2007 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."*
>
> *"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 (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 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). Sites within each patch will be located by dividing the suitable habitat into 100m segments and then randomly selecting the segments.

[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. The sequence or order of sampling within patches is assumed to be unimportant, in terms of estimating probability of presence.

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. If juvenile bull trout are detected during formal sampling, crews may either elect to cease efforts and move to other patches or continue sampling to better determine distribution within the patch and augment the development of the empirical models.

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, 2, and 4 will be sampled at least twice. Initial sampling will be completed within first and last 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 2007 sampling.

Category	S.F. Boise Subbasin	M.F./N.F Boise Subbasin	S.F. Payette Subbasin	Upper Salmon Subbasin	Total
1	12	4	2	15	33
2	17	1	2	8	28
3	13	0	0	25	38
4	0	0	0	3	3
Total	42	5	4	51	102

Using data from the past 7 years (since 2000), all of the patches in the South Fork and Middle Fork/North Fork Boise River subbasins have been sampled. In the Upper Salmon 92% of the patches have been sampled, while 75% in the S.F. Payette on the Forest have been sampled (Table 2).

Table 2 - Number of bull trout patches on the Sawtooth National Forest and the number surveyed within the past 7 years (since 2000) within each subbasin by category (category based on 2007 strata).

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	6	6 (100%)	1	1 (100%)	2	1 (50%)	8	8 (100%)	17	16 (94%)
3	23	23 (100%)	0	0	0	0	26	23 (88%)	49	46 (93%)
4	0	0	0	0	0	0	1	0	1	0 (0%)
Total	42	42 (100%)	5	5 (100%)	4	3 (75%)	51	47 (92%)	102	97 (95%)

2007 Results and Discussion

Monitoring for bull trout on the Sawtooth National Forest occurred in 19 patches in 2007 (Figure 1). In the S.F. Boise subbasins, ten patches were surveyed. Of these patches, bull trout were observed in Boardman, Skeleton, Big Smoky, W.F. Big Smoky, Upper Big Smoky Creeks, and the Upper S.F. Boise River. In Skeleton and Boardman Creeks, bull trout had been found each year sampled since 1994. Bull trout had also been observed in W.F. Big Smoky Creek during surveys in 1993 and 2001, and Upper Big Smoky and upper portions of Big Smoky Creek in 2001, so detecting them in 2007 was anticipated. Bull trout distributions within each patch are similar to earlier surveys, with the exception of bull trout being found more headwater locations in the Upper Big Smoky patch.

In 2006, five sites in Ross Fork Creek in the Upper S.F. Boise patch failed to detect bull trout, even though past surveys in 1993 (Forest Service), 1999 (Idaho Fish and Game) and 2001 (Bureau of Reclamation) found bull trout in several locations. In 2007, four additional sites were surveyed in N.F. Ross Fork, Bass, and Little Bear Creeks. Bull trout were found at all sites in steeper, accessible reaches, but in very low densities. Results suggest that bull trout exist year-round in smaller tributary streams within the Ross Fork portion of this patch. Recent sampling by the forest has not detected bull trout in the mainstem of Ross Fork. Approximately the upper three miles of the mainstem Ross Fork goes subsurface in late summer and fall of most years, as do the lower reaches of the North and South forks. The dewatering is from natural bedload deposits in these reaches, as abundant water is present in the mid- to upper channels of the forks. It is possible that dewatered areas have increased due to lower base flows influenced by several year of drought. This may have limited rearing habitat for juvenile bull trout in the mainstem. It is also possible that bull trout are present in the mainstem, but in very low densities causing ‘‘false absences’’ to be recorded.

Bull trout were not observed in Lick, M.F. Lime, N.F. Lime, and Upper S.F. Lime Creeks despite detection probabilities ranging from of 0.76 and 0.97. Water temperatures in the Lick Creek patch are cold enough to support bull trout populations (MWMT 10.1°C and 15.5°C), but this patch is relatively small in acreage when compared to patches where bull trout have been observed. Additionally, habitat is dominated by brook and rainbow trout that are likely precluding the establishment of bull trout by wondering subadults. Bull trout have never been found in any Lime Creek tributary even though it has been intensively sampled in 1993, 1994, 1999, 2000, 2001, and 2007. It is likely that water temperatures are too warm (MWMT 17.1°C and 23.6°C) in most of the available habitat to support bull trout. Radio telemetry studies completed by Idaho Fish and Game in 1998-1999 also did not detect any migratory bull trout entering Lime Creek from Anderson Ranch Reservoir. This suggests that there have been very few if any bull trout to recolonize the Lime Creek patches.

During 2007 in the Salmon subbasin, eight patches were electrofished using formal protocols. Of the patches sampled, three patches (E.F. Valley Creek, Slate Creek, and Upper E.F. Salmon River) were occupied by juvenile bull trout (Figure 1). In addition, sampling in E.F. Valley and Upper E.F. Salmon confirmed the continued presence of migratory bull trout life histories within these patches. Bull trout had been detected previously in all of these patches and water temperature was below 15°C for most of the patch area. One patch (Baron Creek) was sampled by the Boise National Forest to collect fin clips. Bull trout were found in the headwaters of Baron Creek as they were during the 2004 surveys completed by the Sawtooth National Forest.

Electrofishing surveys failed to detect bull trout in the Pettit Lake, Trap, Stanley, Elk and Huckleberry patches. Probabilities of detection in the patches ranged from 0.76 to 0.98. Bull trout had not been found by previous surveys in Stanley or Huckleberry Creeks, so the 2007 survey continue to show that conditions are not conducive to supporting bull trout or that they occur in very low densities. One juvenile bull trout had been found in 1993 in the headwaters of Trap Creek, but only brook trout and westslope cutthroat were found in this area in 2007. It is possible that the small bull trout population in Trap Creek found in the early 90's may have been replaced by brook trout.

Three bull trout were observed in Pettit Lake by Idaho Fish and Game in 1991. The bull trout were believed to be an adfluvial population due to their size and location. Habitat within Pettit Lake Creek is limited for bull trout due to high water temperatures below the lake and a falls roughly one mile above the lake. For three decades prior to 1996 a rough fish barrier at the lake outlet also prevented all upstream fish migration. Brook trout are the dominant fish in Pettit Lake Creek above the lake, which is likely the reason why no juvenile bull trout were found during the 2007 surveys.

A few juvenile bull trout had been found in lower Elk Creek in 2001 below the meadows, but the headwaters had not been surveyed. Only brook trout were found in the two electrofishing sites in upper Elk Creek suggesting that either brook trout are the only species present or that bull trout are present in very low densities causing ''false absences'' to be recorded.

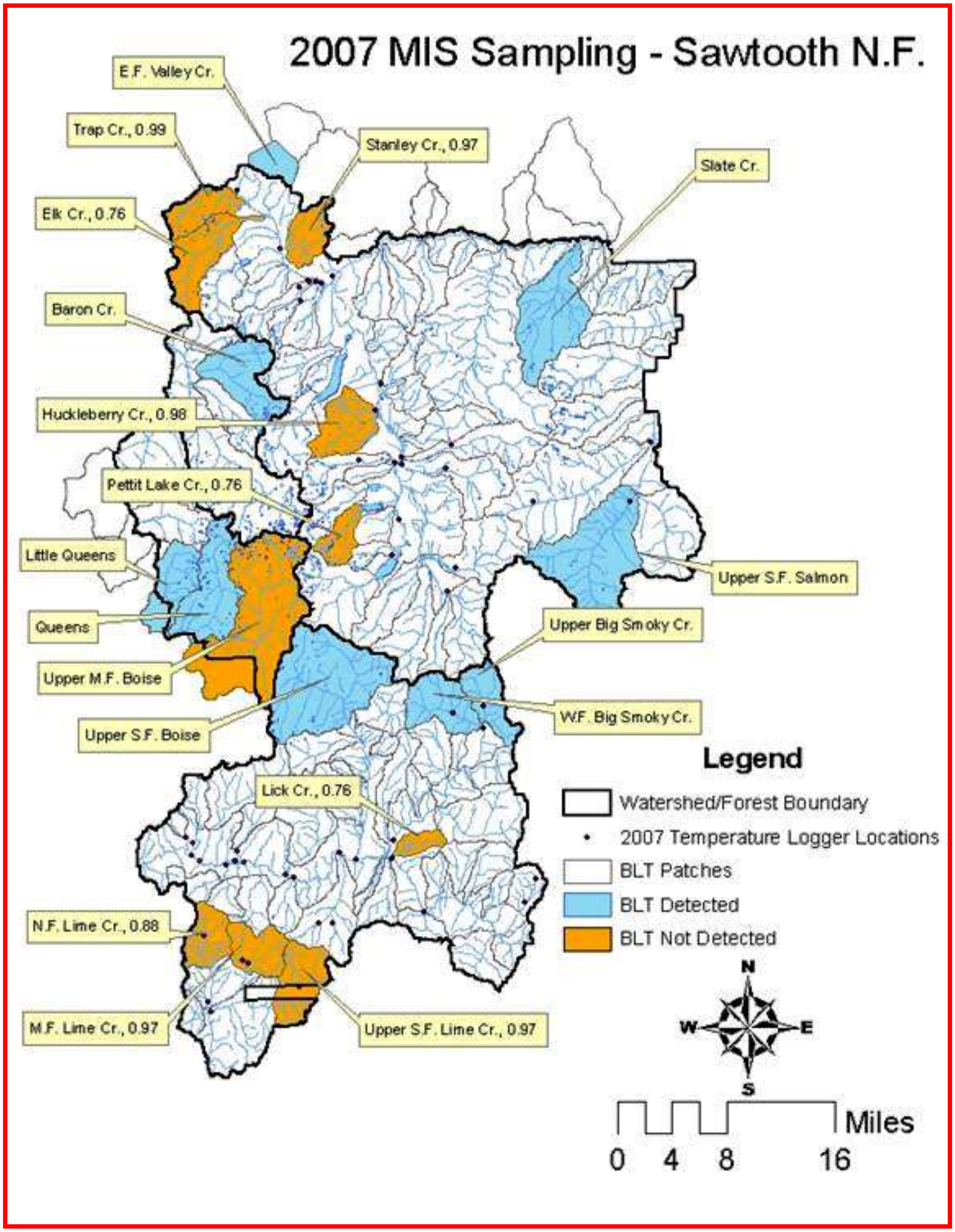

Figure 1 - Bull trout patches sampled, probabilities of detection and temperature loggers deployed on the North Zone of the Sawtooth N.F. (2007).

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 2007 field seasons, crews completed MIS protocol surveys in 97 (95%). Bull trout presence was confirmed in 33 patches; habitat was determined to be suitable but no bull trout were detected in 28 patches; habitat was determined to be unsuitable in 38 patches, and 3 patches still need to be surveyed.

Data collected over the past four years were compared with information collected prior to 2004 to provide a preliminary indication of bull trout trend across the planning unit (Table 3). Results from this comparison indicate a slight increase in bull trout distribution in the S.F. Boise, S.F. Payette, and Upper Salmon subbasins over the last four 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 3 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 daily 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 provides further explanations on how many of these factors are influencing bull trout presence and trend.

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 daily maximum temperature (MDMT) and maximum weekly maximum temperature (MWMT, the mean of daily maximum water temperatures measured over the warmest consecutive seven-day period) exceed 15 °C. Many of the patches with local and potential populations where bull trout have not been found have MDMT above 15 °C. For example, Big Water Gulch and Little Smoky Creek (both local 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.

The second factor influencing bull trout trend is the presence of brook trout. In several patches brook trout are widespread with very high densities. Brook trout are believed to be one of the reasons why bull trout have not been found recently in the Pettit Lake Creek or Salt Creek local populations. 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. Brook trout are frequently implicated in the decline of bull trout, impacting populations through introgressive hybridization, and possibly through interactive segregation (Rieman and McIntyre 1993). For example, in the upper Salmon patches where bull trout were observed, brook trout comprised 5% of the salmonids captured. In contrast, in the patches where bull trout were not observed, brook trout comprised 91% of all captured salmonids. It is possible that when brook trout abundance (or density) reaches a certain threshold, bull trout persistence within a patch is unlikely.

The third factor influencing bull trout trend is habitat access. Twenty two of the 38 patches where habitat is unsuitable (category 3) on the forest have or had culvert or diversion barriers. Bull trout have clearly not had access or there is not enough available habitat above these barriers to support a viable resident population.

Finally, some patches and potential populations (i.e. N.F., M.F. and S.F. Lime Creeks in the S.F. Boise River subbasin) may not sustain bull trout because migratory or neighboring tributary populations are not strong enough to support the colonization of unoccupied habitat. Rieman and McIntyre (1995) found that bull trout never occurred in tributary streams without also occurring in the associated main stems.

These factors individually or in collectively are likely influencing the ability of bull trout populations to occupy patches within designated local or potential populations under the draft recovery plan. These and other factors will be investigated further as the forest continues to monitor bull trout.

Table 3 - Comparison of bull trout patch strata 2003-2007.

Category	S.F. Boise Subbasin		N.F. and M.F. Boise Subbasin		S.F. Payette Subbasin		Upper Salmon Subbasin	
	# Patches 2004	# Patches 2007	# Patches 2004	# Patches 2007	# Patches 2004	# Patches 2007	# Patches 2004	# Patches 2007
1 – Occupied	11	12	4	4	0	2	6	15
2 – Suitable/Unoccupied	22	17	1	1	4	2	28	8
3 – Unsuitable/Inaccessible	10	13	0	0	0	0	3	25
4 - Unsurveyed	0	0	0	0	0	0	8	3
Total	43	42	5	5	4	4	45	51

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 four 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. 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 5 sites are sampled within a patch. This implies that we have a much higher confidence that bull trout densities in patches where juveniles are not detected are lower than densities in other occupied patches in the Salmon, Clearwater and

Boise subbasins in Idaho. In other words there is a higher probability 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 2007 sample patches are noted in Table 5.

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	4	2	2
Upper Salmon	Little Boulder	4	4	3
Upper Salmon	Slate	6	2	0
Upper Salmon	Warm Springs (Pigtail/Martin)	8	4	4
Upper Salmon	E.F. Valley Creek	5	5	5
Upper Salmon	Fishhook	4	4	3
Upper Salmon	Crooked	7	1	1
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
Total		76	47	39
Empirical Estimate of Probability of Detection				**39/76 = 0.51**

Table 5 - Summary of results from 2007 aquatic MIS sampling on the Sawtooth N.F.

Subbasin	Patch	Strata Designation in 2006	Bull Trout Detected	# Sites sampled	# Sites where Bull Trout < 150mm were found	Empirical Probability Of Detection
Upper Salmon	E.F. Valley Creek	2	+	5	5	NA
Upper Salmon	Pettit Lake Creek	2	-	2	0	0.76
Upper Salmon	Slate Creek	1	+	2	1	NA
Upper Salmon	Meadow Creek	2	-	7	0	0.99
Upper Salmon	Stanley Creek	3	-	5	0	0.97
Upper Salmon	Huckleberry Creek	4	-	6	0	0.98
Upper Salmon	Upper EF Salmon	1	+	1	1	NA
Upper Salmon	Elk Creek	2	-	2	0	0.76
S.F. Payette	Baron Creek	1	+	1	1	NA
S.F. Boise	Skeleton Creek	1	+	8	5	NA
S.F. Boise	Boardman Creek	1	+	17	9	NA
S.F. Boise	Lick Creek	2	-	2	0	0.76
S.F. Boise	Upper SF Boise River	1	+	4	3	NA
S.F. Boise	Big Smoky Creek	3	+	1	1	NA
S.F. Boise	W.F. Big Smokey Creek	1	+	3	1	NA
S.F. Boise	Upper Big Smoky Creek	1	+	4	4	NA
S.F. Boise	M.F. Lime Creek	2	-	5	0	0.97
S.F. Boise	N.F. Lime Creek	2	-	3	0	0.88
S.F. Boise	Upper S.F. Lime Creek	2	-	5	0	0.97

Current data also suggests that bull trout are detected more frequently in relatively large patches (2800-6533 ha) vs. smaller patches (1600-2800 ha) (Figure 2). For example, larger patches may have a higher probability of providing the right flows, stream gradients, water temperatures, and habitat necessary for bull trout persistence. 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 in size. Rieman and McIntyre (1995) found that patch size was highly significant in determining bull trout presence. 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. Data we have collected supports these findings and imply that probabilities of detection are very low when patches are even 1600 ha in size. Bull trout do use small streams (down to 2 m), but apparently at a lower frequency than larger streams.

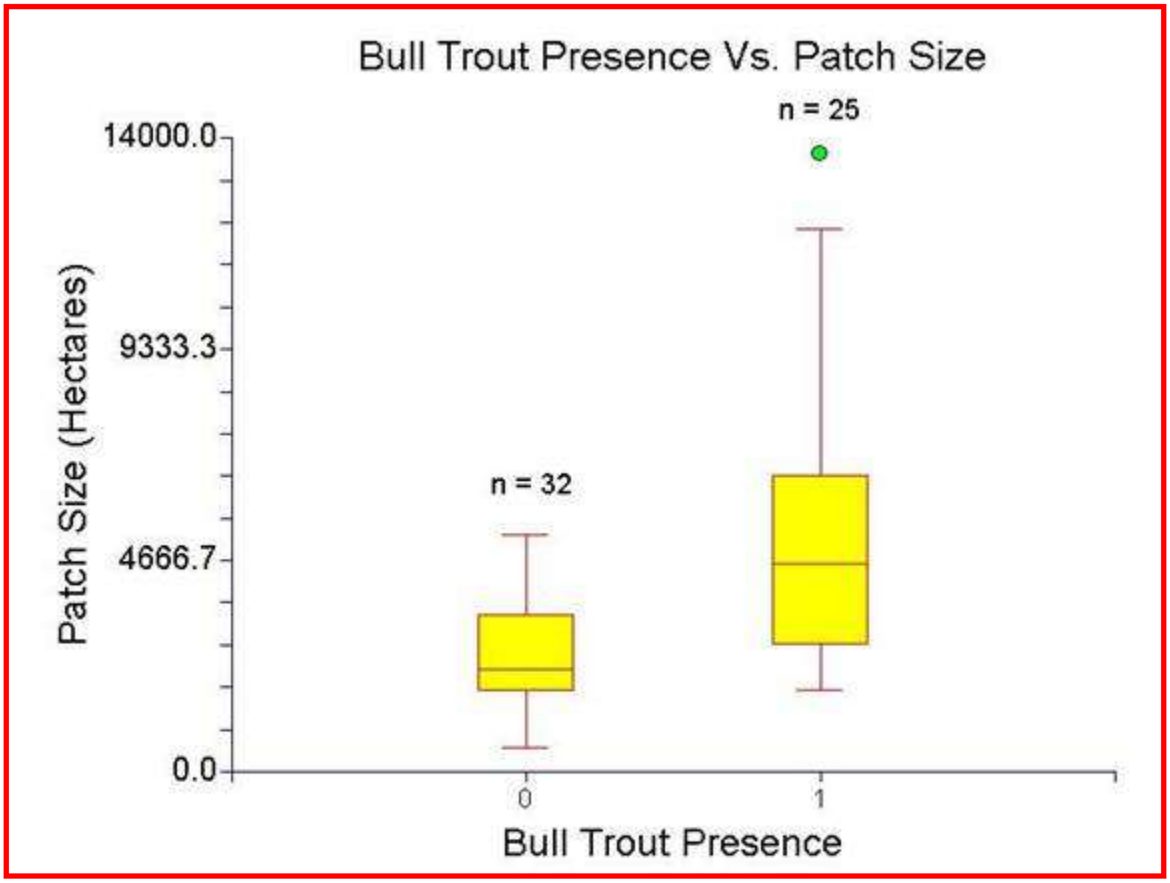

Figure 2 - Patch size (hectares) in patches where bull trout were detected (1) vs. those where bull trout were not observed (0). Figure includes 2004 – 2006 data. Warm Springs Creek (BLT = 1, 20961 hectares) was identified as a severe outlier and was removed from this figure.

Patch Stream Temperature Monitoring

Monitoring stream temperatures allows forest biologists 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. During 2007 in the Boise and Salmon subbasins, 49 temperature loggers were deployed, 11 of these were in bull trout patches (Figure 1). Because maximum water temperatures on the Sawtooth tend to occur between mid-July and mid-September (Sawtooth NF. unpublished data), water temperature loggers are deployed in early summer (prior to July 1) and recovered in early fall (after Sept 1). Gamett (2002) found that mean water temperature (July 1 to September 30) appeared to be the most effective in describing bull trout abundance in the Little Lost river drainage. In addition, Dunham (2003) found that the probability of bull trout occurrence was relatively high (>0.50) in streams with a maximum daily maximum temperature (MWMT, the warmest daily water temperature recorded during a given year or survey) <14-16° C.

Maximum daily maximum temperature (MDMT) and maximum weekly maximum temperature (MWMT, the mean of daily maximum water temperatures measured over the warmest consecutive seven-day period) were calculated for each patch and provide important information for managers when classifying patches into strata or assessing the presence or absence of bull trout. Even though no statistically significant relationship was observed (two sample T-test, $\alpha = 0.05$), median MWMT temperatures where bull trout were observed were lower than median MWMT temperatures where bull trout were not observed (Figure 3)).

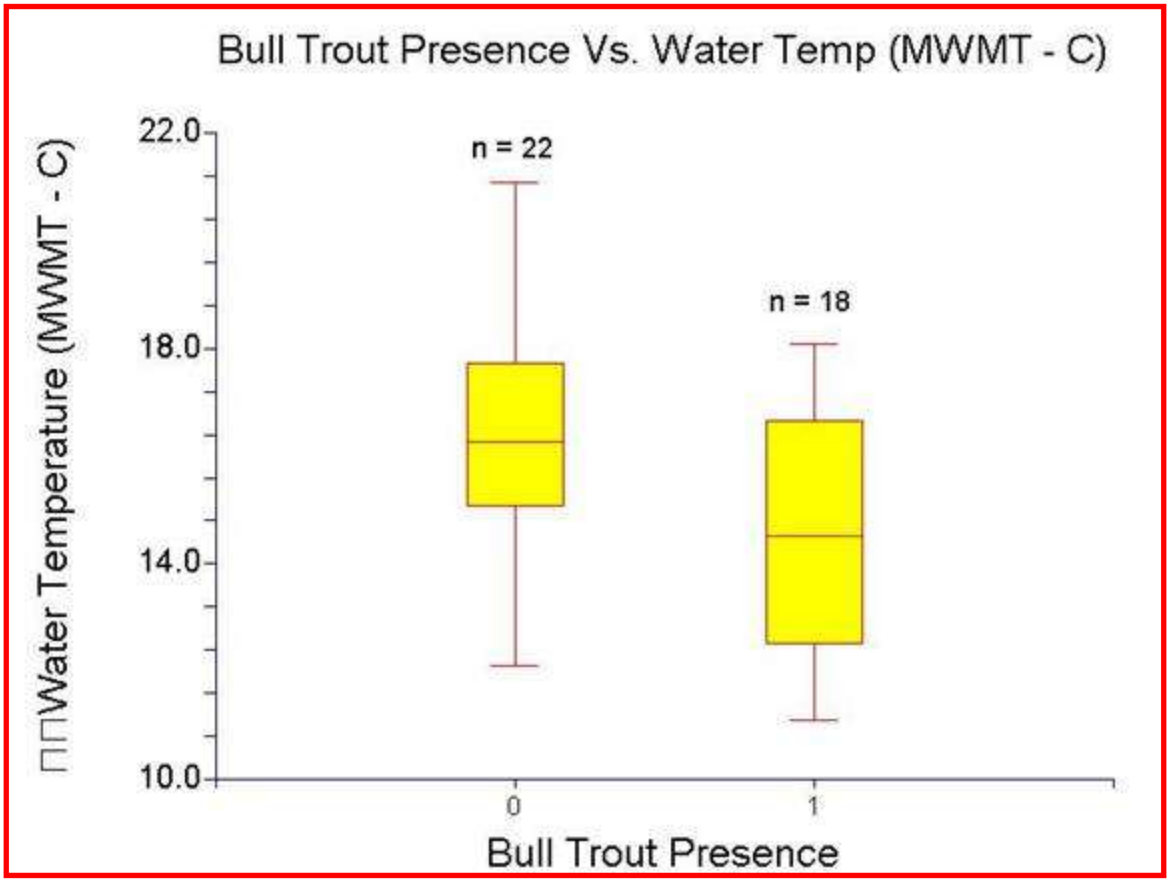

Figure 3 - Maximum weekly maximum temperature (MWMT - ° C) as measured at the confluence of patches where bull trout were detected (1) vs. those where bull trout were not observed (0). Figure includes 2004 - 2007 data.

Barriers

MIS results will also help managers assess the influence of fish passage barriers on bull trout populations. Passage barriers can have a strong influence upon species distributions as well as the life-history expression of fish populations. Current results suggest that patches must be large (greater than 2000 ha) in order for isolated bull trout populations to persist and barriers that isolate small watersheds might prevent bull trout persistence (Figure 4). Fish passage barriers can provide positive or negative influences on bull trout populations, depending upon a variety of factors, including the presence of exotic species, the size of the isolated population, habitat conditions above and below the barrier, etc. Further MIS monitoring will assist in the evaluation of the influence of barriers on the persistence of bull trout populations on the Sawtooth N.F.

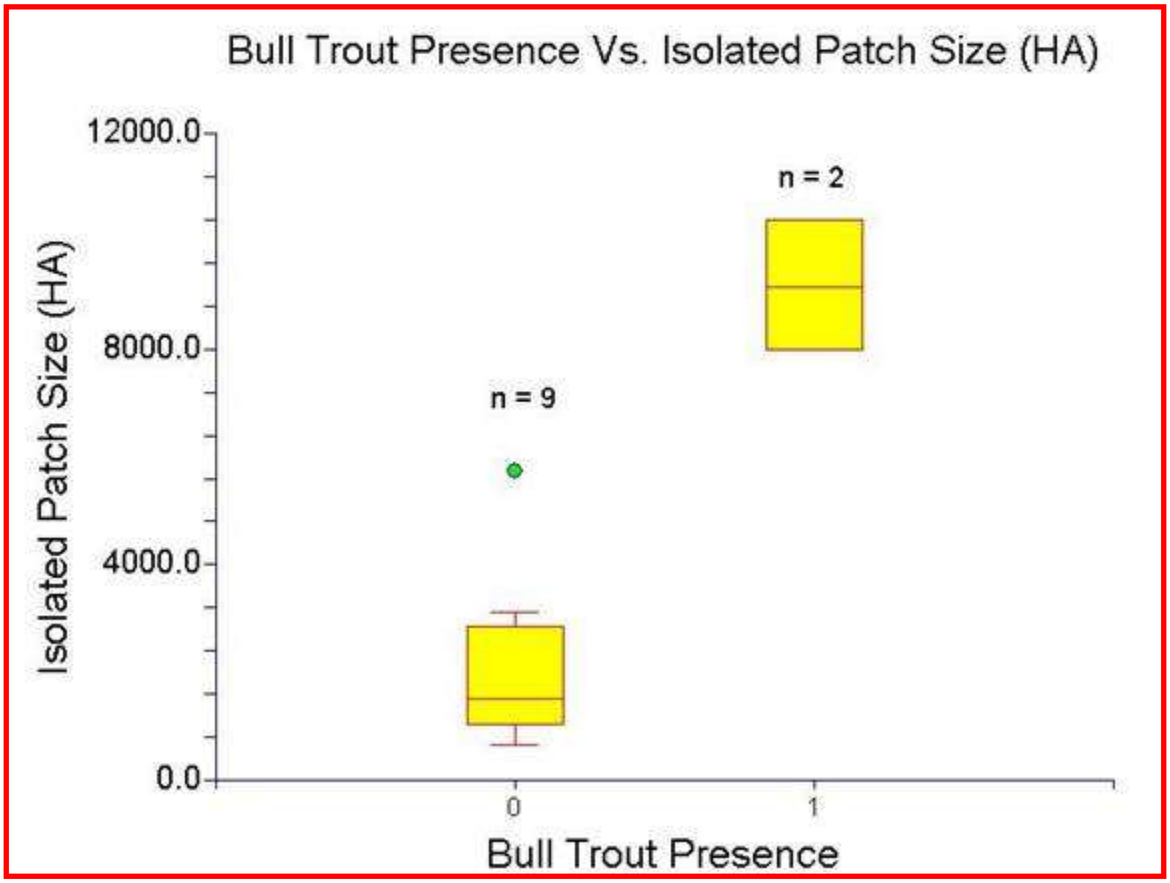

Figure 4 - Isolated patch size where bull trout were detected (1) or were not observed (0). Figure includes 2004-2007 data.

Conclusion

A variety of factors can influence the distribution of bull trout populations. As has been reported in the literature, results from MIS sampling on the Sawtooth N.F. indicates that patch size, stream temperature, fish passage barriers, and the occurrence of brook trout can all be associated with bull trout presence and persistence. In 2007, bull trout populations continue to occupy historically occupied patches, including Boardman, Skeleton, Big Smoky, W.F. Big Smoky, Upper Big Smoky Creeks, Baron Creek, E.F.

Valley Creek, Slate Creek, and Upper E.F. Salmon River. Bull trout were not found in Ross Fork Creek in the Upper S.F. Boise patch in 2006, but were found in 2007 in smaller tributaries (N.F. Ross Fork, Bass, and Little Bear Creeks).

Bull trout continue to absent in Pettit Lake, Stanley, Huckleberry, Lick, M.F. Lime, N.F. Lime, and Upper S.F. Lime Creeks with detection probabilities ranging from of 0.76 and 0.98. One juvenile bull trout had been found in 1993 in the headwaters of Trap Creek, but only brook trout and westslope cutthroat were found in this area in 2007. It is possible that the small bull trout population in Trap Creek found in the early 90's may have been replaced by brook trout. Only brook trout were found in the two electrofishing sites in upper Elk Creek suggesting that either brook trout are the only species present or that bull trout are present in very low densities causing ''false absences'' to be recorded.

Sampling over the past four years has better defined bull trout distributions in the S.F. Boise, S.F. Payette, and Upper Salmon subbasins. Data indicates that bull trout presence is more robust than previously thought and that bull trout are still occupying most patches where previously detected. Additional sampling over the life of the forest plan will continue to refine bull trout distributions and habitat requirements of bull trout populations on the Sawtooth N.F.

Table 6 - Fish species detected during 2007 MIS sampling on the Sawtooth N.F.

		Species Observed						
Subbasin	**Patch**	**BLT**	**BKT**	**RBT**	**CCT**	**CHS**	**SCP**	**WHF**
Upper Salmon	E.F. Valley Creek	+	+		+		+	
Upper Salmon	Pettit Lake Creek		+	+		+	+	
Upper Salmon	Slate Creek	+		+			+	
Upper Salmon	Meadow Creek		+		+	+	+	
Upper Salmon	Stanley Creek		+	+		+	+	
Upper Salmon	Huckleberry Creek		+	+	+		+	
Upper Salmon	Upper EF Salmon	+		+			+	+
Upper Salmon	Elk Creek		+				+	
S.F. Payette	Baron Creek	+		+				
S.F. Boise	Skeleton Creek	+		+				
S.F. Boise	Boardman Creek	+		+			+	
S.F. Boise	Lick Creek			+				
S.F. Boise	Upper SF Boise River	+		+			+	
S.F. Boise	Big Smoky Creek	+						
S.F. Boise	W.F. Big Smokey Creek	+		+			+	
S.F. Boise	Upper Big Smoky Creek	+		+			+	
S.F. Boise	M.F. Lime Creek			+			+	
S.F. Boise	N.F. Lime Creek			+			+	
S.F. Boise	Upper S.F. Lime Creek			+			+	

Note: BLT = bull trout, BKT = brook trout, RBT = redband/rainbow trout, CCT = westslope cutthroat trout, CHS = Chinook salmon, SCP = sculpin, whitefish = WHF.

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