# 2012 Sawtooth Bull Trout Management Indicator Species Monitoring Report

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## Introduction

In order to evaluate the effects of management practices on fisheries and wildlife resources, the U.S. Forest Service monitors select species whose population trends are believed to reflect the effects of management activities on Forest ecosystems. These species are termed "management indicator species" (MIS) and the rationale for MIS monitoring is outlined in federal regulation 36 CFR 219.19.

> *"In order to estimate the effects of each alternative on fish and wildlife populations, certain vertebrate and/or invertebrate species present in the area shall be identified and selected as management indicator species and the reasons for their selection will be stated. These species shall be selected because their population changes are believed to indicate the effects of management activities."*
>
> *"Population trends of the management indicator species will be monitored and relationships to habitat changes determined."*

An important principal to the MIS foundation is that monitoring results must allow managers to answer questions about population trends. Historically, monitoring of habitat was used as a surrogate for direct quantification of MIS populations. However, recent court cases (*Sierra Club v. Martin*, 168 F.3d 1 (11th Cir. 1999)) have ruled that assessing changes in habitat will no longer be accepted as a substitute for direct monitoring of populations. The Forest Service has an obligation to collect and analyze quantitative population trend data at both the Forest-plan and project level.

In response to issues raised by court challenges, the Sawtooth, Boise, and Payette National Forests (Southwest Idaho Ecogroup) revisited aquatic MIS species for the Draft Forest Plan EIS to determine if population data were sufficient to determine trend at the Forest scale.

Following this reevaluation, bull trout (*Salvelinus confluentus)* was selected as the aquatic MIS species (for a full explanation of the MIS review, see Aquatic Management Indicator Species for the Boise, Payette, and Sawtooth Forest Plan Revision, 2003). Bull trout were selected because the species is sensitive to habitat changes, dependent upon habitat conditions that are important to many aquatic organisms, relatively well understood by Forest biologists, and widely distributed across the Ecogroup. In addition, local bull trout populations are not influenced by stocking and likely persist at relatively small spatial scales that do not extend beyond Forest boundaries. Therefore, Forest bull trout populations are probably not heavily influenced by activities occurring outside Forest domains, and therefore changes in local bull trout populations are more likely to reflect local management activities on the Forest.

## Protocol

## Objectives

- Over the existing life of the Forest Plan for the Boise, Sawtooth, and Payette National Forests, determine the status and trend in distribution of bull trout within and among patches of suitable habitat within each subbasin across the planning area.
- To the full extent practicable, use the best available peer-reviewed science to allow formal inferences about observed status and trends in the distribution of bull trout.

## Rationale

Monitoring is focused on patterns of occurrence of juvenile bull trout (<150 mm) for two reasons. First, presence of juvenile bull trout is an indicator of key spawning and rearing areas within a patch. These areas represent habitats that are essential for bull trout population viability within a patch. Other habitats within stream networks may be important for ranging or migrating individuals, but tracking fish in these areas is cost prohibitive and time consuming. Second, sampling patterns of occurrence requires less intense sampling than estimating abundance and is based on a peer-reviewed protocol for sampling of small bull trout (Peterson et al. 2002); similar protocols for larger, more mobile fish have not been developed. Key metrics for monitoring trends will be the proportion of habitat patches occupied in each subbasin across time and the spatial pattern of occupied patches.

## Methods

Monitoring follows procedures specified by (Peterson et al. 2002)[1], with the following specific procedures and modifications.

**Sampling frame** - The fundamental unit for inference is a patch, defined following procedures outlined in Peterson, et al. (2002) and further clarified by the U.S. Fish and Wildlife Service Bull Trout Recovery Monitoring and Evaluation Group. The procedure involves delineating suitable habitats for bull trout within a patch to locate samples and making inferences about presence.

Downstream patch boundaries were delineated by 1600 meter elevation contours in the Boise and South Fork Payette River basins, based on previous research in the basins relating the distribution of juvenile bull trout to elevation. Outside of these basins, downstream patch boundaries correspond to stream temperature <15$^{o}$C (highest seven-day moving average of maximum daily temperature). Downstream limits to patches may also correspond to a confluence with a stream that is classified as too large for bull trout spawning, based on observed relationships between spawning use and stream size, as revealed by redd counts, direct observation of fish, radio telemetry, or other evidence.

During monitoring, efforts will be made to distinguish between "realized" and "potential" patch boundaries. The term "realized" refers to actual stream habitat that is used by bull trout. Realized boundaries may be less than potential boundaries, due to the influence of a number of factors, such as nonnative brook trout, dewatering of stream channels, or habitat alterations that increase stream temperature. The term "potential" refers to the maximum extent of coldwater naturally attainable, absent of irreversible human influences. This assumes the distribution of suitably cold water is the ultimate factor limiting the distribution of small bull trout.

In the upstream direction, stream networks will be truncated to include only those segments[2] with stream gradient of less than 20%. Further, all headwater areas within catchments corresponding to a contributing area of less than 500 hectares will be removed from sampling frames, due to low probability of bull trout occurrence (Dunham and Rieman 1999, as cited in Peterson et al. 2002).

[1] Available at www.fisheries.org and www.fs.fed.us/rm/boise

[2] Stream segments are defined as lengths of stream within drainage networks that are delineated on the up- and down-stream ends by tributary confluences.

Information on local barriers will also be considered in truncating stream networks. For example, it may not be necessary to sample upstream of high natural waterfalls which prevents upstream passage of bull trout.

**Metadata -** For each patch, criteria for delineating down- and up-stream boundaries of the stream network to be sampled will be documented as metadata to accompany spatial data.

**Sample allocation -** Individual samples will be allocated to all patches within a Forest or subbasin. Within patches, only suitable habitat will be inventoried for informal and formal surveys. Suitable habitat is defined according to wetted width (greater than 2 meters), stream gradient (less than 20%), water temperatures (15 °C or less, 7-day average summer maximum), and connectivity (no natural or anthropogenic barriers).

**Sampling unit -** The fundamental sampling unit will be a 100 meter length of stream.

**Sampling method -** Daytime electrofishing will be used to capture fish, with a variable number of passes, depending on site conditions. Habitat variables will also be measured to estimate sampling efficiencies. From 2004 to 2008 single and multiple pass electrofishing with blocknets was completed at random sites within each patch. However, random sites were not monumented to allow the site to be located and resurveyed. In 2009, sampling was changed to only single pass electrofishing without blocknets based on discussions with the Rocky Mountain Research Station. This change was made to increase the number of sample sites completed each year. But it was also made since the overall monitoring objective was only to show bull trout presence/absence and trend within patches over time. However, this approach did not allow the Forest to track fish abundance at smaller scales if desired and has not provided other state and federal agencies the information they often desire. To address this, the Forest in 2011 modified our sampling approach. All patches that do not support bull trout would continue to have single pass electrofishing with no blocknets. All patches that support bull trout would have at least three multiple-pass electrofishing sites without blocknets. We choose not to install blocknets because Young and Schmetterling (2004) found that electrofishing without blocknets on small streams did not appear to cause fish to flee the sample site and that the effect fish movement had on abundance estimates was minor. Random multiple-pass sites were selected in the lower, middle, and upper portions of each occupied patch. Each of these sites was monumented by placing metal tags at the beginning of the reach and GPS coordinates were recorded. Several photo points (beginning, middle, and end of transect) were also established. Each monumented site will be resampled either annually in our sentinel patches or every 3 to 5 years.

Depletion estimates were calculated for sites sampled where bull trout were captured using Microfish 3.0 population parameter calculation software (www.MicroFish.org 2005) (Van Deventer, 1989). In the future once we begin to accumulate enough multiple-pass information, we plan to analyze the relationship between first pass catches and population estimates from three-pass removals.

**Random sampling** - Sample sites within each patch can be determined using a variety of designs (e.g., representative reach, systematic, random, cluster, or convenience sampling). Probabilistic designs are usually best because site selection is randomized, each site has an equal selection probability, statistically valid, and unbiased estimates are provided. Purely random selection, however, can also result in spatial clustering of sites that may not adequately represent the strong environmental gradients that typically occur in small mountain streams. To address this issue, the Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) developed the Generalized Random Tessellation Stratified design (GRTS; Stevens and

Olsen 2004). GRTS uses a randomized hierarchical grid that arrays sites throughout a stream network to achieve spatial representation. Sites using this EMAP approach were generated for all patches to establish potential sample locations. Once this first set of random sites is generated & surveyed, the same sites will be resampled on subsequent surveys in the future.

Selection of sample sites from the GRTS list were based on the unique identifier associated with each GRTS site. So, for example, if 20 GRTS sites are generated for a patch, and eight will be sampled in the field, the sites with the eight lowest identifiers were selected in sequential order. Once in the field, sites were sampled in any sequence that was logistically convenient whenever all sites are sampled. Once bull trout are detected, further sampling is unnecessary unless done for other reasons (e.g., development and refinement of detection efficiency, etc.). If bull trout are not detected, all identified sites within a patch must be sampled to reach the predefined probability of occurrence without detection.

Formal vs. informal sampling - Informal sampling (e.g. snorkeling, electrofishing, weirs, etc.) will be used initially to determine presence of juvenile bull trout, when deemed appropriate by local biologists. If juvenile bull trout are detected the informal sampling effort can cease, unless the local biologists wants to better determine distribution within the patch. If juvenile bull trout are not detected, it will be necessary to conduct formal sampling, as prescribed to estimate probability of presence in cases where bull trout are not detected (Peterson et al. 2002, Peterson and Dunham 2003). Site level detection probabilities will be estimated as outlined in Peterson et al. (2002) or through empirical methods based on repeated sampling of occupied patches and habitat information collected throughout the monitoring effort.

**Sampling schedule -** Initially, four patch types were recognized: 1) Known presence within last 7 years; 2) Likely present due to good habitat or detection > 7 years previous; 3) Likely not present due to poor habitat and bull trout not detected within last 7 years; 4) Patches without data. Patches will be defined relative to "potential" to support bull trout as defined above. Over the 2003-2018 Forest Plan timeline, targeted patches in categories 1 and 2 will be sampled at least twice. Initial sampling will be completed within first 7 years of the Forest Plan, preferably with as much time as possible in-between successive samples for each patch. Patches in category 3 will be sampled at least once. Additional sampling or re-sampling will be conducted if there is specific reason to do so (e.g., passage restoration, habitat improvement). Based on results following sampling, patch strata will be updated yearly (Table 1).

**Table 1 -** Number of bull trout patches on the Sawtooth National Forest within each subbasin by category prior to 2012 sampling.

| Category | S.F. Boise Subbasin | M.F./N.F Boise Subbasin | S.F. Payette Subbasin | Upper Salmon Subbasin | Total |
|---|---|---|---|---|---|
| 1 | 13 | 4 | 2 | 17 | 36 |
| 2 | 7 | 1 | 2 | 7 | 17 |
| 3 | 23 | 0 | 0 | 28 | 50 |
| 4 | 0 | 0 | 0 | 0 | 0 |
| Total | 43 | 5 | 4 | 52 | 104 |

Using data from the past 7 years (since 2005), all of the category 1 and 2 patches in the Middle Fork/North Fork Boise River, South Fork Boise River, and Upper Salmon subbasins have been sampled (Table 2). All category 1 and 50% of the category 2 patches in the S.F. Payette have been sampled.

**Table 2 -** Number of bull trout patches by category on the Sawtooth NF and the number surveyed within the last 7 years (since 2005) within each subbasin based on 2012 sampling.

| Category | S.F. Boise Subbasin | | N.F. and M.F. Boise Subbasin | | S.F. Payette Subbasin | | Upper Salmon Subbasin | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Patches | Surveyed | Patches | Surveyed | Patches | Surveyed | Patches | Surveyed | Patches | Surveyed |
| 1 | 13 | 13 (100%) | 4 | 4 (100%) | 2 | 2 (100%) | 17 | 17 (100%) | 36 | 36 (100%) |
| 2 | 7 | 7 (100%) | 1 | 1 (100%) | 2 | 1 (50%) | 7 | 7 (100%) | 17 | 16 (94%) |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 (0%) |
| Total | 20 | 20 (100%) | 5 | 5 (100%) | 4 | 4 (100%) | 24 | 24 (100%) | 53 | 53 (100%) |
| | | | | | | | | | | |
| 3 | 23 | 18 (78%) | 0 | 0 | 0 | 0 | 28 | 23 (82%) | 50 | 41 (82%) |

**Sentinel Streams** - In 2009 sentinel streams were established in the S.F. Boise (Boardman, Skeleton, Deadwood, and Paradise) and Upper Salmon (Pole, Iron, and Big Boulder) to detect expansion of bull trout populations within downstream marginal habitats or to detect changes in bull trout distribution within suitable areas within a patch. These streams were selected because they represent broad thermal ranges, are near occupied patches which may be more easily colonized, and/or are the focus of restoration actions that may make habitat more suitable for bull trout. All sentinel streams will be sampled more frequently than other patches to detect subtle changes in stream temperatures and bull trout distributions over time.

**PIBO Monitoring Sites -** To evaluate trends in habitat and watershed condition, the Sawtooth National Forest has worked with the PACFISH/INFISH Biological Opinion (PIBO) monitoring program in Logan, Utah. This monitoring approach evaluates the trend of select Watershed Condition Indicators (WCIs) across subwatersheds where PIBO integrator reaches have been established. An integrator reach is the lowest stream reach within the subwatershed that has greater than 50% federal ownership upstream of the sample reach, contains no tributary junctions or beaver activity, and has a stream gradient less than 3%. It is assumed that integrator reaches would be responsive to all management activities that occurred upstream or around the reach. Each integrator reach has been sampled during one of the first five years (2001 to 2005), and will be resampled on a five-year rotation after 2006.

To evaluate select WCIs an integrity index of physical habitat indicators was used. Physical stream habitat and landscape data from reference reaches were used to develop an index of physical habitat condition. PIBO identified candidate attributes from the 17 total attributes collected at PIBO sample sites using a three-step sequence. First, PIBO selected those physical habitat attributes that exhibited relatively low sampling variation based on reaches repeat-sampled within a year, which enabled empirical estimates of signal/noise (Kaufmann 1999). Next, PIBO tested whether attributes with low sampling variation were responsive to management actions. As such, PIBO evaluated the responsiveness of each attribute to management activities by comparing the means of each candidate attribute from reference reaches and managed reaches. Finally, PIBO minimized redundancy of those attributes that met the specific criteria in the first two steps to avoid over-weighting certain components of the physical instream habitat represented in the overall index. Here, PIBO calculated Pearson correlation coefficients for all remaining candidate attributes and considered attributes redundant if correlation coefficients exceeded 0.70.

Once attributes were selected, PIBO used the Forests reference sites to construct the index. Specifically, PIBO incorporated landscape and climatic covariates into multiple linear regression analyses to control for inherent differences in physical habitat attributes among reaches. PIBO used the residuals from these analyses to score individual attributes and summed the 7 attributes

(i.e. d50, average bank angle, the percent of fine sediment in pool tails, the frequency of large woody debris (pieces/km), the volume of LWD, the percent of pool habitat, and the average residual pool depth) retained in the index for an overall index of abiotic condition (range = 0-100). PIBO incorporated the data from managed sites (both landscape and field data) into the regression models used to develop the index (from reference sites) to calculate and score the residuals and overall index for managed sites (again ranging from 0-100).

## 2012 Results and Discussion

Monitoring for bull trout on the Sawtooth National Forest occurred in 13 patches in 2012 (Figure 1). In the S.F. Boise subbasins, six patches were surveyed using formal protocols. Of these patches, juvenile bull trout were observed in Boardman, Deadwood, Bear, and Skeleton Creeks. In the Upper Salmon seven patches were sampled and juvenile bull trout were observed in Little Boulder, Fishhook, Alturas lake Creek, and Big Boulder Creeks. Discussion of changes in bull trout distribution within a patch or abundance is discussed below for each patch.

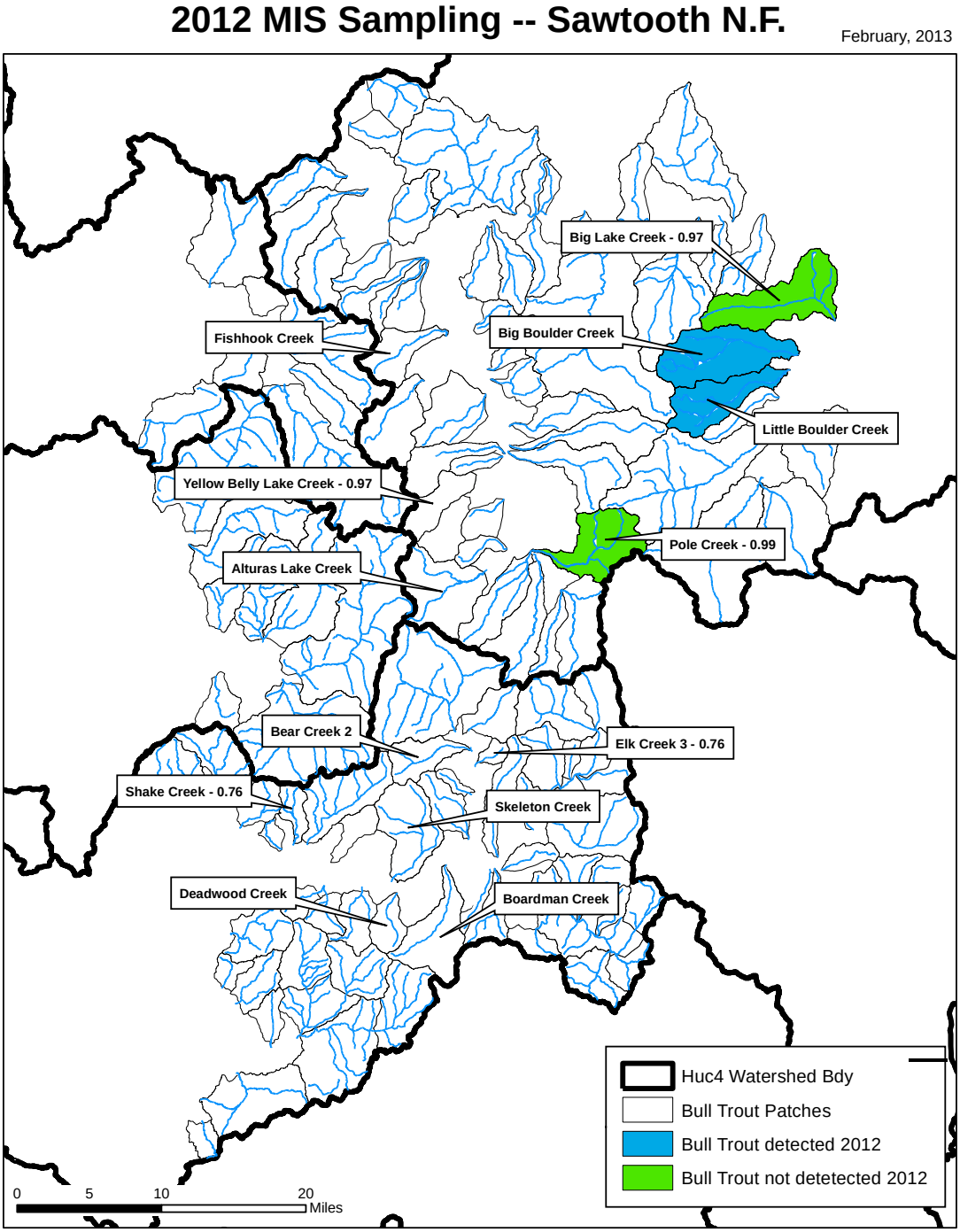



Figure 1 - Bull trout patches sampled and probabilities of detection on the northern portion of the Sawtooth N.F. (2012).

## Patches Where Bull Trout Were Detected

***Boardman Creek*** – Bull trout continue to be distributed throughout this 12,561 acre (10.9 accessible miles) patch (Figure 2). Juvenile bull trout were observed in five of ten 100m electrofishing sites. A total of 86 bull trout were captured at the 8 sites. Population estimates ranged from 4-78 fish per reach (Table 3) within surveyed transects, with the highest abundance observed in the headwater sites of the mainstem of Boardman Creek above the Smoky Dome confluence and Smoky Dome Creek. Bull trout ranged from 65- 175mm total length and dominant age classes were 0+, 1+, and 2+. Findings from the 2011 survey are consistent with other surveys (i.e. the Idaho Fish and Game 1993, 1999, and 2000, and Bureau of Reclamation, Boise National Forest, and Rocky Mountain Research Station in 2001, and Sawtooth National Forest 2002-2011) completed in this patch.

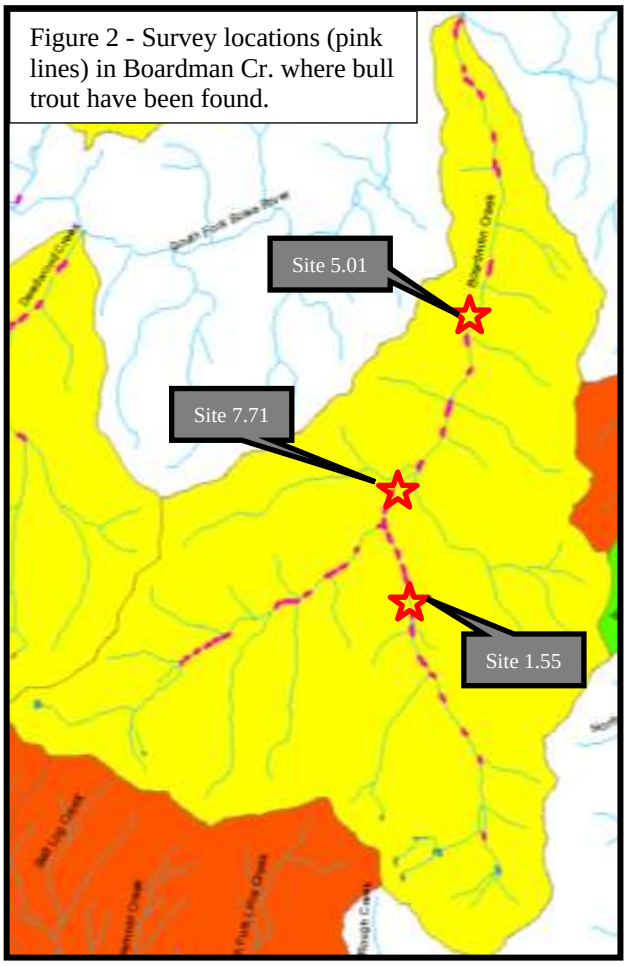


Figure 2 - Survey locations (pink lines) in Boardman Cr. where bull trout have been found.

Three multiple pass sites were resurveyed in 2012. Densities range from 0.84-9.16/100 $m^2$ in 2012 with the highest densities occurring in headwater reaches. The pattern of higher headwater densities is similar to those found in 2011 and is believed related to colder water temperatures. 2012 densities, however, are consistently higher at all sites (Table 3). This is likely due to lower water levels that lead to better electrofishing efficiencies. However, there may be other unknown factors (fish movement, etc.) determining density changes. Densities lower in the drainage are comparable to those found by Kenney in 2002 with 0.53-0.84/100 $m^2$ (2011/2012) vs. 0.1-0.9/100 $m^2$ (2002). The 2011 headwater densities are lower (2.24/100 $m^2$) than what Kenney found 8.8-9.6/100 $m^2$ in 2002. However, the 2012 headwater densities are similar 9.16/100 $m^2$. Again this is attributed to better electrofishing efficiencies.

A small tributary of Boardman Creek drains a cirque pond, called Boardman Creek Lake. IDFG stocking records indicate that this lake has been stocked with several strains of rainbow/redband trout beginning in 1967. Redband trout have been observed at most of the Boardman Creek sites and all of the Smoky Dome sites. It is assumed that most redband are native fish, but some may have been influenced by past stocking.

Stream temperatures (MWMT) near the mouth of Boardman Creek from 2002 through 2007 ranged from approximately 14.0°C to nearly 18.0°C. However, the 7-day max for stream temperatures higher in the subwatershed, where bull trout are known to spawn and rear, typically ranged from approximately 10.0°C to 12.0°C. These stream temperature readings suggest that temperatures are higher than desired for bull trout lower in the subwatershed, but temperatures are optimal or close to optimal in a substantial portion of upper Boardman and Smoky Dome Creeks.

In general, stream habitat is considered in good condition across the drainage (Figures 3 and 4), although fine sediment may be elevated from historic sheep grazing and mining in the headwaters of Smoky Dome Creek, headwater roads, and streamside trails. There is good connectivity to the S.F. Boise River with no known barriers. A PIBO integrator reach is located just above the confluence with the S.F. Boise River. The habitat index score from 2005 survey is 35.1 and in 2010 29.5 indicating poorer habitat conditions within this site compared to reference streams. PIBO found habitat indices averaged 63.4 in unmanaged reference, habitat. PIBO also concluded that habitat in good condition had scores 70 and above, habitat in a moderate condition averaged a 40-70 score, and habitat in poor condition averaged less than a 40 score for streams within the Southwest Idaho Ecogroup. Subtle changes in PIBO scores between 2005 and 2010 appear to be from a decrease in the number of pools, woody debris frequency and volume.

Figure 3 – Site 1.55 in Smoky Dome Creek in 2011

Figure 4 – Site 1.55 in Smoky Dome Creek in 2012

**Table 3** – 2012 bull and rainbow trout densities and population estimates in Boardman Creek

| Transect (rivermile) | Year | Number of Passes | Transect Length (m) | Species | Number Caught | Total Length (mm) | | Density (fish/100m$^2$) | Pop Estimate (Fish ≥ 60 mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Range | | |
| 1.55 (Smoky Dome) | 2012 | 3 | 83 | Bull Trout | 38 | 125 | 78-170 | 9.16 | 78 |
| | | | | Rainbow Trout | 9 | 175 | 120-240 | 2.17 | 8 |
| | | | | | | | | | |
| | 2011 | 3 | 96 | Bull Trout | 11 | 103 | 67-144 | 2.24 | 11 |
| | | | | Rainbow Trout | 2 | 165 | 140-190 | 0.48 | 2 |
| | | | | | | | | | |
| 5.01 | 2012 | 3 | 95 | Bull Trout | 4 | 160 | 67-122 | 0.84 | 4 |
| | | | | Rainbow Trout | 10 | 164 | 110-220 | 2.10 | 11 |
| | | | | | | | | | |
| | 2011 | 3 | 87 | Bull Trout | 3 | 115 | 84-164 | 0.53 | 3 |
| | | | | Rainbow Trout | 8 | 157 | 100-210 | 1.41 | 8 |
| | | | | | | | | | |
| 7.71 | 2012 | 3 | 80 | Bull Trout | 25 | 115 | 65-175 | 5.12 | 35 |
| | | | | Rainbow Trout | 5 | 165 | 90-230 | 1.03 | 5 |
| | | | | | | | | | |
| | 2011 | 3 | 77 | Bull Trout | 18 | 113 | 63-151 | 2.67 | 18 |
| | | | | Rainbow Trout | 5 | 200 | 143-248 | 0.75 | 5 |

***Deadwood Creek*** – Juvenile bull trout were detected at three of the four 100m electrofishing sites within this 4,558 acre (2.22 accessible miles) patch (Figure 5). A total of 15 bull trout were captured at the 3 sites. Population estimates at the one site was 4 fish (Table 4) within the surveyed transect. Bull trout ranged from 92-167mm total length and the dominant age classes were 1+, 2+, and 3+. Bull trout densities are slightly higher in 2012 than 2011 at the one repeat multiple pass site (Table 4). This may be due to lower stream flows and better sampling efficiencies. Densities are similar to what Kenney found in adjacent streams in 2002.

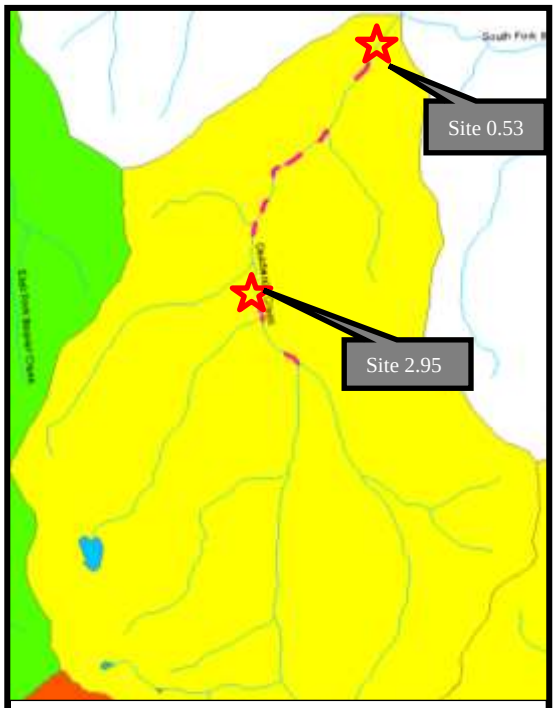


Figure 5 – Survey locations (pink lines) in Deadwood Creek where bull trout have been found.

Bull trout distribution in 2012 continues to mirror what has been observed in previous surveys (Idaho Fish and Game and Boise/Sawtooth National Forests 1991, 1994, 1998, and 2003). Bull trout (presumably migratory individuals) appeared in each of the IDFG Deadwood Creek samples. Several other salmonid species, including redband, westslope cutthroat trout and kokanee salmon, were also collected during these surveys. The presumed origin of the cutthroat trout is Heart Lake, in the Deadwood Creek drainage, which has been stocked approximately every 2-3 years since 1972 by IDFG. Redband trout were the only other species observed during the 2011 surveys.

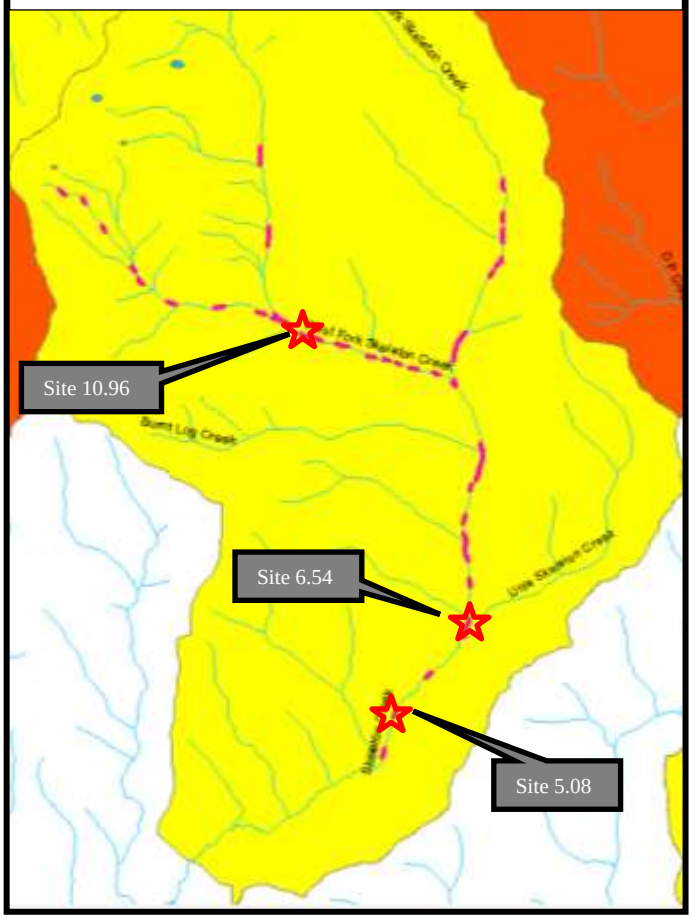
Habitat conditions within Deadwood Creek are believed to be in good condition and there is good connectivity to this patch from the S.F. Boise River. MWMT at the mouth of Deadwood Creek in 2003, 2004, and 2007 ranged between 15°C and 16°C. Livestock grazing has occurred within the patch since late in the 19$^{th}$ century, but major reductions in sheep numbers have been made.

**Table 4** – 2012 bull and rainbow trout densities and population estimates in Deadwood Creek

| Transect (rivermile) | Year | Number of Passes | Transect Length (m) | Species | Number Caught | Total Length (mm) | | Density (fish/100m$^2$) | Population Estimates (Fish ≥ 60 mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Range | | |
| 0.53 | 2012 | 3 | 76 | Bull Trout | 4 | 147 | 92-167 | 1.32 | 4 |
| | | | | Rainbow Trout | 6 | 154 | 142-165 | 1.97 | 6 |
| | | | | | | | | | |
| | 2011 | 3 | 82 | Bull Trout | 2 | 137 | 105-184 | 0.59 | 2 |
| | | | | Rainbow Trout | 5 | 124 | 76-171 | 1.48 | 6 |
| | | | | | | | | | |
| 2.95 | 2011 | 3 | 85 | Bull Trout | 8 | 191 | 149-245 | 2.04 | 8 |
| | | | | Rainbow Trout | 2 | 134 | 131-137 | 0.51 | 2 |
| | | | | Cutthroat Trout | 2 | 156 | 154-158 | 0.51 | 2 |

***Skeleton Creek*** – Juvenile bull trout were detected at seven of the twelve 100m electrofishing sites within this 4,558 acre (11.01 accessible miles) patch (Figure 6). A total of 81 bull trout were captured at the 10 sites. Population estimates ranged from 1-35 fish (Table 5) within surveyed transects with higher abundance observed at the headwater sites; especially in the W.F. Skeleton Creek. These estimates are lower than those observed in 2011, but comparable (0-31 fish) to those made in 2002 by the Sawtooth National Forest (Kenney 2003). Bull trout ranged from 79-233mm total length and dominant age classes are 1+, 2+, and 3+. Findings from the 2012 survey are consistent with other surveys (i.e. the Idaho Fish and Game 1994, 1999, and 2000, and Bureau of Reclamation, Boise National Forest, and Rocky Mountain Research Station in 2001, and Sawtooth National Forest 2002-2009) completed on the mainstem of Skeleton and W.F. Skeleton Creeks in this patch.

Figure 6 – Survey locations (pink lines) in Skeleton Cr. where bull trout have been found.




Three multiple pass sites were resurveyed in 2012. Densities range from 0.5-7.26/100 $m^2$ in 2012 with the highest densities occurring below the confluence of the W.F./E.F. Skeleton Creek. The pattern of higher headwater densities is consistent to those found in 2011 and 2002, and is believed related to colder water temperatures. 2012 densities, however, are lower at site 10.96 than 2011 (Table 5). Densities lower in the drainage are comparable to those found by Kenney in 2002 with 0.5-0.9/100 $m^2$ (2012) vs. 0.3-0.6/100 $m^2$ (2002). Densities in 2011 at site 10.96 are also comparable (14.69/100 $m^2$) to what Kenney found 16.1/100 $m^2$ in 2002. However, the 2012 densities are lower 7.26/100 $m^2$. The precise reasons for this lower density in unknown.

The radio-telemetry study by Partridge et al. (2000) also showed the presence of migratory bull trout in the mainstem of Skeleton Creek, the East and West Forks of Skeleton Creek, as well as Burnt Log Creek. Specifically, in 1998, a 420 mm bull trout was tracked to Burnt Log Creek and a 500 mm fish was last located in Skeleton Creek, while in 1999 a 425mm bull trout was located first in the East Fork and then in the West Fork and a second fish, 515 mm in length, was located in the West Fork. The largest fish found in 2011 surveys was 260 mm at river mile 8.59. Weir counts from 2002 through 2005 captured only a limited amount of large (>300 mm) individuals out-migrating after spawning in these years. Therefore, the size of the spawning population is unclear, although the subpopulation may include a resident spawning component that would likely remain undetected due to lack of migration and therefore low probability of weir capture.

Seven-day max weekly max temperatures near the confluence of Skeleton Creek with the S.F. Boise River in 2001 through 2007 ranged from 18 to 19.5°C. However, MWMT stream temperatures are considerably cooler in headwater locations, as evidenced by temperature samples recorded at electrofishing sites and the presence of a reproducing bull trout population. Thermographs placed in Skeleton Creek within the patch recorded 7-day maximum temperatures from 13.7 to 9.9°C.

In general, stream habitat is in good condition in the drainage, although fine sediment is likely elevated from historic sheep grazing, logging, and mining in the headwaters. There is good connectivity to the S.F. Boise River with no known barriers. A PIBO integrator reach is located just above the confluence with the S.F. Boise River. The habitat index score from 2005 survey is 18.8 and 44.4 in 2010 indicating moderate habitat conditions when compared to reference streams. Changes in PIBO scores between 2005 and 2010 appear to be from an increase in the pool depth and substrate size.

**Table 5** – 2012 bull and rainbow trout densities and population estimates in Skeleton Creek

| Transect (rivermile) | Year | Number of Passes | Transect Length (m) | Species | Number Caught | Total Length (mm) | | Density (fish/100m$^2$) | Pop Estimates (Fish ≥ 60 mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Range | | |
| 5.08 | 2012 | 2 | 92 | Bull Trout | 3 | 189 | 176-207 | 0.50 | 3 |
| | | | | Rainbow Trout | 31 | 172 | 78-301 | 5.18 | 32 |
| | | | | | | | | | |
| | 2011 | 3 | 97 | Bull Trout | 1 | 165 | -- | 0.17 | 1 |
| | | | | Rainbow Trout | 21 | 160 | 104-229 | 3.54 | 21 |
| | | | | | | | | | |
| 6.54 | 2012 | 2 | 87 | Bull Trout | 4 | 187 | 155-210 | 0.90 | 4 |
| | | | | Rainbow Trout | 26 | 167 | 97-247 | 5.86 | 32 |
| | | | | | | | | | |
| | 2011 | 3 | 85 | Bull Trout | 7 | 137 | 116-146 | 1.19 | 24 |
| | | | | Rainbow Trout | 46 | 151 | 68-209 | 7.84 | 67 |
| | | | | | | | | | |
| 10.96 | 2012 | 2 | 101 | Bull Trout | 33 | 175 | 79-233 | 7.26 | 35 |
| | | | | Rainbow Trout | 4 | 186 | 104-222 | 0.88 | 4 |
| | | | | | | | | | |
| | 2011 | 3 | 96 | Bull Trout | 55 | 162 | 85-248 | 14.69 | 58 |
| | | | | Rainbow Trout | 6 | 181 | 154-196 | 1.6 | 6 |

***Bear Creek*** – Juvenile bull trout were detected at all five 100m electrofishing sites within this 6,672 acre (5.93 accessible miles) patch (Figure 7). A total of 67 bull trout were captured at the 5 sites. Population estimates ranged from 9-33 fish (Table 5) within surveyed transects, with higher abundance observed at the headwater sites. Bull trout ranged from 84-157mm total length and dominant age classes are1+ and 2+. Redband trout were also found at all sites. Findings from the 2012 survey are consistent with other surveys (i.e. Idaho Fish and Game in 1993 and 1998, Bureau of Reclamation {BOR}, Boise National Forest, and Rocky Mountain Research Station in 2001, and Sawtooth National Forest 2006) completed in this patch. The BOR survey found 42 bull trout ranging from 39-522 mm in length and 29 redband trout. A radio-telemetry study by Partridge et al. (2000) tracked a 515 mm migratory bull trout in Bear Creek. Goat Creek and its tributaries drain several cirque basins including one called Goat Lake in IDFG stocking records-this lake has been stocked recently with several strains of rainbow/redband trout. It is possible that one or more of the other cirque lakes in the basin have been stocked in the past, possibly with exotic species including cutthroat and/or golden trout and grayling. Two multiple pass sites were

surveyed in 2012. Densities ranged from 1.14 - 6.02/100 $m^2$ with the highest densities occurring in lower Goat Creek (Table 6).

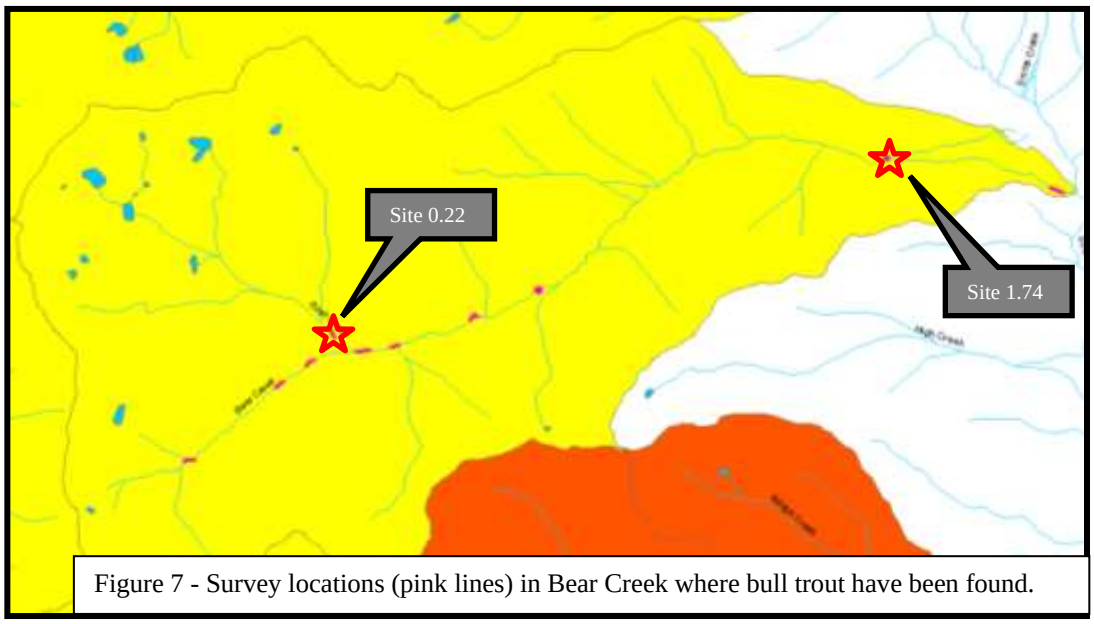


Figure 7 - Survey locations (pink lines) in Bear Creek where bull trout have been found.

MWMT near the confluence of Bear Creek with the S.F. Boise River in 2006 ranged from 12.8 to 13.9°C. MWMT temperatures taken in 2006 in the headwater areas are also relatively cold ranging from 11.6-13.6°C. Spot measurements taken by the Boise N.F. in 1993 ranged from 8.75-10°C on 8/12, while BOR measurements in 2001 ranged from 8.5-10.5°C on 8/21. In general, stream habitat is in good condition in the drainage, although fine sediment is likely elevated from historic sheep grazing, roads accessing headwater mining claims, and mining in the headwaters. There is good connectivity to the S.F. Boise River with no known barriers.

**Table 6** – 2012 bull and rainbow trout densities and population estimates in Bear Creek

| Transect (rivermile) | Year | Number of Passes | Transect Length (m) | Species | Number Caught | Total Length (mm) | | Density (fish/100m$^2$) | Pop estimate (Fish ≥ 60 mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Range | | |
| 1.74 | 2012 | 3 | 96 | Bull Trout | 7 | 151 | 84-152 | 1.14 | 9 |
| | | | | Rainbow Trout | 4 | 185 | 148-221 | 0.76 | 4 |
| | | | | | | | | | |
| 0.22 (Goat Cr.) | 2012 | 2 | 99 | Bull Trout | 28 | 139 | 111-157 | 6.02 | 33 |

***Alturas Lake Creek*** – Juvenile bull trout were detected at nine of the fifteen 100m electrofishing sites within this 15,871 acre (32.1 accessible miles) patch (Figure 8). A total of 58 bull trout were captured at the 9 sites. Population estimates ranged from 3-51 fish (Table 8) within surveyed transects, with higher abundance observed at the headwater sites. Bull trout ranged from 75-199mm total length and dominant age classes are 1+, 2+, and 3+. Brook trout were found in 8 sites within Alturas Lake Creek (rivermile 17.48-26.64) and lower Alpine Creek (rivermile 0.6-1.15). Two bull trout/brook trout hybrids were found in lower Alpine Creek (site 0.6). Bull/brook trout hybrids have been observed previously at the Alturas Lake inlet during Sawtooth NRA reconnaissance surveys in 1979 and 1997.

2012 survey findings are consistent with other inventories. Extensive snorkel surveys conducted by the Sawtooth NRA in 1994 observed many bull trout and chinook in Alturas Lake Creek above the Lake. IDFG has also observed bull trout, chinook and steelhead in transect monitoring conducted in 1987- 1995 above the Lake. Sawtooth NRA reconnaissance surveys in 1979, 1997, and 2005 also observed large adfluvial bull trout in the upper reaches of the drainage, and cutthroat in Alpine Creek.

Rainbow trout were found in 4 sites in Alpine Creek (rivermile 1.15-4.47) and smaller tributaries to Alturas Lake Creek. Westslope cutthroat were found in 5 sites and rainbow/cutthroat hybrids were found in 3 headwater transects of Alturas Lake Creek (rivermile 23.33-26.64), Alpine Creek (rivermile 1.15-4.47), and in smaller tributaries to Alturas Lake Creek.

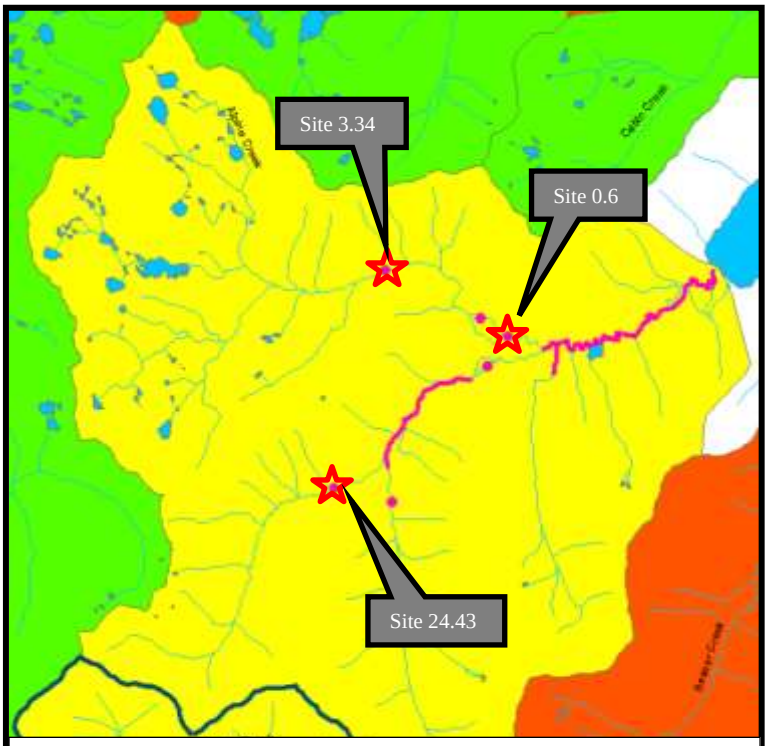


Figure 8 - Survey locations (pink lines) in Alturas Lake and Alpine Creek where bull trout have been found.

Three multiple pass sites were surveyed in 2012. Bull trout densities range from 0.54-3.98/100 $m^2$ in 2012 with the highest densities occurring in upper Alturas Lake Creek (Table 7). Densities are within the range found by IDFG in Fourth of July Creek (0.9-3.5 fish/100$m^2$) for bull trout at least 70mm in fork length (IDFG 2005). Brook trout densities ranged from 1.18-2.36 fish/100$m^2$ with the highest densities occurring in the headwaters of Alturas Lake Creek. Brook trout densities are comparable to what IDFG found in Pole Creek 0.3-2.3 fish/100$m^2$, but much lower than those found in Smiley Creek 3.2-14.1 fish/100$m^2$.

The extensive distribution of rainbow trout is not unexpected given the stocking history in headwater lakes of Alpine Creek, Alturas/Perkins Lakes, and within streams within this patch. Stocking records also indicate that brook trout were planted in Alturas/Perkins Lakes and Alpine Creek.

Since 1998, IDFG has conducted redd count surveys in Alpine Creek to monitor long-term bull trout spawning trends. Two counts (late August and mid-September) are conducted about two weeks apart on Alpine Creek to monitor the timing and numbers of bull trout spawning redds. All redds in progress or completed redds are counted during the first survey and flagged for identification. On the second survey, additional completed redds were counted and included with the number of flagged redds to provide a total number of redds. Redd counts have remained relatively stable from 2000 to 2007, averaging 11 redds per year. No redds have been found in 2008, 2009, or 2010. However, bull trout were observed spawning below the Alpine Creek transect in 2009 and 2010.

**Table 7** – Bull trout redd counts in Alpine Creek

| | # Of Redds | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stream** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| Alpine Creek | -- | 9 | 15 | 14 | 14 | 9 | 13 | 13 | 18 | 0 | 0 | 0 |

Seven-day max weekly max temperatures above the Alturas Lake inlet have ranged from 14.8°C (2010) to 15.3°C (2002). MWMT temperatures taken 1.9 miles above the Alpine Creek confluence was 12.4°C in 2005.

In general, stream habitat is in good condition in the drainage, although fine sediment is likely elevated from headwater grazing and patented mining and granitic parent material. Historic intensive sheep grazing substantially altered stream banks in some localized areas, particularly near the corrals. However, the corrals were closed and removed in the mid-1990s, and the area is no longer authorized for grazing. As a result, streambank recovery is thought to be ongoing. In 2003 Alturas Lake Creek and lower Jakes Gulch were reviewed for impacts from domestic sheep grazing based on tracking collar data. No effects from sheep use were observed above the lake.

The Alturas Creek subwatershed has been a focus for restoration since 1999. In 2000 Alturas Lake Creek was returned to ¼ mile of natural channel above the confluence with Alpine Creek where it had been previously captured by Road 205 a decade earlier. This capture had liberated 1000s of yards of sediment into Alturas Lake Creek. In 2005 and 2006 4.5 miles of headwater road were closed and rehabilitated, including the deteriorating ford through Alpine Creek. As restoration now occurs, these changes have essentially removed all chronic sources of management related sediment within the upper watershed.

There is good connectivity in this patch to the Salmon River with no man-made barriers. A dry reach occurs in late summer in some years just above the confluence with Alpine Creek, extending as much as ½ mile. This condition was first documented in 1895, and is believed to be a natural. A PIBO integrator reach is located on Alpine Creek 1.59 miles above the confluence with the Alturas Lake Creek. The habitat index score from 2005 survey is 62.0 and 65.7 in 2010 indicating moderate to good habitat conditions when compared to reference streams. PIBO found habitat indices averaged 63.4 in unmanaged reference habitat.

**Table 8** – 2012 trout densities and population estimates in Alturas Lake Creek

| Transect (rivermile) | Year | Number of Passes | Transect Length (m) | Species | Number Caught | Total Length (mm) | | Density (fish/100m$^2$) | Pop estimate (Fish ≥ 60 mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Range | | |
| 24.43 | 2012 | 2 | 121 | Bull Trout | 27 | 83 | 75-104 | 3.98 | 51 |
| | | | | Brook Trout | 16 | 124 | 82-190 | 2.36 | 40 |
| | | | | | | | | | |
| 0.6 (Alpine Cr.) | 2012 | 3 | 101 | Bull Trout | 5 | 138 | 115-199 | 0.54 | 5 |
| | | | | Brook Trout | 8 | 89 | 45-131 | 1.18 | 9 |
| | | | | Bull/Brook Hybrid | 2 | 134 | 100-167 | 0.22 | 2 |
| | | | | | | | | | |
| 3.34 (Alpine Cr.) | 2012 | 3 | 101 | Bull Trout | 3 | 131 | 117-155 | 0.63 | 3 |
| | | | | Westslope Cutthroat | 2 | 112 | 88-135 | 0.42 | 2 |

***Big Boulder Creek*** – Juvenile bull trout were detected in five of seven 100m electrofishing sites on the mainstem Big Boulder and Jim Creeks in 2012 within this 17,712 acre (7.64 accessible miles) patch (Figure 9). A total of 27 bull trout of all age classes were captured at 5 sites. Population estimates ranged from 1-11 fish (Table 9) with higher abundance observed just below the barrier falls. These estimates are higher than those found by the Salmon Challis N.F. in Upper Salmon River tributaries (Gamett et al. 2010). Bull trout ranged from 90-200mm total length and dominant age classes are 1+ and 2+.

Bull trout distribution in 2012 continues to be similar to what has been observed in past surveys. Bull trout had been detected previously in Big Boulder in 2006 and 2009-2011 by the Sawtooth National Forest. In 2009 bull trout were found in lower Jim Creek (0.6 miles above the Big Boulder confluence) which is just downstream of barrier falls. Bull trout were also found again up to the barrier falls (1.9 miles above the Jim Creek confluence) in the main channel of Big Boulder Creek. Above these falls only stocked rainbow, westslope cutthroat or hybrids were found at the five surveyed transects. Extensive snorkel surveys of Big Boulder Creek in 2000 also observed steelhead/redband trout, bull trout, cutthroat, and brook trout below the falls, and redband and cutthroat above the falls. Below the falls, both resident and fluvial bull trout were observed.

Three multiple pass sites were resurveyed in 2012. Densities range from 0.15-3.26/100 $m^2$ in 2012 with the highest densities occurring in Jim Creek. 2012 densities at Big Boulder site 7.5 are similar to 2011, while densities in Jim Creek (site 0.77) are higher than 2011 (Table 3). Densities in Jim Creek in 2012 are slightly higher than those found by IDFG in Fourth of July Creek (0.9-3.5 fish/100$m^2$) for bull trout at least 70mm in fork length (IDFG 2005). However, densities in 2011 and 2012 in Big Boulder Creek are generally lower than those found in Fourth of July Creek. This could be due to poor electrofishing efficiencies in Big Boulder due to the substantial size of the stream at sites lower in the drainage.

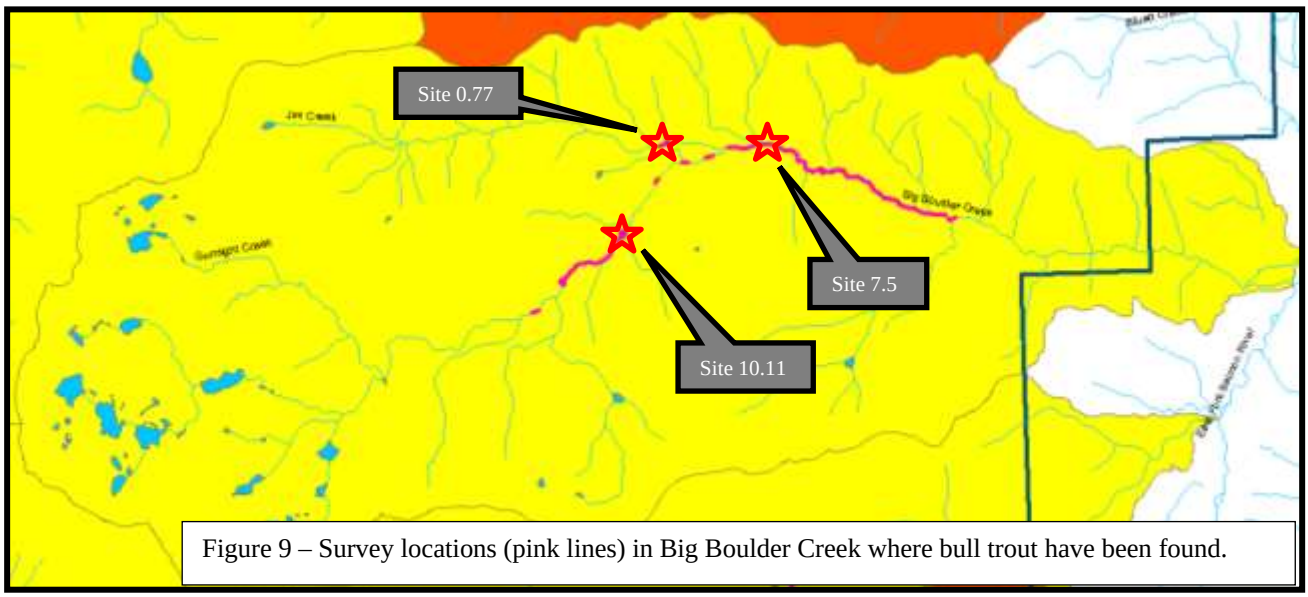



Figure 9 – Survey locations (pink lines) in Big Boulder Creek where bull trout have been found.

Water temperatures monitored in the lower reaches of Big Boulder Creek from May to mid-August 1994 recorded MWMT temperatures less than 16.0°C. Recent temperature monitoring in 2006 and 2010 found stream temperatures of 16.0°C and 13.5°C in Boulder Creek and 14.8°C in 2005 in Jim Creek.

Management disturbances during the past century have been extreme in some areas of this patch, near and below the Livingston Mill mine. In 1925 a power dam was constructed on the mainstem and operated until it was abandoned in 1941. In 1991 a passable notch was cut in the dam, and the accumulated sediments upstream removed. This dam eliminated all migratory fish from E.F. Salmon River from reaching headwater habitat for almost 50 years. Fluvial bull trout have since been observed upstream of the dam.

Portions of the Big Boulder Creek subwatershed has been extensively mined since the 1920's contaminating soils in the valley bottom with zinc, lead, and arsenic. In the 1960s Big Boulder Creek was diverted into a low sagebrush swale near the Livingston Mill to avoid growing conflicts with the mine tailings. The fine textured soils and shallow roots within the swale quickly gave way and an extensive blowout emerged and expanded over the following decades – up to 25 feet in depth, 250 feet across, and nearly ¼ mile in length. Tens of thousands of cubic yards of sediment buried downstream habitats and initiated similar channel responses. Efforts to prevent further expansion of the blowout and rehabilitate the area were attempted in 1994 and have been partially successful.

In 2008 shallow tailings and contaminated soils within the Livingston Mill site were "treated in place" in an on-site repository. All but approximately 120 of the 71,600 cubic yards were placed in a central repository. The remaining 120 cubic yards were treated in place with a mixture of compost and soil amendments. Treatments have reduced exposure to potential contaminants of concern and should in time improve water quality in Jim Creek and Big Boulder Creek by decreasing contaminant loading from the mine tailings areas.

The Big Boulder Creek road (#667) is cut into the steep slope sitting immediately above Big Boulder Creek. The road suffers chronic erosion problems brought on from this untenable location, and from inadequate surface, cut, and fill slope drainage. Chronic disturbance has also occurred from sheep and cattle grazing on public and private lands. Cattle grazing had impacted (i.e. compaction, pedestal formation, and excessive browse) riparian areas below Livingston Mill and within select headwater tributaries. However, this drainage has been rested since 2004 and many impacted areas are beginning to recover. Finally, near the mouth on BLM and private lands, much of Big Boulder Creek is diverted in the summer for irrigation purposes before reaching the East Fork.

A PIBO integrator reach is located 0.89 miles below the Livingston Mill Mine. The habitat index score from 2005 survey is 57.9 and in 2010 49.4 indicating moderate habitat conditions within this site compared to reference streams. The slight changes in the index scores between 2005 and 2010 appear to be from decreases in the number of pools, pool depth, and woody debris frequency. However photos (Figures 10 and 11) show an improvement in riparian condition and streambank stability. This is likely due to the resting the grazing allotment since 2004.

Figure 10 – Riparian and stream conditions in 2005 within the Big Boulder PIBO Integrator reach.

Figure 11 – Riparian and stream conditions in 2010 within the Big Boulder PIBO Integrator reach.

**Table 9 –** 2012 trout densities and population estimates in Big Boulder Creek

| Transect (rivermile) | Year | Number of Passes | Transect Length (m) | Species | Number Caught | Total Length (mm) | | Density (fish/100m$^2$) | Pop Estimates (Fish ≥ 60 mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Range | | |
| 0.77 (Jim Cr.) | 2012 | 2 | 92 | Bull Trout | 6 | 238 | 185-460 | 3.26 | 6 |
| | | | | | | | | | |
| | 2011 | 3 | 92 | Bull Trout | 1 | 162 | -- | 0.45 | 1 |
| | | | | | | | | | |
| 10.11 | 2012 | 2 | 105 | Bull Trout | 1 | 89 | -- | 0.15 | 1 |
| | | | | Westslope Cutthroat | 3 | 153 | 120-216 | 0.44 | 3 |
| | | | | | | | | | |
| | 2011 | 3 | 103 | Bull Trout | 7 | 156 | 90-200 | 0.92 | 7 |
| | | | | Westslope Cutthroat | 2 | 172 | 139-205 | 0.26 | 2 |
| | | | | | | | | | |
| 7.5 | 2012 | 3 | 102 | Bull Trout | 3 | 129 | 101-170 | 0.48 | 5 |
| | | | | Westslope Cutthroat | 11 | 144 | 76-225 | 1.77 | 11 |
| | | | | Cut-Bow | 3 | 118 | 74-199 | 0.48 | 3 |
| | | | | | | | | | |
| | 2011 | 3 | 108 | Bull Trout | 2 | 137 | 102-172 | 0.33 | 2 |
| | | | | Rainbow Trout | 1 | 73 | -- | 0.16 | 1 |
| | | | | Westslope Cutthroat | 3 | 201 | 129-251 | 0.49 | 5 |
| | | | | Cut-Bow | 1 | 138 | -- | 0.16 | 1 |
| | | | | | | | | | |
| 11.12 | 2012 | 3 | 100 | Bull Trout | 7 | 166 | 129-205 | 1.18 | 11 |
| | | | | Westslope Cutthroat | 4 | 152 | 62-240 | 0.68 | 4 |
| | | | | | | | | | |
| 14.0 | 2011 | 3 | 115 | Westslope Cutthroat | 3 | 187 | 171-200 | 0.31 | 3 |
| | | | | Cut-Bow | 5 | 143 | 90-240 | 0.53 | 8 |

***Little Boulder Creek*** – A juvenile bull trout was detected at one of the seven 100m electrofishing sites within this 11,755 acre (6.45 accessible miles) patch (Figure 12). The one bull trout captured at site 5.37 and was 125mm in total length. Rainbow trout were found in 3 sites (rivermile 0.02, 1.04, and 7.66) and westslope cutthroat at 1 site (rivermile 7.66), but in low densities. Low fish numbers are believed due to poor electrofishing efficiency due to high mid-July streamflows. Fluvial bull trout have been observed previously within the mainstem of Little Boulder Creek. Bull trout, westslope cutthroat, and cutthroat/rainbow hybrids have also been found previously in 2000 (R1/R4) and 2006 (bull trout MIS) surveys.

Streams within Little Boulder originate in high elevations and flow much of their lengths to their mouths through shaded environments. During May to mid-August 1994-1996 temperatures in Little Boulder Creek remained below 16°C. in 2006 MWMT was 15.6°C in Little Boulder 1.3 miles above the E.F. Salmon confluence.

Little Boulder Creek was until recently extensively grazed by cattle. The most intensive grazing occurred within the tributaries where riparian habitats were altered and their integrity compromised. As of 2002 riparian conditions adjacent to 22% of the stream miles within the pasture were classified as not moving toward Forest Plan vegetation management objectives. In 2004, however, the pasture was placed in a non-use status until resources recovered (e.g. annual leaf growth of hydric grass exceeded 8"; woody species with at least 10% in sprouts, seedlings and sapling categories; and bank stability is improved to at least 90% of what conditions would be expected under natural conditions). In 2010 a 3.8 mile visual recon survey of the pasture was completed and streambank stability was found to be meeting desired conditions. Much of the

stream was also found to have large beaver dam complexes and improved riparian conditions. Other surveys found, however, that upland riparian areas still needed further recovery. Thus cattle are still excluded from all of Little Boulder Creek.

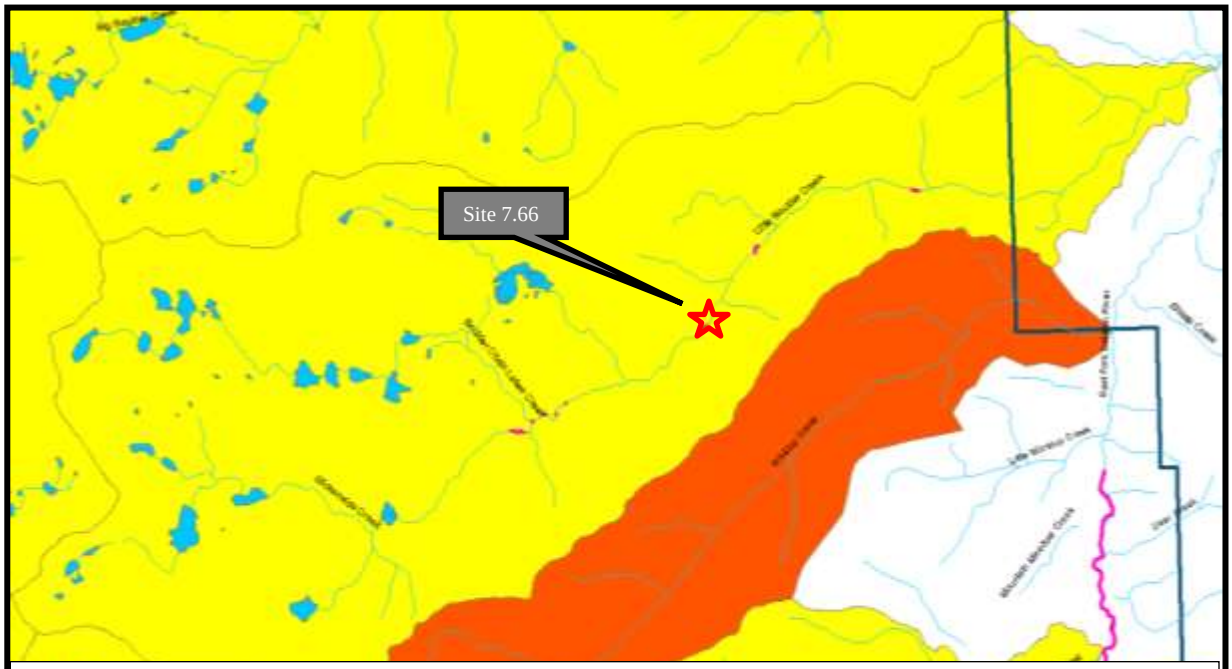



Figure 12 – Survey locations (pink lines) in Little Boulder Creek where bull trout have been found.Figure 3 –

At 1.5 miles from the mouth, Little Boulder leaves the National Forest and passes through adjacent BLM and private lands where water is diverted by two diversions for irrigation. It is unknown to what degree these diversions constrict fish passage. A PIBO integrator reach is located 2.4 miles below the E.F. Salmon River confluence. The habitat index score from 2005 survey is 72.1 and in 2010 68.5 indicating moderate to good habitat conditions when compared to reference streams. PIBO found habitat indices averaged 63.4 in unmanaged reference habitat.

**Table 10 –** 2012 trout densities and population estimates in Little Boulder Creek

| Transect (rivermile) | Year | Number of Passes | Transect Length (m) | Species | Number Caught | Total Length (mm) | | Density (fish/100m$^2$) | Pop estimate (Fish ≥ 60 mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Range | | |
| 7.66 | 2012 | 2 | 89 | Westslope Cutthroat | 1 | 145 | -- | 0.21 | 1 |
| | | | | Rainbow Trout | 1 | 53 | -- | 0.21 | 1 |

***Fishhook Creek*** – Juvenile bull trout were detected at two of the eight 100m electrofishing sites within this 7,853 acre (11.5 accessible miles) patch (Figure 13). A total of 4 bull trout were captured at 2 sites. Bull trout ranged from 84-135mm total length and dominant age classes are 1+ and 2+. Brook trout were found in 3 sites within Fishhook Creek (rivermile 2.23-4.13). One bull/brook trout hybrid was also found higher in the drainage at (site 5.57). Bull and brook trout had been found previously in Fishhook Creek during reconnaissance surveys in 1998 as well as electrofishing surveys in 2008. Brook trout in particular are very abundant in Fishhook likely due to extensive headwater lakes and stream stocking. Lower Fishhook Creek above Redfish Lake is used by bull trout, brook trout, and kokanee for spawning. Migratory bull trout are likely helping to sustain this local population.

Since 1998, IDFG has conducted redd count surveys in Fishhook Creek to monitor long-term bull trout spawning trends. Two counts (late August and mid-September) are conducted about two weeks apart on Fishhook Creek to monitor the timing and numbers of bull trout spawning redds. All redds in progress or completed redds are counted during the first survey and flagged for identification. On the second survey, additional completed redds were counted and included with the number of flagged redds to provide a total number of redds. Redds have ranged from 11-33 over this time period. In 2010 11 redds were observed in the trend transect (Table 11).

**Table 11** – Bull trout redd counts in Fishhook Creek

| | # Of Redds | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stream** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| Fishhook Creek | 15 | 18 | 15 | 17 | 17 | 11 | 23 | 25 | 21 | 13 | 33 | 11 |

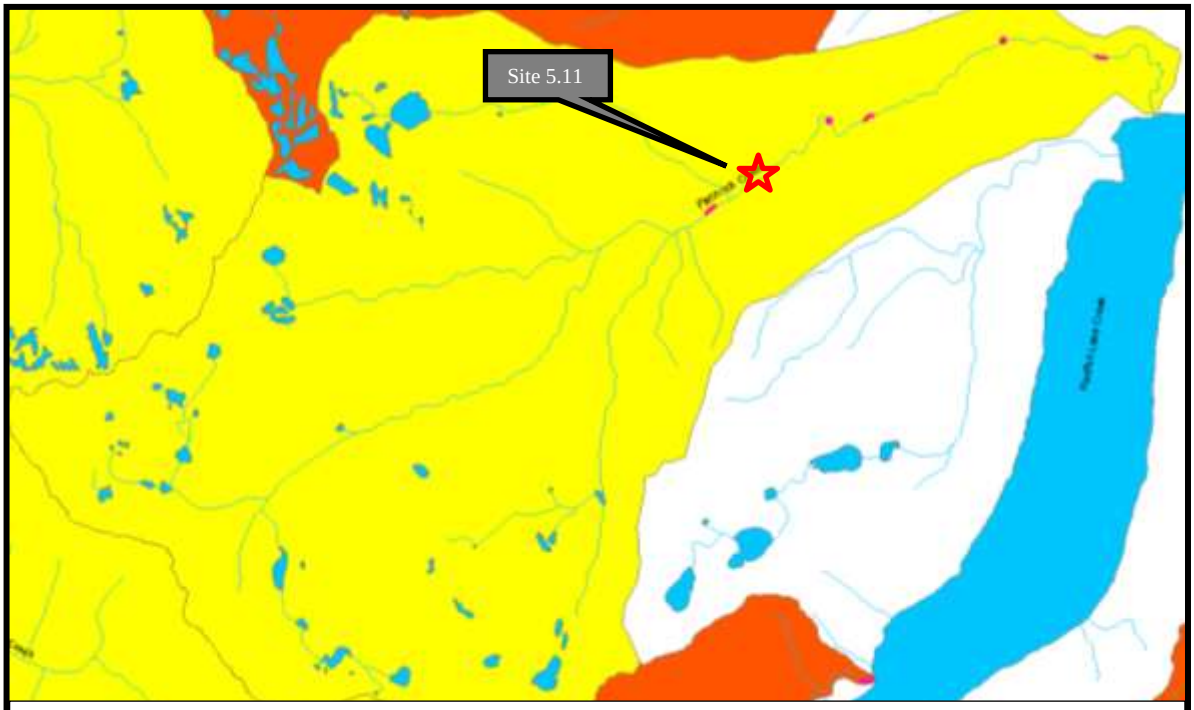



Figure 13 – Survey locations (pink lines) in Fishhook Creek where bull trout have been found.

Temperatures range from 12-15ºC in Fishhook Creek given the high alpine headwaters and unaltered riparian vegetation in this drainage. The large majority of the watershed remains in near natural condition with the exception of fire suppression that has resulted in most forests being in late serial condition. Visual observations in Fishhook Creek suggest that fines are naturally high as result of its granitic source. BURP surveys in Fishhook Creek estimated the percent fines to be 18% near the mouth.

**Table 12 –** 2012 trout densities and population estimates in Fishhook Creek

| **Transect (rivermile)** | **Year** | **Number of Passes** | **Transect Length (m)** | **Species** | **Number Caught** | **Total Length (mm)** | | **Density (fish/100m$^2$)** | **Pop estimate (Fish ≥ 60 mm)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Mean** | **Range** | | |
| 5.11 | 2012 | 3 | 99 | Brook Trout | 4 | 83 | 66-115 | 0.47 | 6 |

## Patches Where Bull Trout Were Not Detected

Bull trout were not detected in Elk and Shake in the S.F. Boise subbasin, and Big Lake, Pole, and Yellowbelly Creeks in the Upper Salmon subbasin. Sampling results and potential reasons bull trout have not been found are discussed in detail below.

***Elk Creek*** – Bull trout were not detected in two 100m electrofishing sites (probability of detection 0.76) within this 1,599 acre patch. Only three redband trout were observed in the mainstem, but other redband were missed due to the difficult sampling (thick brush) conditions. Findings are similar to previous surveys. Redband were the only fish detected in the lower mile in 2005 despite three 100m transects being sampled. Elk Creek was also sampled in 1993 (at 5,960 feet) and in 1994 (at 6,000 feet) by IDFG with only redband trout recorded (Partridge et al. 2000). Despite a lack of observed bull trout, Elk Creek has water temperatures that are preferred by bull trout, with MWMT at the lowest point of the patch recorded as 14.5º C and 12.6º C, respectively. However, accessible habitat within this patch is limited to the lower most mile because of steep gradients (>11%), potential natural barriers, and small stream widths.

Stream habitat is in relatively good condition higher in the drainage. However, lower portions have been impacted by diversions resulting in upstream migration barriers due to the structures or insufficient summer flow. Minimum timber harvest has occurred and with little influence to the drainage. Some hydraulic mining historically had substantial influence in lower reaches of Elk Creek.

***Shake Creek*** - Bull trout were not detected in two 100m presence/absence electrofishing sites (probability of detection 0.76) within this 3,515 acre patch. Sites occurred just upstream (0.03 miles) and 1.58 miles from the S.F. Boise confluence. Only redband trout and sculpin were observed in the mainstem. Subadult-sized bull trout have been previously found by Sawtooth N.F. crews in 2008 and 2002. However, other surveys in 1993, 1994, and 1996 by IDFG only detected redband trout and sculpin despite two 100m electrofishing sites in each year (Partridge et al. 2000). The 2008 crew discovered a steep cascade fish barrier approximately 2.5 miles above the S.F. Boise confluence. No fish were found above this barrier despite several transects being sampled.

The Shake Creek patch has MWMT of 13.6-15.1 ºC (2009) that is within the preferred range of bull trout. However, very little of this cold water habitat is accessible due to a steep cascade fish barrier. Temperatures below this barrier are warmer ranging from 15.5-18.1º C MWMT (2003, 2007, 2009-2010). Habitat conditions lower in the drainage have been influenced by the 005 road, historic sheep grazing, small debris flows from the 2008 South Barker fire, logging, a Forest Service irrigation diversion, and seasonal culvert barriers. The Forest Service irrigation diversion is a known barrier blocking upstream passage during low flows. Numerous redband trout have also been found in the unscreened ditch and stranded in the irrigated pastures/lawn for the Shake Creek guard station.

A PIBO integrator reach is located on Shake Creek 0.2 miles upstream of the S.F. Boise River confluence. The habitat index score from 2003 survey is 50.5 and in 2008 33.2 indicating moderate habitat conditions within this site compared to reference streams. Changes in PIBO scores between 2003 and 2008 are from a decrease in pools and an increase in bankfull width.

While the patch size and upper drainage water temperature of Shake Creek appear to be suitable for bull trout, the lower section of the stream accessible to migratory fish is apparently some combination of too warm and too short to support reproduction by this species.

***Big Lake Creek*** – Bull trout were not detected in five 100m presence/absence electrofishing sites (probability of detection 0.97) within this 17,257 acre patch. Four sites occurred up to 1.83 miles above Jimmy Smith Lake and one site occurred on Corral Creek. Only rainbow trout and sculpin were observed in Big Lake Creek and no fish were found in Corral Creek. Findings are similar to Sawtooth N.F. electrofishing (2005) and snorkel (1999) survey above the lake. It is likely the majority of these fish are redband due to the barrier below Jimmy Smith Lake, but IDFG stocking activities in the 1930's of rainbow trout makes this an uncertainty. Below the lake, little information is available. However, the natural elevated (above 20 ºC in 1999 and 2004) stream temperatures may limit bull trout. MWMT in Big Lake Creek above the lake ranged from 13.1 ºC (1999) to 16.3 ºC (2004).

Other than prescribed fires in the 1980s, primary disturbance has been livestock grazing for over 100 years – sheep and then cattle. Streamside riparian areas are shrub dominated above the lake, but have been diminished in many areas by intensive grazing. The mainstem of Big Lake Creek, particularly the lower half, passes through dense stands of mature willow and alder. These dense stands typically preclude cattle access to the stream except at crossings or watering locations. In many of these reaches the dense mature shrubs provide bank protection while adjacent riparian conditions have been altered.

The headwaters and tributaries of Big Lake Creek, including their source seeps and springs, are typically not associated with riparian shrub habitats, and have experienced the greatest change. Trampling, chiseling, and soil puddling have substantially altered many of these fragile, accessible habitats. Where riparian shrub communities do exist, they are typically mature and decadent. Surface fines range from 17 - 30% in upstream spawning reaches and 37- 47% below the lake. Much of the human activity is focused around Jimmy Smith Lake. The road and trailhead below the lake may contribute fine sediment to stream be causing the greatest impact to habitat.

***Pole Creek -*** Bull trout were not detected in two 100m single pass electrofishing sites (probability of detection 0.76) in the mainstem of the Pole Creek (1.1 miles above Twin Creek tributary) within this 13,023 acre patch. Only brook trout and westslope cutthroat x rainbow hybrids were observed. These surveys in addition to the 2011/2009 Forest Service and 2004 IDFG surveys continue to suggest that this patch does not support a reproducing bull trout population despite 10.1 miles of habitat above the diversion.

Bull trout are believed to not occupy this patch because of warm summer water temperatures (MWMT 16°C to 20°C) on private property and the historic/current effects of water withdrawals lower in the drainage. Prior to 1982, Pole Creek was seasonally isolated by seven irrigation diversions in the lower 4.5 miles of the drainage. During the irrigation season, these water diversions severely reduced the available fish habitat and, in very low water years, prevented upstream migration by fish to unaffected habitat above the diversions. These diversion points were also sources of fish entrainment from Pole Creek to irrigation ditches. Since consolidation into one diversion in 1983, dewatered conditions have occurred less frequently. However, passage issues and habitat impacts still persist. IDFG recently concluded that the presence of a low water barrier upstream of the hydro-power plant return flow and the irrigation diversion structure may be a key reason for the absence of fluvial bull trout in the Pole Creek (IDFG 2005a).

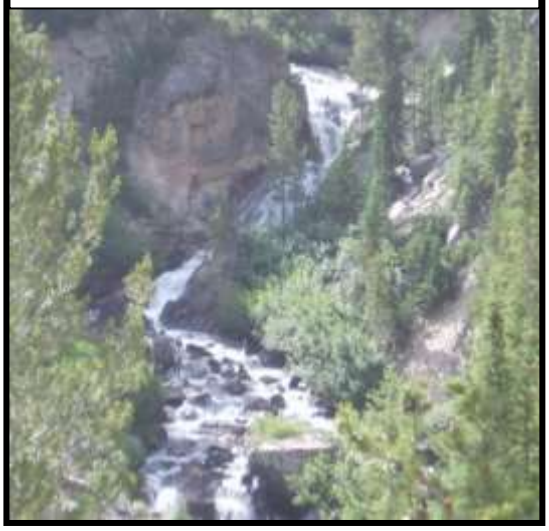
Other conditions that may have contributed to bull trout absence include: (1) impaired habitat conditions on private due to grazing and irrigation pivots; (2) complete and partial culvert barriers (one on private property and three barriers on the Forest above the PC7 diversion); (3) elevated instream sediment from historic mining, high route density and sheep grazing; and (4) high brook trout densities (6.1 fish/100m$^2$).

Stream habitat in the headwaters of this patch is in relatively good condition. Stream temperature (MWMT) measured in Pole Creek (approx. 25 miles below Twin Creek) by the USFS in 2005 was well within the optimal range for bull trout (11.6ºC). Although some localized impacts from sheep grazing, system and non-system roads, and developed and dispersed recreation occur.

A PIBO integrator reach is located 4.57 miles upstream of the Salmon River confluence just above the PC7 water diversion. The habitat index score from 2005 survey is 66.8 and in 2010 50.3 indicating moderate habitat conditions within this site compared to reference streams. Changes in PIBO scores between 2005 and 2010 appear to be from an increase in fine sediment in pool tailouts.

***Yellowbelly Lake Creek*** – Bull trout were not detected in five100m single pass electrofishing sites (probability of detection 0.97) in the mainstem of the Yellowbelly Lake Creek within this 6,795 acre patch. Only sculpin and one westslope cutthroat were found. However, results are far from conclusive given the poor electrofishing efficiency from high water and deep habitat. No bull trout were observed in previous Forest Service sampling efforts (2004) where three single-pass and one three-pass electrofishing sites were completed. Brook trout are believed to be numerous and widely distributed above the lake due to historic stocking. Numerous chinook, steelhead, and cutthroat have been observed in Yellowbelly Lake Creek near the mouth below the lake during IDFG transect monitoring in 1991-95. No bull trout, however, were observed. One bull trout was observed in 2007 electrofishing surveys at the confluence of the creek and Yellowbelly Lake inlet. So a small population may exist in the lake. However, habitat is believed limited above the lake due to barrier cascades (Figure 14) 2.2 miles above the lake's inlet. A natural seasonal impediment also exists approximately 0.5 miles above the mouth where Yellowbelly Lake Creek passes through 0.25 miles of course glacial deposits. In summer this results in subsurface flows beneath this large boulder matrix.

Figure 14 – Barrier cascades below on Yellowbelly Creek Farley Lake.



Temperatures above the Yellowbelly Lake in 2002 and 2005 had a MWMT of 19 $^{o}$C and 18.6 $^{o}$C. Below Yellowbelly lake temperatures during the same time period were much warmer (21.7 and 26 $^{o}$C) likely due to surface heating of the lake. Habitat conditions lower in the drainage have been essentially unaltered and are believed to be functioning appropriately. However, fine sediment is naturally high from granitic parent materials. IDFG management of the lake through the former rough fish barrier and chemical treatments has had the greatest influence on fish populations. A concrete rough-fish barrier constructed in 1962 existed below the lake and

prevented upstream migration prior to its removal in 2000. Recreation use on public land and minor development on private land near the mouth have also had small influence.

**Summary** – The 2012 data continues to show that occupied juvenile bull trout patches are larger (11,261) than unoccupied patches (8,438) (Table 13). Occupied patches also have more accessible miles (7.42 vs. 1.20), better connectivity within and to the patch, colder MWMT (15.7°C vs. 17.8°C), better watershed conditions as determined by the matrix of pathways and indicators, and better PIBO index scores (51.5 vs. 43.3) than unoccupied patches.

Although the factors that influence which patches are occupied or unoccupied are complex, other studies have made similar conclusions to the observations stated above. Rieman and McIntyre (1995) found that patch size was highly significant in determining bull trout presence. Subwatersheds whose overall aquatic conditions are "functioning appropriately" generally have good water quality; lower route densities or no roads; fewer grazing impacts; and fewer dispersed recreation opportunities. Subwatersheds whose overall aquatic conditions are considered "functioning at unacceptable risk" generally have poorer water quality; more culverts or water diversion barriers, simplified habitat conditions, higher route densities, more grazing impacts, and more dispersed recreation. These conditions, coupled with the presence of non-native brook trout in some patches, appear to have made it more difficult for bull trout to maintain or reestablish a local population within a patch.

**Table 13 –** Important indicators within occupied and unoccupied patches

| Patch Name | Patch Acres | Accessible Habitat Miles | Connectivity | % of Miles with Brook Trout | MWMT °C | PIBO Integrity Index | Watershed Condition |
|---|---|---|---|---|---|---|---|
| **Occupied Patches** | | | | | | | |
| Boardman Creek | 12,561 | 10.90 | Unimpaired | 0 | 10.0-17.9 | 29.5 (2010) | **FA** |
| Deadwood Creek | 4,558 | 2.22 | Unimpaired | 0 | 15.0-16.0 | -- | **FA** |
| Skeleton Creek | 13,108 | 11.02 | Unimpaired | 0 | 9.9-16.0 | 44.4 (2010) | **FR** |
| Bear Creek | 6,672 | 5.93 | Unimpaired | 0 | 13.6-14.0 | -- | **FA** |
| Fishhook Creek | 7,853 | 3.73 | Unimpaired | 100 | 12.8-15.2 | -- | **FA** |
| Alturas Lake Creek | 15,871 | 11.50 | Unimpaired | 70 | 12.0-15.2 | 65.7 (2010) | **FR** |
| Little Boulder Creek | 11,754 | 6.45 | Unimpaired | 0 | 15.6 | 68.5 (2010) | **FR** |
| Big Boulder Creek | 17,712 | 7.64 | Unimpaired | 0 | 13.5-16.0 | 49.4 (2010) | **FR** |
| Average or Range | 11,261 | 7.42 | -- | 21 | 12.4-15.7 | 51.5 | **FR-FA** |
| **Unoccupied Patches** | | | | | | | |
| Elk Creek | 1,599 | 0.47 | Unimpaired | 0 | 12.9 | -- | **FR** |
| Shake Creek | 3,515 | 0.56 | Impaired | 0 | 17.1 | 33.2 (2008) | **FUR** |
| Yellowbelly Creek | 6,795 | 0.41 | Unimpaired | 75 | 18.9 | -- | **FA** |
| Big Lake Creek | 17,257 | 0.00 | Impaired | 0 | 14.8-20.2 | 46.3 (2010) | **FR** |
| Pole Creek | 13,023 | 4.57 | Impaired | 90 | 12.0-20.0 | 50.3 (2010) | **FR** |
| Average or Range | 8,438 | 1.20 | -- | 33 | 13.4-17.8 | 43.3 | **FUR-FA** |

Patches in the S.F. Boise River drainage generally support higher bull trout densities (Avg. 1.32-4.12/100m$^2$) than patches in the Upper Salmon (Avg. 0.97-1.72/100m$^2$). In particular Boardman (3.43/100m$^2$), Skeleton (4.12/100m$^2$), and Bear (3.58/100m$^2$) patches support the highest densities based on the last two years of monitoring.

**Table 14 -** Fish species detected during 2012 MIS sampling on the Sawtooth N.F.

| | | Species Observed | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Subbasin** | **Patch** | **Bull Trout** | **Brook Trout** | **Rainbow Trout** | **Westslope Cutthroat Trout** | **Chinook Salmon** | **Sculpin** | **Whitefish** |
| Upper Salmon | Pole Creek | | + | | | | | |
| Upper Salmon | Alturas Lake Creek | + | + | + | + | | + | |
| Upper Salmon | Yellowbelly Creek | | | | + | | + | |
| Upper Salmon | Big Lake Creek | | | + | | | + | |
| Upper Salmon | Fishhook Creek | + | + | | | | + | |
| Upper Salmon | Big Boulder Creek | + | | | + | | | |
| Upper Salmon | Little Boulder Creek | + | | + | + | | | |
| S.F. Boise | Boardman Creek | + | | + | | | + | |
| S.F. Boise | Deadwood Creek | + | | + | | | | |
| S.F. Boise | Skeleton Creek | + | | + | | | + | |
| S.F. Boise | Bear Creek | + | | + | | | + | |
| S.F. Boise | Elk Creek | | | + | | | | |
| S.F. Boise | Shake Creek | | | + | | | + | |

## Bull Trout Detection Probabilities

Electrofishing data collected since 2004 allows for an empirical estimate of probability of detection that is independent from detection probabilities that are modeled by the Western Division of the American Fisheries Society (WDAFS) protocol. Empirical estimates are derived by randomly sampling in patches known to support a local bull trout population and then dividing the number of sites where juvenile bull trout were detected by the number of sites where juvenile bull trout were not observed (Table 15). This estimate can then be used to assess the level of uncertainty associated with a patch where no juvenile bull trout are observed.

When monitoring began in 2004 probabilities of detection at a patch scale typically ranged from 0.21 (3-100m sites) to 0.52 (8-100m sites) using the WDAFS estimates. This implied that we could only be 21-52% confident that bull trout densities in patches where juveniles were not detected were lower than others observed in the Salmon, Clearwater and Boise subbasins in Idaho.

After nine years of sampling every bull trout patch on the Forest it appears that the densities, sampling efficiencies, and site level detection probabilities are higher than those estimated by WDAFS. This has been noted by other sampling efforts in the Boise and Payette subbasins (Rieman and Kellett, personal communication). We have found that when juvenile bull trout are present, they were usually observed during the first electrofishing pass of the first sample site within a patch when there is good electrofishing efficiency. This suggests that in occupied patches, bull trout are relatively easy to detect. With current empirical site-level estimates of detection probabilities, cumulative patch level probabilities approach 0.51 per site or 0.97 when 3 sites are sampled within a patch. This implies that we have a higher level of confidence that juvenile bull trout are either at extremely low densities or are not present within the patch. However, absence can never be 100% certain unless perhaps the stream is dewatered.

**Table 15 -** Overall site-level empirical estimate of bull trout detection probabilities.

| Subbasin | Patch | # of Sites Sampled | # with BLT | # with Juv. BLT |
|---|---|---|---|---|
| Upper Salmon | West Pass | 6 | 4 | 2 |
| Upper Salmon | Bowery Creek | 13 | 5 | 5 |
| Upper Salmon | Big Boulder | 45 | 25 | 17 |
| Upper Salmon | Little Boulder | 8 | 5 | 4 |
| Upper Salmon | Slate | 6 | 2 | 0 |
| Upper Salmon | Warm Spring (Pigtail/Martin/Garland) | 28 | 13 | 9 |
| Upper Salmon | E.F. Valley Creek | 5 | 5 | 5 |
| Upper Salmon | Fishhook | 9 | 6 | 5 |
| Upper Salmon | Crooked | 7 | 1 | 1 |
| Upper Salmon | Alturas | 15 | 9 | 9 |
| Upper Salmon | Champion Creek | 3 | 1 | 1 |
| Upper Salmon | Germania Creek | 7 | 6 | 5 |
| S.F. Payette | Trail Creek | 4 | 3 | 2 |
| M.F./N.F. Boise | Queens River | 7 | 4 | 1 |
| S.F. Boise | Boardman Creek | 24 | 20 | 13 |
| S.F. Boise | Skeleton Creek | 27 | 24 | 17 |
| S.F. Boise | Deadwood Creek | 14 | 13 | 12 |
| S.F. Boise | Willow Creek | 5 | 5 | 4 |
| S.F. Boise | Big Peak | 8 | 8 | 7 |
| S.F. Boise | N.F. Big Smoky | 5 | 4 | 4 |
| S.F. Boise | Bluff | 2 | 2 | 2 |
| S.F. Boise | Upper Big Smoky | 4 | 4 | 4 |
| S.F. Boise | W.F. Big Smoky | 3 | 2 | 1 |
| S.F. Boise | Bear | 10 | 8 | 8 |
| S.F. Boise | Upper S.F. Boise | 11 | 3 | 2 |
| S.F. Boise | Emma Creek | 6 | 4 | 4 |
| | | | | |
| Total | | 282 | 186 | 144 |
| Empirical Estimate of Probability of Detection | | | | **144/282 = 0.51** |

**Table 16** - Summary of results from 2012 aquatic MIS sampling on the Sawtooth N.F.

| Subbasin | Patch | Strata Designation in 2011 | Bull Trout Detected | # Sites sampled | # Sites where Bull Trout < 150mm were found | Empirical Probability Of Detection |
|---|---|---|---|---|---|---|
| Upper Salmon | Pole Creek | 3 | - | 2 | 0 | 0.76 |
| Upper Salmon | Alturas Lake Creek | 1 | + | 15 | 9 | NA |
| Upper Salmon | Yellowbelly Creek | 3 | - | 5 | 0 | 0.97 |
| Upper Salmon | Big Lake Creek | 3 | - | 5 | 0 | 0.97 |
| Upper Salmon | Fishhook Creek | 1 | + | 8 | 2 | NA |
| Upper Salmon | Big Boulder Creek | 1 | + | 7 | 4 | NA |
| Upper Salmon | Little Boulder Creek | 1 | + | 7 | 1 | NA |
| S.F. Boise | Boardman Creek | 1 | + | 10 | 5 | NA |
| S.F. Boise | Deadwood Creek | 1 | + | 4 | 2 | NA |
| S.F. Boise | Skeleton Creek | 1 | + | 12 | 7 | NA |
| S.F. Boise | Bear Creek | 1 | + | 7 | 5 | NA |
| S.F. Boise | Elk Creek | 3 | - | 2 | 0 | 0.76 |
| S.F. Boise | Shake Creek | 3 | - | 2 | 0 | 0.76 |

## Bull Trout Trends on the Sawtooth National Forest Since 2004

In 2004, fisheries staff identified and stratified 97 bull trout patches on the Sawtooth NF. Since that time seven additional patches have been identified in the Upper Salmon subbasin and one dropped in the S.F. Boise subbasin resulting in 104 patches on the Forest. During the 2004 to 2012 field seasons, crews completed MIS protocol surveys in 100% of the category 1 patches. Bull trout presence was confirmed in 36 patches; habitat was determined to be suitable but no bull trout were detected in 17 patches; and habitat was determined to be unsuitable in 51 patches.

Data collected over the past nine years were compared with information collected prior to 2004 to provide a preliminary indication of bull trout trend across the planning unit. Results from this comparison indicate a slight increase in bull trout distribution in the S.F. Boise, M.F./N.F Boise, and Upper Salmon subbasins. Bull trout were probably present, but previously undetected, in many of the patches that are now reclassified as occupied (category 1). Still, the data indicates that bull trout presence is more robust than previously thought in 2004 and that bull trout are still occupying most patches where previously detected. Table 17 shows an increase in the number of unsuitable/inaccessible patches in the S.F. Boise and Upper Salmon subbasins. These patches were reclassified as unsuitable based on recently acquired data that documented unfavorable existing conditions such as streams with culvert barriers, maximum weekly maximum temperature that exceed 15 °C over most of the available habitat, abundant brook trout populations, and no strong bull trout populations in adjacent streams.

**Table 17** - Comparison of bull trout patch strata 2004-2012.

| Category | S.F. Boise Subbasin | | N.F. and M.F. Boise Subbasin | | S.F. Payette Subbasin | | Upper Salmon Subbasin | |
|---|---|---|---|---|---|---|---|---|
| | # Patches 2004 | # Patches 2012 | # Patches 2004 | # Patches 2012 | # Patches 2004 | # Patches 2012 | # Patches 2004 | # Patches 2012 |
| 1 – Occupied | 11 | 13 | 4 | 4 | 0 | 2 | 6 | 17 |
| 2 – Suitable/Unoccupied | 22 | 7 | 1 | 1 | 4 | 2 | 28 | 7 |
| 3 – Unsuitable/Inaccessible | 10 | 23 | 0 | 0 | 0 | 0 | 3 | 28 |
| 4 - Unsurveyed | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 |
| Total | 43 | 43 | 5 | 5 | 4 | 4 | 45 | 52 |

## Conclusion

A variety of factors influences the distribution of bull trout populations across the Sawtooth National Forest. As has been reported in the literature, results from our MIS sampling indicate that patch size, stream temperature, patch connectivity, habitat condition, and the occurrence of brook trout can all influence the presence or absence of reproducing bull trout populations. Information collected over the past eight years has better defined bull trout distributions within patches and across each subbasin. At the subbasin scale it appears bull trout local populations have remained stable since 2003 with the exception of the loss of a hybridized population in Crooked Creek. However, there are concerns that some populations are at risk from hybridization from brook trout (E.g. Fishhook and Alturas Lake Creeks). We have also found more occupied patches than previously thought. This doesn't imply bull trout have expanded their range. Only that we have confirmed their presence in streams that likely supported them all along. In 2012, bull trout populations continue to occupy Boardman, Deadwood, Skeleton, Big Boulder, Little Boulder, Fishhook, and Bear patches and are absent in Elk, Shake, Big Lake, Yellowbelly, and Pole patches with detection probabilities ranging from of 0.76 to 0.97.

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