BOISE RIVER ENHANCEMENT NETWORK

- We are a network of people that live, work and play in the Boise River watershed dedicated to promoting the ecological enhancement of the river

Photo: Gary O. Grimm - Mountain Visions

Boise River Fisheries and Aquatic Habitat

Literature Review | Network Feedback | Key Issues and Enhancement Opportunities

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Prepared by: Ecosystem Sciences Foundation

Contents

Introduction

At the 2011 workshop titled "Lower Boise River: From Vision to Reality", participants identified fisheries and aquatic habitat as the priority enhancement goal. When asked what should happen next, the most common response was: "continue this group and develop a plan." Three years later, a group has been formed, the Boise River Enhancement Network (BREN). Through a grant from the Bureau of Reclamation, the group is widening its membership, developing structure, performing outreach, and developing a watershed plan for how BREN can enhance the Lower Boise River (LBR) which extends from Luck Peak to the confluence with the Snake River. Although the tributaries form an important part of the LBR system, they were beyond the scope of this document. For this reason, we focus on the main stem of the LBR. As part of this planning effort, identifying the key issues and possible solutions associated with fisheries and aquatic habitat of the Boise River is critical.

Purpose

The purpose of this document is to provide a framework for the formation of the fisheries and aquatic habitat section of the BREN Enhancement Plan for the LBR. This is a living document that will continue to be updated with new information and revised based expert opinion and public input. It is meant to be the reference from which the BREN plan will draw its information. It is divided into the following sections:

Summary: This provides a brief narrative overview of the information contained within this document.

Part I: **Existing Information**. An overview of the existing literature pertaining to the Boise River fishery and associated aquatic habitat. Overall conclusions from pertinent existing reports are summarized and the issues and solutions identified within those reports are identified. Much of this information was discussed in a public meeting on April 16th, 2014, in which feedback was solicited and recorded. A reference list is provided at the end of the document.

Part II: **Network Feedback**. This section contains feedback from the BREN participants on fisheries issues. This includes information from the October 2011 workshop and from participants at the April 16th, 2014 fisheries meeting and expert reviewers. At the April 2014 meeting, feedback on issues, solutions, additional literature, and who should perform the expert review was collected. The additional information and resources will be integrated into Part I on an ongoing basis.

Part III: **Priority Issues and Enhancement Opportunities**. This section presents the results of the review process and identifies the priority issues and enhancement opportunities.

References

Summary

The Lower Boise River (LBR) has been highly modified from its original condition over the past 100 years. Flow regulation from upstream dams and irrigation infrastructure, channelization, floodplain development, introduced species, and pollution have significantly changed the character of the river. Restoring the fisheries to historic levels is, therefore, no longer a reasonable goal. Despite these changes, the current fisheries and aquatic habitats provide important natural, cultural and economic resource values to the region. Improvements made to the fisheries and aquatic resources over the past 25 years demonstrate that meaningful improvements to the health of these resources can be achieved; however, significant stressors remain within the system providing enhancement opportunities for improving the LBR fisheries and ecology.

Twenty-two species of fish have been identified in the LBR. The upper 30 miles, from approximately Lucky Peak to Star, supports a coldwater fish community with higher biotic integrity than the lower reach, which supports cool and warmwater fish communities. The coldwater game fishery is composed of wild (*reviewers have noted that these are likely introgressed*) and hatchery rainbow trout, exotic brown trout and mountain whitefish. Salmonid populations have increased dramatically since 1994. These increases can be attributed to higher and more consistent winter flows, improved water quality and high release rates. The warm water fishery is not as well understood. Introduced smallmouth bass, channel catfish, and largemouth bass have established within the lower reaches or seasonally migrate upstream from the Snake River.

Decreased the spring peak flows and increased summer flows, similar to many western river systems managed for flood control and irrigation water delivery, have reduced the amount of salmonid habitat. Spring peak flows rarely reach sufficient magnitudes to mobilize large areas of the river bed, leading to high embeddedness (when cobbles and other stream bed substrates are covered or closely packed by fine sediments). Elevated summer discharge coupled with channel confinement, lack of instream cover, roughness elements, and complexity have led to stream velocities and habitat conditions that are not optimal for trout during much of the irrigation season (May – October). Decreased flows outside of the irrigation season (November – April) dewater near shore habitat leading to a loss of cover and habitat complexity for juvenile and adult fish, thus lowering fish survival. Riparian and wetland habitat along the river's banks and side channels are in need of enhancement. In-stream structure and cover is lacking and enhancement of these elements will benefit fisheries. Irrigation diversions entrain fish (though where and to what degree is unknown) and full-channel spanning structures block upstream fish movement, as well as downstream sediment movement. Poor water quality, from elevated temperatures, phosphorus and suspended sediment levels, impair the fish and other aquatic life in much of the LBR, especially in the lower reaches. Land use, particularly floodplain development, poses a significant threat to the long-term health of the system.

Many opportunities to enhance habitat for fish and other aquatic organisms have been identified. Although most experts agree summer discharges within the river are not ideal for salmonids, they do not agree on whether or not they are a limiting factor. Low winter flows, however, are likely limiting the fishery and increased winter discharges would benefit the resource; the extent of such benefits requires study. Protection of existing riparian and wetland habitat associated with the river is a priority, while enhancement of existing habitats, especially those that increase habitat complexity, would bring additional benefits.

There are several specific enhancement opportunities that will improve aquatic habitat. Reconnecting side channels may improve spawning and rearing habitat, though there are concerns about water quality impacts and the effectiveness of these projects. Leaving large wood in the river, placing boulders, and construction of artificial habitat elements could increase habitat complexity and cover for fish and other aquatic organisms; however these actions come with public safety concerns. Recruitment and development of cottonwood and willow riparian forest could be increased through active (e.g. creating appropriate surfaces) and passive (removing degrading factors) interventions. Water quality could be improved through cooperative efforts that include the irrigation community and municipal and state and federal governments. Reconnecting and re-establishing the floodplain through setting levees back, excavation, conservation easements and municipal zoning would bring widespread benefits. Increasing the number of long-term monitoring stations, the frequency of monitoring, and involving the community in the process, including a centralized database the public can easily access would increase support and awareness. These enhancement opportunities require collaboration and cooperation to achieve their goals.

Part I: Overview of Current Literature

Although more references have been collected than those highlighted in this section (see the references section), we present a short summary of recent fisheries studies on the LBR and present the main issues, solutions, and conclusions from key pieces of literature. This overview is meant to be updated periodically.

Fisheries Studies

***Fish Communities and Related Environmental Conditions of the Lower Boise River, Southwestern Idaho, 1974-2004*. (http://pubs.usgs.gov/sir/2006/5111/)**

By Dorene E. MacCoy, United States geological Survey (USGS)

This paper provides a synthesis of several fisheries studies (but not all) performed by Idaho Department of Fish and game (IDFG) and USGS between 1974 and 2004. This document provides a good overview of the fishery studies performed over this period, which this effort cannot improve upon. The information provided immediately below, including tables, have been copied verbatim from MacCoy (2006) and is displayed in indented block paragraphs.

Abstract
Within the last century, the lower Boise River has been transformed from a meandering, braided, gravel-bed river that supported large runs of salmon to a channelized, regulated, urban river that provides flood control and irrigation water to more than 1,200 square miles of land. An understanding of the current status of the river's fish communities and related environmental conditions is important to support the ongoing management of the Boise River. Therefore, fish community data from the U.S. Geological Survey and the Idaho Department of Fish and Game collected since 1974 were analyzed to describe the status of fish communities in the lower Boise River. Each set of data was collected to address different study objectives, but is combined here to provide an overall distribution of fish in the lower Boise River over the last 30 years. Twenty-two species of fish in 7 families have been identified in the lower Boise River—3 *salmonidae*, trout and whitefish; 2 *cottidae*, sculpins; 3 *catostomidae*, suckers; 7 *cyprinidae*, minnows; 4 *centrarchidae*, sunfish; 2 *ictaluridae*, catfish; and 1 *cobitidae*, loach.

Analysis of fish community data using an Index of Biotic Integrity (IBI) for Northwest rivers shows a decrease in the biotic integrity in a downstream direction, with the lowest IBI near the mouth of the Boise River. The number of tolerant and introduced fish were greater in the lower reaches of the river. Changes in land use, habitat, and water quality, as well as regulated streamflow have affected the lower Boise River fish community. IBI scores were negatively correlated with maximum instantaneous water

temperature, specific conductance, and suspended sediment; as well as the basin land-use metrics, area of developed land, impervious surface area, and the number of major diversions upstream of a site. Fish communities in the upstream reaches were dominated by piscivorous fish, whereas the downstream reaches were dominated by tolerant, omnivorous fish. The percentage of sculpin in the river decreased in a downstream direction, and sculpin disappear completely at sites downstream of Glenwood Bridge. The sculpin population increased downstream of the Lander wastewater-treatment facility within the last decade, possibly as a result of improved wastewater treatment. The condition of the mountain whitefish (*Prosopium williamsoni*) throughout the lower Boise River was good and was similar both to the condition of mountain whitefish from least-disturbed rivers in southern Idaho and to the North American standard weight for mountain whitefish.

Table 1. Summary of U.S. Geological Survey and Idaho Department of Fish and Game sampling of fish communities in the lower Boise River, southwestern Idaho, 1974 to 2004.

[**Abbreviations:** IDFG, Idaho Department of Fish and Game; USGS, U.S. Geological Survey; WAG, Lower Boise Watershed Advisory Group; WRI, Water Resources Investigation; WTF, wastewater-treatment facility]

Date	Project	Lead agency	Study objectives	Reference
March 1974 to February 1975	Snake River Fisheries Investigations	IDFG	Identify fish population, and habitat and water-quality characteristics	Gibson, 1975
January 1988 to March 31, 1988	Regional Fishery Management Investigation	IDFG	Fish community assessment upstream and downstream of WTF	Frenzel and Hansen, 1988; IDFG, 1988; Frenzel, 1990
March 1992 to April 1992	Regional Fishery Management Investigation	IDFG	Fish community assessment upstream and downstream of WTF	IDFG, 2000
December 1993 to March 1994	Regional Fishery Management Investigation	IDFG	Characterize trout1 and whitefish2 population	IDFG, 2000
February and March 1995, October 1996	USGS WRI	USGS	Fish community assessment upstream and downstream of WTF	Mullins, 1998
December 1996 to August 1997	USGS WRI	USGS	Examine biological integrity of fish population as related to water quality	Mullins, 1999
December 2001	USGS Idaho Statewide Water Quality Network	USGS	Examine biological integrity of fish population as part of a long-term trend statewide water-quality study	MacCoy, 2004
November 2003	USGS WRI	USGS	Fish community assessment upstream and downstream of WTF	Data available on USGS web site at http://id.water.usgs.gov/studies/Southwest/LowerBoiseRiver-WaterQuality-Biology/
December 2004	USGS Idaho Statewide Water Quality Network	USGS	Examine biological integrity of fish population as part of a long-term trend statewide water-quality study	Data available on USGS web site at http://greatbasin.wr.usgs.gov/fish/

Idaho Department of Fish and Game (IDFG), 1974-75

The IDFG conducted a survey of fish populations and water quality in the lower Boise from its mouth upstream to Barber Dam during 1974 and 1975 (Gibson, 1975). The 1974 sampling of 10 reaches (1 through 9 and a reach near Notus) of the lower Boise River was part of the Snake River Fisheries Investigation (a survey of the physical and biological information of the Snake River upstream of Brownlee Reservoir; Gibson,

1975). The lower Boise River was included in the investigation because of its importance to the Snake River drainage. This study was the first extensive assessment of the fish community in the lower Boise River. The IDFG found abundant mountain whitefish populations in the Barber Dam to Star reach. The report concluded that these fish were competing with juvenile and adult trout, and it recommended cropping the population. The IDFG also recommended that this reach be managed as a cold water fishery. The Star to mouth reach was dominated by warm water species (mainly in the sloughs), and the IDFG recommended that the reach be managed as a warm water fishery. They also stated that minimum and maximum flow requirements should be established for the well-being of aquatic life (Gibson, 1975).

U.S. Geological Survey, 1988

In 1988, the USGS evaluated the effect of multiple wastewater discharges on water quality and aquatic communities in the lower Boise River (Frenzel, 1988; 1990). The study was designed primarily to assess trace-element effects on aquatic communities. Artificial substrates were used to assess macroinvertebrate communities, and IDFG assisted in the assessment of the fish community by electrofishing reaches 2 through 5 upstream and downstream of the Lander and West Boise WTFs (reaches 2, 3, 4, and 5). Frenzel (1988) found no evidence of adverse affects of the effluent from these facilities on the macroinvertebrate and fish communities. Asbridge and Bjornn (1988) included information from the USGS study and additional data in a survey of potential and available salmonid habitat in the lower Boise River. They concluded that the lower Boise River was not ideally suited to trout due to high velocities in the upper reaches and high temperature in the lower reaches. Winter cover also was mentioned as affecting trout abundance.

IDFG, 1992 and 1993-94

Population estimates of trout and mountain whitefish were conducted by IDFG during the spring of 1992 and the winter of 1993–94 at reach locations similar to those in 1988 through the City of Boise (Frenzel, 1988). IDFG (2000) noted that [gamefish] populations continued to decrease, with the most likely cause being the low winter flows (Allen et al. 1995). Results were also part of an improvement in electrofishing methodology (Allen et al. 2000).

In addition Loggers Creek was electro-fished in March and September 1994 where very few game fish were collected and habitat was noted as generally poor in two of three sites. IDFG recommended the removal of "the special regulations from this irrigation channel" because the stream does not apparently support adult fish and all fish present are small, and "perhaps as "one of the 'few side channels present' on this section of the Boise River so it will continue to have some importance as a rearing area." (Allen et al. 2000).

Table 2. Fish sampling reach locations, lower Boise River, southwestern Idaho, 1988–2004.

[Reach lengths varied according to project sampling protocol; upstream and downstream latitude and longitude given is for the maximum reach sampled using North American Datum of 1983 (NAD 83). **Abbreviations:** WTF, wastewater-treatment plant]

Reach No.	Reach name	Subbasin location	Upstream latitude/longitude	Downstream latitude/longitude
1	Barber Dam	Upstream of Eagle Island	116º08'03"W/43º34'07"N	116º09'34"W/43º34'58"N
2	Upstream of Lander WTF	Upstream of Eagle Island	116º13'53"W/43º37'02"N	116º14'05"W/43º37'23"N
3	Downstream of Lander WTF	Upstream of Eagle Island	116º15'02"W/43º38'30"N	116º16'46"W/43º39'38"N
4	Upstream of West Boise WTF	Upstream of Eagle Road	116º18'09"W/43º40'10"N	116º19'22"W/43º40'16"N
5	Downstream of WTF	Upstream of Eagle Road	116º20'23"W/43º40'30"N	116º21'15"W/43º40'29"N
6	Star	Upstream of Middleton	116º27'01"W/43º40'47"N	116º28"13"W/43º41'02"N
7	Middleton	Upstream of Middleton	116º33'34"W/43º40'55"N	116º34'17"W/43º41'03"N
8	Caldwell	Upstream of Mouth	116º41'19"W/43º40'45"N	116º41'40"W/43º40'40"N
9	Upstream of Mouth	Upstream of Mouth	116º27'03"W/43º67'41"N	116º58'16"W/43º46'41"N

U.S. Geological Survey, 1995–96

As a follow-up study to the 1988 and 1992 studies, the USGS, in cooperation with the City of Boise, sampled fish communities upstream and downstream of the Lander and West Boise WTFs during the spring of 1995 and the autumn of 1996 (reaches 2 through 5). An IBI was calculated using percentages of sculpin, salmonids, pollution-tolerant species, invertivores, juvenile trout (assumed to be those less than 100 mm total length), juvenile mountain whitefish (assumed to be those less than 210 mm total length), and percentage of individuals with one or more anomalies (Mullins, 1999b). High flows in autumn of 1996 in the lower Boise River affected sampling efforts. Therefore, accurate species abundance estimates could not be made, and this data are not included in this report. The IBI scores were similar among the four sampling reaches, although Mullins (1999b) noted variability between riffles sampled within a reach. He suggested that more frequent sampling would help to determine any statistical differences between reaches. Sculpins were only found upstream of the Lander WTF, with shorthead sculpin (*Cottus confusus*) being the most abundant species. Mullins (1999a) also noted the absence of juvenile trout at all locations, which may have been an indication of poor natural recruitment.

U.S. Geological Survey, 1996–97

The USGS conducted fish-community surveys at five locations (reaches 1, 3, 7, 8 and 9) during December 1996 and August 1997, as part of an ongoing water-quality and biological integrity study done in cooperation with IDEQ and the Lower Boise River Water Quality Plan (Mullins, 1999a). Representative reaches at each location were sampled with both boat and backpack electrofishing equipment. IBI for each reach using five metrics (percentages of sculpins, salmonids, pollution-tolerant species, invertivores, and individual anomalies) were summarized only for the data collected in 1996 (Mullins, 1999a). The 1997 data were of poor quality due to problems associated with high-flow sampling, and those data were not used in the assessment of biotic integrity. The IBI scores calculated for reaches 3, 7, and 9 in 1996 indicated a longitudinal decrease in biological integrity, with the lowest score from reach 9 near the mouth. At reach 9, the fish community consisted of a high percentage of pollution-tolerant species, a reduced number of salmonids and invertivores, and a relatively high occurrence of anomalies. Mullins (1999a) concluded that the lower Boise River was moderately impaired in the upper reaches, and that river water quality declined gradually downstream. He described a lack of well-developed pools, riffles, and fish cover, and he also noted extended low winter flow and high summer water temperatures in the lower reaches. Mullins (1999a) recommended monitoring the fish community and habitat in the lower Boise River on a 3- to 5-year cycle.

U.S. Geological Survey, 2001 and 2004

The USGS sampled the fish community at reach 3 in 2001 and 2004, as part of the Idaho Statewide Water Quality Network. Data from 2001 were summarized in MacCoy (2004), but the data collected in 2004 have not been previously published. The IBI score calculated for reach 3 in 2001 (68) was higher than the score calculated for the 1996 data (57), indicating a possible improvement to the fish community.

U.S. Geological Survey and City of Boise, 2003

In November 2003, the USGS, in cooperation with the City of Boise, conducted another follow-up study of the fish community upstream and downstream of the WTFs. This evaluation included reaches 1 through 5, and the sampling reaches were extended to 40 times the channel width (about 1 mi long) to capture the maximum fish diversity in each reach as described by Maret and Ott (2003). The 2003 data have not been previously published.

This concludes the verbatim use of language from MacCoy (2006).

IDFG 1986

A creel census during 1986 estimated that anglers fished some 50,984 hours and harvested 23,188 game fish in the Boise River reach from Barber Park to Glenwood Bridge. The survey covered March 1, 1986 through January 2, 1987. Anglers interviewed were weakly positive towards quality trout fishing regulations and strongly positive with the current program. IDFG recommendations included: initiating a habitat improvement program to increase adult rearing habitat; initiating a stream habitat improvement program on side channels to the Boise River to improve salmonid spawning; working with municipal governments to stabilize streambanks and provide riparian setbacks; continuing to explore the feasibility of establishing a trophy trout section for the Boise River near the City of Boise; and increasing the frequency of catchable trout and steelhead when available (Reid and Mabbott 1987).

IDFG 1988

In 1988, IDFG sampled the Boise River at nine locations between the Parkcenter business park and Star. The sampling was part of the USGS and City of Boise study of fisheries above and below wastewater treatment facilities. IDFG added additional sites to further characterize the fishery. IDFG found the fish populations in the vicinity of Boise were diverse in species composition and contained a larger number of naturally-produced trout than expected. Natural trout were most abundant in the upstream portion of the study area. There are some warning signs in the condition of the stream substrate, but the Boise River is presently growing some very impressive trout. If adequate quantity and quality of water can be maintained, future residents can enjoy the river and its highly-valued recreational opportunities for generations to come (Mabbott and Holubetz 1990a).

IDFG 1989

IDFG sampled the Boise River and portions of Loggers Creek in 1989 following the expansion of Loggers Creek and associated side channels to the Boise River that were part of the River Run and Spring Meadows developments in southeast Boise. Sampling occurred between Lucky Peak and Diversion dams and 200 yards downstream of Barber Dam. The agency recommended continued monitoring of fish descending from Lucky Peak into the Lower Boise River and monitoring of populations and effectiveness of new fishing regulations effects on wild trout in the Boise River. Along Loggers Creek, IDFG recommends introducing instream habitat targeted for juvenile and adult trout such as narrowing and deepening the channel in some sections, meetings with adjacent landowners to improve habitat, securing funding and volunteers, developing a fish habitat plan (Mabbott and Holubetz 1990b).

IDFG 1990

IDFG sampled Loggers Creek at nine locations during December 1990. Sampling found higher densities of trout in the older sections of Loggers Creek, but lower densities in the newly reconstructed reaches, a range of 0 to 40 fish per 100/m^2. IDFG recommended continued improvements to riparian vegetation along Loggers Creek and continued monitoring of fish populations (Grunder et al 1993).

IDFG 1994

IDFG conducted a year-long creel census surveying anglers from Barber Park to Glenwood Bridge. Estimated angler use was 77,881 hours of angling. Harvest of hatchery trout was estimated at 27% of the 35,215 planted (compared to 81% harvest estimate in the 1986 creel census), while total catch (harvest + released) was 68% of planted fish. Additionally, reported harvest of wild rainbow trout at 284 per river km greatly exceeded the estimated wild trout population of 46 fish per km. The creel survey found release rates upstream of Broadway Bridge of 75% of rainbow caught (Allen et al. 1995).

IDFG 1995

Fish sampling in March 1995 showed a rebound in wild trout populations across the sites sampled. For example, the Municipal Park site showed a tripling of population density over 1994 from 0.47 to 1.48 per 100/m^2. Some sites had not been previously assessed (Allen et al. 1998).

IDFG 1996

In December 1996, IDFG electrofished several sections from Barber Park to Capitol Boulevard Bridge by raft due to higher winter flows, which prevented the methodology (gang electrofishing probes) used in 1994 and 1995. Population estimates were not available, but size class and species distribution data were gathered (Allen et al. 1999).

IDFG 1997

A letter report was prepared by IDFG in response to a request from Idaho Department of Environmental Quality (IDEQ) for the development of the Total Maximum Daily Load (TMDL) report. IDFG stated cold water species (trout, whitefish) exist from Diversion Dam to the mouth, although presence is seasonal and not year-round in the two lower reaches. IDFG also stated that natural reproduction occurs in the Boise River based on presence of younger year classes, but that no documented redds have been observed in the mainstem Boise River and only a single brown trout redd in Loggers Creek in 1990. The letter also expounded on the causes of impairment to poor water quality and made recommendations to improve the situation (Trent 1997).

City of Boise 2001

An estimated 11.5% of Ada County residents fished the Boise River in the past year. This information came from a spring 2001 City of Boise telephone survey of Ada County residents to determine their satisfaction with the Boise River and Boise River Greenbelt and to gauge public perception of flood risk and flood prevention options. Clearwater Research completed 1,283 interviews, yielding a 95% confidence interval of approximately ±3% (for binomial proportions) when the entire sample is analyzed. Some 68% of those surveyed identified themselves as Greenbelt or Boise River users (or both). The population of Ada County residents 18 years of age or older in 2000 was approximately 219,000 which would translate to 25,167 anglers on the Boise River (Willmorth 2001).

IDFG 2003

An estimated 53,447 total fishing trips occurred on the Boise River in Ada County in 2003 based on an IDFG statewide survey to estimate the economic value of recreational fishing in Idaho. Data for this

survey were collected using a self-report mail survey of Idaho anglers that had purchased a valid fishing license during calendar year 2003. There were almost 26,000 completed responses to the survey of 48,000 mailings. The IDFG estimated that 424,375 anglers spent more than 3.9 million days (2.9 million trips) on Idaho waters, so the 53,447 trips on the Boise River represents slightly less than 2% of all fishing trips in the state (Grunder et al. 2008).

IDFG 2004

Three sections of the Boise River between Barber Park and the West Parkcenter Bridge were electrofished in fall 2004 to compare species composition, abundance and size structure. The reaches included one section where quality fishing regulations have been in place since 1996, sandwiched between study reaches immediately upstream and downstream. The study began to compare the fish numbers between the reach with special regulations with the two areas outside (nine years after the rules were in place, and with no "pre-treatment" data available for comparison). The reaches outside the special regulation section showed higher densities of rainbow trout than the special regulation section, but the reverse was found for brown trout where the special regulations section showed higher numbers. Brown trout spawning redds were also documented and located with GPS recordings. Two brown trout redds downstream of the Boise City Canal (Goodwin) diversion were observed; the addition of spawning gravel in this side channel to the Boise River could result in increased spawning (Flatter et al. 2011).

Rainbow trout in the Boise River. Photo: Gary O. Grimm - Mountain Visions

Trout Unlimited 2006

The Ted Trueblood Chapter of Trout Unlimited in July 2005 led a project to add spawning gravels to two side channels to the Boise River, one at the Warm Springs Golf Course (Boise City Canal or Goodwin Diversion) on the north side of the River and in three locations along the Island side channel on the south side of the River. Trout Unlimited intern David Cleverley visited both side channels during the fall of 2005 to observe and document any spawning activity in the channels. Cleverley observed three redds in the Island side channel and more than one dozen redds in the Warm Springs Golf Course side channel in the fall of 2005 (Cleverley 2006).

IDFG 2007

Sampling prior to 2004 captured few wild trout. Anecdotal information indicated that the wild trout populations had increased over the past 20 years (IDFG 2007a). Electrofishing efforts in 2007 repeated the same methodology and locations from 2004 and captured 581 wild and 39 hatchery rainbow trout, 111 wild brown trout, and 2,986 mountain whitefish. Brown trout numbers had declined from 2004; rainbow trout numbers were higher. There were changes in the size distribution for both trout species. Equipment problems prevented population estimates for the areas upstream (Bubb Canal diversion to Loggers Creek diversion) and downstream (Parkcenter footbridge at Baybrook Court to Municipal Park) of the special regulations section (Boise City Canal diversion to River Quarry building parking lot). Thus,

the only population estimate available for comparison to the 2004 electrofishing effort was for the special regulations section, showing a population estimated at 1,253/km (Hebdon et al. 2009) compared to 735/km in 2004 (Flatter et al. 2011).

Idaho Fish and Game published an assessment of fisheries losses attributable to the Federal Columbia River Power System for the reach of the Lower Boise River from Lucky Peak Dam to Diversion Dam (Diversion Dam being the only FCRPS project in the Lower Boise River), stating that the 21-meter high dam completed in 1912, along with Barber Dam, were the first fish barriers to salmon and steelhead migration on the Boise River. The 4.6 kilometer inundation of the Lower Boise River caused a loss of habitat for an estimated 5,168 redband trout, 699 brown trout and 8,892 mountain whitefish for a total of 14,759 salmonids lost on an annual basis, or a total of about 1.48 million salmonids through 2007 (IDFG 2007b).

IDFG 2008

A creel census during 2007-2008 estimated that anglers fished over 33,000 hours in the section of river from Barber Dam to Americana Boulevard Bridge during a one-year period. Angler effort was highest during November when the river is stocked with steelhead (Kozfkay et al. 2010). Rainbow catch rate was highest for non-fly and fly anglers during October and September, respectively. Total rainbow harvest was highest in July and September. Rainbow trout release rates were 79%. Combining population and creel survey results, roughly 5% of the wild rainbow trout population was harvested on an annual basis in this section. Harvest of wild brown trout and mountain whitefish was negligible (Kozfkay et al. 2010).

IDFG 2010

Mountain whitefish were the most abundant (2,174) sport fish captured at four electrofishing sites along a cumulative total 3.8-km of four reaches of the Boise River (Kozfkay et al. 2011). The "lower section" from the Baybrook Court footbridge to Municipal Park was dropped from the survey and sections were added from the riffle upstream of the Americana Boulevard Bridge to the riffle downstream of the Fairview Avenue Bridge, and a section in the north channel downstream of the Western Idaho Fairgrounds footbridge to the first riffle upstream of the Glenwood Bridge. Wild rainbow trout (567) far outnumbered hatchery rainbow trout (65); the same was true for brown trout (73 wild – 5 hatchery). Wild rainbow trout were at their highest abundance since routine population monitoring began in 2004. Survey results indicate an increase from 3.3 to 8.3 fish/100m^2 from 2007 to 2010 in the "middle section" that is part of the Boise River managed with quality trout regulations and a 17-fold increase since 1994.[1] The estimated 3,210 rainbow trout in the middle section was an increase compared to the 2004 estimate of 807, while in the upper section the number in 2010 was 544, a drop

[1] The 17-fold increase was determined by using the 1994 survey data for the "lower section" near Municipal Park and dividing the 0.47 wild trout /100m^2 into the 8.3 trout /100m^2 for the "middle section" that was not surveyed in 1994.

from 1,340 in 2004. Wild rainbow trout dominate the reach even though hatchery rainbow trout are stocked on a monthly basis near Barber Park a mile or so upstream.

Trout Unlimited 2010

The 2009 Heron Creek project included stream bank and riparian restoration, sediment removal from the stream bottom, and placement of nine cubic yards of spawning-sized gravels. Monitoring and observation in spring 2010 found wild rainbow trout and steelhead using Heron Creek (TU 2010).

Braun and Walser 2011

A 2009 study comparing current and historical largemouth bass distribution within the Lower Boise River found that largemouth bass have successfully established within the river (Braun and Walser 2011). Originally introduced in 1887, largemouth bass have recently expanded their range upstream to the Settler's Diversion Dam, which appears to be a barrier to upstream movement. The size distribution of 2009 fish indicates that they are likely reproducing within the river system. Given the established negative interactions with native fish species, including predation and competition, understanding largemouth bass ecology within the Boise system would benefit fisheries management of the resource. (*Reviewers have expressed skepticism that this is a large concern in the Lower Boise River, as the upper river is too cold for largemouth bass, and maintain that the largemouth bass population is mainly confined to the lower sections)*

IDFG 2013 – unpublished

Sampling in the middle section of the Boise River (special regulations) in 2013 indicated that wild rainbow trout numbers had declined slightly compared to the 2010 survey. However, numbers were still higher than 1994, when minimum flows were implemented. There were an estimated 2,426 rainbow trout in the middle section, a24% decrease compared to the 2010 estimate of 3,210, but still 300% higher than the 2004 estimate of 807. The 2013 estimate in the upper section was 5,534, a 1,017% increase from the 2010 estimate of 544, and a 413% increase over the estimate of 1,340 in 2004.[2]

[2] A YouTube video of the electrofishing in the upper section shows the crew strayed slightly into the special regulation waters that begin at the Loggers Creek intake.

Fishing in the Boise River near Barber Park. Photo: Gary O. Grimm - Mountain Visions

The following bullet points are based on a review of the literature in the BREN database. They identify the overall LBR fisheries and aquatic habitat issues, solutions and conclusions.

Overall Conclusions from Review of Existing Literature

Fishery

- Upper Reaches:
  - Consists of a cold water fish community of higher biotic integrity compared to the lower reaches using the Idaho River Fish Index of 2003, which is being revised (MacCoy 2006).
  - Dominated by piscivores and invertivores (MacCoy 2006).
  - Wild rainbow trout and brown trout populations have increased in the upper reaches over the past 20 years, including a 17-fold increase from 1994 to 2010. Wild trout predominate even though monthly stocking of hatchery trout has occurred over this period. Rainbow trout populations have increased in proportion to brown trout in recent years (Butts 2010). Mountain whitefish populations far exceed those of wild brown or rainbow trout.
  - A recent survey (IDFG 2013, unpublished data) indicated that wild trout populations have decreased slightly from 2010 to 2013 (in one reach of the river) after a dramatic increase following implementation of minimum flow of about 240 cfs.
- Downstream Reaches:
  - Largemouth bass occur in the Lower Boise River below Settler's Diversion Dam (Braun and Walser 2011) as well as catfish, smallmouth bass perch and other cool-warm water fish
  - Consists of a warm water fish community of lower biotic integrity compared to upper reaches using the Idaho River Fish Index of 2003, which is being revised (MacCoy 2006).
  - Dominated by herbivores and omnivores (MacCoy 2006).

Fisheries Habitat

- When discharges from Lucky Peak are at spring peak flow magnitudes (e.g. >4,430 cfs), most of the upper reaches are run habitat, with the exception of the North Channel and the lower end of Eagle Island to Star, where pool habitat dominates. This situation persists through much of the summer (Asbridge and Bjornn 1988). High velocities in the main channel are not optimal for salmonids during the irrigation season. This information may have changed due to recent development, and many researchers agree that a full habitat assessment should be performed.
- When discharges from Luck Peak and Glenwood are 180 cfs and 242 cfs, respectively – typical flows in fall, winter, and early spring – pools dominate all sections of the river (Asbridge and Bjornn 1988).
- The Boise River substrate between Lucky Peak and the Snake River is cobble dominated with embeddedness varying, but up to 74% (Asbridge and Bjornn 1988).
- In November 1997 and January 1998 pool riffle/run sequences were fairly well balanced near Eckert Road, but dominated by run and riffle below Middleton (Mullins 1999a).
- Cover (refuge from predators and high velocities where fish can rest) is low, with 70% of the surface area providing no cover (Asbridge and Bjornn 1988). Winter cover is especially scarce and important to juvenile wild trout. Vegetative cover ranges between 4-10% in winter months (Mullins 1999a).
- A qualitative habitat assessment in winter 1997-1998 found the best conditions near Eckert Road (sub-optimal), decreasing in a downstream direction (Mullins 1999a).
- Snorkeling surveys in the 1980's observed rainbow trout predominantly utilizing habitat near the banks and near woody debris, while brown trout were almost exclusively found near woody debris or rocks (Asbridge and Bjornn 1988) – highlighting the need for in stream habitat elements.

Issues Identified in Literature Review

Non-native Species

- Largemouth bass present a threat to native and other game fish where present (below Settler's Diversion Dam) (Braun and Walser 2011). (*However, reviewers noted that other more abundant and concerning non-native game fish exist [e.g. smallmouth bass and channel catfish] and cold water environments upstream may be a barrier to largemouth bass expansion.)*
- In the Upper Boise (above the major reservoirs and out of the study area for this report) patterns of hybridization of nonnative cutthroat trout (*Oncorhynchus clarkia*) and hatchery rainbow trout with native redband trout indicate that several populations of native fish have been replaced by hatchery coastal rainbow trout (Neville and Dunham 2011). Analysis of the genetics of the Lower Boise River fish populations may reveal the potential risks and advantages to isolation versus connectivity of certain reaches.

- Oriental weatherfish (*Misgurnus anguillicaudatus*) was first observed near Eagle in 1951 (Courtenay at al. 1987) and continues to populate the lower Boise River and the connected canal and drain system. The omnivorous oriental weatherfish have proven to be successful invaders who compete with native and sportfish, decrease the invertebrate populations, and may prey on salmonid eggs. The oriental weatherfish can tolerate low temperatures and being embedded in ice (Urquhart and Koetsier 2014a). More studies are warranted to examine its potential impacts on the fauna of the lower Boise River (Urquhart and Koetsier 2014b).

Fish Habitat

- Substrate embeddedness (50-75%) and lack of spawning sized gravels (McCoy 2006) reduces spawning habitat and reproduction. Embeddedness also reduces the winter habitat value for salmonids (Asbridge and Bjornn 1988). Substrate embeddedness has been characterized as moderate to extreme, and highest near Middleton (Mullins 1999a).
- Channel confinement: narrowing of active channel by half from historical accounts (MacCoy 2006)
- Lack of pool habitat in winter below Middleton (Mullins 1999a).
- Loss of in-channel landforms (MacCoy 2006).
- Cottonwood habitat currently limited to narrow band along river (MacCoy 2006).
- Loss of willow component (rare or non-existent along the river) (MacCoy 2006). Although it does exist and efforts are underway to increase the willow component of the riparian system.
- Summer water velocities and temperatures are too high in the lower reaches to create ideal trout habitat (Asbridge and Bjornn 1988).
- The main channel lacks roughness elements (rock, large wood, etc.) that provide habitat diversity, cover, and velocity breaks for salmonids (Asbridge and Bjornn 1988).
- A lack of undercut banks, which provide habitat and cover for salmonids (Asbridge and Bjornn 1988) and other fishes. The system may or may not have historically had undercut banks.
- Winter habitat is mainly pool [including run and glide] habitat and is pulled away from the banks where almost all of the cover exists (Asbridge and Bjornn 1988).
- Gravel and other sediments are no longer recruited from upstream or upslope sources due to development and dams (Asbridge and Bjornn 1988).
- There is a lack of access to off channel rearing sites, due to a regulated flow regime (no floods allowed) coupled with encroachment on the historic floodplain by development (IDEQ 1999a).
- In-channel habitat is adversely affected by annual channel maintenance through a population center. This involves removal of large woody debris which presents a hazard to recreationists and threatens a predictable channel. Though beneficial to other uses, these actions reduce the quality of salmonid habitat (IDEQ 1999b).
- There are no water quality standards for habitat or flow, nor are there suitable for estimation of load capacity or load allocations. Because of these practical limitations, TMDLs will not be

developed to address habitat modification or flow alteration. In the Boise River, actions taken to address suspended sediment will improve habitat conditions. In addition, IDEQ anticipates that other causes of impairment will be addressed in the implementation plan developed for 2003 TMDL (IDEQ 2003).

Hydrology

- Reduced peak stream flows (lack of geomorphically effective flows, e.g. where substrates are mobilized) contribute to lack of spawning habitat and river health (MacCoy 2006). *(Reviewers noted that the effect of higher flows on fish and habitat within the current channel form would need to be well investigated based on the magnitude of flows required to move sediment and high in-channel velocities with the current channel form.)*
- Low winter flows are a detriment to the fishery and likely reduce Index of Biotic Integrity (IBI) scores (MacCoy 2006).
- Summer flows do not limit the fishery in the Boise (Leitzinger 2000), but summer flows generally create velocities that are not ideal for trout in the summer months (Asbridge and Bjornn 1988).

Water Quality

- IBI scores for the Boise River have been negatively correlated with water temperature, specific conductance, and suspended sediment (MacCoy 2006).
- Temperature is the primary water quality issue for fish and is strongly negatively correlated with IBI (MacCoy 2006). Instream temperatures exceeded the State of Idaho Standard for cold water biota 34% of the time near Middleton, 48% of the time near Caldwell, and 80% of the time near Parma over a 50-day period in 1996 (Mullins 1998a).
- Nitrogen, phosphorous, and suspended sediment are secondary WQ concerns (MacCoy 2006).
- WQ issues are due to agriculture, wastewater treatment plants, and urban development (MacCoy 2006).
- Wastewater treatment plant effluent contributes to declines in sculpin (sentinel species) populations (MacCoy 2006, Mullins 1998b). IBI scores for macroinvertebrates and fish were generally higher upstream of wastewater treatment facilities (USGS 1998). Two sculpin species were abundant upstream of wastewater treatment facilities while none were found downstream in 1995 and only 2% were found downstream in 1996.

Land Use

- Developed land area, impervious surface area, and the number of major diversions have negative correlations with IBI scores (MacCoy 2006).

Angler Harvest

- Older studies assert that angler harvest may significantly impact the fishery, as fish density has been correlated with low angler access (Asbridge and Bjornn 1988, Holubetz 1988).
- A more recent study in 2007 and 2008 indicates angler harvest of wild trout is minor. Release rates were high; of the 24,074 fish caught, 4,927 were harvested (only 684 of which were wild rainbows). Comparing population surveys and creel surveys about 5% of wild rainbows in the study area were harvested on an annual basis. In contrast, harvest of hatchery rainbow trout often ranges from 40-60%, due to hatchery bred behavior and stocking locations (IDFG, personal communication). These numbers are based on a limited portion of the river where population estimates were available.

Data Gaps

- Lower reaches lack data – more data is available in upper reaches - especially fisheries data (MacCoy 2006).
- The Lower Boise River lacks a recent aquatic habitats study (Leitzinger 2000) although a habitat study was performed in the late 1980's by Asbridge and Bjorn (1988).
- Assessments of benthic invertebrate species have not been performed (MacCoy 2006).
- Assessments of fish health have not been performed (MacCoy 2006).
- Continued monitoring of fish populations is needed (Kozfkay et al. 2011). Evaluate age, growth and mortality of brown and rainbow trout (Kozfkay et al. 2010).
- Identification of important rearing areas for wild trout in the urban reach by shoreline electrofishing is needed to establish trend sites for age-0 trout (Kozfkay et al. 2011).
- Trout spawning areas have not yet been identified or systematically surveyed and only recorded from anecdotal information (Trent 1997) or as a byproduct during electrofishing (Flatter et al. 2011), except for project monitoring (Cleverley 2006; Trout Unlimited 2010).

Solutions Identified in Literature Review

IDFG Flow Recommendations

- Earlier flow recommendations were made in the 1970's. But the 2000 recommendation supersedes these recommendations. The 1975 IDFG flow recommendations were 240 cfs for the Boise River from the Diversion Dam to Notus and 380 cfs below Notus. The need for larger flows below Star is due to higher temperatures and nutrient loads that require more dilution (White and Cochnauer 1975). A later recommendation (Pruitt and Nadeau 1978), based on field data collection, called for 150 cfs minimum flows December through March and 225 cfs for other months outside the irrigation season. The IDFG recommendations to the Idaho Water Resource Board in the early 1990s were a hybrid of the two reports (Leitzinger 2000).

- IDFG recommends post irrigation season flows greater than 600cfs (Leitzinger 2000). Flows of 1,100 -1,200 cfs are the preferred target and represent the historic minimum flows during the non-irrigation season in the Boise River in the general area of Lucky Peak Dam. Although considerable debate as to the historic flows exists.
- Relax flood control rule curves and utilize existing stream channel maintenance flow water (BOR and IDFG storage) to achieve higher winter flows (Leitzinger 2000).
- Shift salmon flow releases to the post irrigation season by requiring Idaho Power to store the following spring salmon flow release in Brownlee Reservoir (Leitzinger 2000). This would provide higher winter flows in the LBR.

Habitat Restoration Recommendations

Recommendations from the **Asbridge and Bjornn (1988)** study include:

- Implement a habitat improvement program in the Boise River to increase channel width, sinuosity, complexity, and the amount of summer and winter rearing habitat.
- Concentrate spawning habitat improvements in Loggers Creek and side channels of the LBR. (*However, reviewers have expressed skepticism as to the spawning habitat quality of low-gradient engineered channels such as Loggers Creek, since these channels don't receive gravel cleaning/rejuvenating flows*).
- Protect and enhance existing riparian vegetation and improve areas with little or no riparian vegetation.

The ***Boise River Resources Management & Master Plan*** **(City of Boise 2014)** recommends:

- Commission an ecological assessment of terrestrial and aquatic habitat, concentrating on the riparian zone and river setback. Develop a riparian management plan when the updated ecological study is complete, include best management practices.
- Work with irrigation interests to prevent fish from entering irrigation canals and ensure that new structures do not block fish migration.
- Provide fish stocking access sites on the river and ponds for Idaho Department of Fish and Game.
- Work with irrigators, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and others to achieve a more natural river flow pattern and ramping rates to enhance riparian plant regeneration and riverbank stability and aquatic habitat.
- Develop criteria for debris and snag removal with interested agencies and irrigation entities; agencies meet and review before implementing.
- Support existing winter and spring river flows and work with other city departments to investigate obtaining water rights to meet aesthetic, ecological, recreational goals.

The previous ***Boise River Resources Management & Master Plan*** **(City of Boise 1999)** recommends:

- Boise Parks and Recreation Department should take opportunities as they arise to work with other organizations to improve fish habitat in the City.
- Participate with the Idaho Department of Fish and Game and conservation organizations in habitat improvement projects to mitigate for removal of debris and snags, i.e., connecting and rehabilitating side channels; constructing fish habitat as the opportunities arise.
- Establish a working relationship with the U.S. Bureau of Reclamation and U.S. Army Corps of Engineers to influence flow regimes for fish and wildlife when possible and support minimum winter flows for fish and wildlife.
- Investigate the City taking a leadership role in managing the setback agreements with homeowners along Logger's Creek in River Run and Wood Duck Island.

The US Army Corps of Engineers in ***Boise Parks and Recreation Department Stewardship Plan for the Riparian Corridor from Barber Park to Glenwood Bridge*** **(USACE 2002)** included several recommendations for "Riverine Habitat Development" as part of its larger document on the riparian corridor:

- It is recommended that Boise Parks and Recreation Department, in cooperation with Idaho Fish and Game and Trout Unlimited, develop a maintenance program to renew spawning gravels such as in Loggers Creek which provides rearing and spawning habitat for salmonids. Off-channel waters provide various habitat functions, which change over time. Once the channel matures and has a viable food chain, it may become spawning habitat if water quality is adequate. When salmonids spawn, they physically displace gravel as they form their spawning beds. Over time, the gravel is moved downstream out of the spawning site. Some gravel is moved to the sides of the channel, and is no longer available for spawning.;
- Boise Parks and Recreation Department and Idaho Department of Fish and Game should undertake in-stream structure improvements to further promote a wild and sustainable fishery;
- Boulder placement in the slower sections would provide enhancement. This is especially true in sections downstream of B. Quinn Riverside Park, and adjacent to Ann Morrison Park is a channelized section that could use extensive boulder placement.
- The area within the 2 fish over 14 inches section, could be upgraded considerably with both boulder and barb placement. Barbs are required to protect the bank where it directly impacts Warm Springs Golf Course.

The Implementation Plan for the Lower Boise River Total Maximum Daily Load (IDEQ 2003) recommends:

- The fundamental goal of the TMDL is to ensure that appropriate beneficial uses in the lower Boise River are being met. In addition to efforts to improve water quality that are outlined in this plan, the Boise River Resource Management and Master Plan (adopted by Boise City in 1999) was developed to protect and enhance public safety, health, and resource preservation associated with the recreational use of the river and its riparian area. The plan includes priority

projects to improve the lower Boise River environment.

- As one tool in an adaptive management process, habitat improvement projects that help restore beneficial uses are supported by the LBRWQP. Appropriate partnerships should be formed to support and complete projects that improve habitat in the mainstem. The Boise River Resource Management and Master Plan identified many such projects that aim to protect and improve riparian and river habitat for the watershed's fisheries and wildlife, as well as enhance water quality. A copy of the plan can be obtained from the Boise City Parks and Recreation Department, Planning and Design Group. Other habitat improvement projects located outside of Boise City are also encouraged to the extent that they help restore beneficial uses within the lower Boise River.

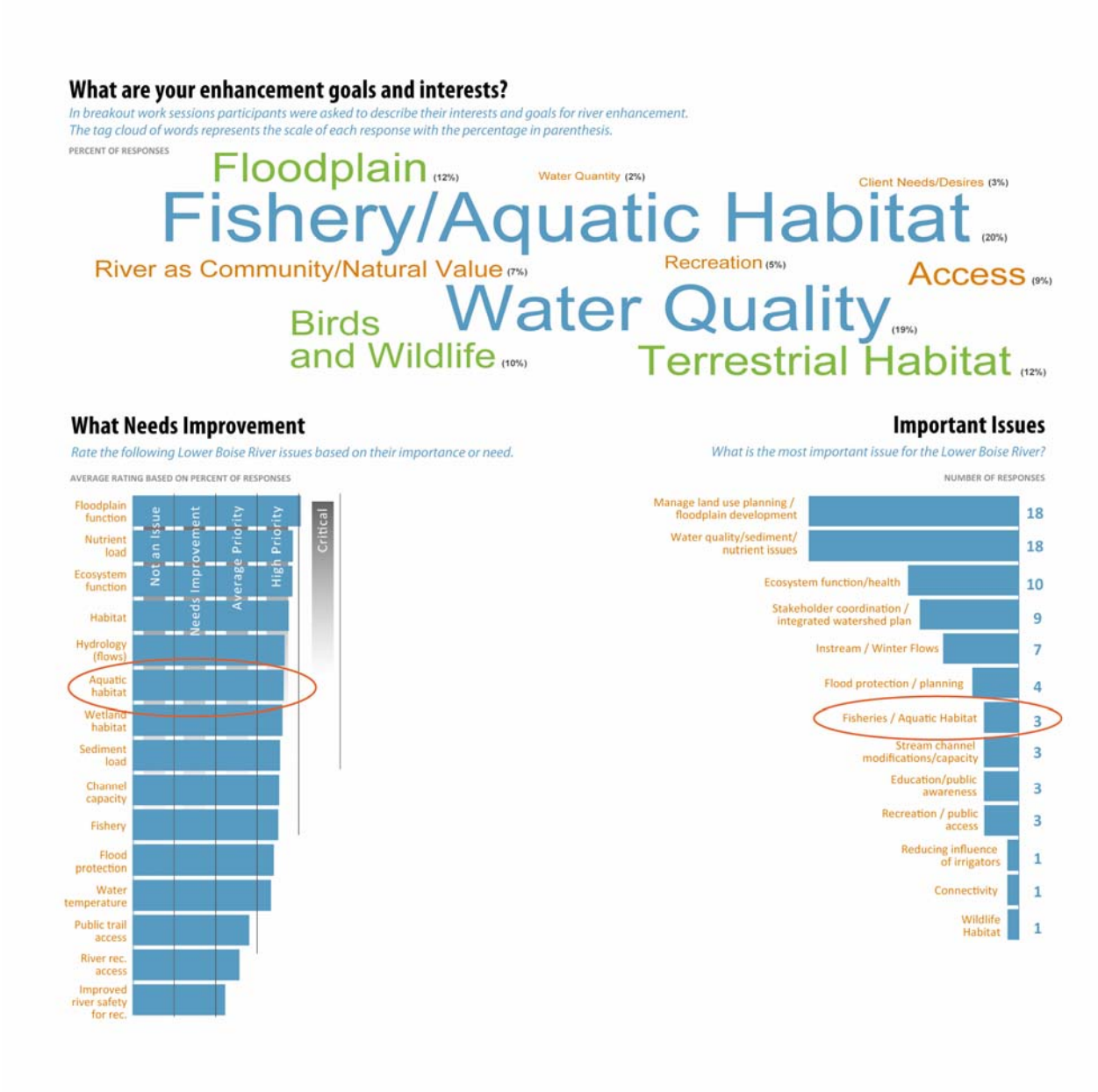
Weast (2004) performed a review of 11 documents (many of the same documents cited above) for the Ted Trueblood chapter of TU. The most common recommendations to improve the Boise river fishery were:

- Re-vegetation of stream banks and the riparian area
- Limiting public access
- Increase side channels
- Improve spawning habitat
- Educational programs
- Take erosion and sedimentation measures to increase water quality
- Non-point source trading
- No mow zones for filtering
- Integrated pest management
- Replacement of sewer lines
- Parking lot cleaning
- Implement BMPs
- Develop the Lower Boise Effluent Trading Demonstration Project (Ross and Associates 2000)
- Buffer strips, filter strip
- Grazing management
- Stream flow changes
- Install barbs, U-structures, and large boulder placement (USACE 2002).

Part II: Network Feedback

2011 Boise River from Vision to Reality Workshop

During and following the October 2013 workshop participants provided feedback though working groups and an online survey. The graphics presented below represent the synthesis of this feedback as it pertains to the Boise River Fisheries and Aquatic Habitat.



April 16, 2014 Fisheries and Aquatic Habitat Meeting

At this meeting at which participants were provided handouts detailing the overall conclusions, issues and solutions from a preliminary literature review, thirty four participants provided written comments and feedback. Although not all participants in the meeting provided written feedback, they all participated in the discussion which consisted of small groups discussions on issues and solutions. Their written feedback is summarized in the table below.

ISSUES	SOLUTIONS
Flow Management • Low winter flows and low peak flows; higher than ideal summer flows. • Too rapid drawdown • No disturbance regime • Negatively impacts water quality o Leads to sediment/embeddedness • Reduced cottonwood recruitment • Bank sloughing leading to riprap, lower channel capacity, increased flood risk • Not enough water for all wanted uses	• Look at extending the drawdown period when reducing to irrigation flows down from high flow releases • Balanced stream flows to help cottonwoods • Increased winter flow • Increased peak flow (especially in wet years) • City of Boise(or other) to acquire water rights • Idaho Power could possibly lease upstream water rights and time flows to increase winter flows • Timing of spring releases important so as not to sweep out redds (apply rule curves) • Use empty lots and parks as floodplain • Find solutions to flow management working within existing restraints – incremental improvements possible with rule curve tweaks • BOR needs to monitor flows more closely
Water Quality • Nutrient and sediment loading • High temperatures, especially downstream • Stormwater returns from urban areas • Irrigation returns from agriculture • Impact on sculpin	• Work with cities and agriculture to improve WQ • New strategies to minimize inflow of sediment and contaminants • Wetland creation and restoration projects • Sedimentation ponds at drains/canal returns • Funding to implement agriculture BMPs • Ada County NPDES program – leverage what is being done • Improve water quality of tributary streams • Trade pollution rights with clean projects
Agriculture Development • Filling of wetlands, loss of riparian and floodplain habitat and channel confinement • Irrigation returns from agriculture • Agricultural runoff • Fish entrainment in canals	• Create wetlands and sediment basins to improve water quality from agricultural runoff (and drains/canal returns) • Implement and fund BMP already identified + identify new opportunities • Reduce flood irrigation practices and convert to sprinkler • Screens on Irrigation Canals • Conversion of agriculture to urban is both and issue and opportunity for enhancement • Outreach to landowners to encourage more riparian areas near river/streams
ISSUES	SOLUTIONS

Urbanization/Residential Development • Loss of riparian habitat • Loss of floodplain and side channel habitat • Increased demand for flood management • Increased demand for bank stabilization • Landowner access • Stormwater returns and waste water treatment plan returns • North side of river is "worse" than the south side, due to development and access	• New HWY 16 road will increase development on the south side of the river. Opportunity to put in place zoning restrictions. • Focus on preserving downstream river habitat has yet to be developed. Encourage downstream communities to adopt setbacks from floodplain • Reconnect floodplain where possible in upstream reaches • Planning and zoning for green space in strategic locations along river • Conversion of agriculture to urban is both and issue and opportunity for enhancement • Identify undeveloped areas for protection that could be used to create side channels/floodplain • Outreach to landowners to encourage more riparian areas near river/streams • Conservation easements
Riparian/Wetland Habitat • Lack of cottonwood and willow • Lack of tree canopy cover • Removal of vegetation along streambank to prevent erosion • Removal of wetlands	• Planting for habitat – willows, cottonwoods (opportunity for volunteer projects) • Educate public about value of having natural vegetation along the river, etc. • Work with flood control districts to maintain streamside vegetation • Wetland creation and restoration projects • Protect streamside vegetation/woody debris below Glenwood Bridge
Invasive Species • False Indigo –increases downstream • Carp, Brown trout, oriental weather fish, bluegill, crappie, etc.	• Paradigm shift from supporting non-native game fish to promoting native fishes. • Weed abatement programs.
Instream Habitat • Lack of structural habitat/cover • Low flows in the winter; higher than ideal flows in the summer; Low peak flows • Poor velocity/holding habitat • Removal/modification of gravel bars for flood control • Lack of pool habitat • Food base	• Leave logs in the river (in areas that do not conflict with floating recreation) • Place large boulders/rocks in river • Develop plan to improve structural integrity and accessibility of fish • Implement innovative habitat technologies • Create side channel habitat in conjunction with instream structure and cover – although further information should be gathered when reconnecting side channels, as they may introduce WQ concerns • Mobilize bed armor, dig holes? • Create undercut banks • Improve habitat in tributary streams too • Daylight Cottonwood Creek
Lack of Monitoring	• Establish long-term monitoring stations • Monitoring at USGS long-term monitoring stations

	• Data collection by students/community volunteers – such as pebble counts, WQ monitoring, fish surveys, etc.
ISSUES	**SOLUTIONS**
Fishery Management • Fishing policy needs to be updated • Fish stocking effect on wild species	• Revision of angler harvest • Enforce fish limits (esp. Warm Spring to Broadway) • Size & bag limits to reduce whitefish population and increase trout population • Revision of stocking policy (steelhead) • Strong river management policy that has teeth
Lack of Funding	• Look into federal programs o Sentinel Species program (private lands near military installations Gowen Field?) • Get in on FERC relicensing (such as Idaho Power) to dedicate mitigation funds to projects benefiting the fishery. • Promote funding to add more people to work on river projects • Reallocate fish stocking funds to spawning habitat
Political • Multiple agencies/groups managing river - makes permitting and project implementation difficult • Idaho Congress • Idaho Power	• Get agencies together to streamline permitting process (parts of Washington have done this) • Most of the issues are biological and ecological, most of the solutions are political
Climate Change/Water Quantity • Not enough water for all wanted uses	• Cloud seeding
Balancing multiple interests & needs • Habitat vs. hazard mitigation vs. agriculture irrigation vs. recreation	• Focus on multiple-benefit projects, such as whitewater park for recreation and habitat improvement • Find win-win scenarios between stakeholders • Build on past successful projects/initiatives
Data gaps in research • Few studies on native non-game species biology • Need more bird/wildlife surveys • Critical habitat needs to be identified • Location and quality of spawning and breeding habitat • Few physical studies • Hydraulic study needed • Don't know optimal winter flows • IFIM (a study that integrates flows and fish habitat) needs to be performed.	• Funding for research and monitoring • Survey spawning locations - place spatially • Use volunteer or student group projects • Use sculpin and other indicator species to measure habitat quality • Continue creel surveys • Study fish entrainment • Study the water bank system rigged against instream flow • Hire full time biologists to evaluate the state of the river • Economic benefit analysis of river to help set priorities • Long term planning • Large telemetry study on salmonids to identify movement • Determine whether canal entrainment is a limiting factor for sport or native fish populations. • Identify fish migration blockages in the lower Boise River and determine population impacts • Focus more on native species data collection

• Lack of data on native and non-game species (distribution, population size, life history) • Study of fish entrainment in canals	
ISSUES	**SOLUTIONS**
Lack of coordination of research and who is doing what	• Central clearing house for all LBR data • Utilize USGS websites to house volunteer monitoring data (http://id.water.usgs.gov/studies/Southwest/LowerBoiseRiver-WaterQuality-Biology/) • Spatial Priority Assessment o help structure solutions and recs o specify where each strategy (or suite of strategies) are best implemented o allow for prioritization o match areas of river that are suitable to suite of habitat improvement solutions
Stakeholder Involvement • Lack of representation from lower reach communities • Lack of representation from irrigators and agriculture	• Bring irrigators into virtually all discussions • Implement outreach effort to Canyon County • Involve sportsmen in management of river • Understand stakeholder goals • Increased fisherman access to river • Invite someone from NRCS and someone familiar with NPDES permitting • Get IDFG as regular participant in IDWR, IWRB water availability meetings. • Field Trips to Harris Ranch/TU project; Julia Davis side channel • Build relationship with historic Boise River tribes • Community education events

Part III: BREN Prioritized Actions and Strategies

Based on the literature, reports, public and expert input, the following Key Issues and Enhancement Solutions were identified.

Key Issues:

1. **Channel confinement and simplification**:
    a. The LBR lacks instream cover (especially outside the irrigation season), habitat complexity, a well-defined thalweg (deepest part of the channel) and refuge from high velocities.
    b. Riparian vegetation along stream banks needs enhancement, and is displaced from the wetted area outside the irrigation season.
    c. Urban and rural development continues to reduce the function and value of the aquatic habitats by modifying the floodplain.
2. **Flow regime**: The LBR experiences insufficient high flows to mobilize sediments, rapid drawdown rates, and insufficient non-irrigation season flows which stress the fishery.
3. **Irrigation infrastructure:** Instream structures block fish passage and canals entrain fish.
4. **Water quality**: Increased temperatures and sediment loads decrease fisheries habitat quality.
5. **Substrate:** The LBR lacks abundant spawning substrates and bed mobility due to embeddedness, armoring, and sediment mobility.

Enhancement Solutions:

1. **Protect existing functional, unconfined areas where the floodplain is connected to the stream channel.** Identify remaining segments of less confined channel and floodplain; act to maintain through purchase or easement.
2. **Increase channel complexity through active interventions:** provide complexity and cover where possible with instream habitat enhancements and removing confining elements (e.g. levees). Re-establish and create side channel habitat. Deeper, narrower channels will also help with water quality (e.g. temperature).
3. **Modify elements of the flow regime.** Work with water managers to produce a more normalized flow regime including less rapid high flow drawdown and higher winter flows if and when possible.
4. **Evaluate and upgrade irrigation infrastructure.** Determine which irrigation structures are the largest barriers to fish passage and which canals entrain the most fish. Upgrade these structures to pass fish and reduce entrainment.
5. **Intercept stormwater and irrigation return water before it reaches the river.** Increase water quality by removing fine sediments and other pollutants before they reach the LBR.
6. **Gravel augmentation:** Artificial gravel recruitment in conjunction with channel and flow regime modifications will provide more suitable spawning habitat.

Fisheries and Aquatic Habitat References

This section will be updated periodically. Below is a list of all the references currently known that are specific to fisheries and aquatic habitat within the Lower Boise River watershed. The following table is an image of a select portion of the BREN database showing all sources that include a discussion on fisheries, though fisheries may not be the primary focus of the citation.

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Allen, D., Yundt., S. and B. J.Flatter (IDFG)	1999	Regional Fisheries Management Investigations Southwest Region	Southwest Idaho
Asbridge, G. and T.C. Bjorne	1988	Survey of Potential and Available Salmonid Habitat in the Boise River	Boise River from Lucky Peak Dam to Snake River
Bonnevile Power Administration	2003	Lower Boise River Wetlands Restoration Project - Description	Boise River from Lucky Peak to Snake River
CH2M Hill	2007	Lower Boise Tributaries Use Attainability Analysis	Fivemile, Blacks, Tenmile and Fifteenmile Creeks
Ecovista	2004	Boise, Payette, and Weiser Subbasins Management Plan	Boise, Payette and Weiser Subbasins
Findorff, D.D. and D.R. Reichmuth	1991	Conceptual Design Report: Boise River Management Plan, Phase II	Boise River, Ada County
Flatter, B.J., Hebdon, L. and J. Dillon	2004	Rivers and Streams Investigations: Lower Boise River Electrofishing	Boise River between Barber Park and Parkcenter Bridge
Frenzel, S.A.	1988	Physical, Chemical and Biological Characteristics of the Boise River fron	Boise River from Veterans Memorial Parkway to Star
Gibson, H.R. (IDFG)	1975	Survey of Fish Populations and Water Quality in the Boise River from its	Boise River from Barber Dam to Snake River
Grunder, S., Parrish, D. and T. Holubetz (IDFG)	1993	Regional Fisheries Management Investigations, Loggers Creek, Middle F	Loaners Crek, Middle Fork Boise, Middle Fork Payette, South Fork Boise
Hebdon, L., Kozfkay, J. and J. Dillon (IDFG)	2009	2007 Southwest Region (Nampa) Fishery Management Report	Southwest Idaho - Nampa
Horton, W.D. and T. Cochnauer	1980	Instream Flow Methodology Evaluation, Biological Criteria Determinatio	Boise River and tributaries
Idaho Department of Environmental Quality	2001	Indian Creek Subbasin Assessment, Draft	Indian Creek
Idaho Department of Environmental Quality	2001	Blacks Creek Subbasin Assessment	Blacks Creek
Idaho Department of Environmental Quality	2001	Fivemile and Tenmile Creek Subbasin Assessment	Fivemile and Tenmile Creeks
Idaho Department of Environmental Quality	2003	Implementation Plan for the Lower Boise River Total Maximum Daily Loa	Lower Boise watershed
Idaho Department of Environmental Quality	2010	Lake Lowell TMDL: Addendum to the Lower Boise River Subbasin Assess	Lake Lowell
Idaho Department of Environmental Quality	2001	Lower Boise River Nutrient & Tributary Subbasin Assessment	Lower Boise river tributaries
Idaho Department of Environmental Quality	2001	Lower Boise River Nutrient Subbasin Assessment	Lower Boise River
Idaho Department of Environmental Quality	1999	Lower Boise River TMDL: Subbasin Assessment Total Maximum Daily Lo	Lower Boise watershed
Idaho Department of Environmental Quality	2001	Lower Boise River Tributary Subbasin Assessment Appendices List	Lower Boise river tributaries
Idaho Department of Environmental Quality	2001	Mason Creek Subbasin Assessment	Mason Creek
Idaho Department of Fish and Game	2007	Assessment of Fisheries Losses in the Upper Snake River Basin in Idaho	Lowe Boise watershed and tributaries
Idaho Department of Fish and Game	2003	Idaho Fisheries Management Plan 2001-2006	Idaho, statewide
Idaho Department of Fish and Game	2007	Idaho Fisheries Management Plan 2007-2012	Idaho, statewide
Idaho Department of Health, Engineering and Sanitation Division	1962	Report of Pollution Problems in the Boise River: Ada and Canyon Countie	Boise River, Ada County and Canyon County
Kozfkay, J., Butts., A., and J. Dillon. (IDFG)	2011	2010 Southwest Region (Nampa) Fishery Management Report	Southwest Idaho - Nampa
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Lindley, D.	2005	Wetland restoration site evaluation: Island Creek, Eagle, Idaho	Boise River at Eagle Island
MacCoy, D.E. (USGS)	2003	Fish Abound in the Boise River!	Boise River at Lander and West Boise
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Maret, T.R.	1997	Characteristics of fish assemblages and related environmental variables	Upper Snake River Basin
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Pruitt, T.A. and R.L. Nadeau	1978	Recommended Stream Resource Maintenance Flows on Seven Southern	Boise River, Dry Creek, Willow Creek, NY Canal, Lake Lowell
Resource Systems, Inc.	1983	Boise River Fish and Wildlife Habitat Study: Wetland Inventory and Man	Boise River from New York Canal Diversion to Eagle Island State Park
Shalkey Walker Associates, Inc.	1995	Boise River System Recreation Study, Phase II	Boise River watershed, including North, Middle and South Forks
Spatial Dynamics, Mary McCown, Agua Tierrra Environmental Consult	1999	Boise River Resource Management and Master Plan	Boise River, Barber Park to Glenwood Bridge
Trout Unlimited	n.d.	Lower Boise River Creel Survey	Lowe Boise River
Trout Unlimited, Quadrant Consulting, Inc., CH2M Hill, Philip Williams	2003	Boise River Side Channel Project at Harris Ranch: Assessment and Reco	Boise River at Harris Ranch
U.S. Army Corps of Engineers	2001	Preliminary Restoration Plan, Section 1135, Boise River below Barber Da	Boise River below Barber Dam
U.S. Bureau of Reclamation	2004	Finding of No Significant Impact and Final Environmental Assessment: Li	Lucky Peak
U.S. Bureau of Reclamation	2002	Finding of No Significant Impact for the Bosie River Diversion Dam Powe	Boise River at Diversion Dam
U.S. Bureau of Reclamation	2005	Finding of No Significant Impact Partial Assignment of New Union Ditch	Boise River upstream of Lucky Peak