks.

The Canal is a barrier to upstream movement in Big Sheep Creek and lower McCully Creek. Fish in upper Big Sheep creek that drop below the diversion are lost to the population above. Losses in McCully Creek are also likely due to drift into the unscreened Canal. Access to upper Little Sheep Creek is precluded by irrigation and hydro system operation, and is dewatered for 3 km (RR 40 - RK 43) as a result of Canal operation from July through October. Blowouts at the hydro facility on Little Sheep Creek occurred in 1993 and 1995 and may have impacted bull trout, Some relief from hydroelectric impacts may be realized soon as hydroelectric facilities and the Ditch are proposed to be removed in the summer of 1997.

In 1995, with modifications in the USFS special use permit, water may be diverted for irrigation or stock water only. Prior to the change, water was diverted from the Canal for power production from October to

November and between 1- 30 April when flows were not needed for irrigation. A minimum flow of 5 cfs must remain in Big Sheep Creek at the diversion from 15 October to 30 November according to terms of the FERC license exemption and Forest Service Special Use Permit (USFS 1994b). The penstocks are screened, but will not prevent young-of-the-year from passing down penstocks because of the mesh size (13 mm).

Instream water rights established at RK 37 on the Imnaha mainstem date from 1961, at the mouth of Little Sheep Creek from 1983, and from RR 5 to the mouth on Big Sheep Creek from 1983. These may not be of any benefit to bull trout in Big and Little Sheep creeks because they are measured below where the diversions occur. There are no diversions below the instream water right point on mainstem Imnaha River.

Bull trout habitat in the mainstem Imnaha River is in generally good condition with good quality water and spawning gravel available, and rearing habitat that is generally pristine to slightly modified from historic conditions (ODFW 1993b).

In the lower Imnaha, stream temperatures in excess of 20° C were measured below the mouth of Fence Creek in August 1990 (USFS 1994a). Downstream of Skookum Creek, temperatures up to 18°C can occur within bull trout distribution in the mainstem. Above Skookum Creek, temperatures seldom exceed 16° C any length of time because of the influence of high elevation and snowmelt (USFS 1994a).

Temperatures in excess of 24° C during June to August 1992 were measured at a thermograph station in Big Sheep Creek near Echo Canyon Creek. High stream temperatures have been attributed to private land alterations that removed shade, diversion of water to the Canal, and natural limitations of the riparian zone to shade stream from the mouth to approximately RK 42 above Carrol Creek (deep canyons, dry climate, and extensive rock outcroppings) (USFS 1994b).

Spawning and rearing habitat in Big Sheep Creek above the Canal is pristine with a relatively steep gradient, most is in wilderness. Spawning habitat in Big Sheep Creek below the Canal was impacted by sediment inputs as a result of fires in 1989. Rearing habitat is in relatively good condition throughout USFS land. Salt Creek was impacted by sedimentation from a fire in 1989 (G. Sausen, USFS Biologist, personal communication, July 1996). Woody debris in Lick Creek has been reduced through logging, campground use, road construction, and tire (ODFW 1993b).

The condition of the riparian vegetation along Big Sheep and Lick creeks in the 55 km surveyed is fair to poor due to past management practices (private land alteration, past timber harvest, road and skid trail construction, and livestock use), wildfires, and insect outbreaks (USFS 1994b). However, riparian habitat between Owl and Lick creeks on Big Sheep Creek is unroaded and in excellent condition (W. Knox, ODFW, personal communication, September 1996).

Habitat in Little Sheep Creek is marginal. Sedimentation from recent fires, subsequent logging and road construction, and water withdrawals reduce summer and fall flows in the upper reaches (ODFW 1993b). Although some spawning probably occurs, ODFW biologists believe the influence of the Canal and periodic influx of bull trout from upper Big Sheep Creek are maintaining the population in Little Sheep Creek. It is the most at-risk population in the Imnaha Basin.

Several major forest fires and landslides since 1989 may have affected bull trout, Some increase in cobble embeddedness was noted in the North Fork Imnaha River after the 1992 landslide (USFS 1994a). In 1994, the Twin Lakes fire burned over 8,094 hectares including areas of the mainstem Imnaha River, and Lick Creek and Mud Springs drainages. The Canal fire in 1989 burned 9,650 hectares in Big and Little Sheep creek subbasins. Much of the upper portion of the watershed burned in the Canal fire is regenerating naturally or artificially planted by hand (USFS 1995b). Monitoring effects of the Twin Lakes fire have shown very little if any impact on the mainstem Imnaha River. The Lick Creek drainage, which wasn't monitored, doesn't look as good visually, and there may be some sediment movement (G. Sausen, USFS, personal communication, July 1996).

There are no documented brook trout in Imnaha Basin streams, Some brook trout occur in Twin Lake, but they are not believed to pose a risk to bull trout because spilling of the lake into the Imnaha River is unlikely.

The downward population trend of spring chinook in the Imnaha Basin may be affecting bull trout abundance as they are considered part of the bull trout's prey base. Other indigenous species found in association with bull trout during fish sampling between 1990 and 1995 included rainbow trout and sculpin. Whitefish are found in the middle and lower reaches of the Imnaha River.

Management Considerations

In 1993, ODFW attempted to sample angler catch using signs and volunteer creel boxes at campgrounds and trailheads. Results were disappointing and did not yield any useful information. The effort was discontinued and regulations were changed in 1994 requiring release of all bull trout caught. ODFW continues to work with OSP, USFS recreation staff, and the local media to inform anglers of bull trout regulation changes. Signs were placed at access sites near traditional bull trout fishing areas and a training session on the new regulations was conducted with USFS campground hosts prior to opening of the recreation season in 1994. Bull trout are a high priority in the Cooperative Enforcement Program of OSP.

Current Status

The status of bull trout in Oregon was first assessed, in 1991 by Ratliff and Howell (1992). Individual populations were identified for the Imnaha River, Big Sheep Creek, Little Sheep Creek, and McCully Creek. All except the Imnaha River were rated "of special concern" because of passage barriers, downstream losses of migrants and, in Big Sheep and Little Sheep creeks, habitat degradation, The Imnaha River was rated at "low risk." Additional monitoring by ODFW and USFS biologists have led to downgrading the 1996 status of Little Sheep Creek to "high risk of extinction". McCully Creek was downgraded to "moderate risk of extinction" because of the isolation of this population, a factor not considered in the previous status report.

Pine Creek Basin

Introduction

The following is a summary of existing information on bull trout in the Pine Creek Basin. Information was gathered from published and unpublished reports of the ODFW and the Wallowa-Whitman National Forest, as well as conversations with state and federal fishery professionals working in the area.

Pine Creek is a tributary to the Snake River entering at about RK 434, and is approximately 60 km in length. Major tributaries include North Pine, Fish, East Pine, and Clear creeks. Pine Creek originates on the South face of the Wallow a Mountains at elevations up to 2,420 m and flows at an elevation of about 110 m at its confluence with the Snake River, 10.3 km downstream of Oxbow Dam (OWRD 1967). The Pine Creek watershed is approximately 78,374 hectares in area, of which 58% are National Forest lands administered by the Wallowa-Whitman National Forest (USFS 1995a). The upper reaches of Norway Creek, and Middle Fork and West Fork of Pine Creek are within the Eagle Cap Wilderness.

Summer holding and rearing areas for bull trout have been identified in the headwater areas of Pine, Clear, East Pine, and in Elk creeks. Bull trout are believed to be seasonally connected to Hell's Canyon Reservoir in the Snake River (ODFW 1993c).

Pine Creek Basin is in the usual and accustomed use area of the Nez Perce Tribe.

Historical Distribution

Our review of known documents do not mention bull trout in the Pine Creek basin prior to the 1960s though it is suspected that they are native throughout the basin as are salmon and steelhead with whom they co-evolved. The completion of Hells Canyon Dam in 1968 closed access to the basin for salmon and steelhead (Fulton 1968 & 1970). Hells Canyon Dam and Oxbow Dam (completed in 1961) limit movement of Pine Creek bull trout in the Snake River to the Hells Canyon pool and tributaries entering from the Idaho side of the river, e.g., Indian Creek.

Known documentation prior to 1990 is limited to creel reports for Lake Fork Creek (1965) and Pine Creek (1978 and 1979). Creel records from Hells Canyon Reservoir in 1987 and 1991 also document bull trout in the creel. In addition, a photograph of a Dolly Varden "bull trout" in a screen box in North Pine Creek, was included in the November 1966 ODFW monthly report.

Physical and Biological (P&B) surveys between 1961 and 1965 in East Pine, Clear, North Pine, Lake Fork, and Little Elk creeks did not note presence of bull trout (ODFW unpublished data). However, these surveys were focused on spawning habitat for anadromous fish, so they did not regularly document distribution of resident fish.

Current Distribution

Recent efforts to locate bull trout in the Pine Creek Basin began in 1990 with presence/absence surveys conducted by ODFW Aquatic Inventory Project. Additional efforts by USFS personnel on federal land in 1994 and ODFW District personnel and Salmon Trout Enhancement Program (STEP) volunteers in 1995, have provided the information on current bull trout distribution in the Pine Creek Basin. Extensive sampling of the Lake Fork of North Pine Creek did not collect any bull trout, but brook trout were found to be common. Elk Creek, a tributary of the Lake Fork, contains bull trout (ODFW 1996a). Figure 46 shows the current distribution of bull trout in the Pine Creek Basin.

A 235 mm bull trout was captured just below Oxbow dam on 12 October 1993, by Idaho Power personnel during a routine electrofishing survey (J. Chandler, Idaho Power Co., personal communication, May 1996). Another bull trout, a mature female 254 to 305 mm in length, was reported in the ODFW creel on 10 June 1993 in Hells Canyon Reservoir.

Life History

Little is known about the specific life history of Pine Creek bull trout. Presence/absence surveys conducted in the summer of 1990 indicate the population is fragmented and numbers are extremely low (59 bull trout captured in 316.7 m of habitat surveyed) (ODFW 1993c). Length-frequencies ranged from 30 to 230 mm for 37 bull trout captured in the North Pine Creek drainage, from 5 1 to 227 mm for 16 bull trout captured in the East Pine drainage, and from 102 to 305 mm for 5 bull trout in the upper Pine Creek drainage.

Presence/absence surveys were conducted by USFS personnel in the Pine Creek Basin in 1994. Data from the 1990 and 1994 surveys are not directly comparable because of differences in sample size and size categories used. Length-frequency distributions for the 1994 data are presented in Figure 47.

An estimate of the Pine Creek bull trout population was calculated using 1994 data where fish were enumerated in every third pool plus “good habitat areas” in four subwatersheds (Table 29) (M. Fedora, USFS, Wallowa-Whitman National Forest, personal communication, December 1997).

Samples for genetic analysis were taken in 1995 from Elk Creek (North Pine Creek Subbasin) and East Fork Pine Creek; and in 1996 from Indian Creek, a small stream that drains into the Snake River across the river from the mouth of Pine Creek. Genetic analysis suggest that bull trout populations from the John Day River Basin and Northeastern Oregon (including the Pine Creek Basin) comprise a major genetic lineage (Spruell and Allendorf 1997).

Specific Limiting Factors

Increased water temperatures, riparian habitat loss, siltation of spawning and rearing areas, channel alteration and loss of instream structure (large wood) and have been identified as probably limiting bull trout survival in the Pine Creek Basin (ODFW 1993c).

The USFS has been collecting temperature data in the basin since 1993. A final report, not yet released, will summarize data collected through 1995. Daily maximums, averaged, and minimums will be

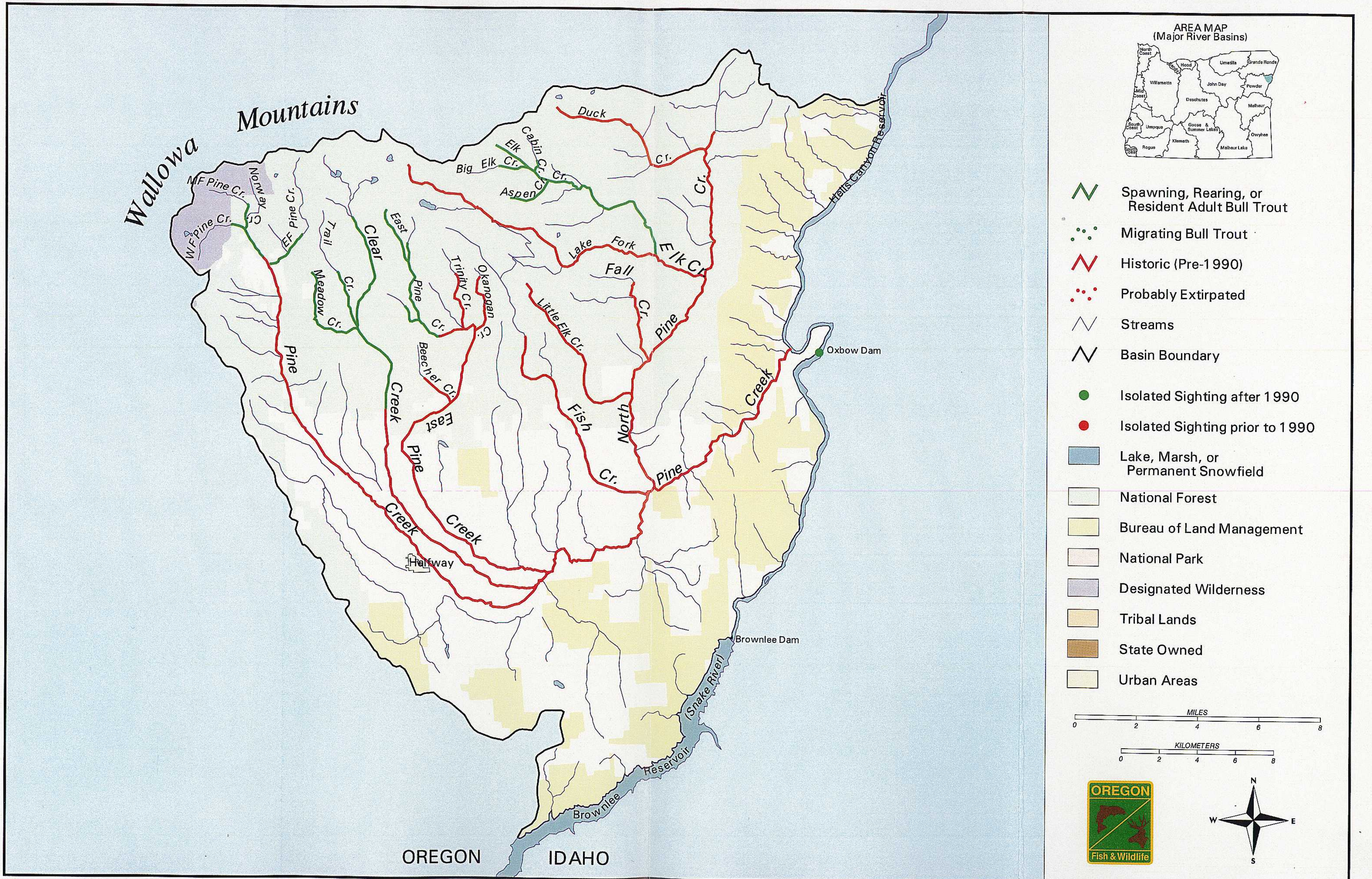


Figure 46. Bull trout distribution in the Pine Creek Basin, Oregon.

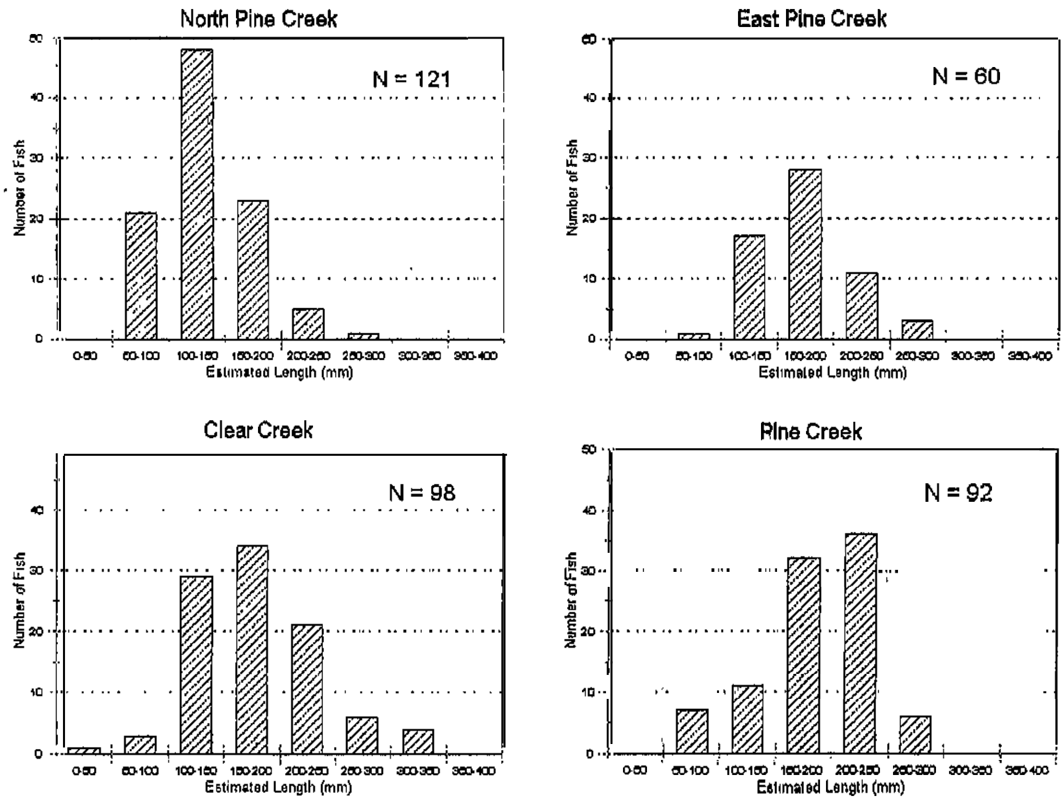


Figure 47. Length-frequency distribution of bull trout electrofished in subwatersheds of the Pine Creek Basin, 1994.

Table 29. Bull trout population estimates for subwatersheds within the Pine Creek Basin, 1994 (USFS data).

Subwatershed	Sample size	Minimum population estimate	Maximum population estimate[b]
North Pine Creek	98	123	368
East Pine Creek	60	75	225
Clear Creek	98	123	368
Upper Pine Creek	92	115	345
Total for basin	348	435	1305

[a]*Number of fish x 1.25 (factor developed by Kim Jones, ODFW, based on available habitat and assumption that single pass technique captures 80% of population).*
[b]*Minimum estimate x 3.*

included for each stream site, as well as the first date in which the site dropped below the bull trout temperature standard of 10° C (M. Fedora, USFS, personal communication, September 1996). Table 30 shows the 7-day maximum average temperatures for stream reaches that also contain bull trout in the Pine Creek Basin.

The impact to bull trout from loss of salmon and steelhead from the ecosystem as a prey base is unknown, but is likely significant.

Several low head irrigation dams in the basin are barriers to fish passage during July and August (irrigation season). A small diversion dam in the headwaters of Aspen Creek is currently dewatering segments of the creek below the structure (ODFW 1993c). Only two irrigation diversions (in the Clear Creek drainage) are screened.

Stocking of the high lakes with brook trout dates from the early 1930s (Gildemeister 1989 and 1992). They have been observed in association with bull trout in Clear Creek. Several bull trout x brook trout hybrids as well as pure brook trout were observed in Clear Creek during surveys in 1994 (USFS data). Brook trout have not been found in other streams with bull trout in the Pine Creek Basin Sculpins and redband trout were also found in association with bull trout (ODFW 1993c).

In 1994, the Twin Lakes fire burned through areas of Big Elk Creek (North Pine Creek tributary), an area known to contain bull trout. The fire burned particularly hot in this area, even burning wood debris laying in the water (ODFW 1995b). The area had been surveyed prior to the fire and was resurveyed after the fire, but analysis of the data has not been completed.

Table 30. Stream temperature data for selected stream reaches in the Pine Creek Basin that contain bull trout, 1995 (USFS unpublished data).

Stream site	Location	Day in	Day-out	7-day maximum average in ° C
Elk Creek #2	T19s R47e Sec 16 nw/se	7/18/95	10/16/95	15.1
Elk Creek #3	T19s R47e Sec 7 nw/se	7/18/95	10/16/95	15.9
East Pine #8	T6s R46e Sec 29/32	7/17/95	10/12/95	13.5
Clear Creek #2	T7s R46e Sec 06 sw/nw	8/2395	10/12/95	14.2
Meadow Creek #1	T7s R46e Sec 1 nw/nw	7/17/95	10/12/95	12.5
Trail Creek #1	T7s R46e Sec 6 nw/nw	7/17/95	10/12/95	13.2

Management Considerations

Since 1991, efforts have been made to increase knowledge about bull trout in the basin including coordination between state and federal fishery personnel on sampling work to identify bull trout distribution and abundance in the basin,

Angling for bull trout has been closed in the basin since 1992. Poaching has not been identified as a problem as all of the populations are located in the extreme headwaters above the common angling areas (ODFW 1993c).

Efforts to increase knowledge and awareness of bull trout in the basin have included installing volunteer creel boxes at campgrounds and trailheads to improve catch records; posting educational signs for anglers about bull trout; coordinating with OSP to raise bull trout to a high priority for creel checks; updating bull trout distribution on Department of Forestry maps for private forest lands; and continuing efforts by USFS and ODFW to gather information on distribution, habitat quality, population numbers, and limiting factor analysis of bull trout in the basin.

Instream water right applications were submitted to OWRD in 1990 for reaches in Duck, Elk, Lake Fork, Little Elk, Clear, and Pine creeks (11 reaches total). Certificates have been issued for Elk, Duck, and Little Elk creeks and one reach on East Pine Creek. The remaining applications were protested. Instream water rights are junior in priority to existing out-of-stream water rights. OWRD is currently reviewing applications submitted by the Oregon Department of Agriculture for reserve water rights for future storage reservoirs on Clear Creek and East Pine Creek.

A limited amount of habitat restoration has taken place on National Forest land in the Pine Creek drainage. In 1990, through cooperative funding provided by the USFS and the R & E program, Schnieder Meadows was fenced and a drop pool system installed in Meadow Creek, a tributary to Clear Creek which runs through the meadows. The purpose of the project was to raise the water table and reconnect the floodplain with the stream. In 1991, the log weirs were notched more deeply to create more flow through the system and reduce stream temperatures in the standing pools, creating a more natural flow regime. The stream has subsequently narrowed and deepened and the streambanks are revegetating with sedges (M. Fedora, USFS, Wallowa-Whitman National Forest, personal communication, September 1996).

Significant data gaps remain in terms of fish habitat quality and quantity, fish species distribution and activities affecting bull trout. Additional information needs to be gathered on the location and impacts of past and present anthropogenic activities, including recreation activities, on bull trout.

Current Status

The status of bull trout in the Pine Creek Basin was first reported by Ratliff and Howell (1992). The 1996 status of bull trout in Elk Creek and Meadow Creek remains at "moderate risk." However, populations in East Pine Creek and Upper Pine Creek have been downgraded from "of special concern" to "moderate risk" category based on additional survey information gathered since the original assessment.

Powder River Basin

Introduction

The following is a summary of existing information on bull trout in the Powder River Basin. Information was gathered from published and unpublished reports of the ODFW and the Wallowa-Whitman National Forest, as well as conversations with state and federal fishery biologists working in the area.

The Powder River, situated in northeastern Oregon, is a tributary to the Snake River entering at about RK 476. It drains an area of approximately 426,675 hectares (OWRD 1967). The mainstem Powder River is approximately 261 km in length. From the headwaters, it flows in a southeasterly direction for approximately 62 km before turning north along the front of the Elkhorn Range returning to a southeasterly direction at about RK 126. Major tributaries include the North Powder River, approximately 37 km in length, which enters the mainstem at about RR 130; and Eagle Creek, approximately 60 km in length, which enters the mainstem at about RK 16.

Headwaters of the Powder River system originate at elevations of 1,829 - 2,134 m on the southeastern slopes of the Blue Mountains and the southern slopes of the Wallowa Mountains. The elevation of the Powder River at its confluence with the Snake River is about 579 m (Thompson and Haas 1960).

Bull trout occur as several remnant, highly fragmented populations in headwater streams of the Upper Powder and North Powder Subbasins.

Historical Distribution

We have no known historic documentation of bull trout in the Powder Basin prior to the 1960s. It is suspected that they were widespread in the Upper Powder drainage and seasonally connected to the Snake River. Passage above RK 112 on the Powder River was blocked in 1932 by construction of Thief Valley Dam, which has no upstream fish passage (ODFW 1993c). Mason Dam, constructed in 1968, isolated bull trout in the Upper Powder Subbasin from bull trout in the North Powder Subbasin. Construction of Brownlee Dam in 1959 limited access of any fluvial bull trout in Eagle Creek to the pool above Brownlee Dam on the Snake River. According to a December 1965 ODFW District monthly report, a twelve inch bull trout was caught in a net set in Brownlee Reservoir in 1959, after the reservoir had filled.

Bull trout were documented in Eagle Creek and West Fork Eagle Creek in creel reports in 1965. Angler reports indicate bull trout were caught in the Martin Bridge section of Eagle Creek (RK 19 - 29) during July, August, and September in the mid-1980s (ODFW 1993c). Oral histories taken from longtime residents indicate Dolly Varden "bull trout" were common in Eagle Creek in the 1940s and 1950s (Gildemeister 1989). Sayre (Undated), reporting the results of a 1967 chemical poisoning project, stated that whitefish, rainbow, Dolly Varden "bull trout," and brook trout are found throughout the upper watershed.

Current Distribution

Concerted efforts since 1990 by ODFW Aquatic Inventory crews, STEP volunteers, USFS, and BLM personnel have resulted in the delineation of the current bull trout distribution (Figure 48).

Extensive snorkeling surveys conducted between 199 1 and 1994 failed to find bull trout in Eagle Creek (ODFW 1995b). The status of Eagle Creek bull trout remains a question mark. If bull trout are present, their distribution and number are extremely limited (ODFW 1995b).

Two populations in the North Powder Subbasin in Anthony/Indian creeks and in the upper mamstem North Powder River were identified by spot sampling during the summer of 1992 (ODFW 1993c). Several streams that drain the eastern face of the Elkhorn Mountains, including Pine, Salmon, Big Muddy, Williams, Rock, and Wolf creeks, have been found recently to contain bull trout. Full distribution for these populations has not been determined.

Life History

Little is known about the specific life history of bull trout in the Powder Basin. Presence/absence surveys conducted in 1990 in the upper Powder and North Powder rivers and snorkeling in the North Powder River in 1991 indicate the population is fragmented and numbers are extremely low (3 fish in 250 m electrofished, and 2 fish in 400 m snorkeled). Population estimates have not been made. Bull trout have not been observed during creel checks since 1990 (ODFW 1993c)

Length-frequency data collected during 1990 from 29 bull trout captured in Little Cracker, Lake and Silver creeks found bull trout ranging between 76 and 305 mm. Bull trout observed during the 1967 chemical poisoning of lower Silver Creek varied in length from 71 to 160 mm (Sayre, Undated). Of 12 bull trout recorded in the creel records in Eagle Creek and upper Powder River subbasins from 1965 to 1990, one bull trout was in the 203 to 254 mm category and most were in the 152 to 203 mm category (ODFW 1993c).

Genetic samples were collected in 1995 from bull trout in Silver Creek (upper Powder River) and from the North Powder River. Fish ranged in size from 8 1 to 17 1 mm in Silver Creek and from 76 to 198 mm in the North Fork Powder River (Hemmingsen et al. 1996). Results suggest that bull trout populations from the John Day Basin and Northeastern Oregon (including the Powder Basin) comprise a major genetic lineage (Spruell and Allendorf 1997).

Specific Limiting Factors

Habitat degradation, as a result of streamflow diversions, upstream passage barriers at dams and downstream losses at unscreened diversions, are suspected limiting factors to the upper Powder River and North Powder River bull trout populations. These factors also affect Eagle Creek bull trout, if they have not been extirpated. Impacts from elevated water temperature, riparian habitat

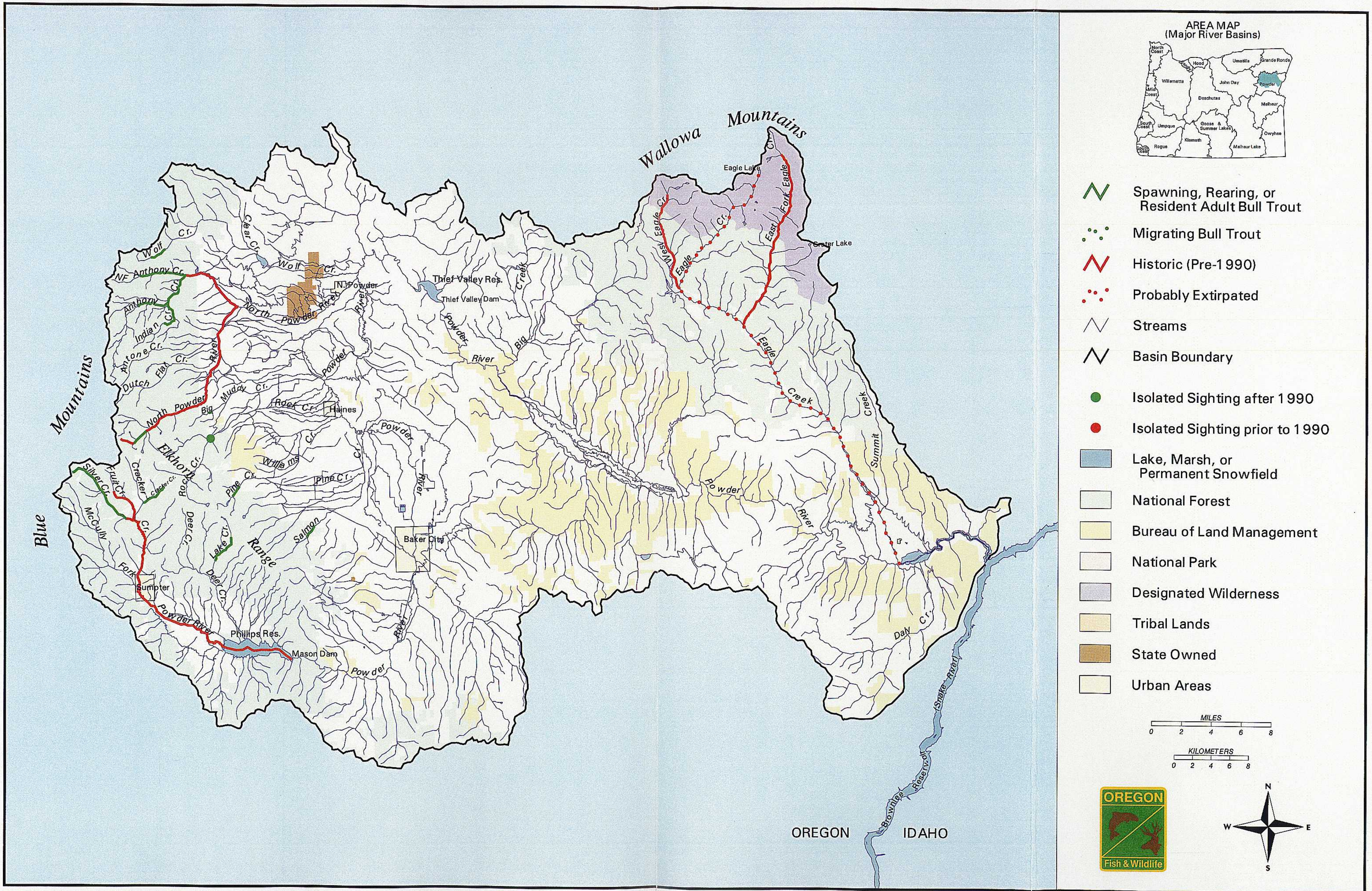


Figure 48. Bull trout distribution in the Powder Basin, Oregon.

loss, channel alterations, and siltation of spawning gravel are believed to also limit bull trout production in the upper Powder River Subbasin (ODFW 1993c).

Habitat and water quality are essentially pristine in the upper reaches of main Eagle Creek, East Fork and West Fork Eagle creeks, which are located in the Eagle Cap Wilderness. Existing habitat is under seeded and could provide potential spawning habitat (ODFW 1993c).

Bull trout were observed rearing in Indian Creek (North Powder Subbasin) where there appeared to be available habitat that was not being used by brook trout. A falls on Anthony Creek, about 10 km above the mouth of Indian Creek, limits upstream migration.

Bull trout in upper Powder River could utilize Phillips Reservoir during fall, winter, and spring months, but have not been documented there to date (J. Zakel, ODFW, personal communication, September 1996).

The USFS has been, collecting temperature data in the basin since 1993. A final report, not yet released, will summarize data collected through 1995. Daily maximums, averaged, and minimums will be included for each stream site, as well as the first date in which the site dropped below the bull trout temperature standard of 10°C (M. Fedora, USFS, personal communication September 1996). Table 3 1 shows the 7-day maximum average temperatures for selected stream reaches that also contain bull trout in the Powder Basin. In addition, the 7-day average maximum temperatures in the Eagle Creek Subbasin exceeded 17.8° C at nine of the 10 stations in 1994, but averaged 13.2° C at a site in middle East Eagle Creek.

Effects from early chemical poisoning projects on Powder River bull trout populations are unknown In 1967, headwater tributaries and the mainstem

Table 3 1. Stream temperature data for selected stream reaches in the Powder Basin that contain bull trout, 1995. Adapted from USFS (1995).

Stream site	Location	Day in	Day-out	1-day maximum average in ° C
N. Fk. Anthony Cr. #1	T6s R37e Sec 14nw/nw	7/12/95	10/06/95	13.3
N.Fk Anthony Cr. #2	T6s R37e Sec 16nw/nw	7/13/95	10/05/95	12
N. Powder R. #4	T8s /r37e Sec 4 sw/sw	7/16/95	10/03/95	11.7
Silver Cr.	T9s R37e Sec 8 nw/se	7/12/95	10/13/95	14.3

Powder River from Sumpter to Mason Dam and from Mason Dam to Thief Valley Reservoir were poisoned to remove nongame fish (Sayre, Undated). Phillips Reservoir, behind Mason Dam has been poisoned several times (J. Zakel, ODFW, personal communication, September 1996).

Approximately 12 unscreened diversions occur in the Eagle Creek Subbasin, which may be passage barriers during lower flow periods (July-Ott). There are 2 major diversions on Anthony Creek and several diversions on the North Powder River downstream of known bull trout distribution, which may be causing potential losses. There are unscreened diversions in the upper Powder River Subbasin as well (ODFW 1993c).

Granitic soils in headwater streams of the Powder Basin are extremely vulnerable to erosion. Road building, mining, grazing, timber harvest, irrigation withdrawal, and associated activities on both public and private lands have the potential to cause increased erosion in the drainage. Road densities in the upper Powder River Subbasin are "higher than desirable" and are "relatively high" in some portions of the upper North Powder River Subbasin (USFS 1995a & 1995b).

Mining activities in the upper Powder River, both historic and current, have had an adverse impact on bull trout habitat. Annual vegetative and stream disturbances and the proximity of placer deposits to bull trout habitat limits the possibilities for bull trout recovery (USFS 1995a). The potential for sedimentation from mining activities is also present in the upper North Powder Subbasin (USFS 1995b). Parts of Cracker Creek and the Powder River have been completely diverted by large piles of mine tailings.

Stocking of the high lakes in the Wallowa Mountains began in the late 1800s according to oral histories collected by Gildemeister (1992). Fingerling rainbow trout, brook trout, and lake trout were stocked by packtrain and later by air. Brook trout occur in six lakes in the subbasin and in West Eagle, Main Eagle, and Summit creeks. Stocking of brook trout in Crater and Eagle lakes was stopped in 1990 (ODFW 1993d).

Gildemeister(1992) also reports that Forest Ranger Thomas H. Parker stocked the high lakes of the Elkhorns, in the late 1800s or early 1920s, transporting "Dolly Varden", whitefish and "wild" trout by packhorse.

Brook trout are abundant in Anthony Creek upstream of the bull trout population and have been observed in the North Powder River downstream of known bull trout distribution, A suspected bull trout x brook trout hybrid was also reported in the North Powder River downstream of the bull trout population by USFS contractors in 1992 (ODFW 1993c). STEP crews found bull trout, brook trout, and bull trout x brook trout hybrids in North Fork Anthony Creek (ODFW 1995b).

The bull trout population in Cracker Creek (upper Powder River) is located adjacent to a brook trout population. ODFW personnel sampling in upper Rock Creek found a bull trout x brook trout hybrid (ODFW 1995b). Other species found in association with bull trout include sculpins and redband trout in Silver, Little Cracker, and Lake creeks (ODFW 1993c), USFS 1995a).

Prior to construction of Thief Valley Dam, large runs of chinook salmon occurred ,in the mainstem, middle, and upper portions of the Powder River. Steelhead were present in the upper Powder River, North Powder River and tributaries, and in Eagle Creek (Fulton 1968 & 1970). The impact to bull trout from loss of salmon and steelhead from the ecosystem as a prey base is unknown, but is likely significant.

Mmnagement Considerations

Since 1991, efforts have been made to increase knowledge about bull trout in the basin including coordination between state and federal fishery personnel on sampling work to identify bull trout distribution and abundance in the basin.

In 1992, angling for bull trout was closed in the Powder Basin, Educational signs were posted for anglers, and volunteer creel boxes were installed at trail heads on Eagle Creek and throughout the District at campgrounds and trailheads near bull trout streams in 1993 (ODFW 1992 & 1993b). The sparse densities and small size of the remaining bull trout reduce attraction for poaching. A volunteer creel box program proved to be ineffective because anglers were unable to differentiate between bull and brook trout even though identification signs were posted in the area (ODFW 1994). Creel checks are a high priority for Oregon State Police (ODFW 1991).

Department of Forestry maps were updated in 1993 to include bull trout distribution relative to private forest land. An effort was made to work with OWRD to identify irrigation diversion that need screening (ODFW 1993d).

Instream water right applications were submitted to OWRD in 1992 for the following bull trout streams in the Powder Basin: West Eagle and Little Eagle creeks (tributaries to Eagle Creek); North Fork Anthony, Anthony, Antone, and Dutch Flat creeks (tributaries of North Powder River); and Wolf Creek, Clear Creek (tributary to Wolf Creek), Big, Daly, McCully Fork, Cracker, and Deer creeks (tributaries to the Powder River). Certificates have been issued for all but eight of the applications. Applications for Little Eagle, Wolf, Big, Rock, and Daly creeks, two reaches in the North Powder River, and the reach on the Powder River between Mason and Thief Valley dams were protested. Instream water rights will be junior in priority to existing water rights.

Significant data gaps remain in terms of fish habitat quality and quantity, fish species distribution and activities affecting bull trout. Additional information needs to be gathered on the location and impacts of past and present anthropogenic activities, including recreation activities, on bull trout.

Current Status

The status of bull trout in Oregon was reported by Ratliff and Howell (1992). Populations in the upper Powder River Subbasin remain at "moderate risk" in 1996. The Indian and Anthony creeks, population has been downgraded from "moderate" to "high risk," and the North Powder River and Big Muddy Creek populations, which were not known in 1991, have been rated at "high risk." The Eagle Creek population has been downgraded from "high risk" to "probably extinct."

Malheur River Basin

Introduction

The following is a summary of existing information on bull trout in the Maiheur River Basin. It updates and builds on the report of Buckman et al. (1992). Much of the information presented is from an unpublished report by Bowers et al. (1993).

The Maiheur River, situated in southeastern Oregon, is a tributary to the Snake River entering at about RK 595. It drains an area of approximately 12,950 sq km and is approximately 306 km in length. It originates at elevations of 1,982 to 2,133 m in the Blue Mountains and flows at an elevation of about 611 m at the confluence with the Snake.

Bull trout are found at elevations above 1,219 m in the forested headwaters of the North and Middle forks of the Maiheur River within the Malheur National Forest. The populations in the two forks were isolated from one another by construction of Warm Springs Dam in 1919 at RK 198 on the mainstem Malheur River (referred to as the Middle Fork Maiheur River above Warm Springs Reservoir) and Agency dam in 1934 at RK 29 on the North Fork Maiheur River. Access to the Malheur from the Snake River was limited after 1881 due to the construction and operation of the Nevada Diversion Dam at about RK 3 1 on the lower Malheur River. Prior to construction of the dams, bull trout in the Maiheur River would have had access to the Snake River, although their typical summer habitat was in the upper part of the basin. The lower reaches of the Malheur River are considered too warm in the summer for bull trout rearing and spawning, but they would have provided a migration corridor to the Snake and Columbia rivers, as well as wintering habitat.

The Malheur Basin is within the usual and accustomed use area of the Burns Paiute Tribe.

Historical Distribution

Documentation on the existence of bull trout in the Malheur River drainage is limited and dates from ODFW observations beginning in 1955. In that year, bull trout were observed as far downstream as Wolf Creek during chemical poisoning of Middle Fork Maiheur River (Hanson et al. 1990). Bull trout appeared in creel checks on the Middle Fork Malheur River between 1957 to 1976 at Dollar Basin, on Big Creek between 1964 to 1971, on Bosonberg Creek between 1957 to 1964, and on Summit Creek from 1968 to 1977. Brook trout were also creeled during most the of the years in Big, Bosonberg and Summit creeks. Collection of a single bull trout in Lake Creek in 1981 was reported by Behnke (1982)

In the North Fork Malheur River, bull trout -appeared in the creels between 1959 and 1981 for Beuiah Reservoir, in the mainstem at Forest Service Road 16, about RK 84 between 1954 and 1978, and in Crane and Sheep creeks in 1957 and 1969. They were documented in the Physical and Biological Survey of the North Fork Malheur River in 1972 at three sample sites between RK 63 and RK 90 in the mainstem, and in Little Crane and Swamp creeks. Bull trout were observed at five sample sites in 1982 and 1983 in the mainstem between Bear Creek and the North Fork Maiheur River headwaters (Pribyl and Hosford 1985).

Although we have no documentation prior to 1955, we assume bull trout in the Malheur Basin had access to the Snake and Columbia rivers before the dams were constructed on these rivers. Anadromous salmon and steelhead historically spawned in the upper basin (Fulton 1968, 1970).

Current Distribution

Bull trout in the Middle Fork and North Fork are considered two distinct populations because of their geographic isolation since construction of the dams on both forks. Their known current and historic distribution based on documented reports is shown in Figure 49.

Habitat and fish population surveys in the Middle Fork and North Fork between 1989 and 1994 have provided most of the information on current bull trout distribution in the Malheur Basin. The results of surveys in 1989 and 1990 were reported by Buckman et al. (1992). Additional surveys in 1991 and 1992 expanded bull trout distribution upstream in the mainstem of the North Fork as well as in Elk, Sheep and Swamp creeks. Bull trout were also observed in Beulah Reservoir, once in April of 1992 when an angler caught one, and in trap nets set in the reservoir in the spring of 1994, 1995, and 1996. We assume bull trout are present in the mainstem North Fork Malheur River from Bear Creek downstream to Beulah Reservoir. Local anglers report catching and releasing bull trout in this segment (R. Perkins, ODFW, personal communication, February 1996).

Surveys in 1993 revealed bull trout in Showshoe Creek, a tributary to Big Creek (Middle Fork Malheur River tributary). Forest Service biologist Carl Corey caught a bull trout while angling in Crooked Creek in the spring of 1995, and another angler caught and released a bull trout in the mainstem Middle Fork Malheur River, at about RK 286, in the spring of 1993.

Life History

Spawning surveys were initiated in the North Fork Malheur River in 1992 to determine the time and location of spawning bull trout. The area covered included the mainstem upstream of RK 70, and the mainstem and selected tributaries of Elk, Sheep, Swamp, and Crane creeks. Biologists report difficulty in finding spawning fish or redds (ODFW 1995c). Results of spawning surveys are presented in Table 32.

Samples for genetic analysis were taken in 1995 from Swamp creek and the Meadow Fork of Big Creek. These bull trout ranged in length from 87 to 330 mm (Hemmingsen et al. 1996). Results suggest that bull trout populations from the John Day Basin and Northeastern Oregon including the Malheur Basin comprise a major genetic lineage (Spruell and Allendorf 1997).

Table 32. Bull trout redd counts in the North Fork Malheur River, 1992-1995.

Year	Redds	km	Redds/km
1992[a]	16	15.3	1.04
1993	8	48.3	0.17
1994	13	40.2	0.32
1995	9	45.1	0.20
1996	28	49.1	0.57

[a] *Includes 14 questionable redds observed by volunteers.*

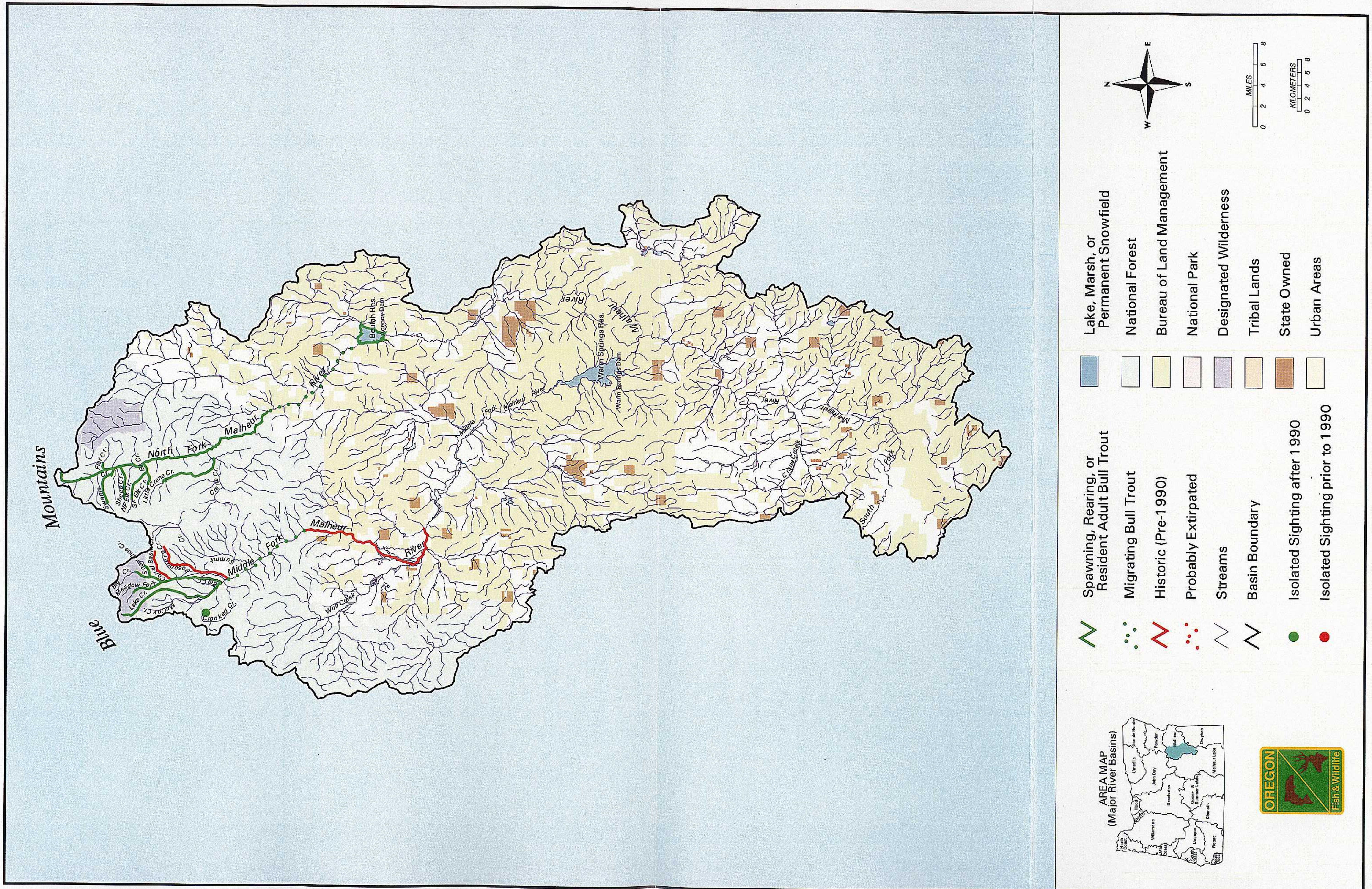


Figure 49. Bull trout distribution in the Malheur Basin, Oregon.

Bull trout sampled during 1991 and 1992 surveys of the North Fork Malheur River ranged in fork length from 50 to 410 mm. Multiple age classes were found in the upper mainstem as well as in the tributaries (Figure 50). Thirty-one bull trout sampled in 1989 from Big Creek and Meadow Fork of Big Creek (Middle Fork Malheur River) ranged from 80 to 380 mm in fork length. The largest bull trout observed in the Malheur Basin was a 560 mm (22 inch) fish captured in the spring of 1995 in a trap net set in Beulah Reservoir and a 660 mm (26 inch) bull trout caught and released by an angler at the mouth of Crane Creek in the fall of 1994 (R. Perkins, ODFW, personal communication, January 1996). The size of these fish and the presence of some large bull trout in the reservoir suggests that the fluvial life form is still present in the Malheur River population.

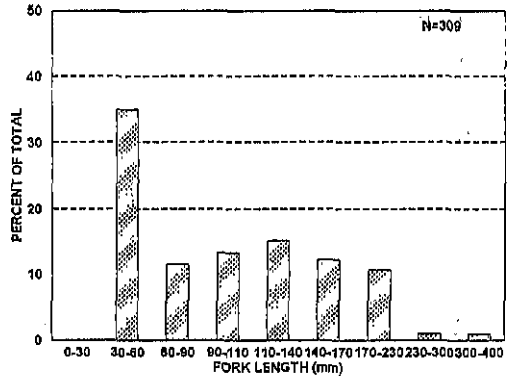


Figure 50. Length-frequency distribution of bull trout sampled in the mainstem and tributaries of the North Fork Malheur River Subbasin in 1991 and 1992 (Bowers et al 1993).

An estimate of 4,132 total bull trout for the North Fork Malheur River population is based on population sampling completed in 1991 and 1992 using a multiple pass removal method (Table 33). The population of age 1+ bull trout in Middle Fork Malheur River was estimated at 3,554 fish based on sampling completed in 1993 and 1994 (Table **34).**

Specific Limiting Factors

Historic land uses affecting bull trout habitat in the Malheur Basin include livestock grazing, timber harvest, road building, dispersed recreation, and irrigated agriculture. Effects have included increased stream temperatures as a result of removal of riparian vegetation, increased sediment loading to stream channels, loss of potential for large woody inputs to streams, loss of streambank integrity, reduced flows from irrigation withdrawals, loss of fish at unscreened diversions, and blocks to migration from major dams constructed for storage and smaller irrigation diversion dams. In addition, chemical poisoning projects conducted between 1950 and 1987 on the North Fork Malheur River and in 1955 on the Middle Fork Malheur River may have killed bull trout, but there is no record of bull trout mortalities (Bowers et al. 1993).

Naturally occurring ecological events, such as the drought from 1985 to 1994, may have stressed bull trout populations further. Major forest tires occurred in both subbasins in 1989 and 1990. Tributaries affected included Snowshoe, Corral Basin, and Big Creek in the Middle Fork Malheur River Subbasin and Sheep, Swamp, North and South Fork Elk, and upper Little Crane creeks in the North Fork Malheur River Subbasin. Guidelines for logging of fire damaged trees, including maintenance of no-cut buffers and exclusion of grazing for a minimum of three grazing seasons, were included in fire salvage and resource recovery plans developed by the Malheur National Forest. Monitoring of water temperature to gauge the effectiveness of best management practices is included in both plans (U. S. Forest Service 1990b and 199Oc). ODFW is also monitoring water temperatures in streams in the fire areas. Increases in water temperatures may be expected until the riparian vegetation has regrown, but long term impacts from these fires are not anticipated.

Livestock grazing and irrigation withdrawals continue to affect bull trout habitat in the lower stream reaches. Several diversions on private land remain unscreened in both the North and Middle Fork Malheur River subbasins. However, efforts are being made to coordinate screening of these diversions with monetary assistance from the statewide screening program. The Forest Service has screened or closed their diversions in both the North and Middle forks of the Malheur River.

Table 33. Population estimates of bull trout in the North Fork Malheur River Subbasin, summer 1991 and 1992.

Stream	Age 0+	Age 1+
1991		
Elk Creek	50	17s
SF Elk Creek	66	113
NF Malheur River, RK 92-96	24	227
1992		
Little Crane Creek	371	703
Sheep Creek	78	247
Swamp Creek	497	875
Swamp Creek Tributary	460	73
Flat Creek	0	12
NF Malheur River, RK 70-96	0	161
Totals	1,546	2,586
+/- 95% CL percent of estimate	66%	30%

Table 34. Population estimates of 1+ age bull trout in the Middle Fork Malheur River sampled during the summers of 1993 and 1994 (ODFW unpublished data).

	Habitat type	Population estimate	Cl % of estimate	Fish per square meter	Fish per lineal meter
Big Creek Complex[a]	Slow Water	154	37%	0.0076	0.150
Big Creek Complex	Fast Water	2,406	44%	0.0484	0.212
Meadow Fork	Slow Water	291	55%	0.1422	0.474
Meadow Fork	Fast Water	458	41%	0.0343	0.131
Lake Creek	Slow Water	67	143%	0.0112	0.057
Lake Creek	Fast Water	178	42%	0.0085	0.039
Total		3,554	31%	0.0316	0.160

[a]Includes the lower portions of Snowshoe Creek and Meadow Fork Big Creek

Loss of large wood recruitment will continue as a result of past logging until trees in the riparian zone mature enough to provide this habitat component. Loss of large wood from riparian zones continues as a result of cutting for firewood for home heating and campfires by non-commercial users.

Habitat surveys conducted in the North Fork Malheur River Subbasin between 1990 and 1992 showed high silt (37%), a scarcity of pools (7.3%), and a lack of wood (5.3 pieces/100m). The quantity of spawning habitat does not appear to be limiting, except in Elk and Sheep creeks; however, its quality is questionable because of the high quantities of fine sediment within the substrate. Fine sediments ranged from 31% in Sheep Creek to 58% in Roaring Springs fork of Little Crane Creek in 1992.

Optimum water temperature for adult bull trout is near 12 to 15°C and optimum juvenile growth is found in waters from 4 to 10°C (McPhail and Murray 1979, Shepard et al 1984, Buckman et al 1992, Ratliff 1992, Buchanan and Gregory 1997). Temperature modeling has shown that temperature is limiting in most of the North Fork mainstem during July (Bowers et al. 1993). Maximum summer temperatures reported in the North Fork Malheur River Subbasin are shown in Table 35.

Table 35. Summary of water temperature data from selected sites in the North Fork Malheur River Subbasin for 1995.

Stream	RK[a]	Day in[b]	Day out[c]	Number of days[d]	Number of days above DEQ standards[e]		
					17.8°C	12.8°C	10.0°C
NF Malheur River	37	6123195	9/7/95	76	71	71	71
NF Malheur River	71	7/1/95	10/18/95	110	52	82	92
NF Malheur River	80	6/13/95	8/21/95	70	0	61	64
NF Malheur River	93	7/16/95	10/13/95	90	0	35	65
L. Malheur River	0	6/23/95	9/6/95	7s	69	69	69
Crane Creek	0	6/13/95	8/23/95	72	21	62	66
L. Crane Creek	5	6/6/95	9/17/95	104	0	0	79
Elk Creek	0	6/2/95	9/17/95	108	0	0	77
Sheep Creek	0	6/15/95	9/23/95	88	0	0	28
Swamp Creek	0	6/15/95	9/23/95	88	0	1	69
Swamp Creek	5	7/1/95	9/25/95	87	0	4	71

[a] *Approximate river km.*
[b] *Day thermograph started recording water temperature.*
[c] *Day thermograph stopped recording water temperature.*
[d] *Number of days with water temperature data.*
[e] *Number of days the 7 day moving average of the daily maximum exceeded the water temperature standards established by the Oregon Department of Environmental Quality. The 17.8" C is the not to exceed standard in all waters except for the time and in waters that support salmon spawning, egg incubation and fry emergence in which case the 12.8° C standard applies or in waters that support bull trout, in which case. the 10° C standard applies.*

Habitat surveys were conducted in the Middle Fork Malheur River Subbasin during the summers of 1993 and 1994. Results showed overall habitat conditions ranged from poor to good. Most of the reaches lacked pool habitat complexity, key pieces of wood, and riparian trees and had excessive fines in riffle areas. While the number of pieces of large wood did not appear to be limiting, the volume of large wood was typically moderate to poor (Rasmussen Undated).

Instantaneous temperature records show a thermal barrier exists in the downstream sections of McCoy, Bosonberg, and Summit creeks. In Lake and Big creeks, a thermal barrier may exist in downstream areas during low runoff years; however, the extent is not known at this time (Bowers et al. 1993). Maximum daily temperatures recorded in the Middle Fork Malheur River Subbasin are shown in Table 36.

Risks to bull trout continue as a result of unscreened irrigation diversions in the Middle Fork Subbasin and water withdrawals for irrigation and loss of large wood in both subbasins. The population in the Middle Fork Malheur River Subbasin is at added risk because of the presence of brook trout throughout much of the range of bull trout. Anecdotal evidence suggests the brook trout were stocked by the Oregon Game Commission and volunteers in the high lakes of Strawberry Mountains during the 1930s (Bowers et al. 1993).

Table 36. Summary of water temperature data from selected sites in the Middle Fork Malheur River Subbasin for 1995.

Stream	RK[a]	Day in[b]	Day out[c]	Number of days[d]	Number of days above DEQ standard[e]		
					17.8° C	12.8° C	10.0° C
Big Creek	0	6/23/95	0	88	36	76	76
Big Creek	5	6/15/95	9/23/95	88	0	60	72
Big Creek	11	6/5/95	9/12/95	100	0	0	0
Snowshoe Creek	0	6/5/95	9/18/95	106	0	0	80
Lake Creek	5	6/15/95	9/23/95	101	28	72	76
McCoy Creek	3	6/23/95	9/23/95	8 9	0	1	76
Bosonberg Creek	5	6/5/95	9/18/95	106	0	58	100
Summit Creek	5	6/5/95	9/17/95	105	85	99	99
MF Malheur River	298	6/2/95	9/15/95	106	78	97	100

[a] *Approximate river km.*
[b] *Day thermograph started recording water temperature.*
[c] *Day thermograph stopped recording water temperature.*
[d] *Number of days water temperature data collected.*
[e] *Number of days the 7 day moving overage of the daily maximum exceeded the water temperature standards established by the Oregon Department of Environmental Quality. The 17.8" C is the not to exceed standard in all waters except for the time and in waters that support salmon spawning, egg incubation and fry emergence in which case the 12.8" C standard applies or in waters that support bull trout, in which case, the 10° C standard applies.*

Management Considerations

Angling for bull trout has been closed since spring of 1991. The closure was preceded by a cooperative campaign between the Malheur National Forest and the BLM, to encourage angler release of bull trout begun in 1990 using educational signs and pocket picture cards to aid in identification of bull trout. Enforcement of the angling closure on bull trout is a high priority for Oregon State Police during the fall spawning season.

During 1990 and 199 1, applications for instream water rights were filed with Oregon Department of Water Resources on stream reaches then known to have bull trout. Granting of the instream water rights should help protect streamflows in these reaches from further out-of-stream appropriation. Twenty-nine requests have been tiled for the Malheur Basin with nine of them for the benefit of bull trout and redband trout. Final certificates have been issued for all but two requests, which were protested (McCoy Creek and Bosonberg Creek).

Management actions proposed for the Malheur Basin include continued collection of flow and temperature data, and gathering of bull trout life history information. ODFW, the Malheur National Forest, and livestock permittees continue to search for ways to improve livestock management. (In the fall of 1996 livestock were removed from riparian pastures with bull trout spawning habitat, which greatly facilitated the identification of redds.) Meetings with irrigators and OWRD are also ongoing in an attempt to resolve the problem of unscreened and unregulated diversions on private land.

Biologists from state and federal agencies and tribal interests in the Malheur River and John Day basins whose jurisdictions include bull trout habitat, and other affected interests have formed a technical working group and initiated meetings to coordinate field work and compare information concerning bull trout.

Current Status

The status of bull trout in Oregon was assessed by Ratliff and Howell (1992). The North Fork Malheur population was ranked "of special concern" attributed to habitat degradation, downstream losses, and past chemical poisoning projects. The Middle Fork Malheur population was ranked at "high risk" of extinction attributed to habitat degradation, a 1955 chemical poisoning project, and competition with brook trout. This ranking of bull trout in the Malheur Basin remains unchanged.

CONCLUSIONS

1. All available published and unpublished bull trout information through 1996 has been assembled, mapped, and summarized in this report for each of Oregon's river basins containing bull trout.

2. Limited historical references indicate that bull trout were once spread throughout at least 12 basins in Oregon. All populations are in the Columbia and Upper Klamath Basins. No bull trout are known from Oregon's coastal systems.

3. Since the 199 1 review of bull trout status (Ratliff and Howell 1992), 7 small populations have been newly discovered, 1 population showed a positive or upgraded status, and 22 populations showed a negative or downgraded, status, out of a total of 69 populations. The downgrading of 32% of Oregon's bull trout populations appears largely due to increased survey efforts and increased survey accuracy rather than reduced abundance or distribution. However, three populations in the Upper Klamath Basin two in the Walla Walla Basin, and one in the Willamette Basin showed decreases in estimated population abundance or distribution.

4. In 1991, Ratliff and Howell (1992) placed 34% of Oregon's bull trout populations in the two lowest risk categories ("low risk of extinction" and "of special concern"). This 1996 status review lists only 19% of the populations in these lowest risk categories, while 8 1% of the populations are considered to be at "moderate risk", "high risk", or "probably extinct". As noted, these finding primarily reflect more extensive and intensive surveys.

5. Some Oregon river basins have bull trout populations at high risks of extinction. Examples are populations in the Hood, Klamath,, and Powder basins, as well as the Odell Lake population in the Deschutes basin, which contain only a few remaining bull trout. Bull trout populations currently in these basins are all listed as having a "moderate risk" or "high risk" of extinction.

6. Platts et al. (1995) reported that the bull trout population in Wallowa Lake was slowly increasing while ODFW fishery managers reported that bull trout have been extirpated since the 1950's and reintroduction efforts with a non-local stock was unsuccessful. Data analyzed in this report supports the ODFW managers.

7. ODFW managers have instigated several major changes to provide additional protection for Oregon's bull trout populations:

   a) All state managed bull trout populations have more restrictive angling regulations compared to 1989. Angling regulations prohibit harvest of bull trout in all Oregon populations except for one population in the Deschutes Basin.

In Lake Billy Chinook Reservoir, one bull trout over 6 10 mm (24 inches) may be harvested per day.

b) Introductions of non-native trout have aggravated fragmentation, caused hybridization and contributed to local extinction's (Leary et al 1991, Donald and Alger 1992, Markle 1992, Rieman and McIntyre 1993, this report). Statewide stocking of brook trout, including the high lakes stocking program, has been discontinued in locations where managers believe brook trout could migrate downstream and interact with bull trout. However, naturally reproducing populations of brook trout can still be found in many high lakes and mountain streams. There are no bag or size limits on brook trout in streams in Oregon including those streams where bull trout are found. Whether this management change is an effective tool that will reduce brook trout populations or inadvertently increase bull trout harvest due to angler misidentification needs to be closely monitored.

c) Stocking legal-size rainbow trout for recreational fisheries has been discontinued in most lodations near bull trout populations to avoid incidental catch of bull trout.

8. Restrictive bull trout angling regulation changes (including the elimination of bull trout harvest in all spawning areas) may be major reasons why the Metolius River/Lake Billy Chinook and "mainstem McKenzie River populations have shown significant increases in abundance. Both of these populations also have access to good spawning and rearing habitats and migratory corridors.

9. Barriers such as mainstem Columbia River dams, lower river tributary dams like Pelton and Round Butte, and headwater tributary dams like Clear Branch, Trail Bridge, and Cougar dams all block historical migration routes, aggravating fragmentation of bull trout populations and suppression of fluvial life histories.

10. Except for the Metolius/Lake Billy Chinook population, quantitative trend data is limited for Oregon's bull trout. We have abundance estimates for only a few bull trout populations.

11. The spatial and temporal distributions of bull trout reported for each river basin in this status report should be used as an accurate baseline for fishery managers, Current distribution and relative change of distribution should be useful indicators of population health and status.

12. Length frequency data is presented for most Oregon bull trout populations. This should provide a basis for evaluating at least two parameters of population health: the presence of multiple age classes and the percent of fluvial size life history component.

13. Elements of habitat that produce bull trout are missing or degraded in many of Oregon's bull trout basins. Dambacher and Jones (1997) list seven variables that define juvenile bull trout

habitat: high levels of shade and undercut banks, high volumes and numbers of large woody debris, high levels of gravel in riffles, and low levels of'bank erosion and fine sediment in riffles. Land uses such as logging, mining, road construction, grazing, and cropland farming adversely affect these habitat variables.

14. Land and water use activities continue to impact bull trout habitat. Approximately 16% of current bull trout habitat has protected status, e.g., Wilderness, Wild and Scenic, or National Park. Habitat outside of a protected area may be subject to further alteration, which may increase risks to bull trout populations. However, unprotected habitat may be benefited by private management activities such as the example provided by Weyerhaeuser (now U.S. Timberlands Inc.) in the Klamath Basin and public management planning efforts such as the Northwest Forest Plan, INFISH, and PACFISH.

15. Temperature appears to be a limiting factor to many of Oregon's bull trout populations. Since these populations are in the southern latitudes of bull trout range, they will be further threatened by global warming and any land and water use changes that cause water temperature increases. An eleven-person subcommittee of Oregon scientists has recommended to the Department of Environmental Quality that "no temperature increase shall be allowed due to anthropogenic activity in present bull trout habitat, or where historical cold water habitat is needed to allow a present bull trout population to remain viable and sustainable in the future" (Buchanan and Gregory 1997).

16. Thirty-two percent of Oregon's bull trout populations are at high-risk of extinction. Leary et al. (1993) and Spruell and Allendorf (1997) found little genetic variation within populations, but significant differentiation between Oregon populations. Their data suggest that the sustainability of many bull trout populations throughout Oregon is necessary for conservation of genetic diversity of the species

17. The GIS maps in this report provide a template to add new layers of data such as critical spawning and juvenile rearing areas, and as a method to compare distribution changes through time.

RESEARCH AND MANAGEMENT NEEDS

1. Continue research to determine the genetic characteristics of Oregon's bull trout. Genetic description should identify populations and estimate the diversity within and among populations. Understanding the relationships between populations will aid in the management and restoration of bull trout.

2. Determine life history characteristics of Oregon's various bull trout populations, Life history traits to be monitored include movement and migration patterns, spawning timing, spawning frequency, disease resistance, hatching timing, food habits and prey base, age structure, and age of maturity.

3. Determine relationships between instream temperature, distribution, and life history stages of bull trout.

4. Determine the interactions between resident and migratory life history forms in bull trout populations.

5. Determine factors influencing adverse interactions between native bull trout and introduced trout. For brook trout-bull trout interactions, we speculate that water temperature, habitat change, gradient, and loss of large, fluvial bull trout may all influence brook trout dominance.

6. Examine the utility of monitoring abundance or distribution of spawners, juveniles and adult bull trout to use as indices of long term population health.

7. Determine the effectiveness of restoration techniques to provide protection for bull trout such that abundance and distribution can be maintained or increased.

8. Identify, monitor and map critical bull trout spawning and juvenile rearing areas throughout Oregon, using existing GIS technology.

9. Identify, monitor and map all cold water tributaries, springs and seeps in current bull trout distribution areas, using existing GIS technology.

10. Identify and map barriers to upstream and downstream migration of bull trout.

RECOMMENDATIONS

1. We recommend a collaborative approach to restoration and protection of bull trout populations and their habitat that makes use of local working groups composed of fishery biologists, land managers, aquatic scientists, and concerned citizens to develop basinwide strategies for the protection and conservation of bull trout. These strategies should be incorporated into local watershed and regional ecosystem management plans.

2. ODFW management direction for bull trout is guided by the Wild Fish Management Policy and implemented using a variety of approaches that, for example, regulate harvest, stocking of hatchery fish, and introduction of non-native species. ODFW will continue to develop and implement policies that encourage restoration of bull trout populations based on the best available science.

   a. Oregon's Wild Fish Management Policy [OAR 635-07-527(6) (a)] sets a minimum of 300 breeding fish as necessary to maintain genetically viable populations. Protection strategies for harvest and habitat management should be designed to meet or exceed this standard.

   b. Restrictive angling regulations currently in effect to protect bull trout should be continued until such time as specific populations are recovered to sustainable levels that may provide tribal subsistence fisheries and public angling for "trophy" or "featured species" fisheries. "Trophy" or "featured species" management approaches are characterized by low harvest rates and maintenance of sustainable populations.

   c. Stocking of hatchery rainbow trout near bull trout populations should be eliminated.

   d. Oregon law prohibits transport or release of live fish into waters of the State without a permit (ORS 498.222). Continued illegal introductions of non-native aquatic species into bull trout habitats should be discouraged by all available means.

3. We recommend that working groups focus their conservation and restoration efforts on the identification of factors limiting individual bull trout populations and then prioritize strategies to address these factors. Limiting factors may include: loss of habitat, passage barriers, siltation of gravels, streambank and riparian degradation, loss of shade and increased water temperatures, loss of large wood recruitment, loss of stream structure favorable to bull trout, loss of instream flows, overharvest, competition with introduced non-native species, and hybridization with introduced brook trout. These may occur in any combination.

   a. Efforts to protect existing high quality bull trout habitat and adjacent habitat that influences bull trout habitat should be encouraged. Working groups should consider: (1) retention of roadless areas; (2) protection of cold water seeps, springs, or tributaries that contribute to water quality; (3) timber harvest and livestock grazing restrictions in riparian areas; and (4) restrictions on instream uses including mining.

Some standards to protect habitat are in place on public land, e.g., special use designations (Wilderness, Wild and Scenic designations and riparian guidelines, e.g., Northwest Forest Plan, INFISH, and PACFISH), and on private land, e.g., Oregon Forest Practice Rules. Agencies, tribes, and bull trout working groups should work cooperatively with private and public landowners to protect and restore preferred habitat conditions (including migratory habitat) for bull trout on private lands.

b. Habitat restoration projects should address limiting factors identified in the conservation strategies based on the needs of bull trout while being cognizant of the project's effects on other native fauna to avoid collateral impacts.

A wide variety of habitat improvement projects may be used to restore bull trout habitat. They include but are not limited to: (1) fencing projects to better manage livestock use in riparian areas; (2) planting projects to restore riparian vegetation; (3) road obliteration and decommissioning; (4) screening water diversions; and (5) instream habitat improvement projects that increase the volume and abundance of large woody debris (especially large complex root wads), restore channels to proper functioning condition, or restore fish passage at artificial barriers that block migratory access to historic bull trout habitat.

c. We support reintroduction of bull trout within their historic range where suitable habitat is identified and risks to bull trout and existing fauna are fully analyzed and criteria developed that take into consideration genetic makeup, disease, ecological considerations, and the reintroduction is consistent with ODFW's Wild Fish Management Policy. Preference should be given to areas where documentation exists for historic occurrence by bull trout.

In addition, reintroductions should be preceded by surveys that confirm no viable bull trout population in the area proposed for reintroduction and habitat surveys that document sufficient and suitable habitat to support the reintroduction of bull trout. Factors which originally contributed to the extirpation of the local bull trout population should be corrected prior to reintroductions.

Where possible, recolonizations by reopening blocked migration corridors and allowing adult bull trout to naturally establish are preferred. The road culvert replacement project in Olallie Creek (McKenzie Watershed) may be used as a template for these activities.

Where natural recolonization is not feasible, wild fry trapped from nearby streams within a watershed is an acceptable alternative assuming the donor population meets conditions outlined above. Only a small percentage of fry from the donor stream should be used each year. These projects should be repeated for minimum of three years, The re-introduction project on Sweetwater Creek (McKenzie Watershed) may be used as a template for these activities.

d. Where they compete with bull trout, eradication or reduction of non-native aquatic species, such as lake, brown, and brook trout, should be considered in any recovery strategy. Eradication may include isolation using barriers or physical removal techniques such as special angling regulations, electrofishing, toxicants, or a combination of these methods. The examples of Buktenica (1997), the Montana Bull Trout Scientific Group (1996), and Dunsmoor (1997) provide guidance in these efforts. Any non-native species removal effort should be preceded by a thorough analysis of the impact of the non-natives on bull trout and risks to the bull trout population and other native fauna from the actual project.

e. Working groups should also consider production of educational materials which increase awareness and appreciation of bull trout as a unique native species. Making anglers, public agencies, and the general public aware of the detrimental effects of illegally introduced non-native species and the consequences of land uses is needed. Increasing awareness of regulations which protect bull trout and their habitats may prevent some habitat loss and overharvest. Examples of educational materials include a bull trout Please Release Me” poster and bull trout/brook trout identification aid cards.

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