2009 Sawtooth Aquatic 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."*
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> *"Population trends of the management indicator species will be monitored and relationships to habitat changes determined."*

An important criterion integral to the MIS foundation is that monitoring results must allow managers to answer questions about population trends. Historically, monitoring of habitat was used a surrogate for direct quantification of MIS populations. However, recent court cases (*Sierra Club v. Martin*, 168 F.3d 1 (11^{th} 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 revisited aquatic MIS species for the Draft Forest Plan EIS to determine if the population data were sufficient to determine trend at the Forest scale.

Following this reevaluation, bull trout 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. As a result, Forest bull trout populations are probably not heavily influenced by activities occurring outside Forest domains, and therefore changes in bull trout populations will more likely reflect local management activities.

Protocol

Objectives

- Over the existing 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 and small resident bull trout (<150 mm) for two reasons. First, presence of small bull trout is an indicator of key spawning and rearing areas. These areas represent habitats that are essential for bull trout populations. Other habitats within stream networks may be important for ranging or migrating individuals, but tracking fish in these areas is much more difficult. 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. In the future we intend to explore indices of abundance and distribution within individual streams that may be useful to characterize linkages with local management.

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 both down- and upstream limits to potentially suitable habitats for bull trout within stream networks, and thus the area for locating samples, and making inferences about presence.

Downstream patch boundaries were delineated by 1600 meter elevation contours in Boise and South Fork Payette River basins, based on previous research in the basins relating the distribution of small bull trout to elevation. Outside of these basins, downstream patch boundaries correspond to stream temperature <15°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 habitat that is used by bull trout. This may be less than potentially occupied habitat, due to the influence of other 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 reversible 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 valley bottom slopes 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). 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 that prevent 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 access (no natural or anthropogenic barriers).

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[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.

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 conditions. Habitat variables needed to estimate sampling efficiencies will be measured. In 2009, sampling was changed from multiple electrofishing passes with blocknets to one electrofishing pass with no blocknets based on discussions with the Rocky Mountain Research Station. Since the monitoring objective is to only detect bull trout juveniles and not estimate densities, blocknets were discontinued.

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, and statistically valid, 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.

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 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 will be 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 2009 sampling.

Category	S.F. Boise Subbasin	M.F./N.F Boise Subbasin	S.F. Payette Subbasin	Upper Salmon Subbasin	Total
1	12	4	2	17	35
2	5	1	2	7	16
3	24	0	0	26	50
4	1	0	0	1	1
Total	42	5	4	51	102

Using data from the past 7 years (since 2003), all of the patches in the Middle Fork/North Fork Boise River, South Fork Boise River, Upper Salmon, and S.F. Payette subbasins have been sampled (Table 2).

Table 2 - Number of bull trout patches by category on the Sawtooth NF and the number surveyed within the last 7 years (since 2003) within each subbasin based on 2009 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%)	16	16 (100%)	35	35 (100%)
2	5	6 (100%)	1	1 (100%)	2	2 (100%)	8	8 (100%)	17	17 (100%)
4	1	0	0	0	0	0	0	0	0	0 (0%)
Total	19	19 (100%)	5	5 (100%)	4	4 (100%)	24	24 (100%)	52	52 (100%)
3	23	16 (70%)	0	0	0	0	27	26 (96%)	50	42 (84%)

Sentinel Streams - In 2009 sentinel streams were established in the S.F. Boise (Boardman, Skeleton, Beaver, 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 and 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 annually to detect subtle changes in stream temperatures and bull trout distributions over time.

2009 Results and Discussion

Monitoring for bull trout on the Sawtooth National Forest occurred in 13 patches in 2009 (Figure 1). In the S.F. Boise subbasins, seven patches were surveyed using formal protocols. Of these patches, bull trout reproduction was observed in Boardman, Skeleton, and Emma Creeks. In Skeleton and Boardman creeks, bull trout had been found each year sampled since 1994. Bull trout had also been observed in Emma Creek during surveys in 1993, 1994, and 2001, so their detection in 2009 was anticipated. However, surveys confirmed juvenile bull trout occupied more headwater areas than previously documented.

One subadult bull trout was sampled in Beaver (221 mm) and one in Paradise (197 mm) Creeks. Both fish were found within the first few survey sites lower in each patch. No juvenile bull trout (individuals <150 mm) were found suggesting that these patches do not support reproducing populations. Subadult fluvial and adfluvial bull trout (typically 175-300 mm in length) have been found in other streams (Little Smoky, Shake, and Carrie Creeks, Big Water Gulch, etc.) in the past. These fish are known to “wander” into habitat which may not be suitable for spawning or early rearing (as opposed to migration to or from spawning and/or early rearing habitat) and may exist for short or long periods in streams reaches that otherwise would be unoccupied (Personal communication, Bruce Rieman, Fisheries Research Biologist, RMRS).

Bull trout were not detected in Basalt or Five Point Creeks. Probabilities of detection for one site in Five Points Creek was 0.49 suggesting there is a moderate chance that the patch does not support a reproducing bull trout population. However, most accessible habitat in Five Points Creek had been sampled previously in 1999, 2000, 2001, and 2007 with no bull trout found. Probabilities of detection for the three sites in Basalt Creek was 0.87 suggesting there is a higher level of certainty that a reproducing population is not present. No bull trout were detected despite extensive electrofishing surveys in 1993, 1999, or 2000 within this patch.

During 2009 five patches in the Salmon subbasin and one patch in the S.F. Payette subbasin were electrofished using formal protocols. Of the patches sampled, three patches (Trail, Big Boulder and Warm Spring Creeks) were occupied by juvenile bull trout (Figure 1). Bull trout had been detected previously in lower Trail Creek in 2004, Big Boulder in 2006, and Warm Spring in 2008. Bull trout were found in lower Jim Creek (0.6 miles above the Big Boulder confluence) for the first time which is just downstream of barrier falls. Bull trout were also found again up to 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. Sites higher in Pigtail, Warm Spring, and Garland Creeks were surveyed in 2009 than previously. A small waterfall in Pigtail Creek was found in one of two mainstem tributaries and no fish were found at the three sites above these falls. Westslope cutthroat had been found above these falls in 1999. The area was severely burned in the 2005 Valley Road Fire, so it is possible this cutthroat population was lost during the fire. Warm Spring Creek was sampled 4.3 miles above the meadow to natural barriers for the first time. Bull trout were found 1.8 miles above the meadow and may occur higher in the drainage. However, presence could not be confirmed due to poor electrofishing efficiency from the wide channel and deep pools. Westslope cutthroat have been found to the headwaters some of which are likely emigrating from the Born Lakes.

Electrofishing surveys failed to detect bull trout in the Pole (11 sites), Beaver (12 sites), and Iron (8 sites) patches. Probabilities of detection for each patch were 0.99 suggesting there is a high probability that juvenile bull trout are not present. Bull trout were not found by Idaho Fish and Game in Pole (11 sites) or Iron (5 sites) Creeks in 2004, so it is not surprising our 2009 surveys did not find them. Both streams have water diversions and elevated water temperatures (above 23 °C) lower in the patch, culvert barriers, and are dominated by brook trout. These factors likely limit access to migratory bull trout to allow recolonization and successful reproduction due to competition from brook trout. Bull trout had also not been found in 2000 Forest Service surveys of Beaver Creek. Beaver Creek is dominated by brook trout except in the very headwaters where westslope cutthroat are present.

Table 3 - Fish species detected during 2009 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	Beaver Creek		+	+	+		+	
Upper Salmon	Iron Creek		+	+			+	
Upper Salmon	Big Boulder Creek	+		+	+			
Upper Salmon	Warm Spring Creek	+		+	+			

S.F. Payette	Trail Creek	+		+	+		+	
S.F. Boise	Boardman Creek	+		+			+	
S.F. Boise	Beaver Creek	+		+				
S.F. Boise	Five Points Creek			+				
S.F. Boise	Emma Creek	+		+			+	
S.F. Boise	Paradise Creek	+	+	+	+		+	
S.F. Boise	Basalt Creek			+			+	
S.F. Boise	Skeleton Creek	+		+			+	

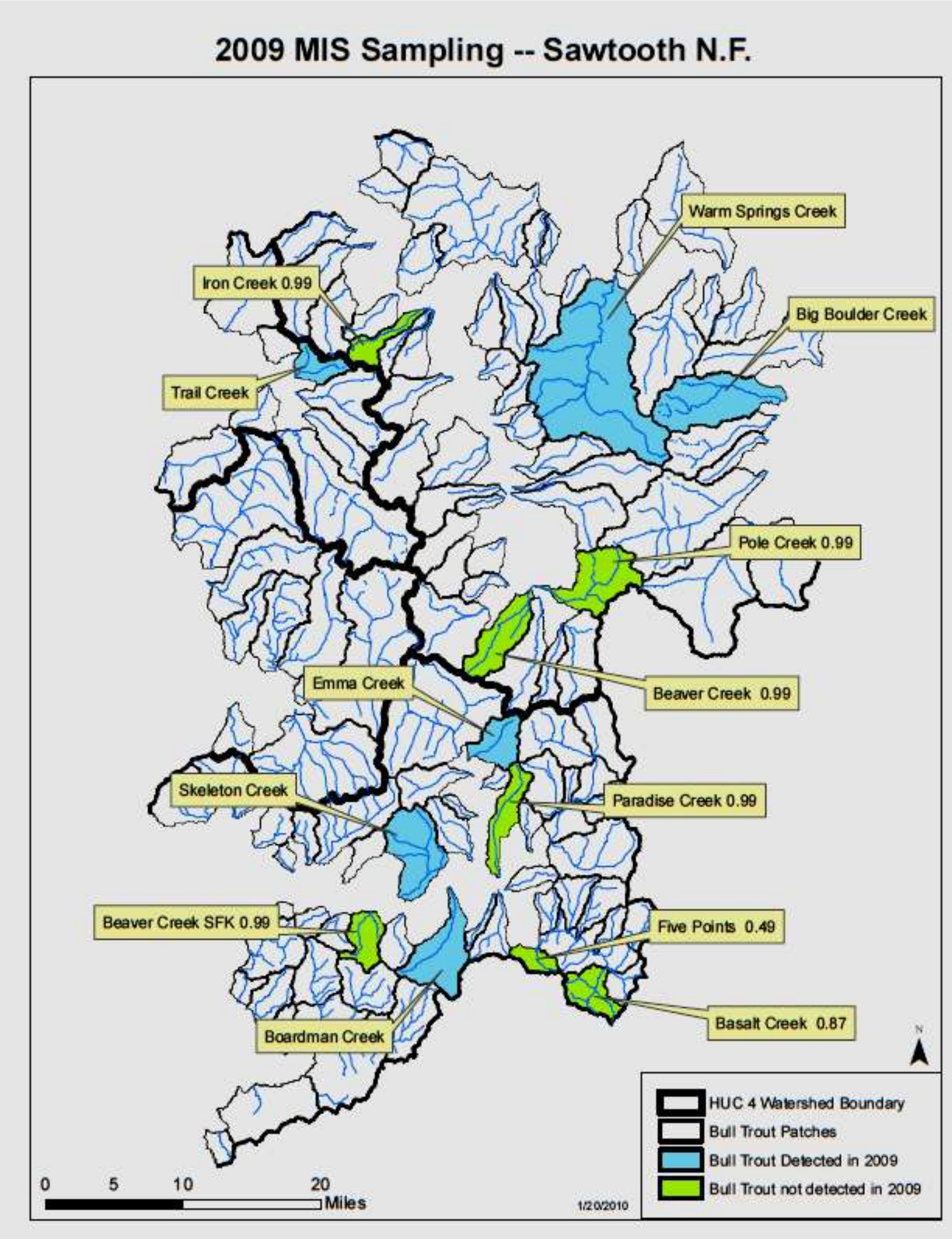


Figure 1 - Bull trout patches sampled and probabilities of detection on the North Zone of the Sawtooth N.F. (2009).

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 4). 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 six years of sampling almost 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 0.49 per site or 0.87 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. Results and estimates of probabilities of detection for 2009 sample patches are noted in Table 4.

Table 4 - 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	Big Boulder	16	9	7
Upper Salmon	Little Boulder	4	4	3
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	4	4	3
Upper Salmon	Crooked	7	1	1
Upper Salmon	Champion Creek	3	1	1
S.F. Payette	Trail Creek	4	3	2
S.F. Boise	Deadwood Creek	3	3	3
S.F. Boise	Willow Creek	5	5	4
S.F. Boise	Big Peak	5	5	5
S.F. Boise	N.F. Big Smoky	3	3	3
S.F. Boise	Bluff	1	1	1
S.F. Boise	Upper Big Smoky	4	4	4
S.F. Boise	W.F. Big Smoky	3	2	1
S.F. Boise	Bear	5	3	3

S.F. Boise	Upper S.F. Boise	11	3	2
S.F. Boise	Emma Creek	6	4	4
Total		129	79	63
Empirical Estimate of Probability of Detection				**63/132 = 0.49**

Table 5 - Summary of results from 2009 aquatic MIS sampling on the Sawtooth N.F.

Subbasin	Patch	Strata Designation in 2008	Bull Trout Detected	# Sites sampled	# Sites where Bull Trout < 150mm were found	Empirical Probability Of Detection
Upper Salmon	Pole Creek	3	-	11	0	0.99
Upper Salmon	Beaver Creek	3	-	12	0	0.99
Upper Salmon	Iron Creek	2	-	8	0	0.99
Upper Salmon	Big Boulder Creek	1	+	12	5	NA
Upper Salmon	Warm Spring Creek	1	+	23	5	NA
S.F. Payette	Trail Creek	1	+	4	2	NA
S.F. Boise	Boardman Creek	1	+	14	13	NA
S.F. Boise	Beaver Creek	2	+	10	0	0.99
S.F. Boise	Five Points Creek	3	-	1	0	0.49
S.F. Boise	Emma Creek	1	-	6	4	NA
S.F. Boise	Paradise Creek	3	+	10	0	0.99
S.F. Boise	Basalt Creek	3	-	3	0	0.87
S.F. Boise	Skeleton Creek	1	+	14	9	NA

Bull Trout Trends on the Sawtooth National Forest Since 2004

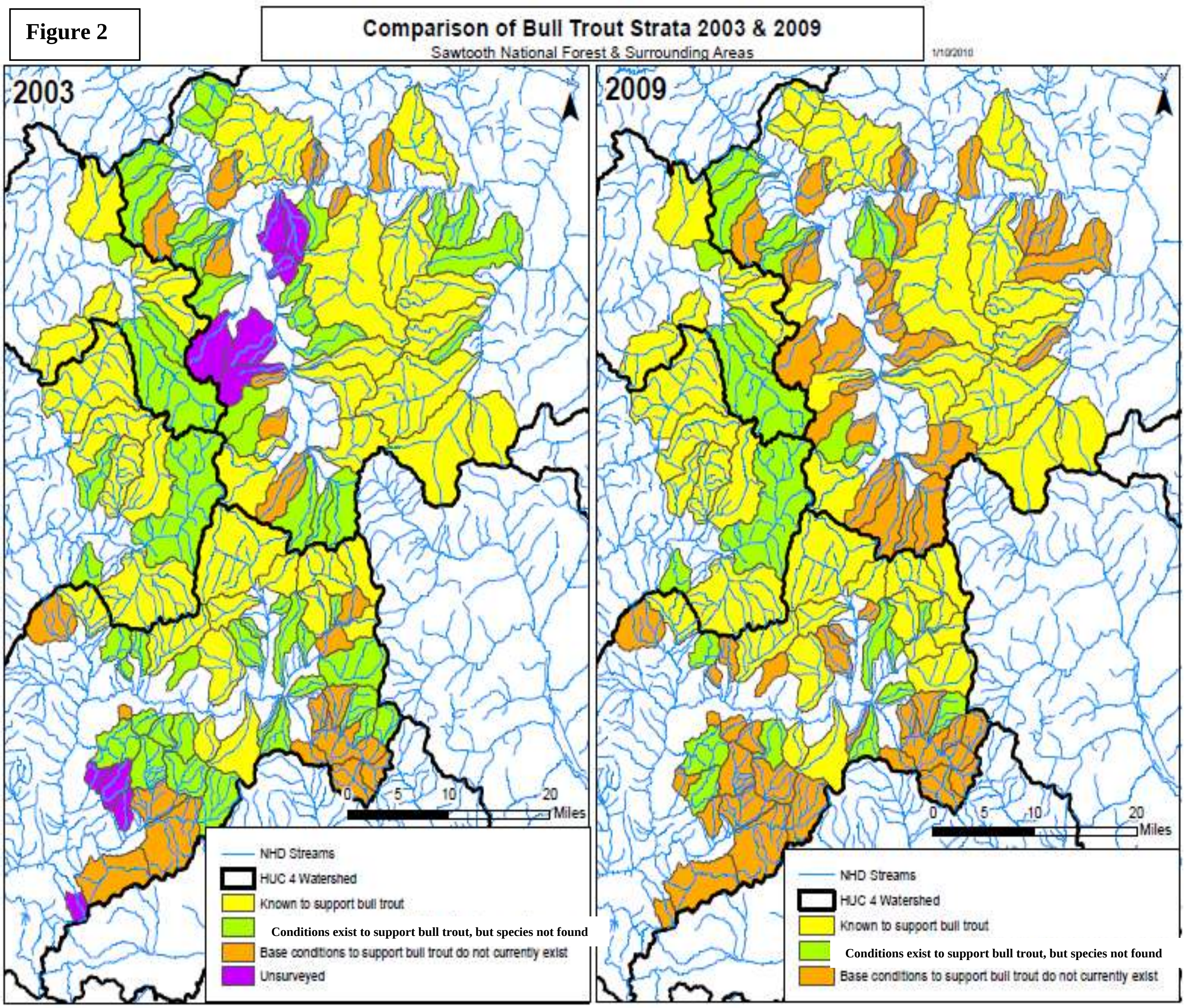
In 2004, fisheries staff identified and stratified 97 bull trout patches on the Sawtooth NF. Since that time six additional patches have been identified in the Upper Salmon subbasin and one dropped in the S.F. Boise subbasin resulting in 102 patches on the Forest. During the 2004 to 2009 field seasons, crews completed MIS protocol surveys in 100% of the category 1-2 patches. Bull trout presence was confirmed in 35 patches; habitat was determined to be suitable but no bull trout were detected in 17 patches; and habitat was determined to be unsuitable in 50 patches.

Data collected over the past five years were compared with information collected prior to 2004 to provide a preliminary indication of bull trout trend across the planning unit (Table 5) (Figure 2). 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 over the last five years. 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 and that bull trout are still occupying most patches where previously detected. Table 6 also 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. The following analysis provides further explanations on how these factors are influencing bull trout presence and trend.

Table 6 - Comparison of bull trout patch strata 2004-2009.

Category	S.F. Boise Subbasin		N.F. and M.F. Boise Subbasin		S.F. Payette Subbasin		Upper Salmon Subbasin	
	# Patches 2004	# Patches 2009	# Patches 2004	# Patches 2009	# Patches 2004	# Patches 2009	# Patches 2004	# Patches 2009
1 – Occupied	11	13	4	4	0	2	6	16
2 – Suitable/Unoccupied	22	6	1	1	4	2	28	8
3 – Unsuitable/Inaccessible	10	23	0	0	0	0	3	27
4 - Unsurveyed	0	0	0	0	0	0	8	0
Total	43	42	5	5	4	4	45	51

Figure 2



Patch Size and Accessible Habitat – Occupied patches were found to be significantly greater in size than unoccupied patches (means, 15,570 acres in occupied vs. 6,787 in unoccupied; $P < 0.001$, n=119) (Figure 3). Occupied patches were also found to have significantly more accessible habitat (means, 8 miles in occupied vs. 3.8 miles in unoccupied; $P < 0.002$, n=100). This makes sense since larger patches may have a higher probability of providing the right flows, stream gradients, water temperatures, and habitat necessary for bull trout persistence. Rieman and McIntyre (1995) found that patch size was highly significant in determining bull trout presence. Studies in western Montana (Rich 1996) and southwest Idaho (Rieman and McIntyre 1995; Dunham and Rieman 1999) showed that bull trout are less likely to occur in streams less than two meters in width and less than 500 ha (1,236 acres) in size. Logistic regression model and the empirical frequency distribution suggested that the probability of observing bull trout exceeded 0.80 at the largest patch sizes, was about 0.50 for patches between 2,000 and 3,000 ha, and was less than 0.10 for patches less than 1,000 ha.

Clearly there are patches that even though they meet the minimum elevation (>1600m) and size criteria (> 500 ha) that are still too small to support the right conditions for a reproducing bull trout population. Abbot Gulch, Bowns, Bridge, Marsh, Elk Creek 3, and Narrow Creeks in the S.F. Boise subbasin are all < 1,000 ha and probably could be dropped from further sampling.

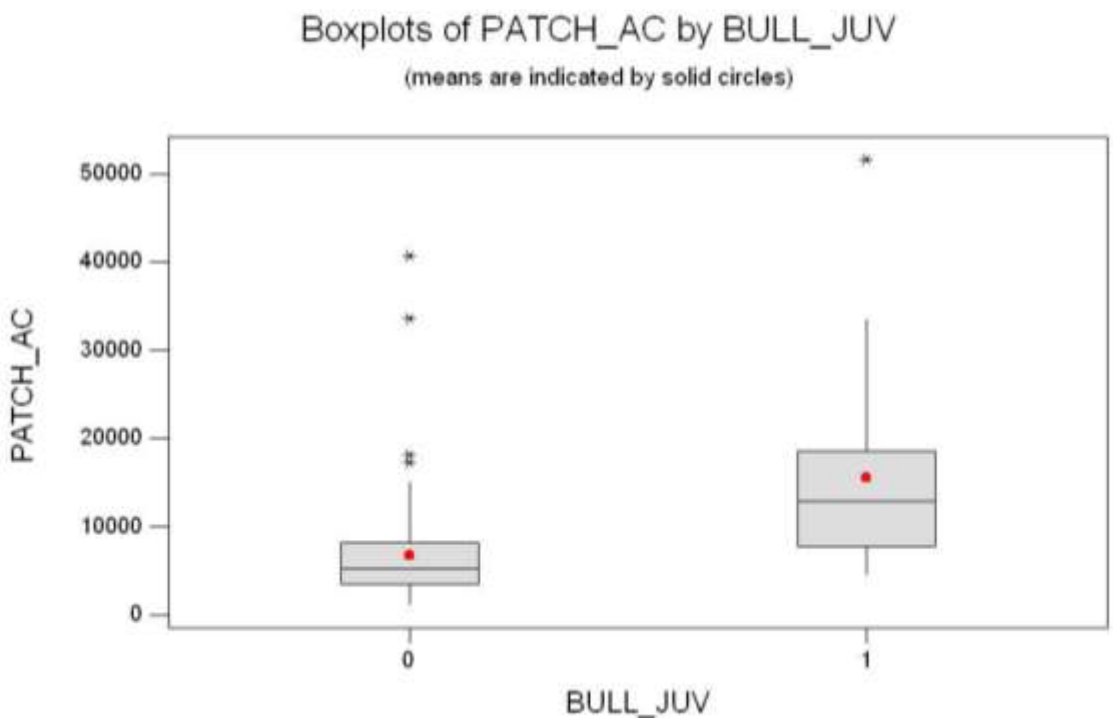


Figure 3 - Patch size (acres) in patches where bull trout were not detected vs. those where bull trout were observed. Figure includes 2001 – 2008 data. Bars denote 25-75% quartiles, while horizontal line on bar indicates median value, diamond shows mean. Whiskers denote full range of values and outliers are denoted by (*).

Water Temperature - One of the most important factors influencing bull trout presence is water temperature. Bull trout are among the most thermally sensitive species and their occurrence declines rapidly as maximum weekly maximum temperature (MWMT, the mean of daily maximum water temperatures measured over the warmest consecutive seven-day period) exceeds 15 °C. Many of the patches with local and potential populations, as designated in the FWS recovery plan, where bull trout have not been found have MDMT above 15 °C. For example, lower Lime Creek and Little Smoky Creek (both potential populations in the S.F. Boise subbasin) have MDMT above 17 °C. Some accessible headwater reaches support water temperatures below 15 °C, but not over enough area to sustain a viable local population.

Monitoring stream temperatures allows the Forest to assess the influence of management practices on water temperatures (Meehan 1991), predict species distributions (Dunham et al. 2003), and update MIS patch strata. As such, stream temperature monitoring plays a critical role in this aquatic MIS approach. From 2004 to 2009 in the Boise and Salmon subbasins, hundreds temperature loggers have been deployed in early summer (prior to July 1) and recovered in early fall (after Sept 1) because maximum water temperatures on the Sawtooth tend to occur between mid-July and mid-September (Sawtooth NF. unpublished data). MWMT was calculated for each patch. MWMT was not significantly different between occupied and unoccupied bull trout patches (means, 11.6°C in occupied vs. 13.0°C in unoccupied; P = 0.203, n=119). This may be in part due to several unoccupied cold water patches (i.e. Vat, Upper Redfish Lake, Upper S.F. Payette, Rough, Boundary, Iron, Goat, Cabin, and Bridge) not being accessible due to natural and management caused barriers or brook trout excluding bull trout from historic cold water habitat (i.e. Big Casino, Stanley, Huckleberry, Paradise, Mays, and Frenchman). It also may be due to some lower patch boundaries needing to be adjusted because they seasonally have MWMT's above 15 °C. Since the p-value is greater than our chosen alpha level of .05, there is no evidence for a difference in mean MWMT in occupied vs. unoccupied patches. Although, MWMT within occupied patches was slightly lower than unoccupied patches (Figure 4).

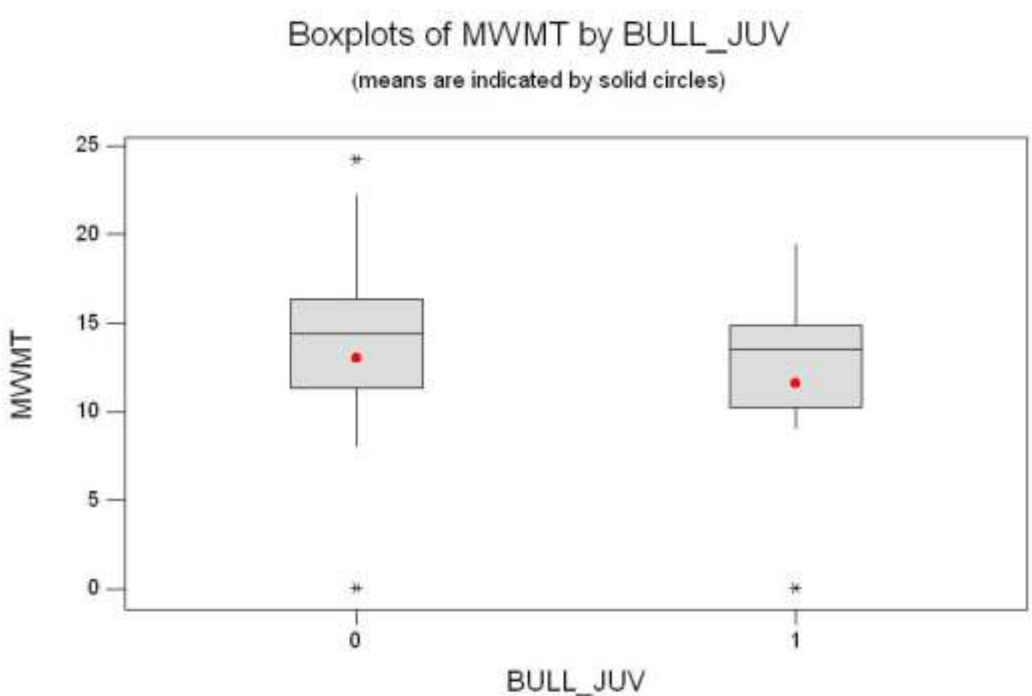


Figure 4 – Highest maximum weekly maximum temperature (MWMT) in ºC) measured within patch. Figure includes 2001 – 2009 data. Bars denote 25-75% quartiles, while horizontal line on bar indicates median value. Whiskers denote full range of values and outliers are denoted by (*).

Route Density – Route density (system roads, motorized trails, and motorized non-system routes) was calculated for each patch and riparian conservation areas (RCAs) within each patch. This information was used as a surrogate to determine how much management activity may have occurred and if this influenced the presence of by bull trout within patches. The mean route densities within unoccupied patches were significantly greater than route densities within occupied patches (means, 1.22 v. 0.62; $P < 0.001$, n=100). Of the 70 unoccupied patches, 37% have road densities less than 0.7 mi/mi^2, 40% are in the 0.7-1.7 mi/mi^2 range, and 23% have densities greater than 1.7 mi/mi^2. Of the 30 occupied patches, 57% have road densities less than 0.7 mi/mi^2, 37% are in the 0.7-1.7 mi/mi^2 range, and only 6% have densities greater than 1.7 mi/mi^2

Riparian Conservation Area (RCA) route densities in unoccupied patches were not significantly different than RCA route densities within occupied patches (means, 2.13, v. 1.61 p=.139, n=100). Even though no significant difference was observed between occupied and unoccupied patches for RCA route densities, mean RCA route densities were greater in unoccupied patches.

Generally, those patches with the highest route densities are areas where bull trout no longer exist. Patches with route densities higher than 1.7 mi/mi^2 are considered more likely to impact aquatic resources (i.e. water quality, slope hydrology, and riparian areas) (Quigley and Arbelbide, 1997). Patches that have higher road densities are more likely to have altered streamflows, higher sediment loading and stream temperatures, greater channel instability and poorer riparian conditions (Chamberlin *et al*. 1991, Furniss *et al*. 1991). Effects associated with motorized access can also reach beyond direct effects to hydrologic functions and increased sediment delivery to streams (Quigley and Arbelbide, 1997). Increased access can results in more developed and dispersed recreation, fire wood cutting in riparian areas, etc.

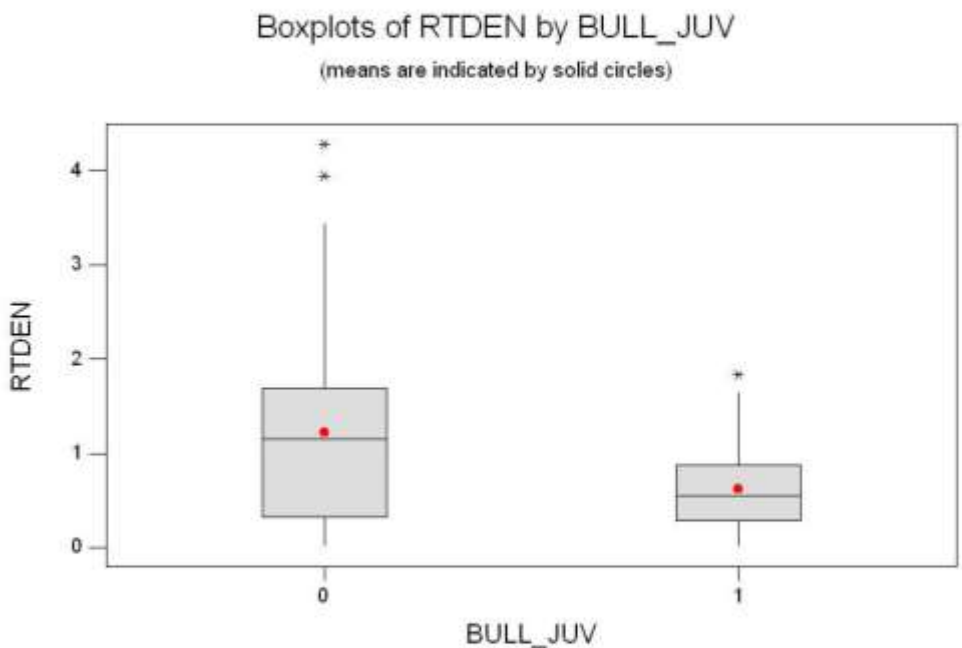


Figure 5 – Route densities in occupied and unoccupied bull trout patches. Bars denote 25-75% quartiles, while horizontal line on bar indicates median value. Whiskers denote full range of values. Whiskers denote full range of values and outliers are denoted by (*).

Patch Connectivity – Culvert inventories were completed on all fish bearing streams in 2003 and 2004 on the Sawtooth National Forest. To understand what affect culverts have had on bull trout, the total miles of historic spawning and rearing habitat that was blocked was estimated within each patch. No culvert barriers were found in any fish bearing streams within occupied bull trout patches. In contrast, 26% (19 of the 72) of the unoccupied patches had culvert barriers. Most of these culverts occur at or just upstream of the patches' confluence, blocking most of the historic habitat. In the S.F. Boise River subbasin 12 miles of habitat is blocked within unoccupied patches, with the most occurring in Worswick (3.70), Lick (3.42), Skunk (2.03), and Five Points (0.91 miles) Creeks. In the Upper Salmon subbasin, approximately 40 miles of habitat is blocked within unoccupied patches, with the most occurring in Pole (5.43), Meadow (5.71), Fisher (4.80), Goat (4.60), Iron (4.41), and Stanley (2.99) Creeks. Culvert barriers appear to be an important reason why bull trout are not found in some patches. There are clearly, however, other influences that limit bull trout presence since only 26% of the unoccupied patches have barriers.

Water diversions may also limit summer access in several patches. Sixty two diversions occur in unoccupied patches vs. 24 diversions in occupied patches. It is unknown to what degree these limit access within and between patches because fish passage has not been inventoried at all of the diversions. However, it is assumed that some of these diversions have structures that interfere with fish passage or remove enough water or create thermal barriers to make passage difficult at certain times of the year.

Habitat Condition - The Sawtooth and Boise National Forests have worked with the PACFISH, INFISH Biological Opinion (PIBO) monitoring group in Logan, Utah to develop a monitoring approach to determine habitat trend of across each forest. This monitoring approach evaluates trend across all subwatersheds where PIBO integrator reaches have been established. An integrator reach is the lowest-most 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 are being resampled on a five-year rotation starting in 2006. As of 2009, approximately 78 bull trout patches had been sampled at least once across the Sawtooth and Boise National Forests.

To evaluate habitat condition an integrity index of physical habitat indicators was used. Physical stream habitat and landscape data from reference reaches was 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 (S/N; 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, we used our reference sites to construct the index. Specifically, we incorporated landscape and climatic covariates into multiple linear regression analyses to control for inherent differences in physical habitat attributes among reaches. We used the residuals from these analyses to score individual attributes and summed the 8 attributes (i.e. d50, percent banks with undercuts, 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).

The average index score for all reaches (mean = 44.8, range 18.69 – 82.83) in occupied bull trout patches was higher than the scores for unoccupied bull trout patches (mean = 36.0, range 15.46 – 74.59), but slightly lower than PIBO reference streams (mean = 48.5) within the Southwest Idaho Ecogroup (Figure 6). The cumulative frequency distribution of unoccupied and occupied scores indicated a substantially higher percentage of unoccupied reaches with lower index scores (<40) than occupied reaches (66% and 35%, respectively), more reaches with scores in a moderate (40-70) range in occupied than unoccupied patches (66% and 35%, respectively), and a slightly lower percentage of unoccupied reaches with high index scores (>70) than occupied reaches (6% and 9%, respectively). These results suggest that habitat conditions are generally better in occupied than unoccupied patches. It also says that habitat conditions in occupied patches are close to index scores found in reference streams.

Al-Chokhachy et al. (2010) found the condition of physical habitat in reference reaches (47.1, SE = 1.4) was significantly higher than for managed reaches (mean = 30.4, SE = 0.7). This study also found that managed reaches had a greater frequency of low habitat index scores than reference reaches. A significant negative relationship was found between lower index scores and stream reaches within catchments containing higher densities of roads and livestock grazing (Al-Chokhachy et al. 2010).

Lower index scores in unoccupied patches may be in part the result of more management activities impacting watershed, riparian, and habitat conditions. Mean route densities were found to be significantly higher within unoccupied patches than occupied patches (means, 1.22 v. 0.62; $P < 0.001$, n=100). Route densities in RCAs were also higher in unoccupied (2.13 mi/mi2) occupied patches (1.61 mi/mi2). The presence of roads can lead to substantial alterations of the catchment hydrology, sediment load, and channel structure (Chamberlin et al. 1991; Jones et al.2000) and have significant effects on instream biota (Eaglin and Hubert 1993; Baxter et al.1999). Kershner et al. (2004) also found that physical habitat within more managed watersheds contained significantly shallower residual pool depths, higher bank angles, fewer undercut banks, and smaller median particle sizes. The lower index scores in unoccupied bull trout patches suggest that some of these indicators may have also been degraded by management activities.

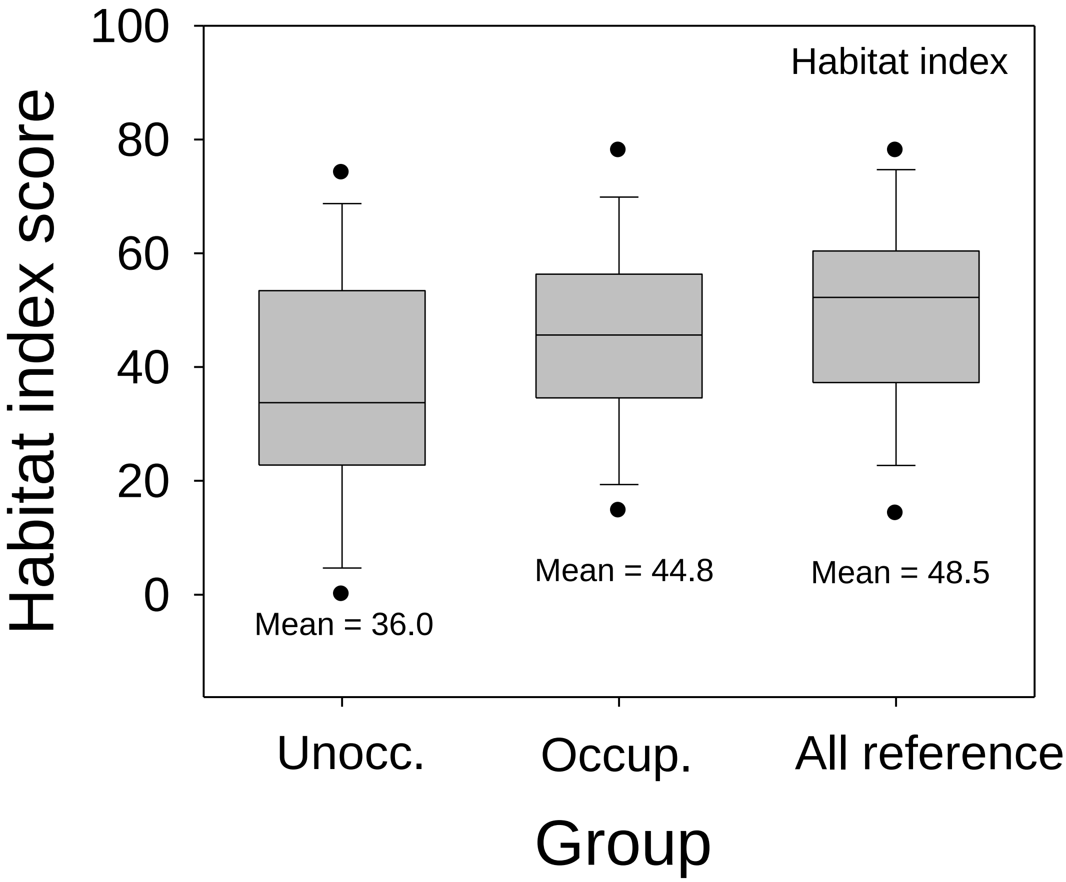


Figure 6 – Physical habitat index in occupied and unoccupied bull trout patches, and reference PIBO within the Southwest Idaho Ecogroup. Bars denote 25-75% quartiles, while horizontal line on bar indicates median value. Whiskers denote full range of values and outliers are denoted by (*).

Watershed Condition – Watershed conditions was evaluated by using the matrix of pathways and indicator determinations for 19 physical indicators and Netica software to build Bayesian belief networks and influence diagrams. Bayesian belief networks were used to derive an overall condition (i.e. FA – Functioning Acceptably, FR – Functioning at Risk, and FUR – Functioning at Unacceptable Risk) for each matrix physical pathway (i.e. water quality, habitat access, habitat condition, etc.) within each bull trout patch. Once this had been derived, another Bayesian belief network model was built using the results of each physical pathway to determine overall watershed condition for each bull trout patch. Some key assumptions in building these models included:

- Where all independent variables (parent nodes) are functioning appropriately, there is zero probability that the overall pathway (daughter node) will be functioning at risk. Conversely, where all independent variables (parent nodes) are functioning at risk, there is zero probability that the overall pathway/threat (daughter node) will be functioning appropriately.
- The greater the uniformity in functional/risk ratings (parent nodes) for a pathway or risk (daughter node), the higher the probability that the predominant rating will apply to the

entire pathway or risk. In other words, a relation table will show a higher probability that the overall pathway (daughter node) will be functioning appropriately (FA) when 4 of its 5 parents nodes are rated FA than when 3 out of 5 are rated FA.

- The probability that the overall pathway (daughter node) is functioning appropriately decreases incrementally with departure from the FA condition in its parent nodes. Conversely, the probability that the overall pathway or risk (daughter node) is functioning at unacceptable risk (FUR) decreases incrementally with improvement from the FUR condition in its parent nodes.

Unoccupied patches were found to have a poorer overall watershed condition than occupied patches. Approximately 31% of the unoccupied patches are in a functioning at unacceptable risk, 59% in a functioning at risk, and only 10% functioning acceptably. In contrast, occupied bull trout patches only have 52% functioning acceptably, 43% in a functioning at risk, and only 5% of functioning at unacceptable risk. Subwatersheds whose overall aquatic conditions are "functioning appropriately" generally have good water quality; streams have good connectivity; there are lower route densities or no roads; fewer grazing impacts; and fewer dispersed recreation. These areas also support many of the strongest remaining bull trout populations on the forest. Subwatersheds whose overall aquatic conditions are in a "functioning at unacceptable risk" generally have poorer water quality (high inchannel sediment and water temperatures); more culvert or water diversion barriers, simplified habitat conditions, higher route densities, higher route densities in riparian conservation areas, 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 harder for bull trout to maintain or reestablish a local population.

Brook Trout - Another factor influencing bull trout distribution and trend is the presence of brook trout. In several patches brook trout are widespread with very high densities. Brook trout are likely one main reason why bull trout have not been found in many of the Upper Salmon (Frenchman, Smiley, Beaver, Mays, Pole, Elk, Crooked, etc.) and some S.F. Boise (Paradise) patches. Rieman and McIntyre (1993) concluded that brook trout presence and density were important variables explaining the observed distributions and number of bull trout among streams. Non-native brook trout are known to hybridize with bull trout and competitively exclude them from suitable stream habitats (Benjamin et al. 2007; Rieman et al. 2006).

To assess the influence of brook trout on bull trout presence, the forest evaluated what portion of the sample sites (2004 to 2009) within patches contained brook trout. It was believed that the higher portion of samples with brook trout would likely preclude a patches ability to support a reproducing bull trout population. Results show that very few patches occupied by juvenile bull trout have brook trout present. Brook trout were found in only 8% of the surveyed sites within bull trout occupied patches and only 7 of the 41 (17%) occupied patches. Bull trout in many of the patches (Fishhook, Fourth of July, Champion, Headwater and E.F. Valley Creek) that contain brook trout are supported by migratory adfluvial or fluvial life histories. It is likely bull trout populations in these patches are sustained in part by annual spawning contributions from migratory fish. These contributions may help to compensate losses from brook trout competition or maintain bull trout in areas not yet invaded by brook trout. Brook trout in Fishhook, Trout, Baron and Fourth of July Creeks occur primarily in lower portions of each patch reducing the chance of competition with bull trout. Other studies have found in systems where bull and brook trout co-occur, bull trout typically occupy headwater habitats while brook trout typically occupy habitats further downstream with some overlap taking place (Paul and Post 2001; Rieman et al. 2006). Maintenance of distinctive distributions may result from important differences in behavior and physiological responses controlling individual species habitat use and (or) their interactions along thermal gradients (Fausch 1989; Taniguchi et al. 1998; Dunham et al. 2002). For native species that have coexisted within individual watersheds for thousands of years, selective segregation could minimize overlap.

Where bull trout have not been found, brook trout are present in 40% of the unoccupied patches. In patches that support brook trout they are found in 86% of all the sample sites suggesting they are dominant species throughout most of the drainage. To what degree brook trout have displaced bull trout in unoccupied patches is unknown. But it's probably occurred where brook trout have been extensive stocked in streams and high mountain lakes. Several unoccupied patches have headwater lakes and it is possible brook trout outcompeted and displaced bull trout out of colder headwater refugia. When brook trout are introduced into headwater lakes, they are often found more widely dispersed throughout a stream (Adams et al. 2001). It is also possible that when brook trout obtained a certain density or distribution, the chance of migratory bull trout reestablishing a population greatly decreased. However, the complete elimination of bull trout is not a foregone conclusion. Brook trout have not invaded all of the habitats accessible to them in the S.F. Boise or Upper Salmon subbasins or eliminated native species where they co-occur (Dunham and Rieman 1999; Rich et al. 2003). Brook trout probably do influence bull trout populations and facilitate local extinctions, but threats probably vary strongly with environmental conditions in each patch.

Finally, the degradation of physical habitat has been shown to significantly reduce fish production (Scheuerell et al. 2006) and distribution (Thurow et al. 1997) and increase the invasion success of non-native fishes (Shepard 2004; Benjamin et al. 2007). PIBO index scores were found to be lower (mean = 36.0) in unoccupied patch reaches than occupied (mean = 44.8) patch reaches. Unoccupied patches were also found to have a poorer overall watershed condition than occupied patches. It is probable that watershed and habitat conditions in some patches were severely impacted by historic grazing, mining, and water diversions and more recent impacts from roads, motorized recreation and culvert barriers. These impacts may have given brook trout a competitive advantage over bull trout and allow them to firmly establish local populations.

Migratory Life Histories – To the best of our knowledge, many larger patches in the Upper Salmon and Boise River basins are supported by migratory bull trout. Unoccupied patches on the other hand have had only occasional use by wondering subadults. Information on migratory bull trout comes primarily from radio telemetry studies completed by Idaho Fish and Game (Partridge et al. 2000 and Schoby et al. 2007) in the S.F. Boise and Upper Salmon subbasins, radio telemetry, trapping, and electrofishing studies completed by Bureau of Reclamation (Salow et al. 2004) in the M.F. and N.F. Boise River, and trapping and electrofishing studies completed by the Sawtooth National Forest (unpublished data).

<u>Adult Migration</u> - Bull trout in the Boise River drainage were originally confined to the fluvial and resident life histories because of a lack of substantial accessible lakes. Presumably, fluvial subadult and adult bull trout reared in the North Fork, Middle Fork, South Fork, and mainstem Boise Rivers, and it is possible that the migration of some individuals reached the Snake River. Construction of Arrowrock (1915) and Anderson Ranch (early 1940s) dams greatly reduced migratory access and allowed the development of an adfluvial life history (Partridge et al. 2000). It is believe that both adfluvial and fluvial bull trout spawn and reside in headwater tributaries during early life stages with fluvial forms moving downstream into larger mainstem riverine habitats for the winter and adfluvial forms moving downstream into large lakes for the winter.

Partridge et al. (2000) radio-tagged 57 adult bull trout in the S.F. Boise River and tracked their subject's movements into spawning streams via fixed-wing aircraft. Bull trout migrated out of Anderson Ranch reservoir in May and typically entering spawning tributaries by the end of June, roughly corresponding to the descending limb of peak runoff. Migratory bull trout were found in most large tributary streams (Boardman, Johnson, Big Smoky, W.F. Big Smoky, Big Peak, Willow, Skeleton, Bear, Emma, and Deadwood) with the exception of Little Smoky and Lime Creeks. Bull trout remained in these streams until late August and early September with most finding their way back to the reservoir by the end of November. Maximum distance traveled from Anderson Ranch reservoir was 93 km by fish in both the Big Smoky and Johnson creek drainages.

Unpublished monitoring conducted by the Sawtooth National Forest with weirs on S.F. Boise tributaries with known reproducing bull trout populations found downstream migrating adults in Willow, Boardman, and Skeleton Creeks. Between the three SNF-monitored streams over all monitored years, 45 of 47 adult outmigrating bull trout were captured between the first week in September and the first week in October.

The U.S. Bureau of Reclamation supported studies of adult migratory bull trout from Arrowrock Reservoir in 1996 and 1997 (Flatter 1998) and from the Middle and North Fork Boise rivers in 2001 through 2003 (Monnot et al. 2008, Salow and Hostettler 2004). Radio-tagged adults captured in the reservoir and at weirs on the Middle and North Forks were tracked on the ground and using aircraft. The data from these studies are voluminous, but some of the key points of the research are 1) the adults migrated upstream from the reservoir as early as March but by mid-June, entered tributaries between late July and early August, exited spawning tributaries by the end of September, and re-entered the reservoir by the third week in October. Many smaller (300-450 mm) adult bull trout caught migrating downstream and tagged at the North Fork weir did not enter the reservoir, but overwintered in the 20 miles of river between the weir and the reservoir; all downstream migrating tagged adults >450 mm entered Arrowrock reservoir. Migratory bull trout on the Sawtooth National Forest have been found in the Upper N.F. Boise River, Johnson Creek, Ballentyne Creek, Queens River, Little Queens River, and the Yuba River.

During 2003 and 2004, 80 bull trout were implanted with radio transmitters in the Upper Salmon subbasin (Schoby et al. 2007). Movements were monitored through 2005 by ground relocations and fixed telemetry stations located at major tributaries. Radio tagged bull trout generally began migrations within the Salmon River towards tributaries during April and May and entered spawning tributaries between June 7 and July 20. The average one-way migration distance between winter habitat and spawning habitat for radio tagged bull trout in the Upper Salmon River Basin was 69.3 km. The longest migration between winter and spawning habitats was 220.2 km, observed in a bull trout spawning in the upper EFSR and wintering in the Salmon River between the towns of Salmon and North Fork. The shortest migration was 11.7 km, by a bull trout spawning in Warm Spring Creek and wintering near Peach Creek (Torrey's Hole) in the Salmon River. Migratory bull trout were found in Yankee Fork, and Fourth of July, Warm Spring, West Pass, Upper E.F. Salmon, Basin, lower Germania, and Herd Creeks. This study also identified Redfish Lake and Little Redfish Lake as wintering habitat for fluvial bull trout populations.

<u>Subadult migration and movement</u> - Relatively small bull trout that move out of their natal streams to rear in larger streams or lakes/reservoirs are often termed "subadults" to distinguish these individuals from similar-sized juveniles in natal streams and from reproductively active adults. Monnot et al. (2008) radio-tagged downstream-migrating bull trout captured in 2002 and 2003 at the North Fork Boise River weir, and many of their study subjects were between 200 and

300 mm in length and presumably were subadults. The migratory behavior of subadult bull trout has not been studied the S. F. Boise River drainage. But subadults have been found by Forest Service crews in the Little Smoky drainage (Carrie Creek and the Little Smoky mainstem), Salt, Paradise, Beaver, and Shake Creeks, and Big Water Gulch.

Unoccupied Patches with Multiple Limiting Factors – Our analysis has shown that each unoccupied patch has its own set of unique factors that probably limits the presence of reproducing bull trout populations. Several patches just do not provide the right combination of conditions (i.e. Abbot Gulch, Bowns, Bridge, Marsh, Elk Creek 3, and Narrow Creeks) to sustain bull trout even without any management impacts or introduced species. Then there are other areas where bull trout historically had limited or no access to the majority of habitat within the patch (i.e. Big Lake, Goat 2 in the S.F. Payette, Rough, Shake, Upper Redfish Lake, Upper S.F. Payette, and Wickiup). The Forest will need to discuss if these patches should remain part of the MIS sampling program over the next five years.

Finally, there are patches that have many perceived limiting factors that will make it extremely difficult for bull trout to reestablish a local population (Appendix A). For example, Fisher Creek in the Upper Salmon has a culvert barrier at the highway, several irrigation diversions on private land that dewater the stream and increase water temperatures, a high road density in RCAs, and abundant brook trout. Other patches have a similar combination of limiting factors. For some patches the cumulative impacts and practicality of addressing these limiting factors (i.e. removing brook trout) may not be possible. For others it may be a long road ahead before enough of these impacts can be elevated before bull trout can sustain themselves.

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 five 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. We have also found more occupied patches than previously thought. However, 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. Still, the data indicates that bull trout presence is more robust than previously thought.

In 2009, bull trout populations continue to occupy historically occupied patches, including Boardman, Skeleton, Willow, Emma, Trail, Big Boulder, and Warm Springs Creek. One subadult bull trout was sampled in Beaver (SF. Boise) and one in Paradise Creeks. Both fish were found within the first few survey sites lower in each patch, but a reproducing population does not appear to exist in either patch. Bull trout continue to be absent in Basalt, Five Point, Pole, Beaver (Salmon River), and Iron Creeks with detection probabilities ranging from of 0.49 to 0.99.

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Appendix A

Table 7 – Limiting factors in unoccupied bull trout patches

PATCH_NAME	Patch <1000 ha	Water Temp >15 °C	Substantial amount is blocked	Barrier has recently been removed	Abundant Brook Trout	Poor Baseline Conditions (FUR or Low Index Score)	High (1.7 mi/mi^2) RCA Route Density	High (1.7 mi/mi^2) Route Patch Density
Abbot Gulch	**X**					**X**		
Basalt Creek		**X**				**X**	**X**	
Beaver Creek		**X**			**X**		**X**	**X**
Beaver Creek SFK							**X**	
Big Casino Creek		**X**	**X**		**X**		**X**	
Big Lake Creek			**X***					
Big Water Gulch				**X**		**X**	**X**	
Blackhorse Creek						**X**		**X**
Boundary Creek			**X**			**X**		
Bowns Creek	**X**	**X**				**X**		**X**
Bridge Creek	**X**							**X**
Cabin Creek				**X**				
Carrie		**X**				**X**	**X**	**X**
Crooked Creek					**X**			
EFK Kelley Creek							**X**	
Elk Creek 1					**X**			
Elk Creek 2		**X**						
Elk Creek 3	**X**							
Fisher Creek			**X**		**X**	**X**	**X**	
Five Points						**X**	**X**	**X**
French Creek			**X**		**X**	**X**		
Frenchman Creek						**X**	**X**	
Goat Creek 1		**X**	**X**		**X**	**X**		
Goat Creek 2			**X***		**X**			
Gold Creek					**X**			
Grindstone		**X**				**X**		
Hell Roaring Creek			**X**					
Holman Creek			**X**					
Huckleberry Creek		**X**			**X**	**X**		
Iron Creek			**X**					
Liberal						**X**	**X**	**X**
Lick Creek						**X**	**X**	
Little Casino Creek					**X**		**X**	
Little Smoky Creek						**X**	**X**	**X**
Lower Harden			**X**					
Marsh Creek	**X**						**X**	**X**
Mays Creek					**X**		**X**	
Meadow Creek 1		**X**					**X**	
Meadow Creek 2			**X**					
MF Lime						**X**	**X**	**X**
Narrow Creek	**X**							
NF Lime						**X**		
NMFK Lime Creek							**X**	
Paradise Creek					**X**		**X**	
Peach		**X**						

Pettit Lake Creek				**X**				
Pole Creek					**X**		**X**	
Rough Creek			**X***		**X**		**X**	
Salt Creek						**X**	**X**	**X**
SF Lime Hearn						**X**	**X**	
Shake Creek			**X***			**X**	**X**	
Skillern Creek								
Skunk Creek							**X**	**X**
Smiley Creek		**X**			**X**		**X**	**X**
Stanley Creek		**X**			**X**		**X**	**X**
Stanley Lake Creek		**X**				**X**		
Upper Harden			**X**					
Upper Little Smoky						**X**	**X**	**X**
Upper MFK Boise River								
Upper Redfish Lake Creek			**X***		**X**			
Upper Salmon River					**X**	**X**	**X**	
Upper SF Lime							**X**	
Upper SF Payette River			**X***		**X**			
Vat Creek					**X**		**X**	
WFK Kelley Creek							**X**	**X**
Wickiup Creek			**X***					
Williams Creek	**X**					**X**		
Worswick		**X**				**X**	**X**	
Yellow Belly Lake Creek		**X**		**X**	**X**		**X**	**X**