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Edited by Pritpal S. Soorae

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Re-introduction of bull trout in the upper Willamette River basin, USA

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Introduction

Bull trout (*Salvelinus confluentus*) is a species of char native to northwestern North America from northern California and Nevada, USA, to the Northwest Territories, Canada. The species is iteroparous and expresses a flexible life history that commonly includes long-distance seasonal migrations (>100 km). Threats such as habitat fragmentation, habitat simplification, angling-related mortality, and introduced species led to widespread declines in the past century. Bull trout is listed as vulnerable (A2e) on the IUCN Red List, threatened in the coterminous United States under the Endangered Species Act, and as a species of special concern in Alberta and British Columbia, Canada.

In the Willamette River basin in western Oregon, USA, bull trout historically occupied coldwater drainages in the Cascades Mountains. Populations were extirpated from the Clackamas, Santiam, and Middle Fork Willamette drainages by the 1990s and persisted only in the McKenzie River drainage. An interagency working group has coordinated a comprehensive effort to recover bull trout in the upper Willamette River basin, and a primary component of this effort has been the re-introduction of bull trout to two streams in the upper McKenzie River basin, where impassable culverts were renovated, and to the upper Middle Fork Willamette River drainage.

Small adult bull trout from the upper Willamette River basin © Andrew Talabere

Goals

- Goal 1: Ameliorate sources of excessive mortality to bull trout in the upper Willamette River basin.
- Goal 2: Restore habitat conditions to increase productivity for all life stages of bull trout.
- Goal 3: Re-establish spawning populations in streams where impassable culverts have been modified to restore upstream fish passage.

- Goal 4: Reestablish spawning populations of bull trout in the Middle Fork Willamette River basin.
- Goal 5: Evaluate effectiveness of using various life stages and captive rearing procedures for re-introduction efforts.

Success Indicators

- Indicator 1: Conservation officers and creel surveys report minimal incidence of angling-related mortality and poaching of bull trout.
- Indicator 2: Adequate amounts of spawning habitat, early rearing habitat, and historical prey base (i.e., Chinook salmon) available; connectivity restored, allowing migratory bull trout to utilize downstream habitats and potentially exchange genetic material among populations.
- Indicator 3: Stable long-term spawning abundance in the Middle Fork Willamette River basin and in streams where access to spawning habitat has been restored. Local abundance and genetic exchange among local populations sufficient to minimize risk of adverse genetic effects.
- Indicator 4: Information on success of different release strategies used to adaptively guide this project and made available for other re-introduction projects.

Project Summary

Feasibility: Agency biologists surveyed coldwater streams to determine status of bull trout in the basin. Bull trout persisted in the McKenzie River below Trail Bridge Dam (>100 km reach) and two isolated populations at high-risk of extirpation upstream of dams in the McKenzie River (5 km) and South Fork McKenzie River (35 km). Bull trout were considered extirpated from the Middle Fork Willamette River. The Upper Willamette Bull Trout Working Group identified several historical and contemporary threats to bull trout. These included fishery management practices and angling regulations that failed to protect bull trout, construction of impassable dams that fragmented bull trout habitat and eliminated Chinook salmon runs, and past forestry management practices that led to simplified instream habitat and elevated water temperatures. Resource management agencies specified measures to address many of these threats through management plans, Endangered Species Act consultations, and hydroelectric dam relicensing processes.

Evaluations of potential re-introduction sites in the basin focused on water temperature, spawning and rearing habitat, macroinvertebrate productivity, presence of migration barriers, and occurrence of nonnative brook trout. The Working Group identified two McKenzie River tributaries (Olallie and Sweetwater creeks) where impassable culverts in lower reaches blocked access to over 5 km of former spawning and rearing habitat (Capurso, 1997; Ziller & Taylor, 2000). In the Middle Fork Willamette River drainage, three short spring runs and one 8 km tributary (Swift Creek) were considered potentially suitable for spawning and early rearing (UWBTWG 2007). The Working Group identified Anderson Creek in the McKenzie River drainage as a suitable donor population, and elected to use wild, out-migrating age-0 bull trout trapped in the lower reach. Advantages included:

Monitoring spawning by counting bull trout redds in Anderson Creek © Nik Zymonas

Low impact on the donor population (out-migrating bull trout fry likely exceed tributary rearing capacity and experience high mortality); Relatively high genetic diversity attributable to comparatively high adult abundance and collection of fish from numerous family groups; avoided domestication and selection effects associated with artificial spawning or broodstock programs; Early lifestage likely to imprint on the recipient habitat.

Implementation: Resource management agencies modified angling regulations and trout stocking practices, conducted public education efforts, and posted informational signs to reduce the incidence of angling mortality. The US Forest Service began an ongoing effort to add large woody debris to the main stream and tributary reaches to capture gravel and nutrients, increase channel complexity, and provide cover. Spawning gravel was added to two spring runs that offered suitable habitat for early rearing. Adult Chinook salmon were out-planted upstream of dams beginning in 1993 to increase productivity. We collected and directly transferred annual totals of 142 - 3,386 fry from Anderson Creek to recipient streams during February - May of 1993 - 2005. Fry were transferred to Sweetwater Creek from 1993 - 1999 (N = 6,377), to Olallie Creek in 1994 - 1997 (N = 670), and to the Middle Fork Willamette River drainage from 1997 - 2005 (N = 10,408). Low survival of fry released into Swift Creek inspired the Working Group to initiate a captive-rearing program in 2007 to evaluate survival of larger juveniles. During 2007 - 2011, fry were transferred to Leaburg Fish Hatchery, reared for 5 - 8 months, and released as age 0 juveniles in August - December or as age 1 fish in April.

Post-release monitoring: Biologists established a comprehensive monitoring program to evaluate status of extant and re-introduced populations in the basin. Snorkeling and minnow-trapping surveys indicated fairly high abundance of transferred fry rearing in several re-introduction sites for at least one year. We detected spawning by adult bull trout in Sweetwater Creek in 2000, seven years after the first transfers of fry. Annual totals increased to 9 redds by 2005, then 20 to 22 redds in 2006 - 2009. In Olallie Creek, any effect of augmentation was unclear because bull trout spawned in the upstream reach in 1995, which was the first year access was restored and only one year after the initial transfer of fry.

We first detected mature bull trout in the Middle Fork Willamette River drainage in 2005, eight years after initial transfers. However, total annual redd counts have remained low, reaching only 15 redds. Few directly transferred bull trout fry and no spawning were detected in Swift Creek, although captively reared juvenile bull trout have been detected at moderate densities and may return as migratory adults beginning in 2013. A genetics assessment indicated that re-introduced populations in Sweetwater Creek and the Middle Fork Willamette River drainage held levels of genetic variation comparable to the Anderson Creek source population, with no evidence of genetic input from other populations. Individual cohorts of captive reared bull trout held significantly lower genetic variation than the source population, suggesting that transfers should be conducted over multiple years to maintain comparable levels of genetic variation. Redd counts and trapping efforts indicated considerable variability in abundance of juveniles and adults in the Anderson Creek source population.

Major difficulties faced

- Low numbers of bull trout fry were available for the re-introduction effort in some years, largely because only one suitable donor population was available. Low redd counts in some years elicited concern over potential effects of removing fry; however, relationships among redd counts, fry abundance, and older juvenile abundance are weak.
- Increased abundance in Middle Fork Willamette River drainage may be constrained by limited availability of spawning habitat in tributaries having sufficiently cold incubation temperatures and protection from excessive scouring by high flows in late autumn and winter.
- Direct transfers of fry to the relatively large Swift Creek watershed were unsuccessful in producing spawning adults, possibly because of high predation rates.
- Logistical difficulties (large watershed area, seasonal high flows, and inaccessibility of study sites), low abundance, a migratory life history, and a period of several years before maturation present challenges in precisely quantifying abundance, monitoring survival, and identifying potential bottlenecks.
- Although construction of an upstream fish passage facility at Cougar Dam has been completed and construction of up- and downstream facilities at Trail Bridge Dam is scheduled to begin in 2013, fragmentation and other effects of high-head dams are difficult to remedy and will continue to affect bull trout populations in the basin.

Major lessons learned

- Direct translocation of bull trout fry proved successful in suitable locations holding relatively few competitors or predators; spawning adults returned to re-introduction streams 6 to 8 years after initial transfers.
- Sustained transfers over several years were necessary to build increasing abundance of adults and to maintain genetic variation comparable to levels in the source population.
- Direct translocation of fry was unsuccessful in a relatively large tributary (Swift Creek), given the quantity of fry available for the effort.

- Augmentation was unnecessary in one tributary (Olallie Creek) where spawning occurred in a short reach below a barrier prior to restoring access to upstream habitat and a nearby source population may have contributed spawning adults.
- The re-introduction project required a comprehensive effort to reduce mortality, restore habitat, and increase productivity in a highly altered system.
- Cooperation among various agencies and other groups has greatly facilitated this effort.

Success of project

Highly Successful	**Successful**	Partially Successful	Failure
	√		

Reason(s) for success/failure:

- Spawning populations have been re-established upstream of corrected barriers in Sweetwater and Olallie creeks.
- A spawning population has been re-established in the Middle Fork Willamette River drainage. Adult abundance has been relatively low to date, but abundance of juveniles originating from spawning by transferred fish has been relatively high for several years and the project has only now reached the point when these individuals should begin to reach maturity.
- Direct transfer of bull trout fry to the larger Swift Creek was unsuccessful, but better survival among larger captive reared juveniles may lead to returns of spawning adults beginning in 2013.
- Conditions for survival of bull trout in the upper Willamette River basin have improved as a result of ongoing restoration activities and reduction of angling-related losses.

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