2005 Boise Aquatic Management Indicator Species Monitoring Report

Electroshocking below a natural barrier on Bear creek in the South Fork Payette Subbasin.

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 (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.

Methods

Development of MIS Sampling Protocol for Bull Trout

An approach to monitoring MIS bull trout was developed with the Boise National Forest, Regional Office, and the Boise Rocky Mountain Research Station in 2004. The following provides a summary of this monitoring approach.

A key question that this approach addresses is how does one monitor trend? For aquatic species, trend is typically monitored using relative abundance estimates over time in a select set of streams. However, the challenge with abundance data is that it is often influenced by sampling error and natural variation (Platts and Nelson 1988; Maxell 1999; Dunham et al. 2001).

Given these well-known limitations, an alternative trend monitoring approach was developed that focuses on monitoring the spatial patterns of occurrence (distribution) through time. Monitoring distributions can be particularly appropriate for bull trout because it has very particular habitat requirements. Specifically, bull trout distributions are limited to cold water (Dunham et al. 2003), and suitably cold habitats are often patchily distributed throughout river networks (Poole et al. 2001). Dunham and Rieman (1999) found that bull trout populations in the Boise River basin were linked closely to available habitat “patches” or networks of cold water. A patch is defined for bull trout as the contiguous stream areas believed suitable for spawning and rearing (Rieman and McIntyre, 1995). Rieman and McIntyre (1995) analyzed bull trout in the Boise River basin and found occurrence to be positively related to habitat size (stream width) and patch (stream catchment) area, as well as patch isolation and indices of watershed disruption. Patch size (area) was the single most important factor determining bull trout occurrence.

Spatial patterns can also provide information on population persistence, local extirpations, and recovery (recolonization). The stability and persistence of metapopulations are related to the number, size, degree of isolation, and relative distribution of populations (Dunham and Rieman 1999). Bull trout populations in larger, less isolated, and less disturbed habitats appear more likely to persist over time.

Based upon the above approach the following metrics for determining trend were used:

(1) The proportion of habitat patches that bull trout occupy within each subbasin across time.
(2) The spatial pattern of occupied bull trout patches within each subbasin across time.

It was assumed in the forest plans that as restoration and conservation activities are implemented, constraints on watershed processes and habitat condition would be reduced. This in turn would maintain or restore properly functioning subwatersheds and slowly improve degraded subwatersheds respectively. However, it was also realized that it would take time for populations to respond to restoration and conservation measures. This might be particularly true for bull trout, which have a relatively long generation time (5-10 years). Therefore, it was assumed that the number and distribution of strong or depressed bull trout populations would change relatively slowly over the 15 years of the forest plan.

We anticipate, then, that important changes in the distribution and proportion of occupied bull trout patches will only be apparent over time scales approximating the life of the forest plan. Bull trout may become more widely distributed in occupied patches as populations begin to expand, and recolonization of unoccupied patches may occur as barriers are removed. However, only with sustained restoration and sufficient time for natural recovery, are we likely to see substantial changes in the portion of occupied patches or increases in bull trout distributions within occupied patches.

The trend of occupied patches and spatial pattern will not explain why changes have occurred. As the CFR states, "Population trends of the management indicator species will be monitored and relationships to habitat changes determined." Therefore, an approach is currently being developed to tie MIS monitoring with forest plan implementation and effectiveness monitoring to determine how habitats and individual populations change in relation to management activities.

Initial Determination of Bull Trout Patches

Bull trout patches were identified in two ways. First, several subbasins (e.g. Boise and Payette) already had patches delineated by existing work following Rieman and McIntyre

(1995) and Dunham and Rieman (1999). For these subbasins, district and forest biologists reviewed patch designations to determine if they included all known or potential streams that could support bull trout. Second, for subbasins where patches had not been established, a consistent set of criteria was applied to delineate patches.

Forests used criteria similar to those used by the RMRS in the Boise and Payette subbasins. Patches were initially defined based on major physical gradients (patch size, as it related to stream size and elevation). Patches were identified as catchments above 1600 m and were delineated from U.S. Geological Survey 10 m Digital Elevation Models (DEM). The 1600 m elevation criteria was used because data from the Boise basin indicated that the frequency of juvenile bull trout (<150 mm) occurrence increased sharply at about 1,600 m (Rieman and McIntyre 1995; Dunham and Rieman 1999).

Subwatersheds that were above 1600 m, but less than 500 hectares, were not included because they rarely supported perennial streams large enough to support bull trout. Watson and Hillman (1997) only found bull trout in streams greater than two meters in width and studies in western Montana (Rich 1996) and southwest Idaho (Rieman and McIntyre 1995; Dunham and Rieman 1999) show bull trout are less likely to occur in streams less than two meters in width. We assumed that patches less than 500 hectares would have streams with a wetted width smaller than 2 m at 1600m in elevation.

We initially assumed that 1,600 m elevation approximated the lower limits of habitat suitable for spawning and early rearing of bull trout. Because of the association with temperature, elevation should define habitat patches that are at least partially isolated by distance across warmer waters (Rieman and McIntyre, 1995). The 1600m elevation in the Boise and Payette subbasins currently forms the downstream boundary of each patch. However, in subbasins in higher latitudes, there may not be a clear elevation threshold. Therefore, further verification described below was completed.

Once delineated, district and forest biologists reviewed patch designations and made refinements based on stream temperature and presence of bull trout smaller than 150mm. Patches were defined as areas generally not isolated from the larger subbasin by a yearlong barrier (physical, chemical, etc.) to fish movements and by water temperatures no higher than 15 °C (7 day average summer maximum). Recent analysis of stream temperatures and bull trout occurrence indicates juvenile bull trout are unlikely to be found in stream sites with maximum summer temperatures of 18-19 °C (Dunham et al. 2003).

Observations used to define patch boundaries were also based on the more restricted movements of small (less than 150 mm) bull trout. Although some bull trout may exhibit seasonal movements from natal habitats to wintering or foraging areas (e.g. larger rivers, lakes or reservoirs), fidelity to the natal environments is likely during spawning and initial rearing. Because spawning salmonids home to natal streams and even reaches (Quinn 1993), occupied patches separated by thermally unsuitable habitat are likely to represent populations with some reproductive isolation. Other information (e.g. genetic, mark-recapture, radio-telemetry, etc.) may be collected over time to determine distinctiveness of the populations associated with the patches we define.

Classification of Patches and Stratification of Sampling

Once bull trout patches were identified, they were classified into four categories to further focus sampling efforts over the life of the forest plan (2003 – 2018). These categories included: (1) patches known to support a bull trout population (i.e., spawning and/or early rearing has been documented) as indicated by past surveys (within the last 7 years); (2) patches that have been surveyed and baseline conditions likely will support a bull trout population, but they have not been detected or patches where bull trout have been detected, but observation are older than 7 years; (3) patches that have been surveyed and baseline conditions (i.e., stream temperature, etc.) likely will not support a bull trout population and bull trout have not been detected (i.e. we assume these patches are unsuitable and unoccupied); and (4) patches that have not been surveyed.

There are 170 bull trout patches that occur within three basins (nine subbasins) on the Boise National Forest; 43 patches in category 1; 65 patches in category 2; 12 patches in category 3; and 50 patches that have not been surveyed in category 4 (Table 1).

Changes to Bull Trout Patches

Expansion, contraction, or shifting distributions of bull trout within patches are likely to be influenced by changing environmental conditions. Water temperature is one of the most significant habitat parameters for bull trout and therefore will be important when evaluating patch boundaries over time. All patches falling into category 1, 2, or 4 will be sampled for bull trout at least twice over the life of the forest plan (e.g. at least once within the first and second 7 year period). In the year prior to sampling of a patch, at least one thermograph will be installed at the downstream patch boundary and at several other points upstream.

Annual temperature monitoring will also be conducted within specific patches in each category (e.g. 1, 2, and 3) over the life of the forest plan. With this information we can examine natural variation in stream temperatures, evaluate whether patch boundaries should be changed (e.g. elevated temperature due to an unusually hot summer) based on one year's monitoring, and determine if temperatures in select category 3 patches are improving enough to justify future sampling for bull trout.

The thermograph data will also help us evaluate whether a patch is still suitable for bull trout (i.e., whether a Category 1, 2, or 4 patch is actually Category 3 or whether the downstream (temperature-based) boundary of the patch is pushed upstream so far as to eliminate [because of the area criterion] the subject drainage from consideration as a patch). Thermograph data may also be used to determine if conditions within selected Category 3 patches have improved enough that the patch category needs to be redefined to a 2.

Patch Sampling Frequency

How frequently a patch is sampled is dependent upon how many patches fall within each strata and if some patches require more intensive sampling to establish presence or absence to the level of detection allowed by the methodology. All patches that fall within categories 1, 2 and 4 will be sampled at least twice over the life to the forest plan (2003 – 2018), while patches that fall within strata 3 will be sampled at least once.

Within the first half of the forest plan (0-7 years), all patches in strata 1, 2 and 4 would be prioritized for inventory. Patches in category 1 would be sampled no later than 7 years from the last documented bull trout observation. For example, if bull trout were last documented in 1999, then the patch would need to be sampled again no later than 2006. Patches within strata 2 and 4 would also be surveyed to help establish bull trout presence or absence to the level of certainty allowed by the methodology.

Depending on the survey results, patches may be reclassified. For example, once all patches in strata 4 are surveyed, they would be reclassified (e.g. 1, 2, or 3). Likewise, if no bull trout were found where previously observed (category 1 patch), it would be reclassified. If bull trout were still present then the patch would remain in category 1.

In the second half (8-15 years) of the forest plan, all patches in strata 1 and 2 would be sampled. Patches in strata 3 (degraded baselines with high stream temperatures, high amount of fine sediment, etc.) would only be sampled if environmental conditions or limiting factors (e.g. culvert barrier removed) improved, increasing the likelihood that the patch might support bull trout or if a neighboring patch were colonized by bull trout.

Informal and Formal Surveys

To maximize effort and facilitate fieldwork, we plan to use a combination of informal and formal surveys. Informal surveys may use any fish sampling method, but if informal surveys fail to detect bull trout, formal surveys must be completed. Formal surveys will follow a consistent protocol, sampling intensity, sampling effort, etc. designed to estimate the probability that bull trout actually occur in a site or patch given that they are not detected (i.e. a false absence).

The sample design (delineation of patches and sample sites within patches) attempts to focus on habitat that has the highest probability of supporting bull trout. While this design increases the probability of detecting bull trout, it does not guarantee it. Determination of bull trout presence is certain only when a bull trout is detected or captured (Peterson and Dunham 2002). Absence can never be certain (unless perhaps the stream is dewatered). Many patches within the Boise and Sawtooth National Forests are either believed to be unoccupied or have very low bull trout densities. If a species is not detected, then either it is truly absent or it is present but not detected during the survey.

The goal is to sample in a way that allows the estimation of the probability of presence or absence in a patch given sampling effort and site characteristics that will influence the probability of detection when bull trout are actually present.

The general methods outlined by Peterson et al. (2002) or their extension by Peterson and Dunham (2003) will be used to estimate probability of bull trout presence in sampled patches. The probability of bull trout detection for each site will be estimated from Appendix 1, Table 3, in Peterson et al. 2002 or with empirical methods as discussed by Wintle et al. 2004. This protocol provides forest biologists with a pseudo-quantitative measure assessing the likelihood that sampling efforts were intensive enough to detect bull trout, assuming that they are present in the patch. If habitat conditions in a patch are known, biologists can determine the extent of sampling required to reach a predetermined level of confidence that bull trout are not present. In addition, calculating probabilities of detection following sampling efforts helps biologist to determine whether future sampling is necessary.

Selecting Sites within Patches

To focus sampling within a patch, only suitable habitat will be inventoried. 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). All suitable habitat in each patch that meets these criteria will be identified prior to surveying. For formal surveys, sites within each patch will be located by randomly selecting elevations within the extent of the suitable habitat. Randomizing sample sites within a patch will allow us to make conditioned inferences to all perennial streams greater than 2 meters within the patch.

Sampling within each site

Informal surveys will be done in all strata 1 patches where bull trout have been found in the past, if bull trout are not found formal surveys will be done. Formal sampling will be based on a standardized electrofishing method selected to maximize the probability of detection within a patch by balancing the effort within a site against the number of sites within a patch. The minimum formal sampling will consist of a 100m double-pass transect with blocknets. Additional electrofishing passes can be completed if an index of abundance, sampling efficiency data, or other information is desired. If juvenile bull trout (i.e., less than 150 mm) are found within any site, bull trout will be declared present within that patch. If bull trout are not detected in the first sample site, additional sites will be sampled in each patch until bull trout are detected, until a desired probability of detection in the patch is reached, or until maximum allowable effort given logistical constraints is reached, which ever comes first. Additional sites can also be surveyed to describe distribution within the patch.

Sampling sites within a patch will be 100 m in length. In models used by the Rocky Mountain Research Station, 100 m sites had slightly higher densities of bull trout; and, thus, detectability of bull trout is greater, assuming equal sampling efficiencies.

Results and Discussion

MIS monitoring for bull trout on the Boise N.F. occurred in 29 patches in 2005 (Figure 4 and Table 2). Bull trout were detected in 19 out of the 29 patches surveyed. For the 10 patches sampled in 2005 where no bull trout were captured, probability of detection of bull trout ranged from 7-59%. The probability of detection calculations do not include two patches where no fish were detected above natural barriers.

N.F./M.F. Boise subbasin

In the N.F./M.F. Boise subbasin, ten patches (Pikes Fork, Crooked River, Bear, Bear River, Hunter, Johnson, Hot, Phifer, Buck and Upper North Fork Boise River) in categories 1, 2 and 4 were surveyed. Bull trout were observed in six of these patches, Crooked River, Bear, Bear River, Johnson, Buck and the Upper North Fork Boise River. Adult bull trout >150mm were found in Bear River but not juveniles. Juvenile bull trout had previously been detected in Crooked River, Bear River, Johnson and the Upper North Fork Boise River in 2002. Juvenile bull trout were detected in Bear, in 2001. Sampling will be conducted in Bear River during the 2006 field season to further determine presence or absence of juvenile bull trout.

Bull trout were not observed in Pikes Fork or Hunter Creek, but only one site was sampled in each of these two patches. This level of sampling resulted in probabilities of detection of 9.7% and 7.0% respectively. The Boise National Forest and the Rocky Mountain Research Station had sampled Pikes Fork and Hunter previously. Pikes Fork was electrofished a total of 25 times in 1993-1997 1999-2001 and 2004. Bull trout were detected in Pikes Fork in 1993 and 1995, but were <u>not</u> found during any of the subsequent surveys. Bull trout have not been documented in Hunter Creek, but it has only been shocked in 1994 and 2005 with one site near the bottom of the patch each year. A more thorough survey of each patch is needed. No fish at all were found in Phifer or Hot Creek. A barrier was found on Phifer creek just above the patch boundary and multiple barriers were found on Hot Creek. There were no previous surveys in the Phifer or Hot Creek patches.

S.F. Boise subbasin

In the S.F. Boise subbasin, five patches (Spring, Whiskey Jack, Trinity, Parks, and Slickear) in categories 1, 2 and 4 were surveyed. Bull trout were observed in two of these patches, Parks and Trinity. Both of these patches had been surveyed numerous times in the past, Trinity in 1993 and 1994 Parks in 1995 and 1999, but juvenile bull trout had not been detected in either of these patches.

Bull trout were not observed in Spring or Whiskey Jack, even though 4 milti-pass sites were conducted in each patch. This level of sampling resulted in probabilities of detection of 59%. The Boise National Forest and the Rocky Mountain Research Station had previously sampled Spring and Whiskey Jack Creeks, but no bull trout have ever been found.

One multiple pass electrofishing site was done on Slickear Creek. This patch had not been previously surveyed and bull trout were not found. Multiple sites were not done because of the small size of the stream -1.5m average width. This level of sampling resulted in probabilities of detection of 12.7%.

<u>S.F. Payette subbasin</u>

During 2005, eleven bull trout patches were sampled in the S.F. Payette subbasin (Deadwood Resivoir, Deer, Clear, Eightmile, Canyon, Wapiti, Bear, Rock, Tenmile, Chapman and Warmspring). Bull trout were found in nine of these patches using single-pass electrofishing (Deadwood Reservoir, Deer, Warm Spring, Tenmile, Eightmile, Canyon, Chapman, Clear, and Wapiti). Crews from the Boise N.F. and/or Bureau of Reclamation had previously detected bull trout in all nine of these patches. No bull trout were detected in multiple-pass electrofishing conducted at two sites on Bear Creek and one site on Rock Creek. Both of these category 2 patches had previous surveys, none of which detected bull trout. This level of sampling resulted in a probability of detection of 20% and 10.7% respectively. This year's ratio of patches containing bull trout in the South Fork Payette subbasin is high, because sampling was done mostly in patches where bull trout were known to exist in order to get DNA samples for a genetics project.

<u>M.F. Payette subbasin</u>

One patch was surveyed on the Middle Fork Payette in 2005, Upper Middle Fork Payette River. Bull trout were found at each of three single pass electrofishing sites. Bull trout have been found here in the past with the most recent surveys done in 2002.

<u>Mores Creek subbasin</u>

One patch was surveyed in the Mores Creek subbasin in 2005, Mores. Bull trout were not detected in 2 multi-pass electrofishing sites. Bull trout were previously found in 2000 and 2001. The probability of detection for the 2005 sampling was 18%.

<u>Middle Fork Salmon</u>

One patch was surveyed in the Middle Fork Salmon subbasin in 2005, Elk/Cook. Juvenile bull trout were found here at one of two sites. Only adult bull trout had been found here in the past.

<u>**Bull Trout Detection**</u>

Juvenile bull trout (<150mm) were detected in 18 of the 29 patches sampled on the Boise National Forest in 2005. Juvenile bull trout were detected at the first sample site in ten of these 18 patches. In four patches, juvenile bull trout were not detected until the second electrofishing site. In another four patches, juvenile bull trout were not detected until the third electrofishing site. At sites where juvenile bull trout were detected, they were observed during the first electrofishing pass 17 out of 18 times (Table 2).

In 8 of the 18 patches where juvenile bull trout were detected in 2005, the field crew discontinued electrofishing after completing the first site. However, multiple sites (n=43) were electrofished in 10 of the 18 patches that had at least one juvenile bull trout detection in 2005. Although juvenile bull trout were confirmed present in these 10 patches, none were detected at 34% (n=14) of the sites. Upper Middle Fork Payette

River was the only one of these 10 patches where bull trout were detected at all [3] sites that were sampled. This indicates that bull trout were not evenly distributed within occupied patches. The electrofishing results and spatial distribution of sample sites within these ten patches indicate that juvenile bull trout were detected more frequently and in greater abundance at higher elevations within patches (Figure 1).

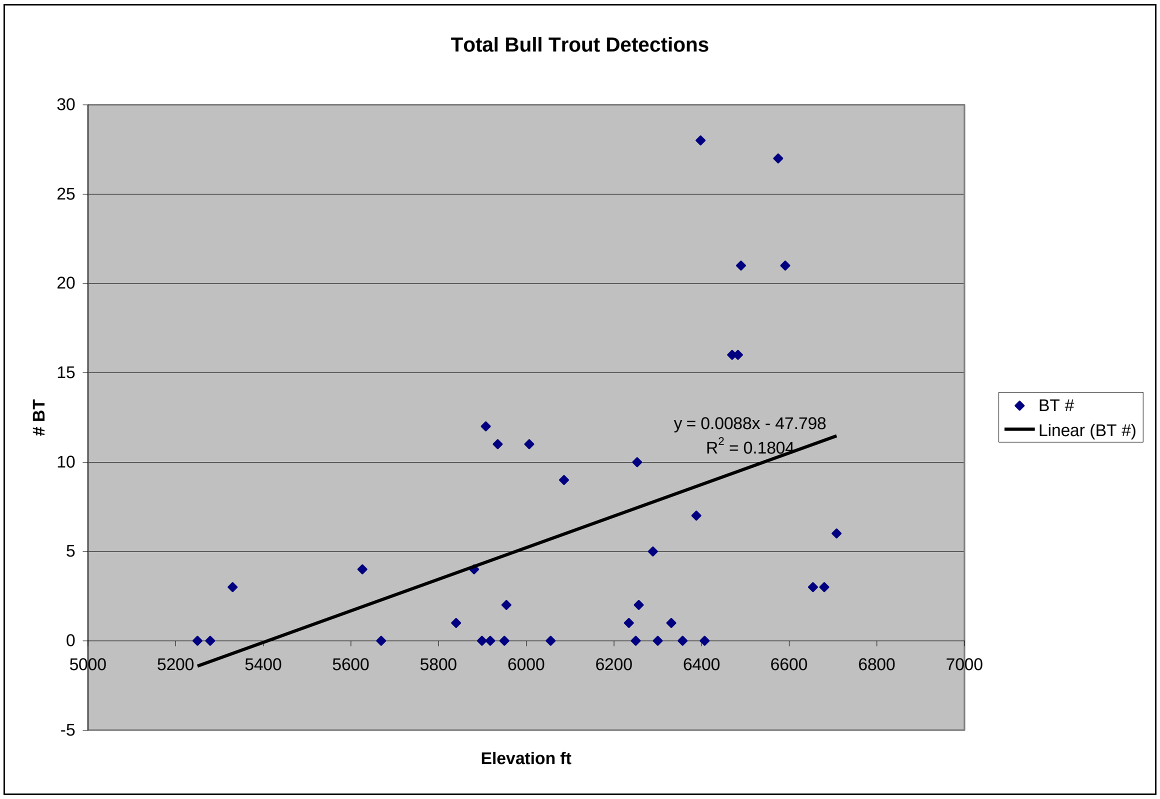

Figure 1. Bull trout detections by elevation for occupied patches with multiple sample sites in 2005.

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 2003), and update MIS patch strata. As such, stream temperature monitoring plays a critical role in this aquatic MIS approach. During 2005, the Boise N.F. crew deployed 35 temperature loggers in 27 patches on the Boise N.F. Only 32 were retrieved this fall, one was lost and 2 were not accessible due to early snowfall (Figure 2-Figure 4). Because maximum water temperatures on the Boise N.F. tend to occur between mid-July and mid-September (Boise NF unpublished data), water temperature loggers are deployed in early summer (early July) 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 drainage. 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. Dunham (2003) found that the probability of bull trout occurrence was relatively high (>0.50) in streams with a maximum daily maximum temperature (MDMT, the warmest daily water temperature recorded during a given year or survey) <14-16° C.

Bull trout were detected in five of the patches where temperature loggers were deployed during the 2005 season, Elk/Cook, Canyon, Wapiti, Trinity and Parks. Streams occupied by bull trout had a mean MDMT of 16.64°C (14.8-20.5 range) and MWMT of 15.72 °C (14.0-19.5 range) at the lowest elevation within each patch (Figure 2). Cook Creek had a MDMT of 20.5 and a MWMT of 19.5, but bull trout were found in this patch. This may be explained by the small tributary just above the shocking site possibly bringing in cold water. More temperature loggers will be deployed in Cook creek in 2006 to evaluate the influence of the tributary.

Temperature loggers were deployed at the lowest elevation in the patch (usually 1600m) and at other various elevations within patches. In six strata 1 patches; Canyon, Parks, Riordan, Trapper, Trinity, and Wapiti temperature loggers were deployed at 1600m, the MDMT was 15.72°C (14.3-17.3 range) and MWMT 14.87 °C (13.5-16.6 range) (Figure 2). In the nine strata 2 patches; Bear SFS, Bear SFP, Dollar, German, Grouse, Lincoln, Miller, Spring, and Trail SFS the MDMT was 16.40°C (13.6-20.2 range) and MWMT 15.47 °C (12.8-19.5 range) (Figure 2). In the two strata 3 patches; Bear SFB and Lunch the MDMT was 16.80°C (16.3-17.3 range) and MWMT 16.1 °C (15.5-16.7range) (Figure 3). In the four strata 4 patches; Evans, Green, Wagontown, and Wolf the MDMT was 14.90°C (13.0-18.5 range) and MWMT 14.18 °C (12.4-17.7 range) (Figure 3).

Temperature loggers were deployed in two patches where the lowest elevation was not 1600m; Elk/Cook and Sand, 1948m and 2048m in elevation respectively. Cook Creek had a MDMT of 20.5 and a MWMT of 19.5, Sand creek had a MDMT of 20.2 and a MWMT of 19.3. Both of these streams are very warm for their elevation, because they are slow moving C channels with little riparian cover. Sand Creek had two more temperature loggers deployed at higher elevations 6801 and 6922 with MDMT of 18.8 and 17.8 and MWMT of 17.9 and 16.9 respectively. (Figure 2 and 3) Because of these high temperatures throughout the patch, Sand creek will be changed to strata 3.

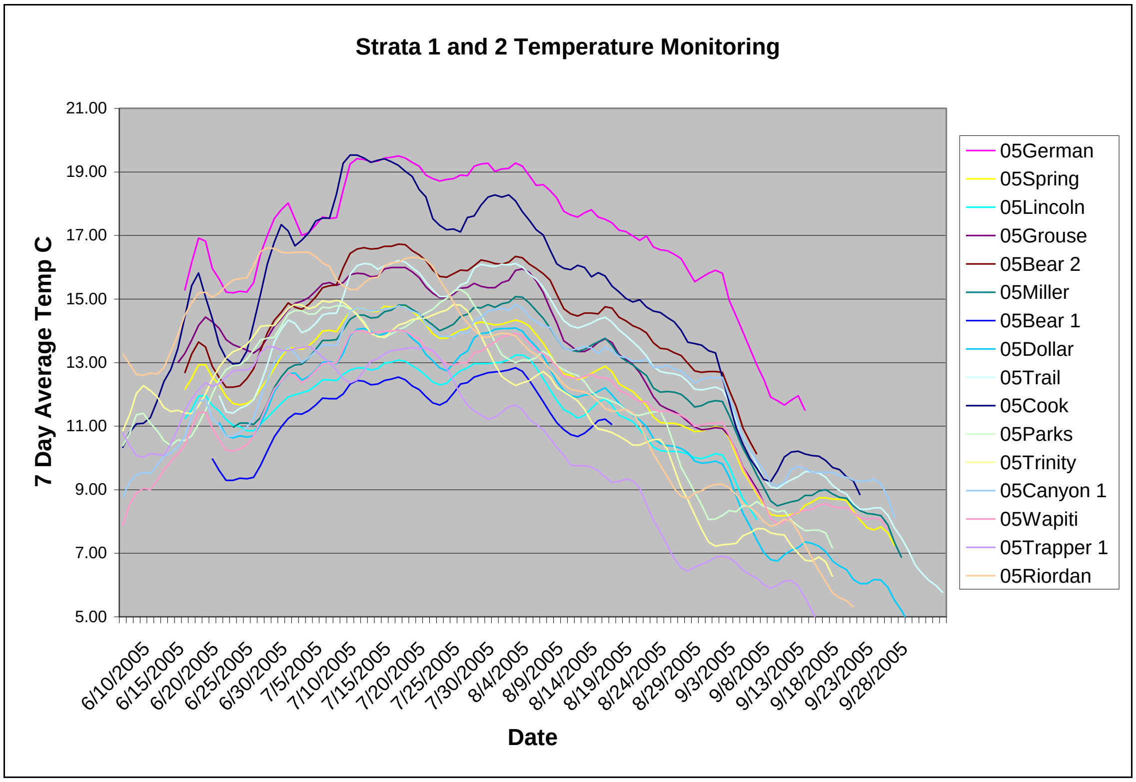

Figure 2. 7 day average water temperatures monitored in strata 1 and 2 patches in 2005.

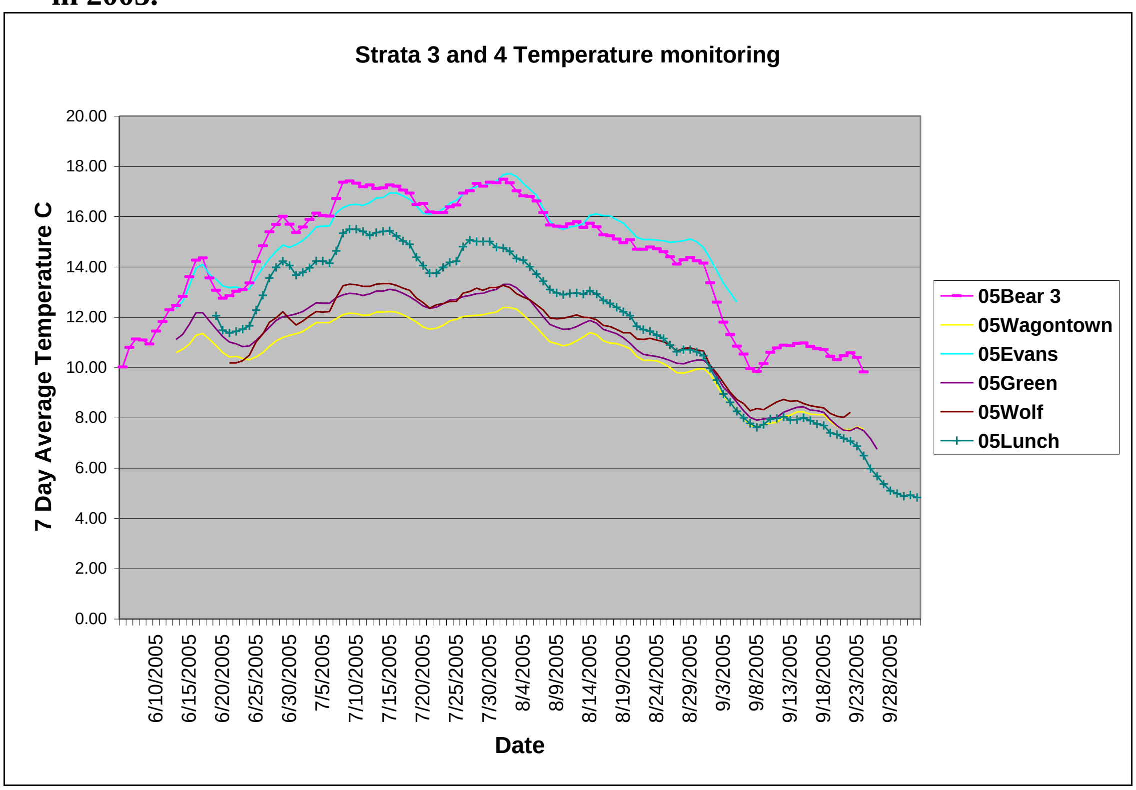

Figure 3. 7 day average water temperatures monitored in strata 3 and 4 patches in 2005.

Factors other than water temperatures (i.e. groundwater inputs, over-wintering habitat, and habitat connectivity) are also likely influencing bull trout distribution. In several of the 2005 patches, temperature appeared to be suitable for bull trout even though no bull trout were detected during summer sampling. The perceived absence of bull trout could be related to other factors including passage barriers and sampling error. It is likely that a larger sample size of patches is needed before associations between bull trout occurrence and stream temperature can be better defined.

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. Several of the patches sampled during 2005 contained barriers that could influence the presence or persistence of bull trout. Identified culvert barriers block access to Bear SFP, Hunter, Mores, Phifer, and Spring, and no bull trout were detected in these patches. However, juvenile bull trout were detected in one patch upstream of an identified culvert barrier: Wapiti Creek. Natural barriers (waterfalls) were also found in four of the patches surveyed this year; Phifer, Bear SFP, Hot, and Beaver Creek in the Deadwood Reservoir patch. Phifer and Hot had no fish at all within the patch boundries, Bear had fish below the waterfall and Beaver Creek had bull trout below the waterfall.

Barriers can also occur in less discrete locations as a result of thermal difference between stream sections. Thermal barriers (>20ºC) were verified in Cook, Sand, and German through water temperature monitoring in 2005. However, juvenile bull trout were detected in Cook Creek upstream from the temperature logger location. 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 Boise N.F.

Hybridization

MIS monitoring did detect a variety of game and non-game species across the Boise N.F. (Table 3) including brook trout (*Salvelinus fontinalis*), a species known to hybridize with bull trout (Markle 1992, Leary et al. 1993). During the 2005 sampling season, three patches were found to have both bull trout and brook trout (Elk/Cook, Bear Creek NFB and Crooked River). Bull trout / brook trout hybrids were not phenotypically confirmed, but fin clips were taken for DNA verification. DNA studies have been done in the past by the USBR showing a high percentage (29%) of bull trout were actually hybrids in Bear Creek (Whiteley et al. 2003) Recent research indicates that bull trout/brook trout F1 generation hybrids can reproduce, though less successfully than pure crosses between parent species (Kanda et al 2002). Bull trout hybridization with *S. fontinalis* is recognized as a major threat to the persistence of bull trout, largely as a result of population-scale wasted reproductive effort and genetic introgression (Markle 1992, Leary et al. 1993, Kanda et al. 2002).

Strata Changes

The strata of seven patches changed as a result of sampling in 2005. Phifer and Hot Creeks had no fish and changed from strata 2 to strata 3 because of natural barriers (waterfalls). Sand Creek change from stratum 2 to 3, due to high temperatures described earlier. Juvenile bull trout were found in 4 patches where they had not previously been detected. Cook Creek was changed from strata 3 to strata 1. Buck creek was changed from strata 4 to strata 1. Parks and Trinity were changed from strata 2 to strata 1.

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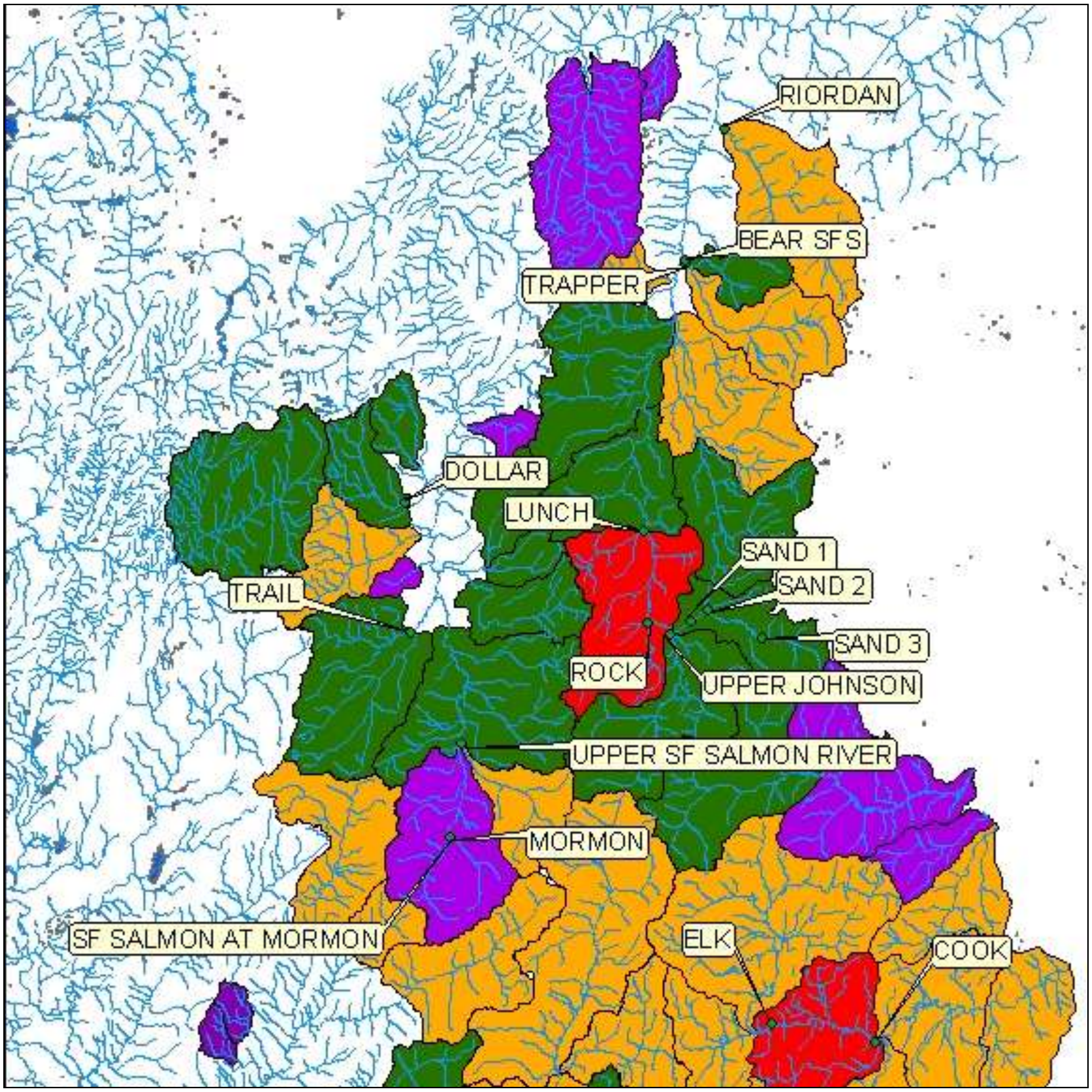

Figure 4a. Temperature Loggers Deployed in the North Half of the Boise N.F. (2005).

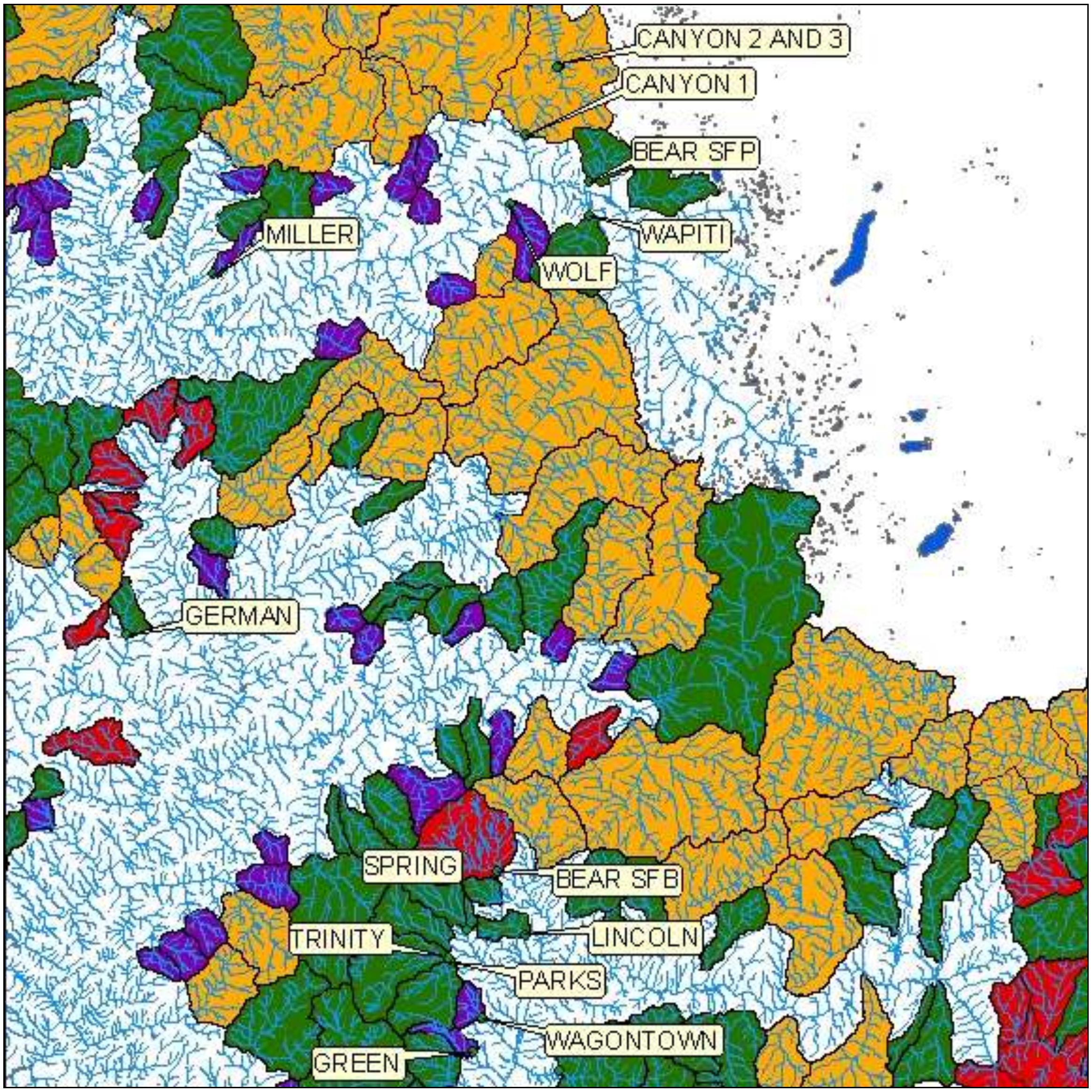

Figure 4b. Temperature Loggers Deployed in the South Half of the Boise N.F. (2005).

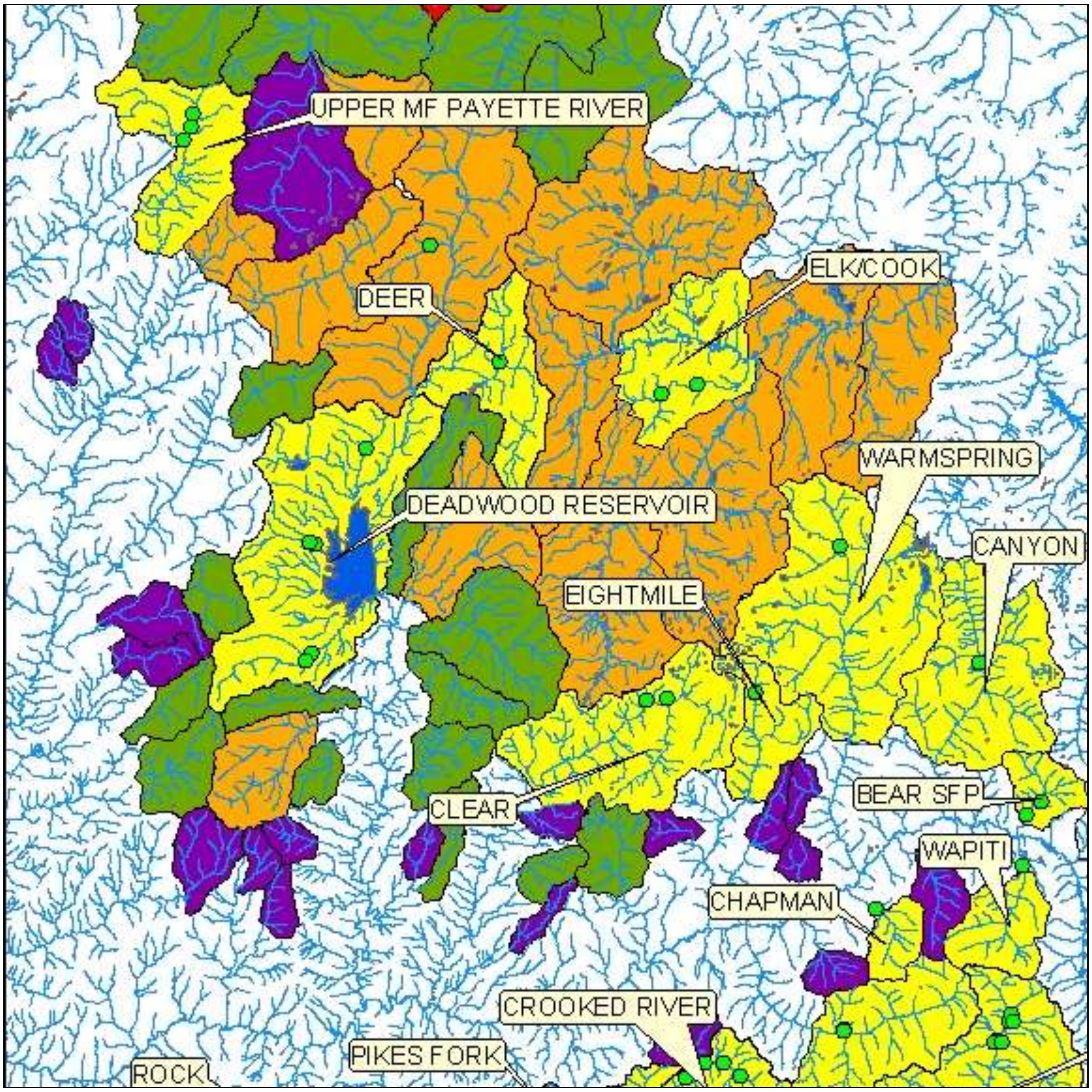

Figure 5a. Bull Trout Patches Sampled on the Boise N.F. during 2005 – North Half
● = Electroshocking sites

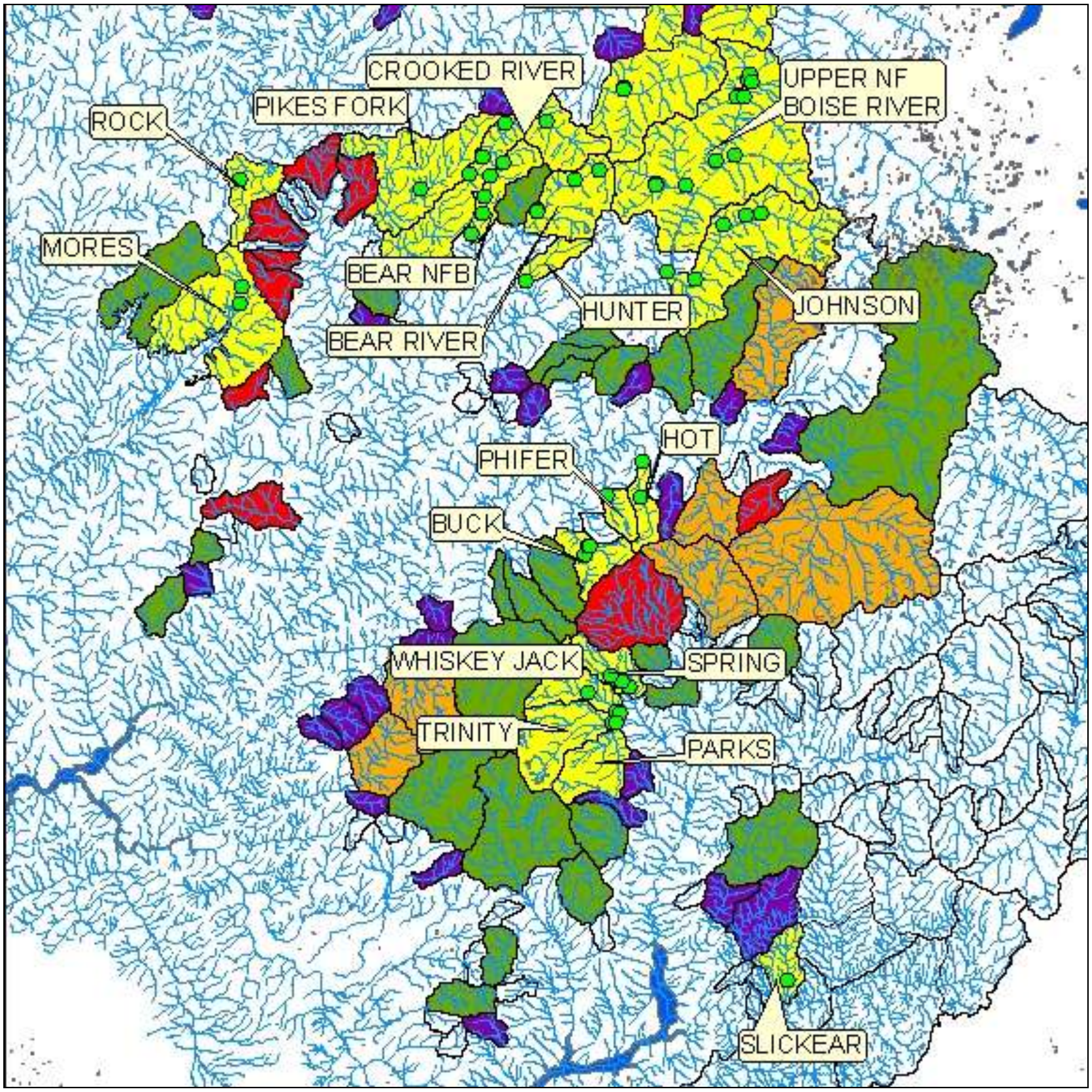

Figure 5b. Bull Trout Patches Sampled on the Boise N.F. during 2005 – South Half
●= Electroshocking sites

Table 1a. Number of bull trout patches on the Boise National Forest within each basin by category prior to 2004 sampling.

Strata	Boise Basin		Payette Basin		Salmon Basin		Forest Total	
	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed
1	12	6 (50%)	18	9 (50%)	13	0	43	15 (35%)
2	36	9 (25%)	19	3 (16%)	14	0	69	12 (17%)
3	10	0	0	0	2	1 (50%)	12	1 (8%)
4	22	2 (9%)	18	0	6	0	57	2 (4%)
Total	80	17 (21%)	55	12 (22%)	35	1 (3%)	170	30 (18%)

Table 1b. Number of bull trout patches on the Boise National Forest and the number surveyed in 2005 within each subbasin by strata. The percent of patches that have been surveyed are displayed in parentheses.

Strata	S.F. Boise Subbasin		N.F. and M.F. Boise Subbasin		Boise Mores Subbasin		Boise Basin Total	
	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed
1	2	0	9	5 (56%)	1	1 (100%)	12	6 (50%)
2	14	4 (29%)	19	5 (22%)	3	0	36	9 (25%)
3	2	0	8	0	0	0	10	0
4	10	1 (10%)	9	1 (11%)	3	0	22	2 (9%)
Total	28	5 (18%)	**45**	11 (24%)	**7**	1 (14%)	80	17 (21%)

Strata	S.F. Payette Subbasin		Middle Fork Payette Subbasin		Payette (Squaw Creek) Subbasin		North Fork Payette Subbasin		Payette Basin Total	
	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed
1	11	8 (73%)	3	1 (33%)	4	0	0	0	18	9 (50%)
2	13	3 (23%)	4	0	1	0	1	0	19	3 (16%)
3	0	0	0	0	0	0	0	0	0	0
4	13	0	5	0	0	0	0	0	18	0
Total	**37**	12 (32%)	**12**	1 (8%)	**5**	0	**1**	0	55	12 (22%)

Strata	South Fork Salmon Subbasin		Middle Fork Salmon Subbasin		Salmon Basin Total	
	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed
1	6	0	7	0	13	0
2	13	0	1	0	14	0
3	1	0	1	1 (100%)	2	1 (50%)
4	5	0	2	0	7	0
Total	**25**	0	**11**	1 (9%)	36	1 (3%)

Table 2. Summary of results from 2005 aquatic MIS sampling on the Boise N.F.

Subbasin	Patch Name	Category (2003)	Patch Size (ha)	Sampling Method (#of sites)	Bull Trout Detected	Probability of Detection*	# Sites where Bull Trout < 150mm were found	Electrofish Site when Bull Trout were First Detected	Electrofish Pass when Bull Trout were First Detected
SFP	Bear	2	1430	Depletions	No	20%	0	NA	NA
NFB	Bear Creek	1	1553	Depletions	Yes	N/A	1	1	2
NFB	Bear River	1	2965	Depletions	Yes	N/A	0	3	1
MFB	Buck	4	1543	Depletions	Yes	N/A	1	3	1
SFP	Canyon	1	7558	1-pass	Yes	N/A	2	1	1
SFP	Chapman	1	1170	1-pass	Yes	N/A	2	1	1
SFP	Clear	1	8061	1-pass	Yes	N/A	2	1	1
NFB	Crooked River	1	6941	Depletions	Yes	N/A	5	2	1
SFP	Deadwood Reservoir	1	13044	1-pass	Yes	N/A	4	1	1
SFP	Deer	1	4349	1-pass	Yes	N/A	1	1	1
SFP	Eightmile	1	2705	Depletions	Yes	N/A	1	1	1
MFS	Elk/Cook	3	5381	Depletions	Yes	N/A	1	2	1
MFB	Hot	2	991	Depletions	No	**	0	N/A	N/A
NFB	Hunter	2	878	Depletions	No	7%	0	N/A	N/A
NFB	Johnson	1	6904	Depletions	Yes	N/A	2	3	1
Mores	Mores	1		Depletions	No	18%	0	N/A	N/A
SFB	Parks	2	2161	1-pass	Yes	N/A	1	1	1
MFB	Phifer	2	748	Depletions	No	**	0	N/A	N/A
NFB	Pikes Fork	2	5194	Depletions	No	9.7%	0	N/A	N/A
SFP	Rock	2	1613	Depletions	No	10.7%	0	N/A	N/A
SFB	Slickear	4	1361	Depletions	No	12.7%	0	N/A	N/A
SFB	Spring	2	1446	Depletions	No	59%	0	N/A	N/A
SFP	Tenmile	1	5739	1-pass	Yes	N/A	2	2	1
SFB	Trinity	2	3087	Depletions	Yes	N/A	1	2	1
SFB	Upper Middle Fork Payette	1	5037	1-pass	Yes	N/A	3	1	1
NFB	Upper North Fork Boise	1	13501	Depletions	Yes	N/A	6	3	1
SFP	Wapiti	2	2470	1-pass	Yes	N/A	1	1	1
SFP	Warmspring	1	11789	1-pass	Yes	N/A	1	1	1
SFB	Whiskey Jack	2	1922	Depletions	No	59%	0	N/A	N/A

Note: Probability of detection calculated from Petersen et al. (2002). * Probabilities of detection were calculated only when bull trout were not found. ** No fish were found in these patches, natural barriers were identified. N/A Bull trout were found so a probability of detection is not needed.

Table 3. Fish species detected during 2005 MIS sampling on the Boise N.F.

			Species Observed											
Subbasin	**Patch**	**Strata**	**BLT**	**BKT**	**RBT**	**CCT**	**RBTxCCT**	**SCP**	**MWF**	**NPM**	**LND**	**SPD**	**RSS**	**BLS**
NFB	Bear	2			+									
NFB	Bear Creek	1	+	+	+	+		+						
NFB	Bear River	1	+		+									
MFB	Buck	4	+		+									
SFP	Canyon	1	+		+	+	+							
SFP	Chapman	1	+											
SFP	Clear	1	+											
NFB	Crooked River	1	+	+	+			+						
SFP	Deadwood Resivoir	1	+		+	+								
SFP	Deer	1	+											
SFP	Eightmile	1	+			+								
MFS	Elk/Cook	3	+	+	+			+						
SFB	Green	4			+									
MFB	Hot	2												
NFB	Hunter	2			+									
NFB	Johnson	1	+		+			+						
Mores	Mores	1		+	+		+	+	+	+	+	+	+	+
SFB	Parks	2	+		+			+						
MFB	Phifer	2												
NFB	Pikes Fork	2		+	+			+						
SFP	Rock	2			+									
SFB	Slickear	4			+									
SFB	Spring	2			+			+						
SFP	Tenmile	1	+		+									
SFB	Trinity	2	+		+			+						
SFP	Upper Deadwood	1												
SFB	Upper Middle Fork Payett	1	+		+									
NFB	Upper North Fork Boise	1	+		+			+	+					
SFP	Wapiti	2	+											
SFP	Warmspring	1	+											
SFB	Whiskey Jack	2			+			+						

Note: BLT = bull trout, BKT = brook trout, RBT = redband/rainbow trout, CCT = cutthroat trout, RBTxCCT = redband / cutthroat hybrid, SCP = sculpin, MWF = mountain whitefish, NPM = northern pikeminnow, LND = long-nosed dace, SPD= speckled dace, CHS = Chinook salmon, RSS = redsided shiner, BLS= bridgelip sucker.