

2008 Boise NF Aquatic Management Indicator Species Monitoring Report



Adult bull trout pair photographed during ScCS 2007.

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.

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 population 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. 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 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 observations 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.

Based on the 2008 update, there are 179 bull trout patches that occur within three basins (nine subbasins) on the Boise National Forest; 60 patches in category 1; 63 patches in category 2; 50 patches in category 3; and 6 unsurveyed patches in category 4 (Tables 1a & 1b).

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 periods). 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 stratum 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 stratum 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 stratum 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 stratum 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 habitats in each patch that meet 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 stratum 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, whichever 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; 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 26 patches in 2008 (Figure 4a-4b and Table 1). Bull trout were detected in 7 out of the 26 patches surveyed this year. For the 19 patches sampled in 2008 where no bull trout were captured, probability of patch occupancy ranged from 10.5-33% (Table 2). The probability of detection calculations do not include sites where no fish were detected above natural barriers. The probability of detection estimates are based on equations from Peterson et al. (2002) and observed detection rates from 101 single-pass electrofishing sites and 76 multiple-pass electrofishing sites sampled on the Boise N.F. during 2004-2006.

N.F./M.F. Boise subbasin

In the N.F./M.F. Boise subbasin, five patches (Granite Creek, E.F. Swanholm tributary, West Warrior Creek, Lake Creek, and W.F. Lost Man Creek) in categories 2 and 4 were surveyed. Juvenile bull trout were detected in West Warrior Creek for the first time in 2008. No juvenile bull trout were observed in the other four patches in this subbasin.

The Boise N.F. Fisheries database has no prior record of juvenile bull trout detections in Granite Creek, E.F. Swanholm tributary, West Warrior, Lake Creek, and W.F. Lost Man Creek. During the 2008 field season, one site was sampled in W.F. Lost Man Creek and two sites were sampled in the E.F. Swanholm tributary. Based on these efforts, there is a 33% probability of undetected bull trout occupancy in the W.F. Lost Man Creek patch and a 19% probability of undetected bull trout occupancy in the E.F. Swanholm tributary patch. Both of these patches remain in stratum 2.

Two sites were sampled in the Lake Creek patch and two sites were sampled in the Granite Creek patch during 2008. No fish were detected in the Granite Creek patch. Only westslope cutthroat trout were detected in the Lake Creek patch (believed to be outmigrants from stocking in Lake Creek Lake). Based on these results, the Granite Creek and Lake Creek patches are considered inaccessible to bull trout, due to natural, high-gradient barriers downstream. Both of these patches have been updated from stratum 4 to stratum 3.

Boise-Mores subbasin

Five patches were surveyed in the Boise-Mores subbasin in 2008 (Upper Elk Creek, Logging Gulch, Devils Creek, E.F. Sheep Creek, and Sheep Creek). Juvenile bull trout were detected in the Sheep Creek patch, but none of the other four patches. The Sheep Creek patch was last sampled in 1999. The previous sampling efforts also detected juvenile bull trout in Sheep Creek.

No bull trout were detected in multiple-pass electrofishing conducted at two sites on Upper Elk Creek, two sites on Devils Creek, or the three sites on E.F. Sheep Creek. Based on this level of sampling, there is an estimated 19% probability of undetected bull trout occupancy in Upper Elk Creek and Devils Creek, and 10.5% probability of undetected bull trout occupancy in E.F. Sheep Creek. Upper Elk Creek is a category 2 patch with two previous surveys on record (1993); no bull trout were detected during the prior sampling efforts. Devils Creek and E.F. Sheep Creek were category 4 patches (no prior sampling effort). Based on the 2008 data, both of these patches have been updated from stratum 4 to stratum 2.

One site was sampled in the Logging Gulch patch during 2008. No fish were detected. Based on this result, the Logging Gulch patch is considered inaccessible to bull trout, due to natural, high-gradient barriers downstream. This patch has been updated from stratum 4 to stratum 3.

S.F. Boise subbasin

Two patches in the S.F. Boise subbasin were surveyed in 2008, Rock Creek (stratum 2) and Elk Creek (stratum 1). One multiple-pass electrofishing site was surveyed in the Rock Creek patch, but no bull trout were detected. Based on this effort, there is a 33% probability of undetected bull trout occupancy in the Rock Creek patch. However, juvenile bull trout were detected at the only site surveyed in the Elk Creek patch in 2008. Juvenile bull trout were last detected in the Elk Creek patch in 2003.

S.F. Payette subbasin

During 2008, five bull trout patches were sampled in the S.F. Payette subbasin (Long Creek, Eightmile Creek, Tenmile Creek, MacDonald Creek, and Jackson Creek). Bull trout were

found in Eightmile Creek and Tenmile Creek using single-pass electrofishing. Crews from the Boise N.F. had previously detected bull trout in both of these patches. Sampling was done in these two patches primarily to get tissue samples (fin clips) for a genetics study.

No bull trout were detected in multiple-pass electrofishing conducted at two sites each on Long Creek and Jackson Creek. Based on this level of sampling, there is an estimated 19% probability of undetected bull trout occupancy in Long Creek and Jackson Creek. Long Creek patch (stratum 2) had one previous survey (1997); no bull trout were detected. There are no recorded surveys in Jackson Creek prior to 2008. The Jackson Creek patch was updated from stratum 4 to stratum 2.

One site was sampled in the MacDonald Creek patch during 2008. No fish were detected. Based on this result, the MacDonald Creek patch is considered inaccessible to bull trout, due to natural, high-gradient barriers downstream. This patch has been updated from stratum 4 to stratum 3.

M.F. Payette subbasin

One patch was surveyed in the M.F. Payette subbasin in 2008. Two sites were sampled in the Long Fork Silver Creek patch. Redband trout were detected at a site near the downstream end of the patch, but no fish were detected at the upstream site. The MIS survey crew identified a natural, high-gradient barrier upstream of the lower 2008 sample site that apparently prevents fish passage to all but the lowermost 500 meters of Long Fork Silver Creek. Based on this result, the Long Fork Silver Creek patch is considered inaccessible to bull trout, due to natural, high-gradient barriers. This patch has been updated from stratum 2 to stratum 3.

N.F. Payette subbasin

One patch was surveyed in the N.F. Payette subbasin in 2008. Two sites were sampled in the N.F. Gold Fork River patch; bull trout were detected both sites. Three different streams within this patch were sampled in 2007, but no bull trout were detected. The 2008 MIS monitoring data provide the first documentation of bull trout in the N.F. Gold Fork River since 1992. This patch has been updated from stratum 2 to stratum 1.

Payette subbasin

Two patches in the Payette subbasin were surveyed in 2008, Squaw Creek (stratum 1) and Sagehen (stratum 3). One multiple-pass electrofishing site was surveyed in the Squaw Creek patch, and juvenile bull trout were detected. Juvenile bull trout were last detected in the Squaw Creek patch in 2003. Two single-pass electrofishing sites were surveyed in the Sagehen patch, but no bull trout were detected. Furthermore, no fish were detected at the upper site. Based on this result, the Sagehen patch is considered inaccessible to bull trout, due to natural, high-gradient barriers downstream. This patch has been updated from stratum 4 to stratum 3.

Middle Fork Salmon

No patches were surveyed in the Middle Fork Salmon subbasin in 2008.

South Fork Salmon

Four patches were surveyed in the South Fork Salmon subbasin in 2008 (Reeves Creek, Sheep Creek, Halfway-Trout and Bear Creek); no bull trout were detected. Multiple-pass electrofishing was conducted at two sites per patch in Reeves Creek, Halfway-Trout, and Bear Creek, and three sites in Sheep Creek. Based on this level of sampling, there is an estimated 19% probability of undetected bull trout occupancy in the Reeves Creek, Halfway-Trout, and Bear Creek patches, and a 10.5% probability of undetected bull trout occupancy in the Sheep Creek Patch. The Bear Creek and Halfway-Trout patches remain in stratum 2. However, numerous brook trout were detected in all sites on Reeves Creek and Sheep Creek during the 2008 sampling effort. Therefore, the Reeves Creek and Sheep Creek patches have been updated from stratum 2 to stratum 3.

Bull Trout Detection

Juvenile bull trout (<150mm) were detected in 7 of the 26 patches sampled on the Boise National Forest in 2008. Juvenile bull trout were detected at the first sample site in 6 of these 7 patches. In one patch (N.F. Gold Fork River), juvenile bull trout were not detected until the second electrofishing site. At six of seven sites where juvenile bull trout were detected, they were observed during the first electrofishing pass. At one site (Sheep Creek), juvenile bull trout were not detected until the second pass.

In 6 of the 7 patches where juvenile bull trout were detected in 2008, the field crew discontinued electrofishing after completing the first site. However, two sites were electrofished in the N.F. Gold Fork River patch.

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 2008, the Boise N.F. crew deployed 28 temperature loggers in 27 patches on the Boise N.F (Figures 5a-b). A total of 26 were retrieved at the end of the field season; the other two were lost or stolen (Bush Creek and Six-bit Creek). 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 (June) 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 one of the patches where temperature loggers were deployed during the 2008 season, West Warrior Creek. This occupied bull trout stream had a 15.2°C MDMT and a 14.5°C MWMT at the lowest elevation within the patch.

Temperature loggers were deployed at the lowest elevation in the patch (usually 1600m) and at other various elevations within certain patches. In addition to West Warrior Creek (discussed above), two other stratum 1 patches (Riordan Creek and Upper M.F. Payette) had temperature loggers deployed in 2008. The Riordan Creek MDMT was 14.2°C and the MWMT was 13.8°C. The Upper M.F. Payette patch had thermistors deployed in both Stoney Meadow Creek and the upper M.F. Payette River, where the MDMTs were 12.8°C and 14.5°C and the MWMTs were 12.0°C and 14.0°C, respectively. Temperature loggers were also deployed in thirteen stratum 2 patches (Bear, Halfway-Trout, Valley, Long, E.F. Eightmile, Jackson, Upper S.F. Payette, E.F. Swanholm tributary, French, W.F. Lost Man, Wide West Gulch, Lincoln and Dog), and seven stratum 3 patches (Reeves, Sagehen, Long Fork Silver, Granite, Lake, Logging Gulch, and Wood Creek). The summary data from these sites are presented in Figures 1-3.

Factors other than water temperatures (i.e. groundwater inputs, over-wintering habitat, and habitat connectivity) are also likely influencing bull trout distribution. In most of the patches sampled in 2008, temperature appeared to be suitable for bull trout even though no bull trout were detected by electrofishing. 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 2008 contained barriers that could influence the presence or persistence of bull trout. Identified culvert barriers block access to Halfway-Trout, Reeves, Sagehen, Long, MacDonald, Granite, W.F. Lost Man and Rock Creek, and no bull trout were detected in these patches. However, juvenile bull trout were detected in one patch (Elk Creek) upstream of identified culvert barriers. Natural barriers (waterfalls) were also found within or downstream from six patches during surveys this year (Long Fork Silver Creek, Sagehen, MacDonald, Granite, Lake and Logging Gulch).

Barriers can also occur as a result of thermal difference between stream sections. A thermal barrier (>20°C) was verified in Wood Creek through water temperature monitoring in 2008. 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 detected 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 2008 sampling season, no patches were found to

have both bull trout and brook trout and two patches were found to support brook trout but no bull trout (Reeves Creek and Sheep Creek). No bull trout / brook trout hybrids were phenotypically confirmed. 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 fifteen patches were changed as a result of sampling in 2008. N.F. Gold Fork and West Warrior were changed from stratum 2 to stratum 1, because juvenile bull trout were detected. Logging Gulch, Granite, Lake, and MacDonald were changed from stratum 4 to stratum 3, due to natural barriers (waterfalls). Wood Creek was changed from stratum 4 to stratum 3, because of high water temperatures (>20°C). Sheep Creek and Reeves Creek were changed from stratum 2 to stratum 3, due to high densities of brook trout. Sagehen and Long Fork Silver Creek were changed from stratum 2 to stratum 3, because of natural barriers (waterfalls). Jackson, E.F. Swanholm tributary, Devils Creek and E.F. Sheep were changed from stratum 4 to stratum 2 after the first recorded surveys found they had suitable habitat conditions and were occupied by redband trout.

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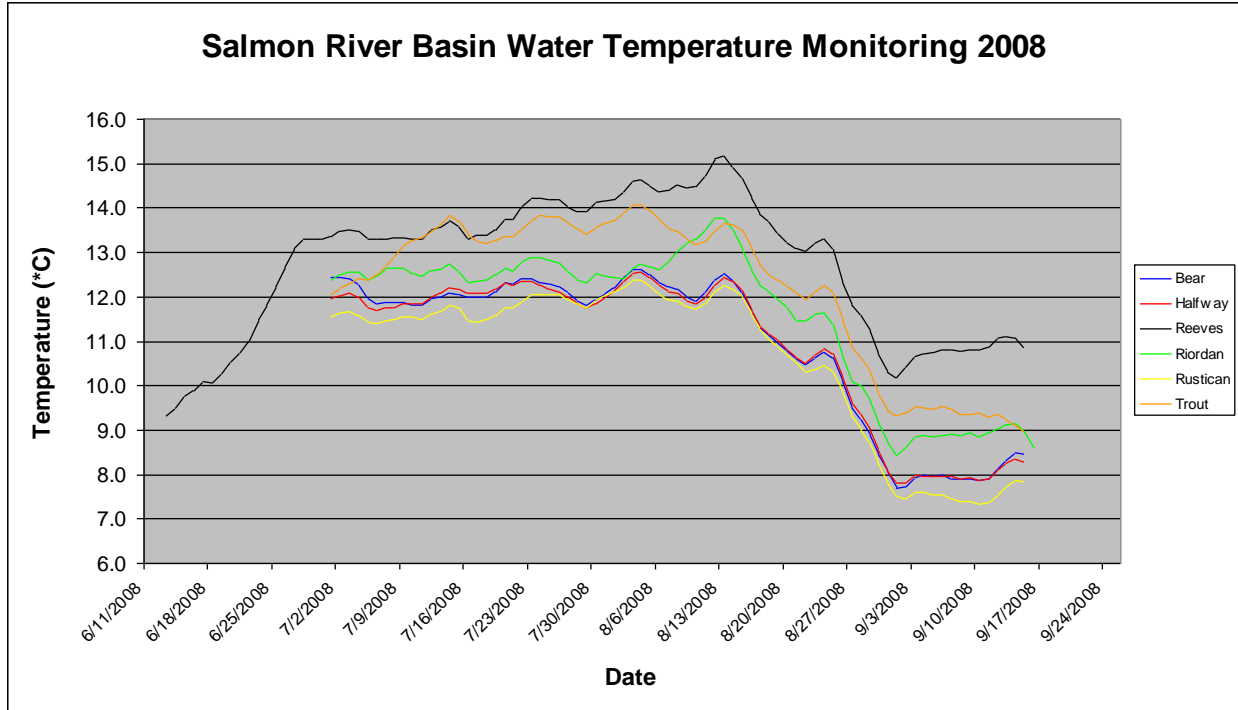


Figure 1. 7-day Average Maximum Daily Water Temperature Monitoring Results for the Salmon River Basin 2008.

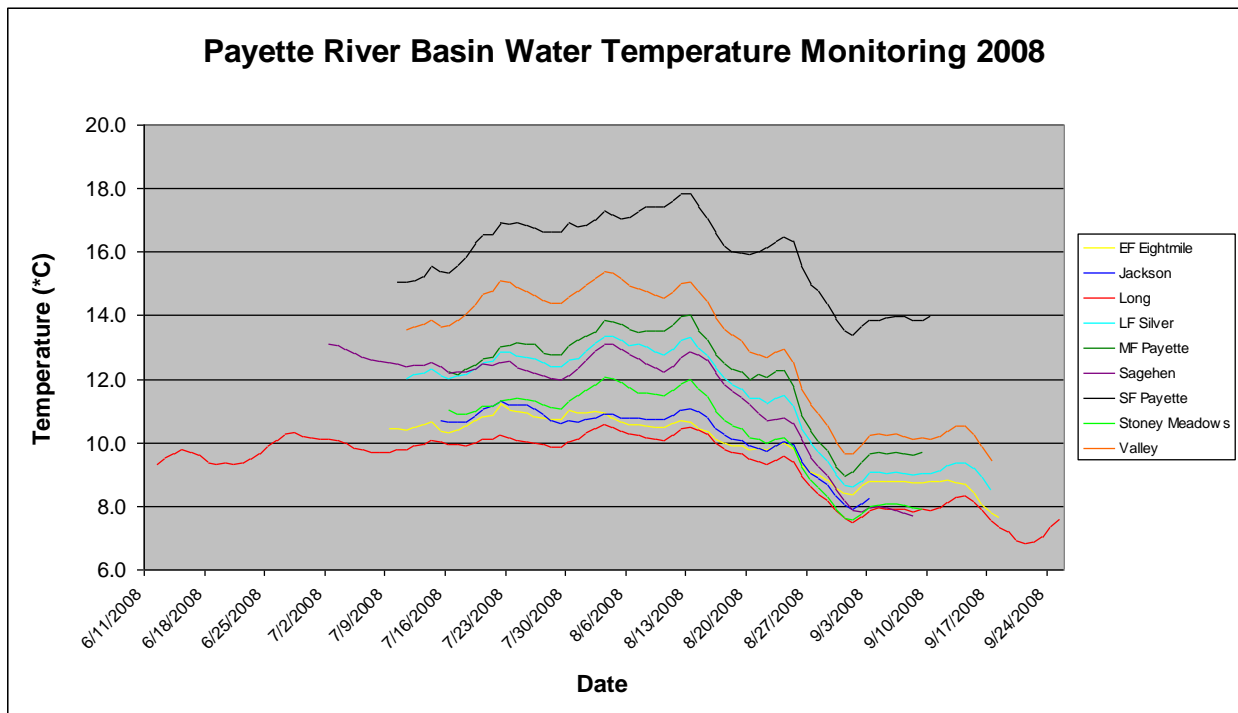


Figure 2. 7-day Average Maximum Daily Water Temperature Monitoring Results for the Payette River Basin 2008.

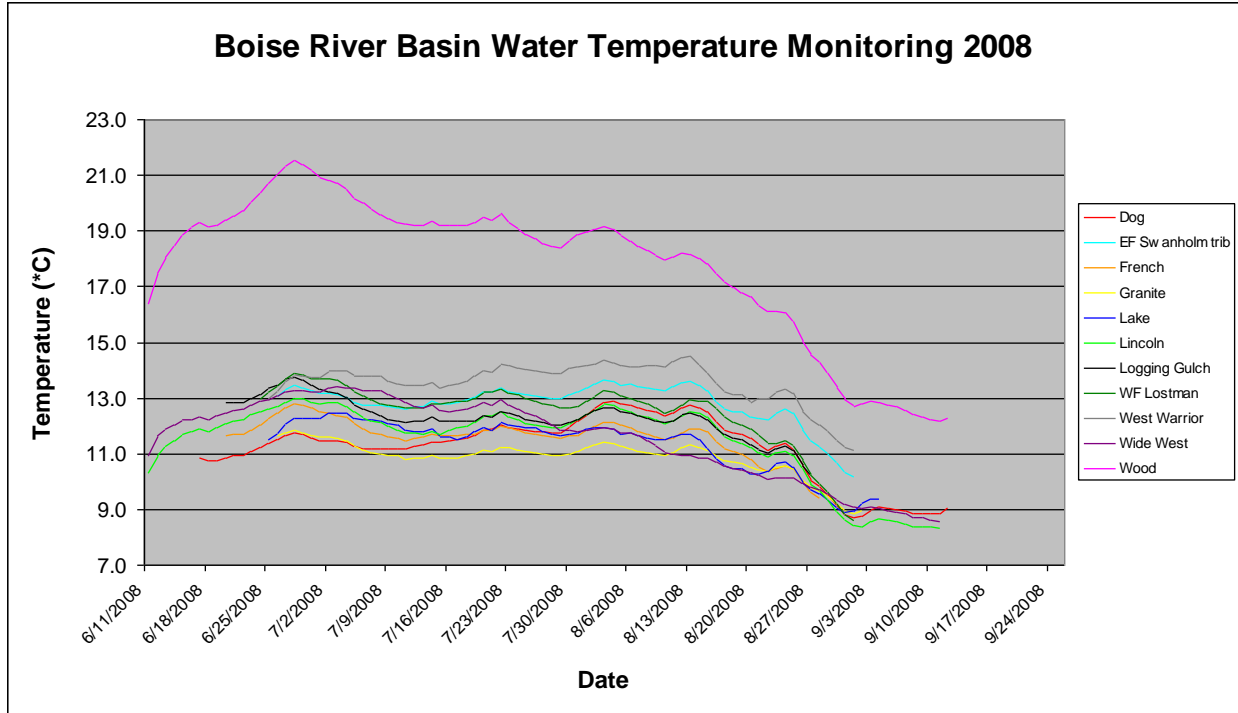


Figure 3. 7-day Average Maximum Daily Water Temperature Monitoring Results for the Boise River Basin 2008.

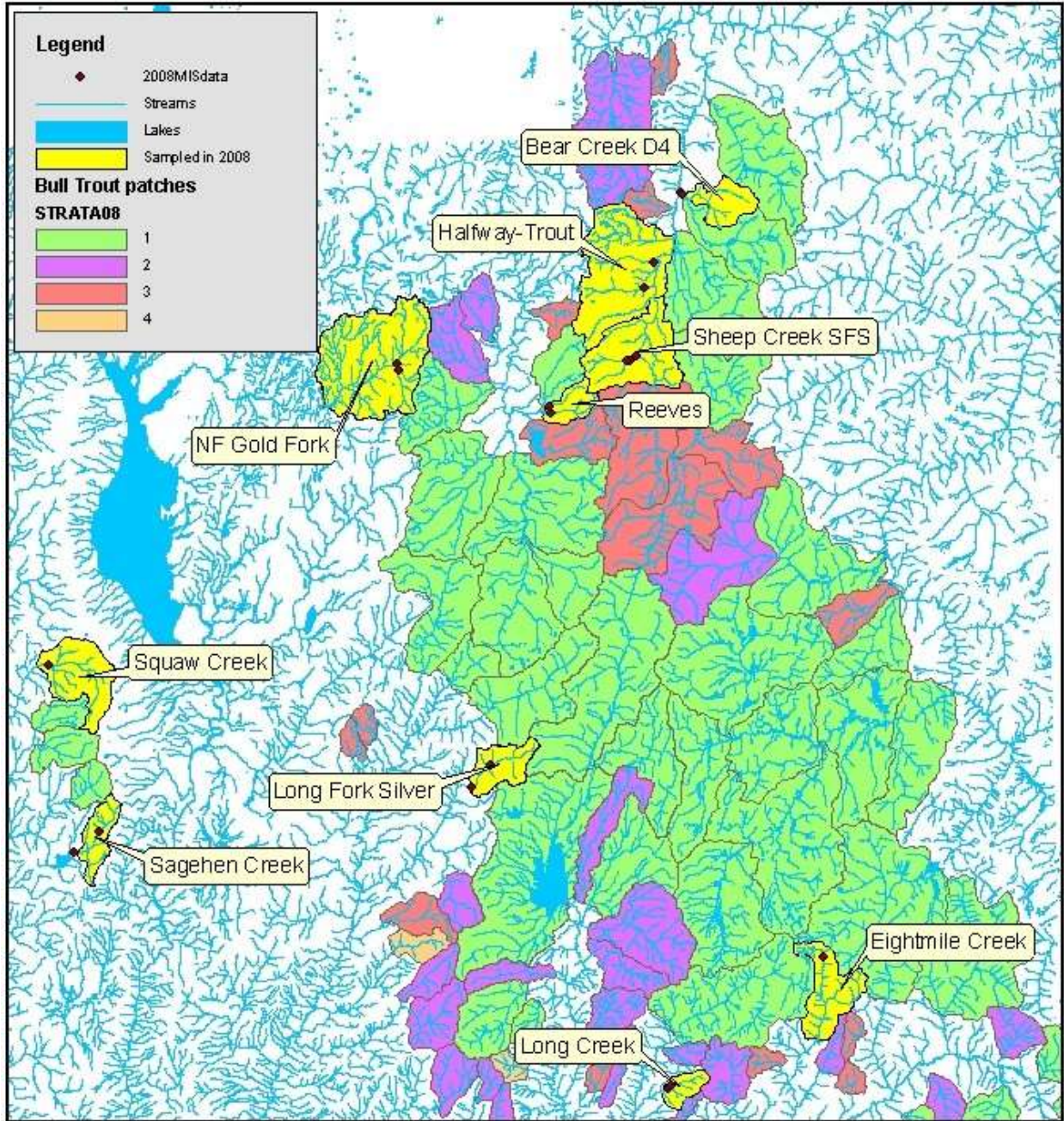


Figure 4a. Bull Trout Patches Sampled on the Boise N.F. in 2008 - North Half

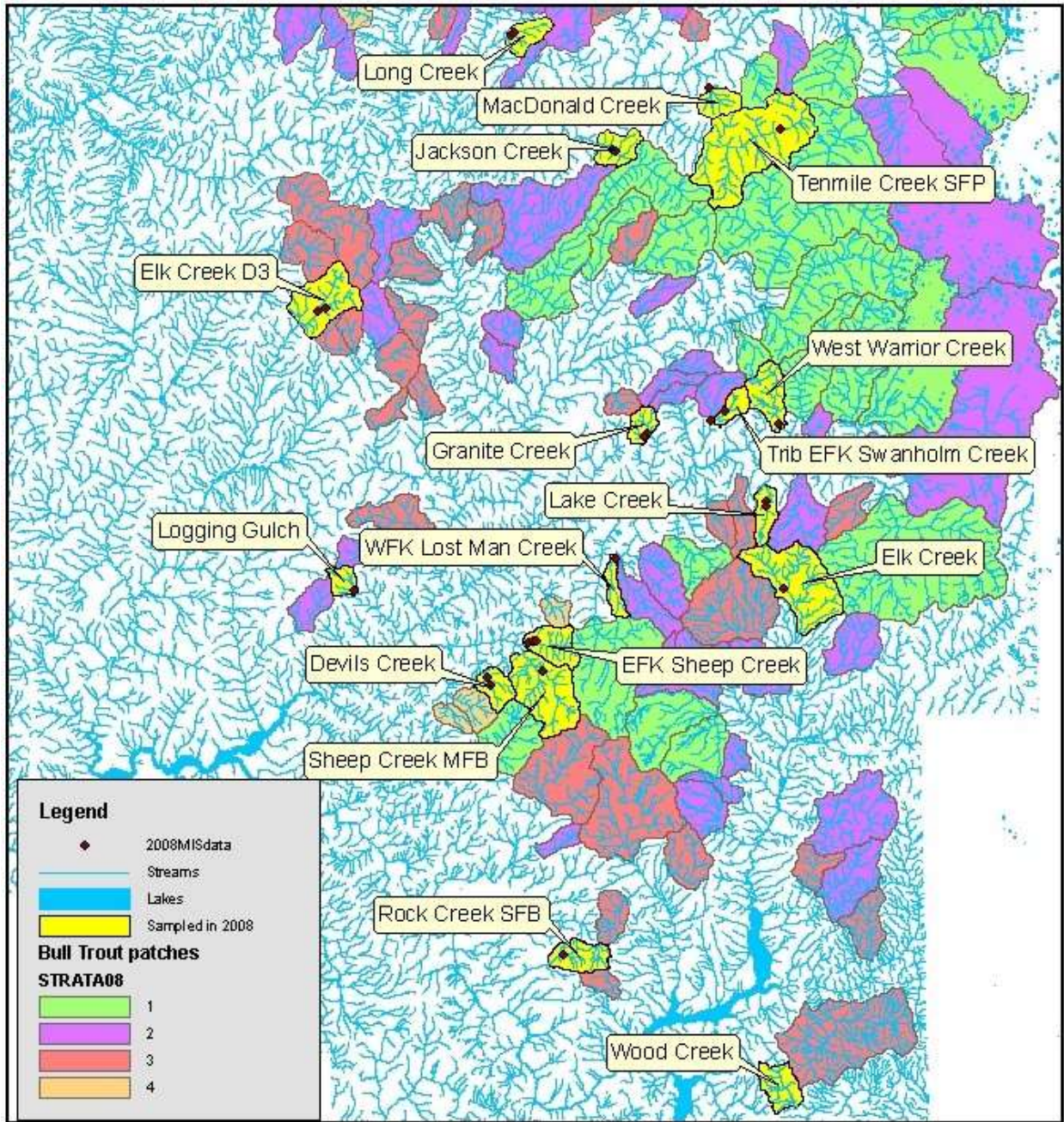


Figure 4b. Bull Trout Patches Sampled on the Boise N.F. in 2008 - South Half

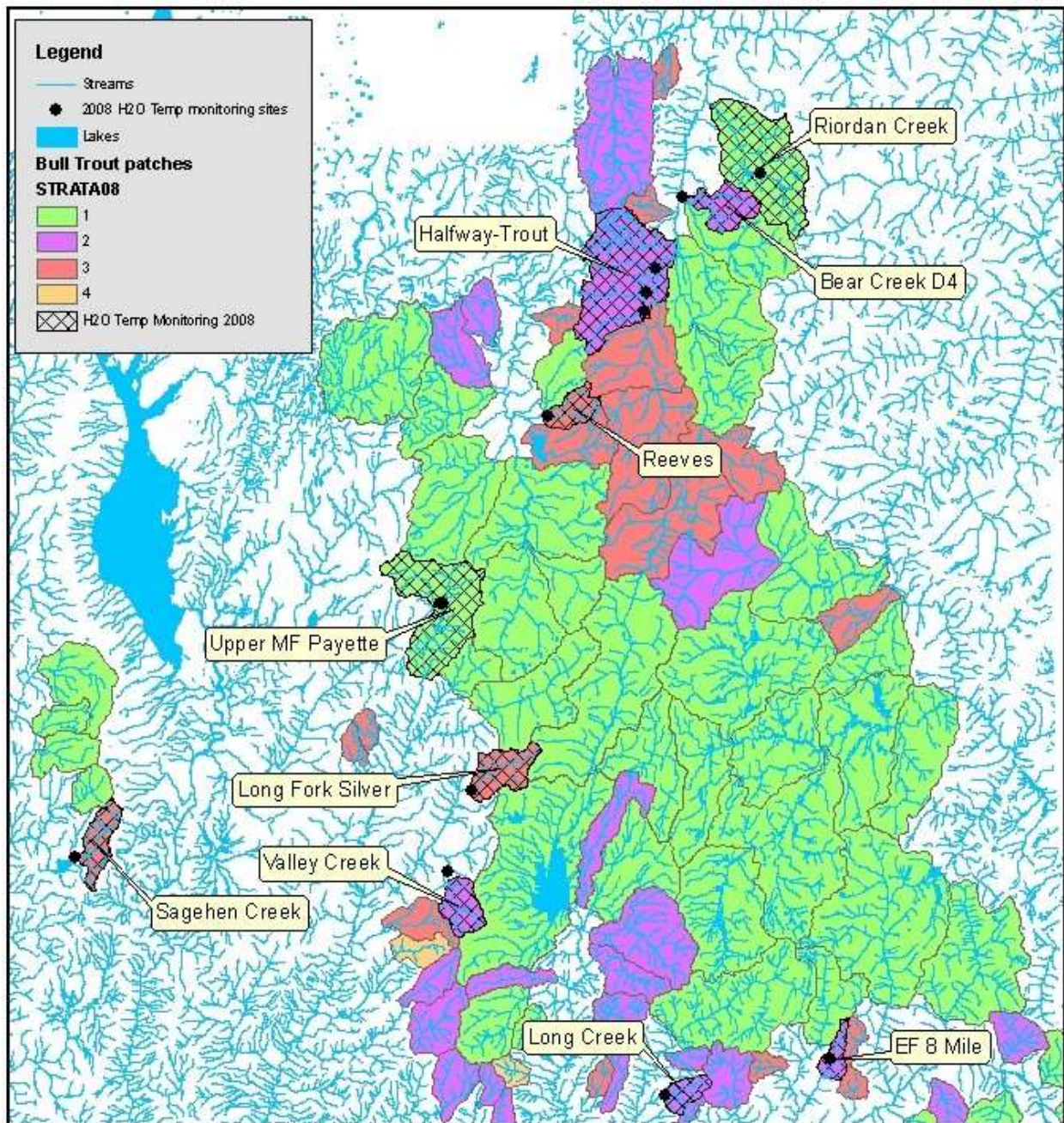


Figure 5a. Bull Trout Patch Water Temperature Monitoring 2008 - North Half

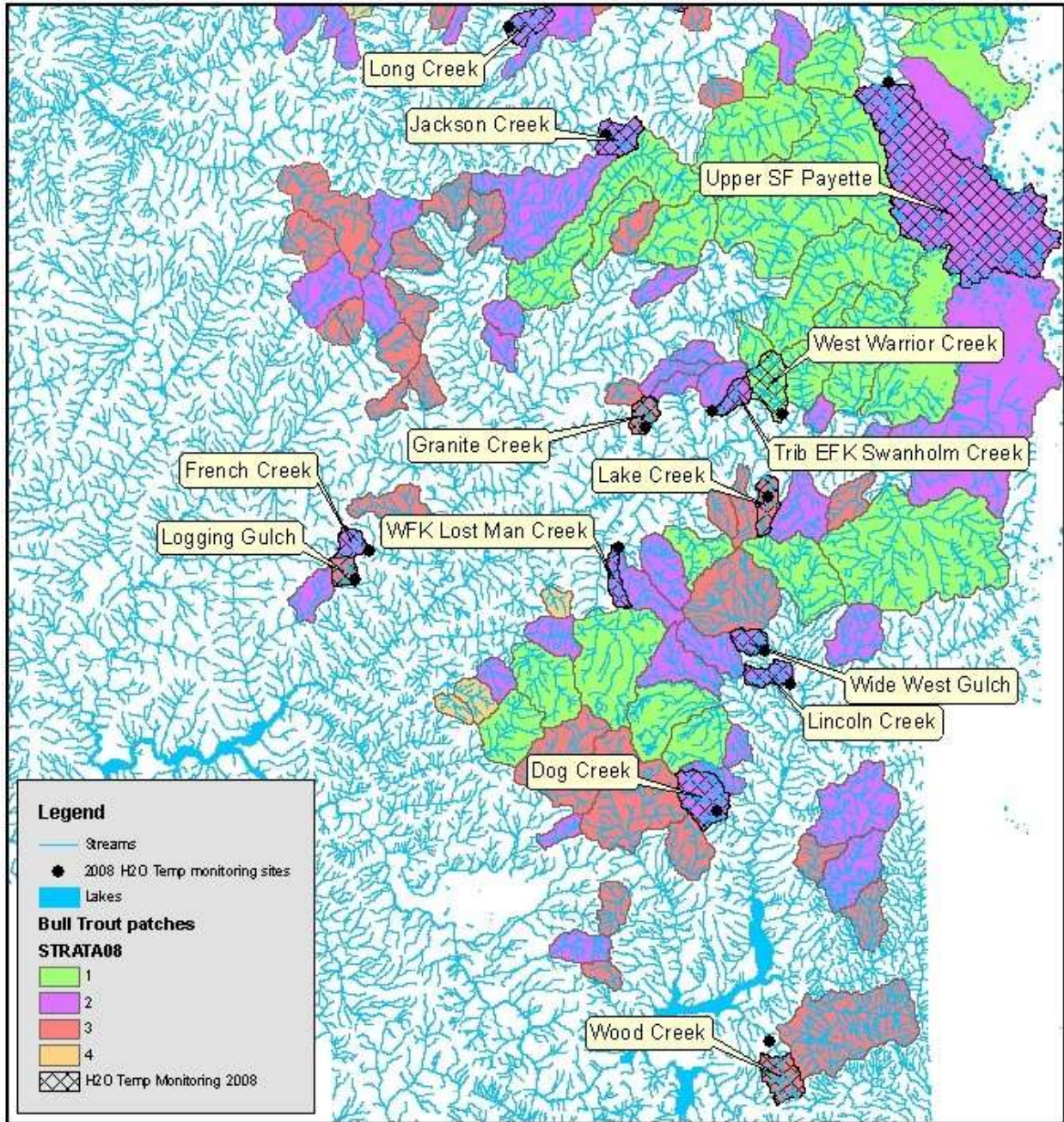


Figure 5b. Bull Trout Patch Water Temperature Monitoring 2008 - South Half

Table 1a. Number of bull trout patches on the Boise National Forest within each basin by category based on 2008 update.

Stratum	Boise Basin		Payette Basin		Salmon Basin		Forest Total	
	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed
1	18	3 (17%)	23	4 (17%)	19	0	60	7 (12%)
2	34	6 (18%)	23	2 (9%)	6	2 (33%)	63	10 (16%)
3	30	4 (13%)	10	3 (30%)	10	2 (20%)	50	9 (18%)
4	4	0	2	0	0	0	6	0
Total	86	13 (15%)	58	9 (16%)	35	4 (11%)	179	26 (15%)

Table 1b. Number of bull trout patches on the Boise National Forest and the number surveyed in 2006 within each subbasin by strata. The percent of patches that have been surveyed are displayed in parentheses.

Stratum	S.F. Boise Subbasin		N.F. and M.F. Boise Subbasin		Boise Moors Subbasin		Boise Basin Total	
	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed
1	4	1 (25%)	13	1 (8%)	1	1 (100%)	18	3 (17%)
2	12	1 (8%)	17	2 (12%)	5	3 (60%)	34	6 (18%)
3	10	1 (10%)	14	2 (14%)	6	1 (17%)	30	4 (13%)
4	1	0	1	0	2	0	4	0
Total	27	3 (11%)	45	5 (11%)	14	5 (36%)	86	13 (15%)

Stratum	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	15	2 (13%)	3	0	4	1 (25%)	1	1 (100%)	23	4 (17%)
2	19	2 (11%)	4	0	0	0	0	0	23	2 (9%)
3	5	1 (20%)	4	1 (25%)	1	1 (100%)	0	0	10	3 (30%)
4	1	0	1	0	0	0	0	0	2	0
Total	40	5 (13%)	12	1 (8%)	5	2 (40%)	1	1 (100%)	58	9 (16%)

Stratum	South Fork Salmon Subbasin		Middle Fork Salmon Subbasin		Salmon Basin Total	
	Patches	Surveyed	Patches	Surveyed	Patches	Surveyed
1	10	0	9	0	19	0
2	5	2 (40%)	1	0	6	2 (33%)
3	9	2 (22%)	1	0	10	2 (20%)
4	0	0	0	0	0	0
Total	24	4 (17%)	11	0	35	4 (11%)

Table 2. Summary of results from 2008 aquatic MIS sampling on the Boise N.F.

Subbasin	Patch Name	Category (2008)	Patch Size (ha)	Sampling Method (#of sites)	Bull Trout Detected	Probability of Occupancy Given No Detection*	# Sites where Bull Trout < 150mm were found	Electrofishing Site when Bull Trout were First Detected	Electrofishing Pass when Bull Trout were First Detected
SFS	Bear Creek D4	2	1534	Depletion (2)	No	19%	0	-	-
SFS	Halfway-Trout	2	6582	Depletion (2)	No	19%	0	-	-
SFS	Sheep Creek SFS	3	4212	Depletion (3)	No	11%	0	-	-
SFS	Reeves Creek	3	1043	Depletion (2)	No	19%	0	-	-
PAY	Squaw Creek	1	3030	Depletion (1)	Yes	N/A	1	1	1
PAY	Sagehen NF Gold Fork	3	1354	1-pass (2)	No	30%**	0	-	-
NFP	Long Fork Silver	1	7522	Depletion (2)	Yes	N/A	1	2	1
MFP	Tenmile Creek	3	1706	Depletion (2)	No	33%**	0	-	-
SFP	Eightmile Creek	1	5739	1-pass (1)	Yes	N/A	1	1	1
SFP	Long Creek	1	2706	1-pass (1)	Yes	N/A	1	1	1
SFP	MacDonald Creek	2	781	Depletion (2)	No	19%	0	-	-
SFP	Jackson Creek	3	737	1-pass (1)	No	**	0	-	-
SFP	Elk Creek D3	2	942	Depletion (2)	No	19%	0	-	-
Boise-Mores	Logging Gulch	2	2211	Depletion (2)	No	19%	0	-	-
Boise-Mores	Devils Creek	3	505	1-pass (1)	No	**	0	-	-
Boise-Mores	EF Sheep Creek	2	1167	Depletion (2)	No	19%	0	-	-
Boise-Mores	Sheep Creek	2	1173	Depletion (3)	No	19%**	0	-	-
Boise-Mores	West Warrior Trib EF	1	2893	Depletion (1)	Yes	N/A	1	1	2
MFB	Swanholm Granite Creek	1	1356	Depletion (1)	Yes	N/A	1	1	1
MFB	Lake Creek	2	553	Depletion (2)	No	19%	0	-	-
MFB	Granite Creek	3	588	1-pass (2)	No	**	0	-	-
MFB	Lake Creek	3	762	Depletion (2)	No	**	0	-	-
MFB	WF Lost Man	2	548	Depletion (1)	No	33%	0	-	-
SFB	Elk Creek	1	3542	Depletion (1)	Yes	N/A	1	1	1
SFB	Rock Creek SFB	2	1136	Depletion (1)	No	33%	0	-	-

Note: Probability of detection calculated from Petersen et al. (2002). * Probabilities of detection were calculated only when bull trout were not found. ** Natural barriers were identified. N/A - Bull trout were found so a probability of detection is not needed.

Table 3. Fish species detected during 2008 MIS sampling on the Boise N.F.

Subbasin	Patch	Stratum	BLT	BKT	RBT	WCT	SCP
SFS	Bear Creek D4	2			+	+	
SFS	Halfway-Trout	2			+	+	
SFS	Sheep Creek SFS	3		+	+		
SFS	Reeves Creek	3		+			+
PAY	Squaw Creek	1	+		+		
PAY	Sagehen	3			+		
NFP	NF Gold Fork	1	+				
MFP	Long Fork Silver	3			+		
SFP	Tenmile Creek	1	+				
SFP	Eightmile Creek	1	+				
SFP	Long Creek	2			+		
SFP	MacDonald Creek	3	-	-	-	-	-
SFP	Jackson Creek	2			+		
Boise-Mores	Elk Creek D3	2			+		+
Boise-Mores	Logging Gulch	3	-	-	-	-	-
Boise-Mores	Devils Creek	2			+		
Boise-Mores	EF Sheep Creek	2	+		+		
Boise-Mores	Sheep Creek	1	+		+		
MFB	West Warrior	1	+		+		+
MFB	Trib EF Swanholm	2			+		
MFB	Granite Creek	3	-	-	-	-	-
MFB	Lake Creek	3				+	
MFB	WF Lost Man	2			+		
SFB	Elk Creek	1	+		+		+
SFB	Rock Creek SFB	2			+		

Note: BLT = bull trout, BKT = brook trout, RBT = redband/rainbow trout, WCT = cutthroat trout, SCP = sculpin.