Assessment of Native Salmonids above Hells Canyon Dam, Idaho

Annual Report
2001

DOE/BP-00004261-1

November 2002

This Document should be cited as follows:

Meyer, Kevin, James Lamansky, Jr., ''Assessment of Native Salmonids above Hells Canyon Dam, Idaho'', Project No. 1998-00200, 79 electronic pages, (BPA Report DOE/BP-00004261-1)

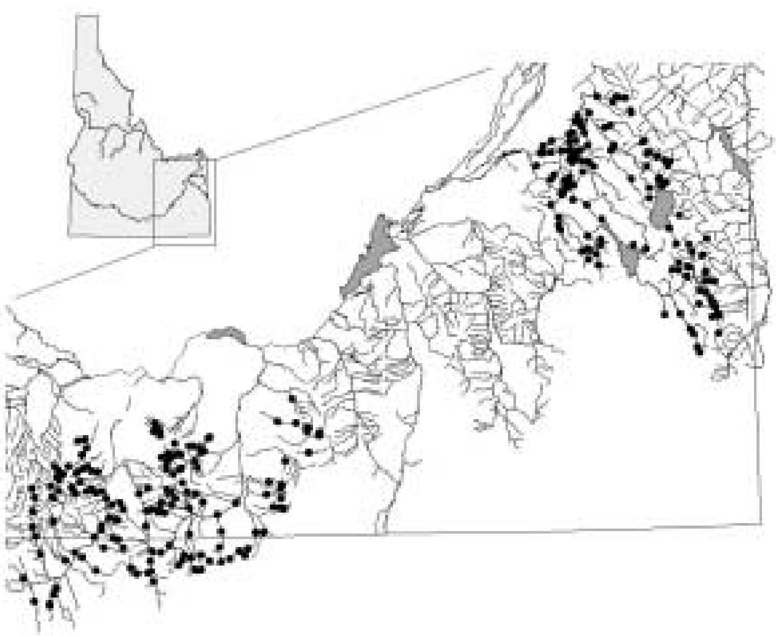
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

FISHERY RESEARCH

ASSESSMENT OF NATIVE SALMONIDS ABOVE HELLS CANYON DAM, IDAHO

ANNUAL PROGRESS REPORT



July 1, 2001—June 30, 2002

Prepared by:

Kevin A. Meyer
Fisheries Research Biologist

James A. Lamansky, Jr.
Senior Fisheries Technician

IDFG Report Number 02-57
November 2002

Assessment of Native Salmonids Above Hells Canyon Dam, Idaho

Project Progress Report

2001 Annual Report

By

Kevin A. Meyer

James A. Lamansky, Jr.

Idaho Department of Fish and Game
600 South Walnut Street
P.O. Box 25
Boise, ID 83707

To

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97283-3621

Project Numbers 1998-00200
Contract Numbers 98-BI-01462

IDFG Report Number 02-57
November 2002

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF APPENDICES

PART #I: STATUS OF YELLOWSTONE CUTTHROAT TROUT IN PORTIONS OF THE UPPER SNAKE RIVER SUBBASIN, AND FACTORS INFLUENCING THEIR DISTRIBUTION AND ABUNDANCE

ABSTRACT

We investigated factors affecting the distribution and abundance of Yellowstone cutthroat trout (YCT), the abundance of all trout, and species richness in several drainages in the upper Snake River basin in Idaho. A total of 326 randomly selected sites were visited within the four study drainages, and of these, there was sufficient water to inventory fish and habitat in 56 of the sites in the Goose Creek drainage, 64 in the Raft River drainage, 54 in the Blackfoot River drainage, and 27 in the Willow Creek drainage. Fish were captured in 36, 55, 49, and 22 of the sites, respectively, and YCT were present at 17, 37, 32, and 13 of the sites, respectively.

There was little consistency or strength in the models developed to predict YCT presence/absence and density, trout density, or species richness. Typically, the strongest models had the lowest sample sizes. In the Goose Creek drainage, sites with YCT were higher in elevation and lower in conductivity. In the Raft River drainage, trout cover was more abundant at sites with YCT than without YCT. In the Blackfoot River drainage, there was less fine substrate and more gravel substrate at sites with YCT than at sites without YCT. In the Willow Creek drainage, 70% of the sites located on public land contained YCT, but only 35% of private land contained YCT. The differences in variable importance between drainages suggests that factors that influence the distribution of YCT vary between drainages, and that for the most part the variables we measured had little influence on YCT distribution.

In sites containing YCT, average cutthroat trout density was 0.11/m^2, 0.08/m^2, 0.10/m^2, and 0.08/m^2 in the Goose Creek, Raft River, Blackfoot River, and Willow Creek drainages, respectively. In sites containing trout in general, average total trout density in these same drainages was 0.16/m^2, 0.15/m^2, 0.10/m^2, and 0.10/m^2. Models to predict YCT density, total trout density, and species richness were either weak (i.e., explained little variation) or contained small sample sizes. Based on our results, it appears that factors other than those we measured are affecting fish populations in these drainages.

Authors:

Kevin A. Meyer
Fisheries Research Biologist

James A. Lamansky, Jr.
Senior Fisheries Technician

INTRODUCTION

Populations of native salmonids have experienced significant reductions in distribution and abundance across much of their historical range in the Interior Columbia River basin (Rieman et al. 1997; Thurow et al. 1997; Kruse et al. 2000). In June 1998, the U.S. Fish and Wildlife Service listed Columbia River basin bull trout as a threatened species under the Endangered Species Act (ESA). During the past decade, petitions have also been filed to list redband trout and Yellowstone cutthroat trout (YCT) under the ESA, although neither are currently listed. Idaho Department of Fish and Game (IDFG) (2001) listed all three species as species of special concern category A, which are top priority species. Despite the sensitive status of these salmonids, current knowledge of the population distribution, abundance, and trends is unknown for a large proportion of streams in the study area.

Most commonly, declines in distribution and abundance of native salmonids throughout North America, including areas in the Rocky Mountains, have been attributed to exotic species introductions, habitat degradation, and overharvest (Rieman and McIntyre 1993; Young 1995). In general, populations of native salmonids that still persist in western North America tend to be located at high elevation, steep gradient reaches that are relatively unproductive (Gresswell 1995; Rieman and McIntyre 1995; Young 1995). While this may hold true in a broad perspective, factors that influence native salmonid persistence within individual drainages may vary. For example, Watson and Hillman (1997) found numerous variables that were positively related to bull trout occurrence and abundance, including the presence of undercut banks, large substrate, deep pools, and wood and boulder cover, and the absence of exotic trout species. However, the combinations of variables that correlated with bull trout densities varied considerably between basins, and the relationships deteriorated at finer scales of analysis. Their results suggest that recovery and protection strategies need to be site-specific.

Most previous fish/habitat relationship models have had low predictability, and those with high predictability have had low transferability to different times or places (Fausch et al. 1988). That models would be highly transferable across many drainages suggests that limiting factors would be the same across those drainages, a tenuous assumption that probably rarely if ever is met. Fish/habitat models have typically focused on specific small-scale attributes of streams (McFadden and Cooper 1962; Binns 1982; Chisholm and Hubert 1986; Kozel and Hubert 1989). However, more recent studies have begun to investigate factors that affect stream-dwelling salmonids at broader scales, taking into account large-scale geomorphic features and developing multi-tiered models that more accurately mimic the structure of a watershed (Watson and Hillman 1997; Dunham and Rieman 1999; Isaak 2001). Such a study design has better potential of elucidating patterns in salmonid populations at both local and broad scales. We are currently assembling information to develop several broad-scale variables, such as road density, irrigation diversions, and an index of angling pressure, as well as others that will be included in future modeling efforts. For this annual progress report, however, we have focused primarily on site-specific stream attributes.

OBJECTIVE

1. Assess the influence that site-specific stream attributes have on YCT distribution and abundance, total trout abundance, and species richness in the upper Snake River basin.

STUDY AREA

The study occurred in five drainages in the upper Snake River subbasin (Figure 1). The Goose Creek drainage encompasses approximately 3,007 km^2. The headwaters of Goose Creek originate in the South Hills south of the town of Twin Falls, Idaho and flow south into Nevada, east into Utah, then north into Idaho. There are several spring-fed headwater tributaries contributing significant flows in all three states before Goose Creek reaches Oakley Reservoir, an impoundment about four miles south of the town of Oakley, Idaho. The Idaho legislation designated that Goose Creek below Oakley Reservoir is no longer a river, and it no longer has a connection to the Snake River.

The Big Cottonwood Creek drainage originates from springs, seeps at an elevation of 2,240 m in the South Hills, and flows northeast approximately 26 km through a rugged canyon before reaching a diversion in the foothills, where essentially all of the flow is diverted for crop irrigation. Total watershed area upstream of the diversion is approximately 130 km^2. The Big Cottonwood Wildlife Management Area (BCWMA), owned and managed by IDFG, is at the lower end of the canyon. Because of their geologic similarity, close proximity, and the fact that there was not a sufficient sample size to analyze the Big Cottonwood drainage alone, the Big Cottonwood Creek drainage was considered part of the Goose Creek drainage for analysis purposes.

Located to the east of the Goose and Big Cottonwood creek drainages, the Raft River drainage encompasses an area of about 3,733 km^2 of Cassia County, with the headwaters originating near the Idaho-Utah border in the Raft River Mountains southeast of Oakley, Idaho. As the river flows northward through the high desert of the Raft River plain, it is continually dewatered for irrigation, and before the river enters the Snake River at river kilometer 1,113, it is completely dry except during extremely high flows.

The Blackfoot River drainage encompasses about 2,833 km^2 and over 557 km of streams in Bingham, Caribou, and Bonneville counties. Diamond Creek and Lanes Creek originate in the Caribou and Webster mountain ranges and combine to form the Blackfoot River, which winds its way west for 209 km before reaching the Snake River west of the city of Blackfoot. Blackfoot Reservoir, created in 1910, covers 70 km^2, is operated by the U.S. Bureau of Indian Affairs, and divides the Blackfoot River into what is referred to as the upper Blackfoot River and lower Blackfoot River. One of the largest phosphate ore reserves in the United States is located in the upper portion of the drainage.

The Willow Creek drainage is located just to the north of the Blackfoot River and drains 1,687 km^2 of Bingham, Bonneville, and Caribou counties. Elevation in the drainage is relatively low for the Rocky Mountains, ranging from a valley floor at 1,200 m to peaks less than 2,200 m. Ririe Reservoir, built in 1976 for flood control and irrigation storage, has a total capacity of 80,540 acre feet, and is located 32 km above the confluence with the Snake River. The segment of Willow Creek below the reservoir is annually dewatered to keep ice buildup from causing floods near Idaho Falls. Many streams above Ririe Reservoir are in narrow canyons. The Soil Conservation Service has identified the Willow Creek drainage as one of the most serious (ten worst) soil erosion areas in the United States. Since 1924, up to 20,000 acre feet of water a year have been diverted from the Willow Creek drainage to Blackfoot Reservoir through Clark's Cut Canal.

METHODS

Sampling Design

It was infeasible and unreasonable to sample fish and habitat at several sites within each stream in each drainage of the Upper Snake River basin in a reasonable timeframe. Instead, we identified perennial streams on 1:100,000 land status maps, then randomly selected at least 50% of these streams for sampling. Two to five 100 m sampling sites were distributed randomly from the mouth to the headwaters, the exact number depending on the length of the stream. Sampling in each drainage was distributed randomly across public and private land in order to include land ownership as a factor that may influence native salmonid distribution and abundance. Using the above methodology, 33% and 67% of our sampling in these drainages occurred on private and public land, respectively. Based on 1:24,000 topographic maps, 17% of our sites were on 1st order stream reaches, 27% on 2nd order reaches, 18% on 3rd order reaches, 5% on 4th order reaches, and 1% on 5th order reaches. Thirty-two percent were dry or had too little water to sample fish or habitat.

Fish inventories were performed with backpack electrofishers. Sampling occurred during low to moderate flow conditions (after spring runoff and before the onset of winter) to facilitate effective fish capture and standardization of sampling conditions. To increase the number of sites that could be sampled in a given amount of time, we did not make multi-pass electrofishing removals at all sites. Instead, using data from the multi-pass removal sites, we developed for each drainage a relationship between the numbers of fish captured in the first passes and the maximum-likelihood abundance estimates calculated with the MicroFish software package (Van Deventer and Platts 1989). From this relationship, we then predicted abundance at sites where only a single removal pass was made (Lobon-Cervia et al. 1994; Jones and Stockwell 1995; Kruse et al. 1998). Standardized residuals were investigated to remove outliers from the regression models (Montgomery 1991) before estimates were made. Ninety-five percent confidence intervals (CIs) were calculated for multi-pass estimates (using MicroFish), and 95% prediction intervals (PIs) for single-pass estimates (following Zar 1996). Blocknets installed at the upper and lower end of the sites were used to meet the modeling assumption that the populations were closed. Because electrofishing is size selective (Reynolds 1996), fish were separated into age-0 [<100 mm total length (TL)] and age-1+ (i.e., age-1 and older; >100 mm TL) categories, and abundance estimates were made separately for these two size groups. Not all populations of native salmonids in the upper Snake River basin adhere to such a length-age cutoff, but for the sake of consistency, we applied this rule-of-thumb to all populations. Length was recorded for each salmonid captured and weight (g) recorded for approximately 30 fish per site. At sites too large to perform depletions, mark-recapture estimates were made with the Mark-Recapture for Windows software package (Montana Fish, Wildlife and Parks 1997).

Capture efforts were focused on trout species, but at each site where they occurred, non-game fish were captured, identified to species, categorized as absent, sparse (1-10), many (10-50), or abundant (>50), and a subsample of 20 were measured and weighed. Herpetofauna encountered were also recorded. Non-game fish and herpetofauna data were not included in this report.

The objectives in developing this sampling methodology were to allow us to: 1) collect information sufficient to calculate abundance of native salmonids at each site and over entire streams and drainages with a reasonable amount of confidence, 2) provide a high probability of detecting the presence of native salmonids when they are rare, and 3) determine stream characteristics at each site where fish sampling takes place. We assumed that sampling 2-5 sites in at least 50% of the perennial streams in a particular drainage would adequately characterize the distribution and abundance of native salmonids within that particular drainage.

The establishment of two to five sampling sites per stream was based on preliminary analysis of the number of sample sites needed to estimate the size of a trout population in a given stream. In Pike's Fork, a small stream in the Boise River drainage, we conducted multi-pass electrofishing removals over the entire length of fish-bearing stream (~9.4 km) in 1998. Mean density of trout was 30 fish per 100 m of stream; the calculated variance was 99.6. The mean density was comparable to the mean of density estimates from study sites in this report (mean 27 fish per 100 m of stream, range 1-150, n = 144). Using these values, we estimated that a sample size of three would be required to achieve a 95% CI of ±18.5 fish per 100 m of stream at Pike's Fork (Table 1). The upper 95% CI exceeded the mean by 61%. It should be noted that the calculations in Table 1 consider only the variation in the estimate in the mean density of the population, and assume there was no error in the estimate of density at each sample site that went into estimating the density of the entire stream. However, such error typically is an insignificant part of the overall variance between sites (Dambacher et al. 2001). The lower CI can be considered much narrower than 61% under most circumstances, because CIs below the mean were often lower than the number of fish captured, thereby raising the lower CI to the actual number of fish captured and narrowing the precision of the estimate. We assumed that the variation observed in Pike's Fork density would be representative of the variance observed in other streams in the upper Snake River basin.

After completing fish surveys, we measured physical stream characteristics and delineated and characterized habitat units within the site; measurements were based on standards set by Platts et al. (1983), Hawkins et al. (1993), Hillman and Platts (1993), Rosgen (1994), and Overton et al. (1997). Global position was determined from a GPS unit and recorded as Universal Transverse Mercator (UTM) position. The UTM positioning was used to determine site elevation (using 1:24,000 USGS topographical maps). Gradient was expressed as the percent of drop in water surface elevation per unit of channel length and was determined two ways. Using a hand-held level rested on a dipnet, a reading was taken from a stadia rod held at the water surface within 0.1 m of the level and at a distance upstream. The distance was recorded to 0.1 meters, and the level was moved to the upstream location to repeat the process twice more. A sum of water surface rise and total distance measured was used to calculate gradient. In addition, on a 1:24,000 USGS map, stream length (m) was traced between the two contour lines that bounded the study site (using UTM coordinates to determine site location), and gradient was calculated as the elevational increment between the contours (usually 6.1 or 12.2 m) divided by the traced distance. Comparisons were made to test for differences between the two methods.

Stream order was treated as a discrete variable and was determined from 1:24,000 USGS maps as follows: first order streams were defined as the first solid blue line on topographical maps, second order streams formed below the junction of two first order streams, etc. Dominant riparian vegetation was recorded separately for both sides of the stream as the type of vegetation making up the majority (>50 %) of the stream margin riparian community, coded as 1 for non-vegetated, 2 for grasses or forbs, 3 for shrubs, and 4 for trees (including any woody material such as willows or alders). Conductivity (µS/cm) was measured with a hand-held conductivity meter. Rosgen stream type was categorized for each site based on Rosgen's (1996) stream classification system of A through G.

Starting at the downstream end of the study site and working upstream, habitat units were classified, and for each habitat unit, we measured the following characteristics:

1) Average wetted width was determined along three representative transects within each unit as the distance from one stream margin to the other, measured perpendicular to the flow;

2) Average depth was determined at the same transects by measuring the depth at ¼, ½, and ¾ distance across the channel and dividing the sum by four (Platts et al. 1983);

3) Maximum depth was measured as the deepest point of the habitat unit, not of the established width-depth transects;

4) Percent substrate composition for each habitat unit was a visual estimate of the percentage of the streambed that was covered by fine sediment (<1 mm), sand (1-5 mm), gravel (5-76 mm), cobble (76-300 mm), boulder (>300 mm), and bedrock, and was broken into and assigned to one of six categories: 0) absent; 1) 1-10%; 2) 10-25%; 3) 25-50%; 4) 50-75%; 5) >75%;

5) Percent trout cover for each unit was a visual estimate of the percent of the wetted channel containing trout cover due to large woody debris, boulders, undercut banks, or overhanging vegetation, and was broken into the same six percentage categories as above. Measurements were taken separately for each type of cover, an average was calculated for the study site, and then all averages were summed for an total trout cover rating for the study site;

6) Percent shading was a visual estimate of the amount of the habitat unit that would be shaded in one way or another when the sun was directly overhead, broken into the same six categories;

7) Percent unstable banks was a visual estimate of the percent of streambank (both sides combined) in the habitat unit that was unstable due to fracture, slumping, sloughing, or erosion, and were broken into the same six categories.

We either measured 10 habitat units or measured habitat to the end of the study site, whichever came first. From the measurements within each habitat unit, averages or totals for the study site were calculated. All fish and habitat data for each study site is included in Appendix 1.

Statistical Analyses

We related physical and biological stream characteristics to four dependent variables: 1) YCT presence/absence; 2) YCT density; 3) trout density, and 4) species richness. In order to reduce the initial size of the models being built, we carefully considered each independent variable describing stream conditions and chose those that we felt were most accurately measured and were most likely to influence specific dependent variables being modeled. See Table 2 for a complete list of those variables included in each modeling attempt. This list is not exhaustive, and other layers of data, such as road density, grazing density, continuous water temperature data, and the distribution, types, and abundance of irrigation diversions have not yet been compiled, but will be included in our final analysis of YCT/habitat relations next year.

Data were then screened for multicollinearity using correlation analysis, but none was detected in the variables listed in Table 2. Scatter plots, residual plots, and normal probability plots of residuals were used to assess homoscedasticity and normality of the data. Gradient was a highly skewed variable and appeared homoscedastic and possibly nonlinear in relation to some of the dependent variables, most notably species richness. The transformation, exp(-gradient), reduced homoscedasticity and nonlinearity with species richness and caused no diagnostic problems in other models, so the transformation was used for all modeling. Because we were attempting to develop, for each dependent variable being modeled, individual models for each of the four drainages as well as an overall model (thus, five models), and for each dependent variable we assessed about 10 independent variables, we could expect that, by chance alone, independent variables would be found to be significant (at $\alpha = 0.05$) about 2.5 times. By accepting significance at $\alpha = 0.005$, we reduced the maximum probability of committing a type I error to $1 - (1 - 0.005)^{50} = 0.2$.

We investigated whether physicochemical conditions differed between sites with and without YCT. We first explored this by calculating mean values and 95% CIs for continuous variables at sites with and without YCT, then attempted to develop logistic regression models for each drainage and for all drainages combined. We compared these models to multiple regression models, because when dependent variables have only two categories (present or absent), linear and logistic regression results are usually quite similar (Goodman 1978, as cited in Tabachnick and Fidell 1989). In order to include categorical independent variables, the general linear model procedure (SAS 1999) was used for multiple regression analysis. We first fit models with independent variables without interaction, and after non-significant variables were screened from the model, first order interaction terms were tested for the remaining variables. Model strength for the logistic models was evaluated using Akaike's Information Criteria (AIC; Akaike 1973) and the level of concordance (i.e., the proportion of correctly classified data points). Model strength for the general linear models was evaluated using coefficients of determination and significance values for the independent variables. The statistical significance of each independent variable included in the models was evaluated with Wald Chi-square *P*-values ($\alpha = 0.005$).

Density of YCT was related to stream characteristics using simple correlation analysis and by developing multiple regression models. This analysis was performed only for sites containing YCT. Density was calculated as the number of YCT per m^2. This was highly correlated with other metrics, such as number of YCT per m^3 as well as YCT biomass per m^2 and per m^3. As with presence/absence analysis, the general linear model (SAS 1999) was used so that categorical independent variables could be included in the analysis. Density of all trout and species richness was analyzed in the same way. Estimates of trout density included only fish >100 mm.

Most of the data reported herein was collected in 2001. However, some of the data was collected in 2000. Because 2001 was an extremely dry year, we often included year (as a discrete variable) in our models as a blocking factor to control for the nuisance variation in our response variables that was attributable to time. When modeling YCT density, we used the density of all other trout (non-YCT density) as a covariate factor in the model.

RESULTS

A total of 326 sites were visited within the four study drainages, including 87 in the Goose Creek drainage, 99 in the Raft River drainage, 81 in the Blackfoot River drainage, and 59 in the Willow Creek drainage. Of these, sufficient water existed to inventory fish and habitat in these same drainages at 56, 64, 54, and 27 sites, respectively, and fish were captured in 36, 55, 49, and 22 of the sites, respectively. Goose Creek sites were lowest in average elevation and conductivity and highest in trout cover and shading (Table 3). Willow Creek sites were highest in average elevation and conductivity and lowest in the presence of exotic trout (only three of 27 sites). Raft River sites were highest in the presence of exotic trout (39 of 64 sites) and stream gradient, and Blackfoot River sites were lowest in gradient and shading but highest in unstable banks.

Gradient appeared to have been underestimated using maps (Figure 2). Although the relationship between field gradient and map gradient was strong (r^2 = 0.69), map gradient measured lower than field gradient for most observations, causing the linear relationship between the variables to fall below the 1:1 scale. Based on the strength of the relationship, however, we felt map gradient was sufficiently accurate to act as a surrogate for field gradient, and that use of map gradient would not bias the influence that gradient may have on YCT presence/absence or density or on species richness.

Presence/Absence of YCT

Of the sites that were surveyed for fish and habitat, YCT were present at 17 (30%) of the sites in the Goose Creek drainage, 37 (58%) of the sites in the Raft River drainage, 32 (59%) of the sites in the Blackfoot River drainage, and 13 (48%) of the sites in the Willow Creek drainage (Table 4). Allopatric populations of YCT made up 14 (25%), 15 (23%), 19 (35%), and 12 (44%) of those sites, respectively.

In the Goose Creek drainage, sites with YCT were higher in elevation and lower in conductivity based on lack of overlap in 95% confidence limits (Table 4). In the Raft River drainage, the only difference between sites with and without YCT was in trout cover (higher for sites with YCT). In the Blackfoot River drainage, there was less fine substrate and more gravel substrate at sites with YCT than at sites without YCT. In the Willow Creek drainage, 70% of the sites located on public land contained YCT, but only 35% of private land contained YCT. Combining all drainages, only site elevation differed between sites with and without YCT based on confidence intervals.

A model to predict YCT presence/absence was constructed for all drainages combined and included elevation, gravel substrate, and stream order (Table 5). The model was weak, however, explaining only 18% of the variation in YCT presence/absence. In the Goose Creek drainage, elevation, width, trout cover, and stream shading comprised the best model. Including these variables in a general linear model explained 37% of the variation in that model. In the Raft River drainage, elevation, gravel substrate, trout cover, and unstable banks comprised the best model, and in a general linear model explained 35% of the variation in YCT presence/absence. In the Blackfoot River drainage, gradient, gravel substrate, trout cover, and unstable banks comprised the best model, and explained 48% of the variation in YCT presence/absence. In the Willow Creek drainage, elevation and gradient were not significant variables, but they comprised the best model and explained 45% of the variation of YCT presence/absence in a general linear model.

Density of YCT

Yellowstone cutthroat trout density was not particularly high in any of the drainages, averaging $0.11/m^2$, $0.08/m^2$, $0.10/m^2$, and $0.08/m^2$ in the Goose Creek, Raft River, Blackfoot River, and Willow Creek drainages, respectively. These averages only included sites that contained YCT.

For all drainages combined, there was little correlation between YCT density and any continuous independent variables (Table 6). Within individual drainages, correlations were higher but still not very strong in most instances (Table 6).

Using the general linear model, no model could be built to predict YCT density from stream characteristics with all drainages combined; the highest r^2 of any model was 0.10. In the Goose Creek drainage (n = 17), stream order (P = 0.005) and elevation (P = 0.002) are the only significant variables; the model explained 83% of the variation in YCT density. For the Raft River drainage (n = 37), shading (P = 0.02) and elevation (P = 0.01) produced a weak model that explained only 42% of the variation in YCT density. In the Blackfoot River drainage (n = 32), shading (P = 0.007) and elevation (P = 0.04) are the best predictors of YCT density, but the model explained only 36% of the variation. In the Willow Creek drainage (n = 13), year and non-YCT density were removed because all sampling occurred in 2001 and almost no other trout were present. With the inclusion of landownership (P = 0.02), conductivity (P =0.002), width:depth ratio (P = 0.001), and trout cover rating (P = 0.01), the model explained 82% of the variation in YCT density.

Total Density of Trout

As with YCT density, total trout density was not particularly high in any of the drainages, averaging $0.16/m^2$, $0.15/m^2$, $0.10/m^2$, and $0.10/m^2$ in the Goose Creek, Raft River, Blackfoot River, and Willow Creek drainages, respectively. These averages only included sites that contained trout. There was a strong relationship between the number of trout captured on the first pass and subsequent estimates of trout density in most instances (Figures 3-6).

As with YCT density, few variables correlated with trout density (Table 7), and models were difficult to construct. No useful model could be constructed for all drainages combined, or for the Goose Creek, Raft River, or Blackfoot River drainages. In the Willow Creek drainage (n = 15), trout cover (P = 0.01), landownership (P = 0.003), conductivity (P = 0.0002), and width:depth ratio (P = 0.001) built the best model, explaining 84% of the variation in trout density.

Species Richness

Few variables correlated strongly with species richness (Table 8). The most consistent variables that were correlated with species richness for most drainages was stream width and stream order. For all drainages combined, the best model developed included stream order

(P = 0.007), gradient (P = 0.003), and width (P = 0.004) and explained 35% of the variation in species richness. For the Goose Creek drainage (n = 56), landownership (P = 0.001) and gradient (P <0.0001) explained 66% of the variation in species richness. For the Raft River drainage (n = 64), gradient (P <0.0001), width (P <0.0001), WD ratio (P <0.0001), fines substrate rating (P <0.0001), and gravel substrate rating (P = 0.0001) all contributed significantly to the model, but explained only 52% of the variation in species richness. For the Blackfoot River drainage (n = 54), gradient (P = 0.02) and width (P = 0.008) explained 37% of the variation in species richness. In the Willow Creek drainage (n = 27), stream order (P = 0.001), width (P = 0.02), and WD ratio (P = 0.0007) explained 74% of the variation in species richness.

DISCUSSION

We found YCT at a total of 99 sites in the Goose Creek, Raft River, Blackfoot River, and Willow Creek drainage out of the total of 201 sites that contained sufficient surface flow to inventory fish and habitat. Stream characteristics that affected YCT presence/absence included elevation, gravel substrate, stream order, stream width, gradient, trout cover, stream shading, and unstable banks. Elevation consistently was included in presence/absence modeling and was one of the only variables to achieve statistical significance. Because the drainages we surveyed in 2001 were used heavily for irrigation purposes, and many streams lacked water soon after leaving the high gradient, mountainous areas, it was not surprising that elevation would have an influence on YCT presence/absence. It appeared that sites that were higher in elevation, higher in gravel substrate and trout cover, steeper in gradient, and lower in unstable banks were more likely to contain YCT. Not surprisingly, such conditions portray streams that are healthy and functioning relative to streams that have been damaged by anthropogenic activities.

In general, however, few of the models were very strong, and the inclusion of some variables was tenuous at best. This observation held for nearly all the modeling performed above and was especially true when modeling all drainages together. This suggests that factors limiting species richness, YCT distribution and abundance, or trout abundance in one drainage are not having the same effect in other drainages. Similar results were found in our earlier work (Meyer and Lamansky 2002). For example, in the Teton River drainage in the upper Snake River basin, sites that contained YCT tended to be lower in elevation than sites without YCT, and no other measured variables appeared to affect YCT presence/absence. However, in the Portneuf River, a number of variables influenced YCT presence/absence, including stream order, conductivity, fine substrate, and the amount of riffle and run habitat present (Meyer and Lamansky 2002).

Our models tended to explain more variation when sample sizes were smallest, and often the only relatively precise (i.e., high r^2 or R^2) models that could be constructed were for drainages that had low sample size. Our findings are not unique. Fausch et al. (1988) reviewed mathematical models that predict stream fish standing stock from measurable stream attributes, including 98 models that reported sample size. They divided the studies into those with datasets of more than and less than 20 observations. Of the models with more than 20 observations, 46% of them had values of r^2 >0.75. In comparison, of the models with sample size less than 20 observations, 68% of them had values of r^2 >0.75. Similarly, of the 20 models we developed for YCT presence/absence, trout and YCT abundance, and species richness, only 20% of the models that had a sample size of more than 20 observations had values of r^2

>0.75. In comparison, 100% of the models that had a sample size of less than 20 observations had values of r^2 >0.75. Fausch et al. (1988) concluded that relatively precise models often lack generality.

Average trout density (>100 mm) at our study sites was 0.16/m^2, 0.15/m^2, 0.10/m^2, and 0.10/m^2 in the Goose Creek, Raft River, Blackfoot River, and Willow Creek drainages, respectively; trout density for all drainages combined was 0.13/m^2. In the native range of YCT in northwestern Wyoming, Kruse et al. (1998) found that average density of trout >60 mm was 0.05/m^2. Platts and McHenry (1988) reported average trout densities (all sizes included) of 0.41/m^2 for the Intermountain ecoregion, which includes our area of sampling. In previous work in the upper Snake River basin, we found average trout densities (fish >100 mm) of 0.15/m^2 and 0.15/m^2 in the Portneuf and Teton river drainages, respectively (Meyer and Lamansky 2002).

This work on YCT in Idaho is preliminary and will be completed at the end of the 2002 field season when sampling in southeastern Idaho is completed. At that time, all Idaho YCT drainages will be included in our analysis, and we expect to have completed GIS coverages such as road density, grazing density, stocking locations, and irrigation diversions to make a complete assessment of the factors that influence YCT distribution and abundance. Our analysis to date suggests that these factors will vary widely between drainages, and that data we are currently collecting may not consistently relate to YCT distribution and abundance.

ACKNOWLEDGMENTS

The authors would like to thank Paul Badame, Josh Gable, Ryan Harnish, Sheila Lien, and Winston Morton for data collection and compilation, and Liz Mamer for building the GIS graphs. Dan Schill and Paul Thompson reviewed the manuscript and made helpful suggestions for improvement.

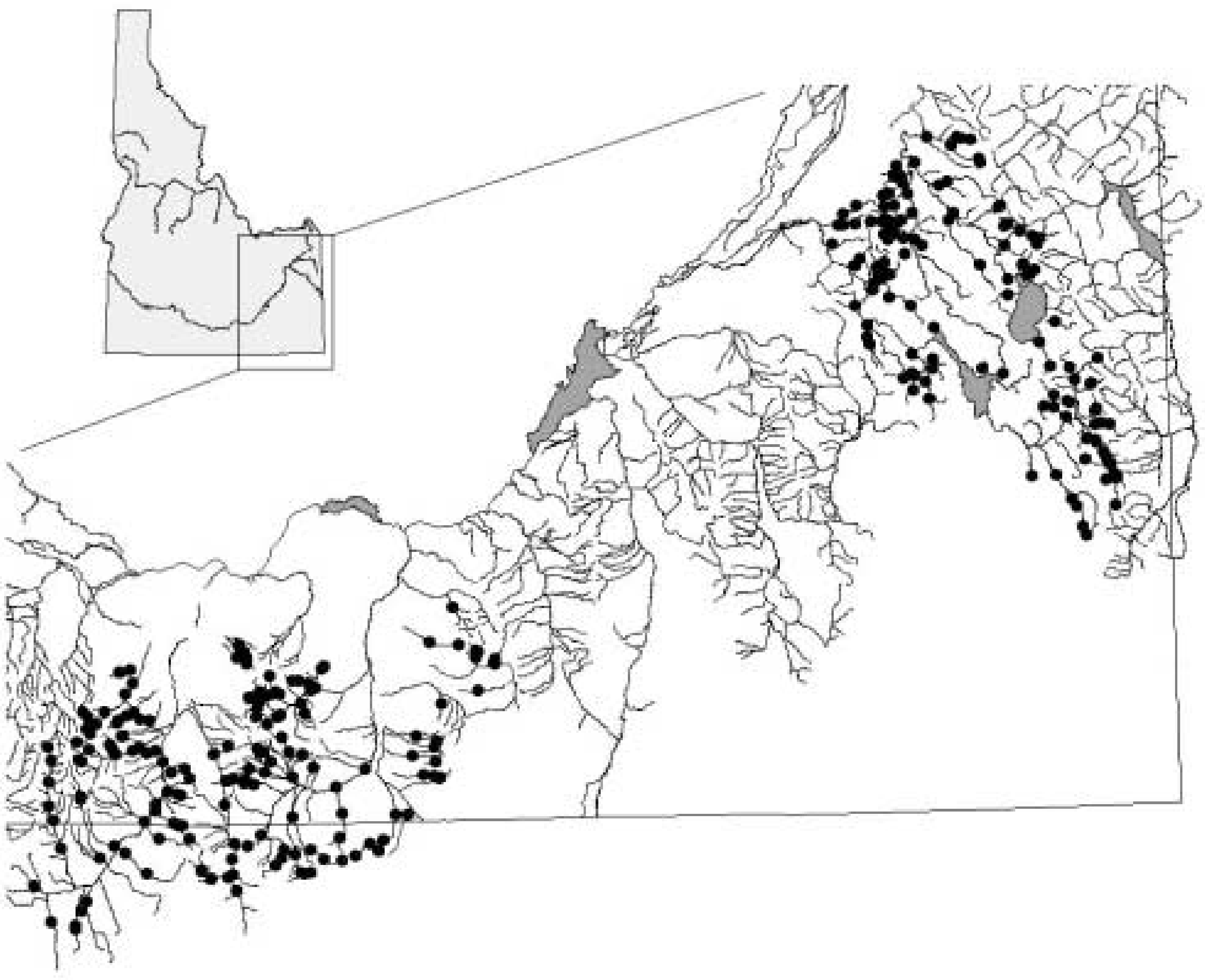


Figure 1. Distribution of sampling locations in the Goose Creek, Raft River, Blackfoot River, and Willow Creek drainages where fish/habitat inventorying took place in 2001.

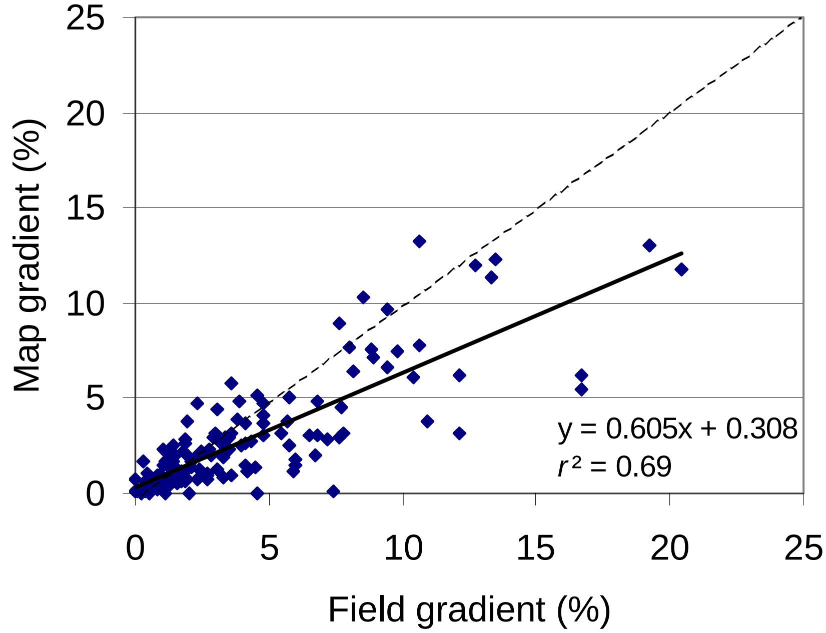


Figure 2. Comparison of stream slope estimates derived from a map or from the field for sites surveyed in 2001. Dashed line depicts a 1:1 ratio.

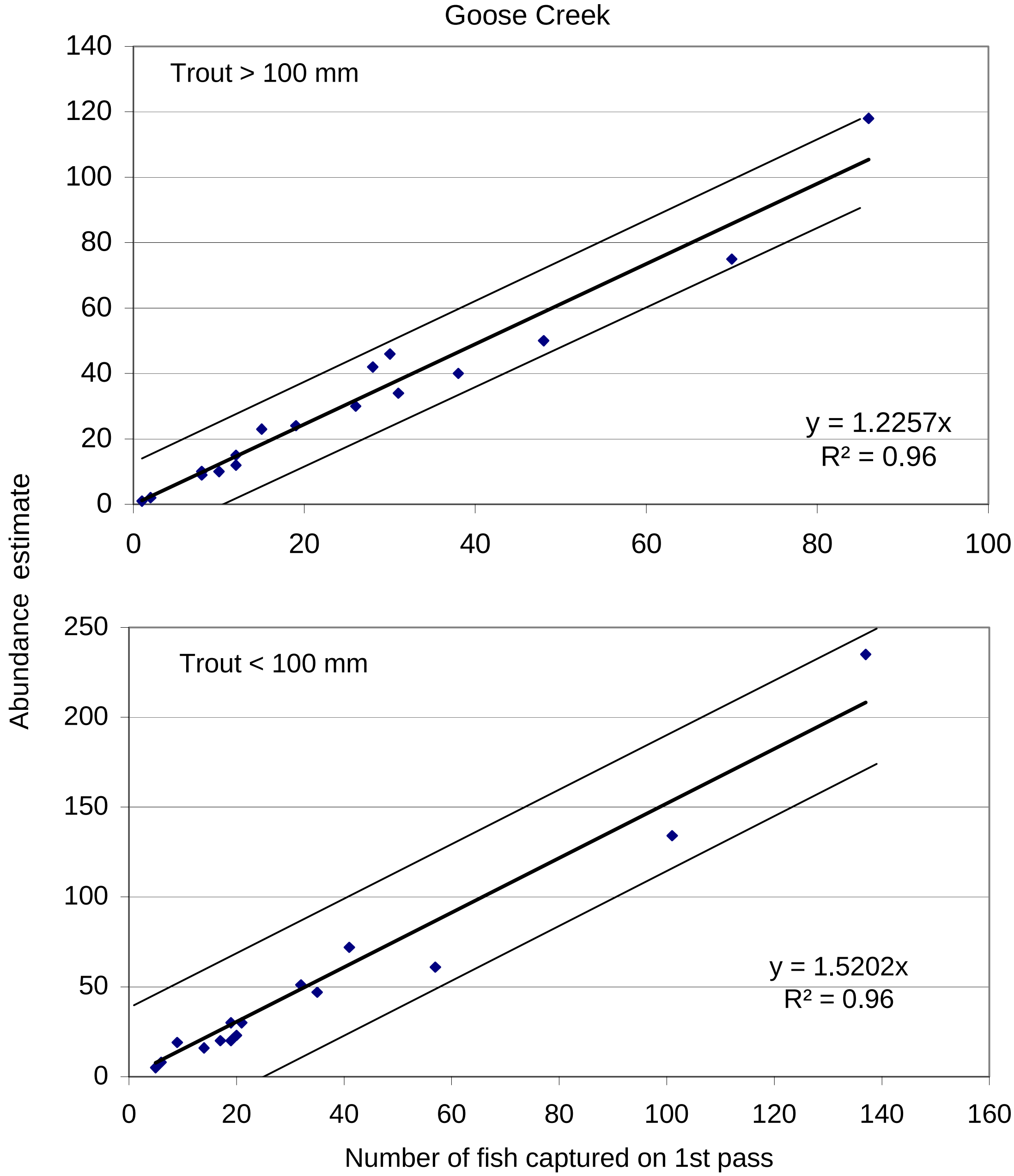


Figure 3. The relationship between the number of trout captured on the first pass and the corresponding abundance estimates for age-0 (<100 mm) and age-1+ (i.e., age-1 and older; >100 mm) trout from the Goose Creek drainage in 2001. Outer lines depict the 95% prediction intervals.

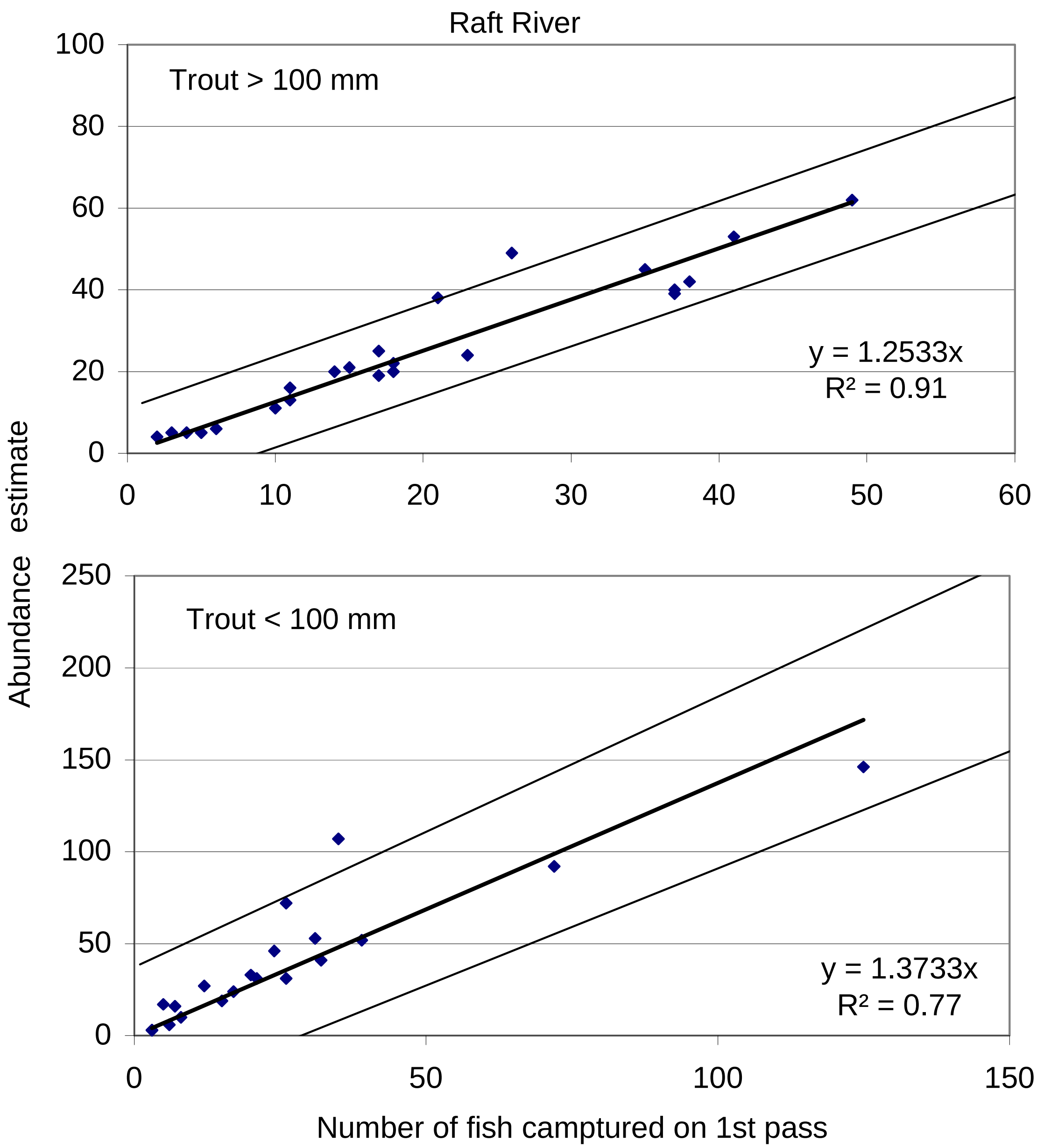


Figure 4. The relationship between the number of trout captured on the first pass and the corresponding abundance estimates for age-0 (<100 mm) and age-1+ (i.e., age-1 and older; >100 mm) trout from the Raft River drainage in 2001. Outer lines depict the 95% prediction intervals.

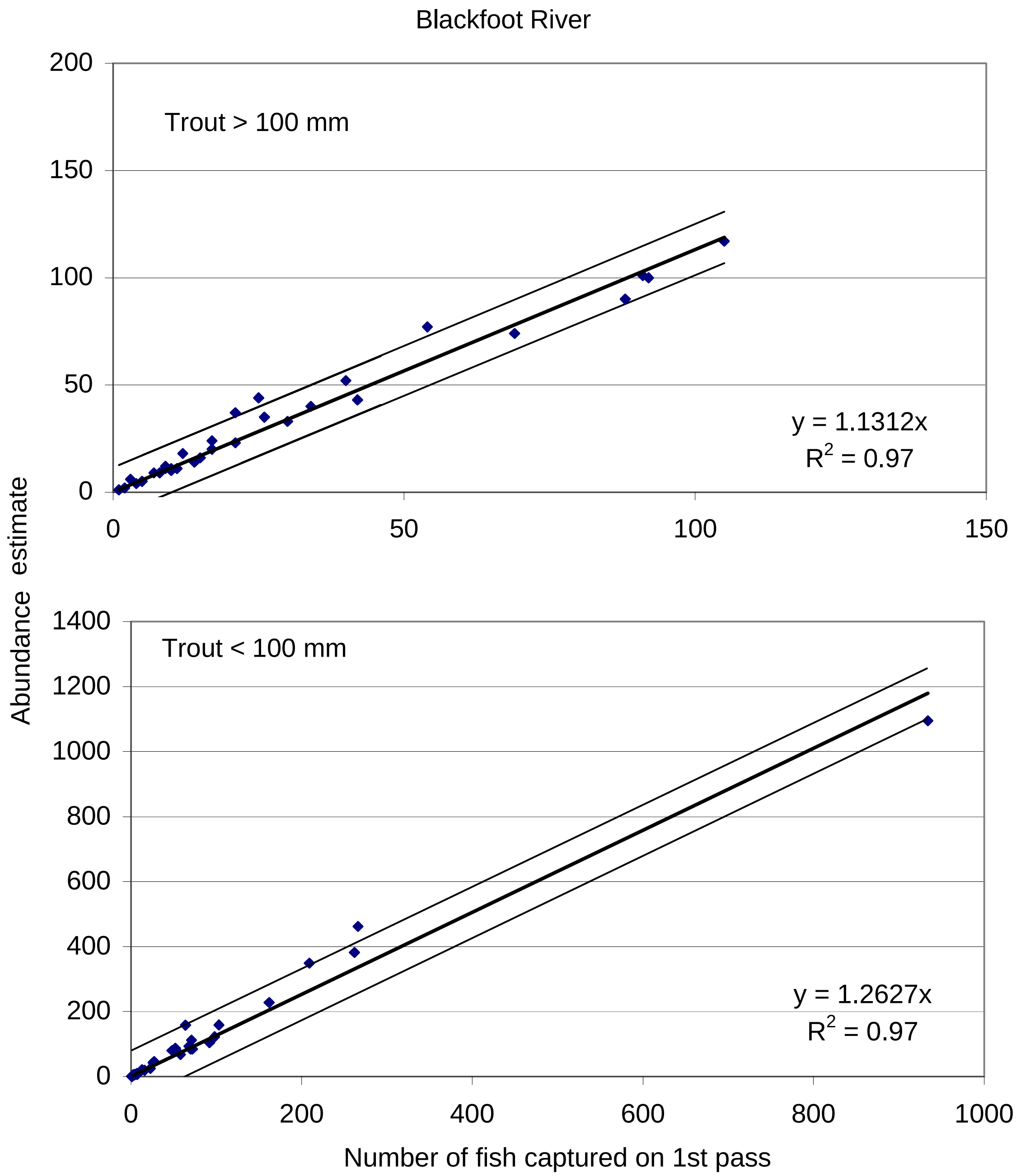


Figure 5. The relationship between the number of trout captured on the first pass and the corresponding abundance estimates for age-0 (<100 mm) and age-1+ (i.e., age-1 and older; >100 mm) trout from the Blackfoot River drainage in 2001. Outer lines depict the 95% prediction intervals.

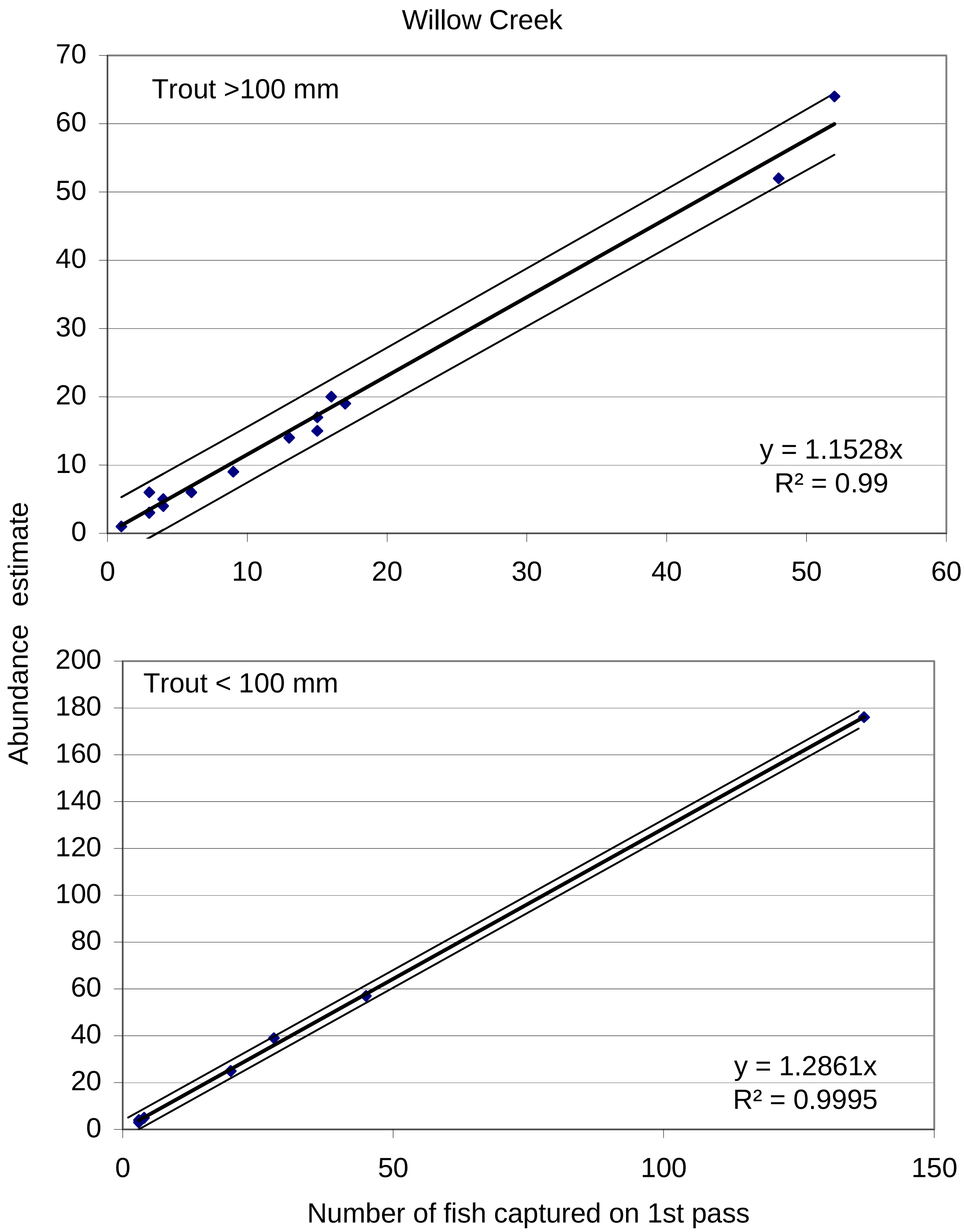


Figure 6. The relationship between the number of trout captured on the first pass and the corresponding abundance estimates for age-0 (<100 mm) and age-1+ (i.e., age-1 and older; >100 mm) trout from the Willow Creek drainage in 2001. Outer lines depict the 95% prediction intervals.

Table 1. Determination of the sample size needed to achieve a stated precision in estimating the mean density (30 fish/100 m of stream) of trout in Pike's Fork.

N	Width of 95% CI around the mean (# of fish)	Exceeds mean density estimate by (%)
20	4.7	16
10	7.0	23
5	11.5	38
4	13.9	46
3	18.5	61
2	30.4	101
1	127.1	424

Table 2. Variables considered for inclusion within various types of fish/habitat analyses in southeast Idaho streams.

Variable	YCT Presence / Absence	YCT Density	Trout Density	Species Richness
Year[a]	X	X	X	X
Stream order	X	X	X	X
Elevation (m)	X	X	X	X
Landownership[b]	X	X	X	X
Stream gradient (%)	X	X	X	X
Conductivity (µS/cm)		X	X	
Width (m)	X			X
Width:depth ratio		X	X	X
Fines substrate rating	X			X
Gravel substrate rating	X			X
Trout cover rating (sum)	X	X	X	
Shading rating	X	X	X	X
Unstable bank rating	X	X	X	
Presence of exotic trout	X			
Non YCT trout density[c]		X		

[a] Used to account for error associated with differences between years of sampling.
[b] Private or public
[c] Used as covariate in YCT density modeling

Table 3. Means of stream attributes from sites sampled across southeastern Idaho in 2001.

	Goose		Raft		Blackfoot		Willow	
Variable	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**	**Mean**	**CI**
Elevation (m)	5930	195	6118	185	6219	150	6465	97
WD ratio	24.8	2.8	27.4	3.6	22.6	2.6	19.9	3.0
Stream order (1:24,000 scale)	2.0	0.3	2.2	0.2	2.1	0.2	1.7	0.2
Conductivity (µs/cm)	171.5	39.7	289.4	60.4	339.7	18.0	427.0	31.3
Gradient (%)	4.4	1.1	4.5	1.1	1.8	0.5	3.0	1.0
Width (m)	2.2	0.4	2.1	0.3	2.7	0.4	1.6	0.3
Fines rating	1.9	0.3	1.9	0.3	3.0	0.4	3.7	0.5
Gravel rating	3.1	0.2	3.0	0.2	2.3	0.3	1.7	0.5
Rating of trout cover (sum)	3.3	0.4	2.5	0.3	2.0	0.3	2.0	0.5
Shading rating	2.3	0.3	2.2	0.3	1.3	0.3	1.7	0.3
Unstable banks rating	1.1	0.3	1.3	0.3	1.6	0.4	0.8	0.4
Exotic trout (avg. No./site)	0.4	0.2	0.8	0.2	0.4	0.2	0.1	0.1
Exotic trout (present/absent)	18/38		39/25		17/37		3/24	
Landowner (private/public)	8/48		19/35		19/54		17/10	

Table 4. Comparison of stream characteristics at sites with and without Yellowstone cutthroat trout for each drainage sampled in 2001.

	Goose				Raft				Blackfoot				Willow				Overall			
Variable	With	CI	Without	CI	With	CI	Without	CI	With	CI	Without	CI	With	CI	Without	CI	With	CI	Without	CI
Elevation (m)	6434	351	5711	208	6275	243	5903	282	6280	209	6129	222	6567	140	6371	131	6342	125	5929	125
WD ratio	24.2	5.3	25.0	3.4	28.6	5.5	25.7	4.3	22.7	3.5	22.5	4.3	18.2	4.4	21.7	4.5	25.0	2.6	23.8	2.0
Stream order (1:24,000 scale	1.7	0.6	2.2	0.3	2.3	0.3	2.0	0.4	2.1	0.3	2.1	0.4	1.8	0.2	1.6	0.4	2.1	0.2	2.0	0.2
Conductivity (µS/cm)	96.8	50.7	203.5	50.6	232.0	49.3	368.0	125.0	334.5	18.5	348.0	38.6	418.0	36.0	435.0	55.0	266.4	28.8	310.4	42.8
Gradient (%)	4.6	2.0	4.3	1.4	4.0	1.6	4.1	1.6	2.0	0.5	1.5	0.9	2.8	1.7	3.2	1.3	3.6	0.8	3.5	0.7
Width (m)	2.3	0.6	2.2	0.4	2.3	0.4	2.1	0.5	2.7	0.5	2.7	0.8	1.7	0.6	1.5	0.4	2.3	0.3	2.2	0.3
Fines rating	1.9	0.5	2.0	0.4	1.7	0.3	2.2	0.5	2.4	0.4	3.9	0.6	3.6	0.6	3.7	0.9	2.2	0.2	2.7	0.3
Gravel rating	3.1	0.5	3.2	0.3	3.1	0.2	2.8	0.4	2.9	0.3	1.5	0.5	2.2	0.6	1.3	0.8	2.9	0.2	2.5	0.3
Rating of trout cover (sum)	3.3	0.6	3.2	0.5	3.0	0.3	1.9	0.6	2.1	0.4	1.8	0.7	1.9	0.7	2.1	0.8	2.6	0.2	2.4	0.3
Shading rating	2.8	0.7	2.1	0.4	2.3	0.3	1.9	0.6	1.4	0.4	1.2	0.5	1.6	0.6	1.9	0.5	2.0	0.2	1.8	0.2
Unstable banks rating	0.8	0.7	1.3	0.4	1.4	0.4	1.2	0.4	1.3	0.5	2.2	0.7	1.2	0.7	0.5	0.5	1.2	0.2	1.3	0.3
Exotic trout (avg. no./site)	0.2	0.2	0.4	0.2	0.8	0.3	0.8	0.3	0.5	0.3	0.2	0.1	0.1	0.2	0.1	0.2	0.5	0.1	0.4	0.1
Exotic trout (present/absent)	3/14		15/24		22/15		17/10		13/19		4/18		1/12		2/12		39/60		38/65	
Landowner (Private/Public)	1/16		7/32		13/24		6/11		11/21		8/14		6/7		11/3		31/65		32/61	

Table 5. Results of logistic regression models and general linear models (r^2 only) relating stream variables to Yellowstone cutthroat trout presence/absence. Results are for the best model (using Akaike's Information Criteria; AIC), and for the best model when the weakest coefficient in the best model is removed. Coefficients were considered to be statistically significant if Wald Chi-square *P*-value was less than α = 0.005 (see text for details).

Variable	Coefficient estimate	SE	Wald Chi-square *P*-value	AIC	Percent concor-dance	General linear model r^2
Comprehensive model (*n* = 201)				245.8	77.2	0.18
Elevation	0.002	0.0002	< 0.0001			
Gravel substrate	0.6	0.2	0.0002			
Stream order	0.5	0.2	0.01			
Remove stream order				250.6	73.7	0.15
Goose Creek model (*n* = 56)				53.1	88.8	0.37
Elevation	0.003	0.001	0.002			
Width	0.9	0.4	0.02			
Trout cover	- 1.0	0.4	0.01			
Stream shading	0.9	0.4	0.03			
Remove stream shading				56.3	85.3	0.30
Raft River model (*n* = 64)				69.8	87.0	0.35
Elevation	0.001	0.001	0.0009			
Gravel substrate	0.3	0.4	0.06			
Trout cover	1.3	0.4	0.0007			
Unstable banks	1.1	0.4	0.008			
Remove gravel substrate				71.9	85.1	0.30
Blackfoot River model (*n* = 54)				49.9	90.2	0.48
Gradient (transformed)	- 4.0	1.9	0.04			
Gravel substrate	1.7	0.6	0.002			
Trout cover	- 0.9	0.5	0.06			
Unstable banks	- 0.6	0.3	0.04			
Remove trout cover				52.1	87.9	0.44
Willow Creek model (*n* = 27)				28.0	90.7	0.51
Elevation	0.012	0.006	0.05			
Gradient (transformed)	12.6	5.0	0.01			
Gravel substrate	0.5	0.5	0.26			
Remove gravel substrate				27.4	89.6	0.45

Table 6. Correlations (*r*) between stream attributes and Yellowstone cutthroat trout density for drainages in southeastern Idaho sampled in 2001.

Variable	Goose	Raft	Blackfoot	Willow	Combined
Stream order (1:24,000 scale)	-0.13	0.21	0.20	0.17	-0.04
Elevation (m)	0.47	0.30	-0.35	-0.04	0.09
Gradient (%)	0.13	-0.17	-0.11	-0.23	-0.07
Conductivity (µS/cm)	0.42	-0.01	-0.07	-0.33	-0.13
Width (m)	0.43	-0.43	-0.11	0.20	-0.23
WD ratio	-0.59	-0.18	-0.15	0.51	-0.19
Fines rating	0.06	0.04	0.00	-0.29	-0.01
Gravel rating	-0.15	0.15	0.04	0.52	0.08
Rating of trout cover (sum)	0.31	-0.44	-0.13	0.21	0.06
Shading rating	0.49	-0.45	0.38	0.00	0.12
Unstable banks rating	-0.49	0.34	-0.10	0.63	-0.03
Exotic trout (present/absent)	-0.46	-0.38	0.13	-0.06	0.17
non YCT trout density	-0.39	-0.18	0.14	-0.06	-0.11

Table 7. Correlations (*r*) between stream attributes and total trout density for drainages in southeastern Idaho sampled in 2001.

Variable	Goose	Raft	Blackfoot	Willow	Combined
Stream order (1:24,000 scale)	0.01	-0.10	0.21	-0.25	0.01
Elevation (m)	0.26	0.11	-0.29	0.01	0.05
Gradient (%)	0.00	0.03	-0.08	-0.16	0.06
Conductivity (µS/cm)	0.30	-0.24	-0.19	-0.48	-0.11
Width (m)	-0.19	-0.28	-0.04	0.00	-0.18
WD ratio	-0.31	-0.12	-0.13	0.42	-0.10
Fines rating	0.08	-0.25	-0.09	-0.61	-0.18
Gravel rating	-0.06	0.20	-0.17	0.67	0.18
Rating of trout cover (sum)	-0.02	0.04	-0.19	0.27	0.05
Shading rating	0.05	0.03	0.33	-0.05	0.14
Unstable banks rating	0.20	0.04	-0.13	0.37	0.08

Table 8. Correlations (*r*) between stream attributes and species richness for drainages in southeastern Idaho sampled in 2001.

Variable	Goose	Raft	Blackfoot	Willow	Combined
Stream order (1:24,000 scale)	0.52	0.48	0.33	0.47	0.45
Elevation (m)	-0.48	-0.30	0.08	-0.09	-0.25
Gradient (%)	-0.38	-0.18	-0.47	-0.28	-0.30
Width (m)	0.56	0.48	0.55	0.67	0.51
WD ratio	-0.11	0.07	0.00	-0.39	-0.04
Fines rating	0.15	0.16	0.00	0.18	0.12
Gravel rating	0.07	0.06	-0.02	-0.13	0.00
Shading rating	-0.41	0.04	-0.28	0.05	-0.21
Unstable banks rating	0.16	0.09	-0.03	0.11	0.09

LITERATURE CITED

Akaike, H. 1973. Information theory and an extension of the maximum likelihood principle. Pages 267-281 *in* B. N. Petran and F. Csaki, editors. International symposium on information theory, 2nd edition. Akademiai Iadi, Budapest, Hungary.

Binns, N. A. 1982. Habitat quality index procedures manual. Cheyenne, Wyoming: Wyoming Game and Fish Department. 209 pp.

Chisholm, I. M., and W. A. Hubert. 1986. Influence of stream gradient on standing stock of brook trout in the Snowy Range, Wyoming. Northwest Science 60:137-139.

Dambacher, J. M., K. K. Jones, and H. W. Li. 2001. The distribution and abundance of Great Basin redband trout: an application of variable probability sampling in a 1999 status review. ODFW, Information Reports 2001-08, Portland, Oregon.

Dunham, J. B., and B. E. Rieman. 1999. Metapopulation structure of bull trout: influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications 9:642-655.

Fausch, K. D., C. L. Hawkins, and M. G. Parsons. 1988. Models that predict standing crop of fish from habitat variables: 1950-1985. Gen. Tech. Rep. U.S. Forest Service, Pacific Northwest Research Station, Portland, Oregon. PNW-GTR-213.

Goodman, L. A. 1978. Analyzing qualitative/categorical data. Abt, Books. Cambridge, Massachusetts.

Gresswell, R. E. 1995. Yellowstone cutthroat trout. Pages 36-54 *in* M. K. Young, 1995.

Hawkins, C., and 10 others. 1993. A hierarchical approach to classifying stream habitat features. Fisheries 18(6):3-12.

Hillman, T., and W. Platts. 1993. Survey plan to detect the presence of bull trout. Report of Don Chapman consultants to the Intermountain Forest Industry Association, Coeur d'Alene, Idaho.

Idaho Department of Fish & Game. 2001. Fisheries management plan 2001-2005. Boise, Idaho.

Isaak, D. J. 2001. A landscape ecological view of trout populations across a Rocky Mountain watershed. Ph.D. dissertation. University of Wyoming, Laramie, Wyoming. 148 pp.

Jones, M. L. and J. D. Stockwell. 1995. A rapid assessment procedure for the enumeration of salmonine populations in streams. North American Journal of Fisheries Management 15:551-562.

Kozel, S. J., and W. A. Hubert. 1989. Factors influencing the abundance of brook trout *Salvelinus fontinalis* in forested mountain streams. Journal of Freshwater Ecology 5:113-122.

Kruse, C. G., W. A. Hubert, and F. J. Rahel. 2000. Status of Yellowstone cutthroat trout in Wyoming waters. North American Journal of Fisheries Management 20:693-705.

Kruse, C. G., W. A. Hubert, and F. J. Rahel. 1998. Single-pass electrofishing predicts trout abundance in mountain streams with sparse habitat. North American Journal of Fisheries Management 18:940-946.

Lobon-Cervia, J., C. Utrilla, and E. Querol. 1994. An evaluation of the 3-removal method with electrofishing techniques to estimate fish numbers in streams of the Brazilian Pampa. Arch. Hydobiol. 130:371-381.

McFadden, J. T., and E. L. Cooper. 1962. An ecological comparison of six populations of brown trout *Salmo trutta*. Transactions of the American Fisheries Society 91:53-62.

Meyer, K. A, and J. T. Lamansky. 2002. Assessment of native salmonids above Hell's Canyon Dam, Idaho. Idaho Department of Fish and Game Annual Report No. 02-04. Boise, Idaho.

Montana Fish, Wildlife and Parks. 1997. Mark Recapture for Windows, Version 5.0. Bozeman, Montana.

Montgomery, D. C. 1991. Design and analysis of experiments, 3rd edition. Wiley, New York, New York.

Overton, C., S. Wollrab, B. Roberts, and M. Radko. 1997. R1/R4 (Northern/Intermountain Regions) fish and fish habitat standard inventory procedures handbook. U.S. Forest Service, Ogden, Utah. Gen. Tech. Rep. INT-GTR-346.

Platts, W. S., and M. L. McHenry. 1988. Density and biomass of trout and char in western streams. Gen. Tech. Rep. INT-241. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 17 p.

Platts, W., W. Megahan, and G. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. U.S. Forest Service, Ogden, Utah. Gen. Tech. Rep. INT-138.

Reynolds, J. B. 1996. Electrofishing. Pages 221-254 *in* B. Murphy and D. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Rieman, B. E., D. C. Lee, and R. F. Thurow. 1997. Distribution, status, and likely future trends of bull trout within the Columbia River and Klamath River basins. North American Journal of Fisheries Management 17:1111-1125.

Rieman, B. E., and J. D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124:285-296.

Rieman, B. E., and J. D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S. Forest Service, Ogden, Utah. Gen. Tech. Rep. INT-302.

Rosgen, D. L. 1994. A classification of natural rivers. Catena 22:169-199.

SAS Institute Inc. 1999. SAS/STAT User's Guide, Version 8. Cary, North Carolina.

Tabachnick, B. G., and L. S. Fidell. 1989. Using multivariate statistics, 2nd edition. Harper Collins Publishers, Inc. New York, New York.

Thurow, R. F., D. C. Lee, and B. E. Rieman. 1997. Distribution and status of seven native salmonids in the Interior Columbia River Basin and portions of the Klamath River and Great basins. North American Journal of Fisheries Management 17:1094-1110.

Van Deventer, J., and W. Platts. 1989. A computer software system for entering, managing, and analyzing fish capture data from streams. Research Note INT-352. Ogden, Utah: USDA Forest Service, Intermountain Research Station.

Watson, G., and T. W. Hillman. 1997. Factors affecting the distribution and abundance of bull trout: an investigation at hierarchical scales. North American Journal of Fisheries Management 17:237-252.

Young, M. K, tech. ed. 1995. Conservation assessment for inland cutthroat trout. U.S. Forest Service Gen. Tech. Rep. RM-256.

Zar, J. H. 1996. Biostatistical analysis, third edition. Prentice Hall, Inc., New Jersey.

APPENDICES

Appendix 1. Compiled data from sites sampled in the Goose Creek, Raft River, Blackfoot River, and Willow Creek drainages during 2001 inventorying in the upper Snake River basin, Idaho.

Stream Loc ID Number	Subbasin	Stream Name	Stream Site	Region	Sample Date	UTM East	UTM North
395	Blackfoot River	Angus Creek	Lower	5	8/11/2001	472417	4741598
518	Blackfoot River	Angus Creek	Middle	5	8/11/2001	469588	4743950
478	Blackfoot River	Angus Creek	Upper	5	8/11/2001	467322	4744574
500	Blackfoot River	Bacon Creek	Upper	5	8/25/2001	479571	4743467
501	Blackfoot River	Bacon Creek	Middle	5	8/25/2001	479359	4742823
399	Blackfoot River	Bear Canyon	Only	5	8/9/2001	482532	4730278
411	Blackfoot River	Bear Creek	Only	5	8/9/2001	441487	4754117
494	Blackfoot River	Browns Canyon	Upper	5	8/24/2001	478768	4749424
495	Blackfoot River	Browns Canyon	Middle	5	8/24/2001	478514	4749113
482	Blackfoot River	Brush Creek	Only	5	8/13/2001	431898	4771404
43	Blackfoot River	Brush Creek	Lower	5	10/9/2000	427901	4773350
45	Blackfoot River	Brush Creek	Middle	5	10/9/2000	428314	4773410
44	Blackfoot River	Brush Creek	Upper	5	10/9/2000	436813	4769281
28	Blackfoot River	Cedar Creek	Only	5	10/10/2000	418963	4784334
36	Blackfoot River	Chicken Creek	1	5	10/22/2000	441470	4756592
476	Blackfoot River	Chippy Creek	Lower	5	8/9/2001	474619	4750426
524	Blackfoot River	Chippy Creek	Middle	5	8/9/2001	473590	4753455
396	Blackfoot River	Cold Spring Creek	Lower	5	8/10/2001	476216	4713596
412	Blackfoot River	Collet Creek	Lower	5	8/9/2001	453115	4753820
33	Blackfoot River	Corral Creek	Lower	5	10/10/2000	436843	4757856
516	Blackfoot River	Corral Creek	Middle	5	8/11/2001	439741	4750991
517	Blackfoot River	Corral Creek	Upper-upper	5	8/11/2001	440335	4747110
34	Blackfoot River	Corral Creek	Upper	5	10/22/2000	439732	4751001
398	Blackfoot River	Coyote Creek	Only	5	8/9/2001	481079	4733135
31	Blackfoot River	Deadman Creek	Only	5	10/10/2000	423884	4769719
51	Blackfoot River	Diamond Creek	3	5	7/20/2000	479480	4735553
52	Blackfoot River	Diamond Creek	2	5	7/19/2000	479079	4735907
53	Blackfoot River	Diamond Creek	4	5	7/19/2000	481636	4732056
54	Blackfoot River	Diamond Creek	6	5	7/21/2000	483438	4720448
55	Blackfoot River	Diamond Creek	GAWS 2	5	8/29/2000	483346	4727787
56	Blackfoot River	Diamond Creek	GAWS 1	5	8/29/2000	483605	4727421
57	Blackfoot River	Diamond Creek	GAWS 4	5	8/30/2000	482174	4730544
58	Blackfoot River	Diamond Creek	GAWS 3	5	8/30/2000	482524	4729938
413	Blackfoot River	Dry Canyon	Only	5	8/9/2001	473149	4722319
394	Blackfoot River	Grave Creek	Middle	5	8/7/2001	426443	4762149
408	Blackfoot River	Grave Creek	Lower	5	8/9/2001	426504	4764965
490	Blackfoot River	Grave Creek	Upper	5	8/14/2001	426993	4760488
37	Blackfoot River	Grizzly Creek	Only	5	10/22/2000	436531	4753305
38	Blackfoot River	Horse Creek	Only	5	10/23/2000	429528	4775870
479	Blackfoot River	Horse Creek	Upper	5	8/12/2001	432374	4776779
515	Blackfoot River	Horse Creek	Middle	5	8/12/2001	430820	4776246
27	Blackfoot River	Jones Creek	Only	5	10/24/2000	420448	4789006
496	Blackfoot River	Jones Creek	Middle	5	8/25/2001	421512	4788782
497	Blackfoot River	Jones Creek	Upper	5	8/25/2001	424444	4789204
46	Blackfoot River	Kendall Creek	Only	5	7/19/2000	477022	4736337
48	Blackfoot River	Lanes Creek	3	5	7/26/2000	480236	4755319
397	Blackfoot River	Maybe Creek (Canyon)	Upper	5	8/9/2001	476703	4731468
491	Blackfoot River	Meadow Creek	Lower	5	8/14/2001	458070	4752363
39	Blackfoot River	Miner Creek	Upper of 2	5	10/24/2000	425333	4780638
40	Blackfoot River	Miner Creek	Lower of 2	5	10/9/2000	424077	4779145
487	Blackfoot River	Miner Creek	Lower	5	8/13/2001	423883	4779082
512	Blackfoot River	Poison Creek	Middle	5	8/12/2001	430534	4777743
513	Blackfoot River	Poison Creek	Upper	5	8/12/2001	430874	4779763
35	Blackfoot River	Poison Creek	Lower	5	10/21/2000	442143	4763773
41	Blackfoot River	Poison Creek	Only	5	10/23/2000	429617	4776810
42	Blackfoot River	Rawlins Creek	Only	5	10/9/2000	428284	4774772
480	Blackfoot River	Rawlins Creek	Middle	5	8/12/2001	429386	4777170
514	Blackfoot River	Rawlins Creek	Upper	5	8/12/2001	429161	4778514
32	Blackfoot River	Sawmill Creek	Only	5	10/22/2000	434543	4752089
47	Blackfoot River	Sheep Creek	3	5	7/20/2000	473500	4745134
522	Blackfoot River	Sheep Creek	Middle	5	8/10/2001	469664	4746812

Appendix 1. Continued

Stream Loc ID Number	Subbasin	Stream Name	Stream Site	Region	Sample Date	UTM East	UTM North
521	Blackfoot River	Sheep Creek	Lower	5	8/10/2001	472751	4745435
488	Blackfoot River	Slug Creek	Lower	5	8/14/2001	469766	4728119
519	Blackfoot River	Slug Creek	Upper	5	8/10/2001	475558	4715597
520	Blackfoot River	Slug Creek	Middle	5	8/10/2001	474240	4720459
400	Blackfoot River	Stewart Canyon	Lower	5	8/9/2001	483677	4726718
477	Blackfoot River	Stewart Creek (Canyon)	Upper	5	8/9/2001	481360	4726401
409	Blackfoot River	Thompson Creek	Lower	5	8/9/2001	437084	4752732
523	Blackfoot River	Timber Creek	Only	5	8/9/2001	483893	4727146
49	Blackfoot River	Timothy Creek	Thurow 1	5	8/31/2000	479104	4739833
50	Blackfoot River	Timothy Creek	2	5	8/31/2000	480533	4740068
493	Blackfoot River	Timothy Creek	Upper	5	8/24/2001	482617	4739669
489	Blackfoot River	Trail Creek (3 Springs trib.)	Upper	5	8/14/2001	463962	4727989
410	Blackfoot River	Unnamed trib. to Thompson Creek	Upper	5	8/9/2001	436687	4749285
29	Blackfoot River	Wolverine Creek	Lower	5	10/10/2000	421655	4791360
30	Blackfoot River	Wolverine Creek	Upper	5	10/10/2000	424952	4793285
768	Goose Creek	(Big) Cottonwood Creek	Lower	4	10/7/1999	745400	4686282
364	Goose Creek	Big Cottonwood Creek	Upper-upper	4	9/25/2001	735800	4673901
365	Goose Creek	Big Cottonwood Creek	Upper	4	9/25/2001	735501	4674560
370	Goose Creek	Big Cottonwood Creek	Lower	4	7/14/2001	743736	4683553
371	Goose Creek	Big Cottonwood Creek	Middle	4	9/24/2001	737106	4676426
371	Goose Creek	Big Cottonwood Creek	Middle	4	7/15/2001	737106	4676426
769	Goose Creek	Big Cottonwood Creek	Upper (@ Father/Son CG)	4	10/7/1999	732613	4671819
364	Goose Creek	Big Cottonwood Creek	Upper-upper	4	7/14/2001	735800	4673901
365	Goose Creek	Big Cottonwood Creek	Upper	4	7/14/2001	735501	4674560
360	Goose Creek	Billys Hole Creek	Middle	4	7/13/2001	738859	4679268
232	Goose Creek	Birch Creek	Middle-middle	4	7/25/2000	261034	4652363
323	Goose Creek	Birch Creek	Only	4	6/30/2001	269174	4668832
253	Goose Creek	Birch Creek	Upper (UT)	UT	6/7/2001	262755	4649188
255	Goose Creek	Birch Creek	Lower (UT)	UT	6/7/2001	260200	4652287
260	Goose Creek	Birch Creek	Lower-lower	4	7/1/2001	255040	4655895
767	Goose Creek	Birch Creek	Only	4	10/7/1999	259300	4653100
608	Goose Creek	Bluff Creek	Lower (NV)	NV	9/20/2001	736313	4634181
618	Goose Creek	Bluff Creek	Upper (NV)	NV	9/23/2001	735292	4631845
338	Goose Creek	Cave Gulch	Only	4	7/2/2001	257150	4667560
609	Goose Creek	Cedar Mountain Draw	Lower (NV)	NV	9/20/2001	733991	4628382
611	Goose Creek	Cedar Mountain Draw	Upper (NV)	NV	9/20/2001	734011	4627590
332	Goose Creek	Cold Creek	Lower	4	7/1/2001	258993	4665040
333	Goose Creek	Cold Creek	Upper	4	7/1/2001	263265	4663573
358	Goose Creek	Dry Fork	Upper	4	7/13/2001	745800	4679600
359	Goose Creek	Dry Fork	Lower	4	7/13/2001	747428	4677939
607	Goose Creek	Dry Gulch	Lower (NV)	NV	9/20/2001	728297	4629091
344	Goose Creek	Ecklund Creek	Upper	4	9/23/2001	734720	4675101
345	Goose Creek	Ecklund Creek	Lower	4	9/24/2001	735273	4675200
344	Goose Creek	Ecklund Creek	Upper	4	7/12/2001	734720	4675101
345	Goose Creek	Ecklund Creek	Lower	4	7/12/2001	735273	4675200
283	Goose Creek	Emery Canyon	Lower	4	6/17/2001	271818	4662616
307	Goose Creek	Emery Canyon	Upper	4	6/20/2001	273164	4662885
284	Goose Creek	Emery Canyon	Middle	4	6/17/2001	272350	4662568
285	Goose Creek	Emery Canyon	Upper	4	6/17/2001	273534	4662967
331	Goose Creek	Emery Creek	Upper	4	7/1/2001	261052	4659482
329	Goose Creek	Emery Creek	Lower	4	7/1/2001	258098	4660613
330	Goose Creek	Emery Creek	Middle	4	7/1/2001	260142	4659781
231	Goose Creek	Goose Creek	Only	4	7/25/2000	252335	4653589
337	Goose Creek	Goose Creek	Lowest	4	7/2/2001	254948	4657486
590	Goose Creek	Goose Creek	Upper (NV)	NV	10/4/2001	729963	4646770
594	Goose Creek	Goose Creek	Upper-middle (NV)	NV	10/4/2001	742479	4647755
771	Goose Creek	Goose Creek	Upper	4	10/7/1999	725834	4670404
772	Goose Creek	Goose Creek	Near mouth of Jones Cr	4	10/7/1999	726739	4667239
773	Goose Creek	Goose Creek	At Thoroughbred Cr	4	10/8/1999	727825	4653008
775	Goose Creek	Goose Creek	Up from Rattlesnake Cr	4	10/8/1999	726600	4656600
774	Goose Creek	Goose Creek	at Winecup Cr	4	10/8/1999	726300	4662200
339	Goose Creek	Hardesty Creek	Upper (UT)	UT	7/2/2001	252396	4641111
610	Goose Creek	Hardesty Creek	Lowest (NV)	NV	9/20/2001	744985	4646015
355	Goose Creek	Little Cedar Canyon	Upper	4	7/13/2001	742209	4688680
356	Goose Creek	Little Cedar Canyon	Middle	4	7/13/2001	742467	4688819

Appendix 1. Continued

Stream Loc ID Number	Subbasin	Stream Name	Stream Site	Region	Sample Date	UTM East	UTM North
357	Goose Creek	Little Cedar Canyon	Lower	4	7/13/2001	744596	4689330
342	Goose Creek	Little Cottonwood Creek	Middle	4	7/2/2001	742279	4677485
770	Goose Creek	Little Cottonwood Creek	Only	4	10/7/1999	744208	4678467
341	Goose Creek	Little Cottonwood Creek	Lower	4	7/2/2001	254367	4677590
343	Goose Creek	Little Cottonwood Creek	Upper	4	7/2/2001	741900	4676860
620	Goose Creek	Little Goose Creek	Upper (NV)	NV	9/22/2001	723895	4637627
334	Goose Creek	Lone Cedar Canyon	Upper	4	7/1/2001	253533	4669791
335	Goose Creek	Lone Cedar Canyon	Middle	4	7/1/2001	255548	4670402
377	Goose Creek	Pickett Spring Creek	Lower	4	7/17/2001	733840	4667464
378	Goose Creek	Pickett Spring Creek	Upper	4	7/17/2001	733400	4667486
254	Goose Creek	Pole Creek	Only (UT)	UT	6/7/2001	255696	4649344
315	Goose Creek	Robinson Creek	Lower of 2	4	6/29/2001	276800	4691978
316	Goose Creek	Robinson Creek	Upper of 2	4	6/29/2001	277582	4691493
362	Goose Creek	Sawmill Creek	Upper	4	7/13/2001	733760	4679050
361	Goose Creek	Sawmill Creek	Lower	4	9/24/2001	735473	4675801
361	Goose Creek	Sawmill Creek	Lower	4	7/13/2001	735473	4675801
363	Goose Creek	Sawmill Creek	Middle	4	7/13/2001	735142	4677886
314	Goose Creek	Smith Creek	Lower	4	6/29/2001	276096	4694625
317	Goose Creek	Smith Creek	Upper	4	6/29/2001	277264	4693075
245	Goose Creek	South Carson Creek	Middle	4	6/14/2001	272515	4670936
340	Goose Creek	South Cottonwood Creek	Lower	4	7/2/2001	747677	4671114
372	Goose Creek	South Cottonwood Creek	Upper	4	7/15/2001	743286	4673641
373	Goose Creek	South Cottonwood Creek	Middle	4	7/15/2001	743392	4673606
336	Goose Creek	Squaw Creek	Lower	4	7/2/2001	741491	4669668
346	Goose Creek	Squaw Creek	Middle	4	7/12/2001	740880	4670691
347	Goose Creek	Squaw Creek	Upper	4	7/12/2001	740468	4671532
777	Goose Creek	Thoroughbred Creek	Only	4	10/8/1999	727882	4653060
376	Goose Creek	Trapper Creek	Upper-upper	4	7/17/2001	735610	4670129
328	Goose Creek	Trapper Creek	Upper	4	7/1/2001	741925	4669280
374	Goose Creek	Trapper Creek	Lower	4	7/16/2001	747433	4670962
375	Goose Creek	Trapper Creek	Middle	4	7/16/2001	745824	4670348
621	Goose Creek	Trout Creek	Only (NV)	NV	9/22/2001	738906	4644679
776	Goose Creek	Trout Creek	Only	4	10/8/1999	733900	4658990
59	Goose Creek	Trout Creek	Only	4	8/11/2000	733972	4658427
319	Goose Creek	Willow Creek	Lower	4	6/29/2001	275358	4691633
320	Goose Creek	Willow Creek	Upper	4	6/29/2001	277480	4690081
300	Raft River	Almo Creek	Lower	4	6/19/2001	279963	4668796
766	Raft River	Almo Creek	Only	4	10/7/1999	279500	4669900
250	Raft River	Basin Creek	Upper (UT)	UT	6/5/2001	265223	4641244
251	Raft River	Basin Creek	Middle (UT)	UT	5/16/2001	267556	4639642
263	Raft River	Basin Creek	Lower (UT)	UT	5/16/2001	271596	4639745
279	Raft River	Big Canyon	Only	4	6/17/2001	323123	4678988
248	Raft River	Blacksmith Creek	Middle	4	6/14/2001	295400	4688420
249	Raft River	Blacksmith Creek	Upper	4	6/14/2001	295745	4688810
291	Raft River	Blacksmith Creek	Lower	4	6/18/2001	293607	4683726
62	Raft River	Cassia Creek	Upper (Reg 4 site)	4	9/20/2000	280038	4680914
305	Raft River	Cassia Creek	Upper	4	6/19/2001	280329	4681026
312	Raft River	Cassia Creek	Lower	4	6/28/2001	292628	4683302
616	Raft River	Cassia Creek	Upper	4	9/21/2001	280329	4681026
617	Raft River	Cassia Creek	Lower	4	9/21/2001	292628	4683302
298	Raft River	Circle Creek	Lower	4	6/18/2001	278231	4661517
275	Raft River	Clear Creek	Lower	4	6/17/2001	311453	4653220
613	Raft River	Clear Creek	Upper (UT)	UT	8/21/2001	301597	4643800
802	Raft River	Clear Creek	lower (UT)	UT	8/21/2001	308437	4647360
803	Raft River	Clear Creek	middle (UT)	UT	8/21/2001	305265	4646470
324	Raft River	Clyde Creek	Upper	4	9/20/2001	280595	4683470
324	Raft River	Clyde Creek	Upper	4	6/30/2001	280595	4683470
326	Raft River	Clyde Creek	Lower	4	9/20/2001	282421	4682534
326	Raft River	Clyde Creek	Lower	4	6/30/2001	282421	4682534
60	Raft River	Cold Creek	Only	4	7/25/2000	262182	4665819
280	Raft River	Cold Spring Canyon	Only	4	6/17/2001	331853	4681934
247	Raft River	Conner Creek	Lower	4	6/14/2001	291877	4685071
287	Raft River	Conner Creek	Middle	4	6/17/2001	289660	4685509
297	Raft River	Conner Creek	Upper	4	6/18/2001	288438	4685689
63	Raft River	Cottonwood Creek	Only (Reg 4 site)	4	9/19/2000	284245	4683177

Appendix 1. Continued

Stream Loc ID Number	Subbasin	Stream Name	Stream Site	Region	Sample Date	UTM East	UTM North
299	Raft River	Cottonwood Creek	Lower	4	6/18/2001	285004	4682624
310	Raft River	Cottonwood Creek	Upper	4	6/28/2001	282951	4686992
313	Raft River	Cross Creek	Only	4	6/28/2001	285214	4677842
318	Raft River	Dry Creek	Lower	4	6/29/2001	284305	4677234
327	Raft River	Dry Creek	Upper	4	6/30/2001	279574	4677351
302	Raft River	Edwards Creek	Upper	4	6/19/2001	280895	4669171
294	Raft River	Edwards Creek	Lower	4	6/18/2001	282566	4666880
74	Raft River	Eightmile Creek (Canyon)	Grunder's 80's site	4	8/17/2000	321035	4668931
70	Raft River	Fall Creek	Lower of 2	4	10/5/2000	331694	4690884
71	Raft River	Fall Creek	Upper of 2	4	10/6/2000	331624	4691196
276	Raft River	Fisher Canyon	Lower	4	6/17/2001	315882	4667097
309	Raft River	Flat Canyon Creek	Lower	4	6/28/2001	279801	4681128
309	Raft River	Flat Canyon Creek	Lower	4	9/20/2001	279801	4681128
308	Raft River	Flat Canyon Creek	Upper	4	6/28/2001	277876	4682022
288	Raft River	George Creek	Lower	4	6/18/2001	287089	4653535
612	Raft River	George Creek	Middle (UT)	UT	7/3/2001	294301	4643336
615	Raft River	George Creek	Upper (UT)	UT	8/22/2001	298460	4642651
622	Raft River	George Creek	Lower (UT)	UT	6/14/2001	291258	4645569
295	Raft River	Graham Creek	Lower	4	6/18/2001	281119	4664208
301	Raft River	Graham Creek	Upper	4	6/19/2001	277235	4665301
292	Raft River	Grape Creek	Lower	4	6/18/2001	287480	4662857
293	Raft River	Grape Creek	Middle	4	6/18/2001	286823	4668934
264	Raft River	Grape Creek	Upper	4	6/16/2001	285205	4672237
321	Raft River	Green Creek	Upper	4	6/30/2001	281890	4675559
322	Raft River	Green Creek	Lower	4	6/30/2001	284711	4677143
270	Raft River	Jim Sage Canyon	Middle	4	6/16/2001	292470	4665032
267	Raft River	Johnson Creek	Lower (UT)	UT	6/13/2001	287568	4644454
268	Raft River	Johnson Creek	Upper (UT)	UT	6/13/2001	288632	4640232
259	Raft River	Junction Creek	Lower (UT)	UT	6/6/2001	273165	4647738
306	Raft River	Junction Creek	Upper	4	6/20/2001	271376	4656933
246	Raft River	Keg Hollow Canyon	Only	4	6/16/2001	289948	4668245
272	Raft River	Kelsaw Canyon	Lower	4	6/17/2001	318448	4662457
76	Raft River	Kelsaw Canyon	Only	4	10/5/2000	322315	4661738
273	Raft River	Kelsaw Canyon	Upper	4	6/17/2001	320954	4661906
68	Raft River	Lake Fork	Upper	4	10/6/2000	332113	4690970
69	Raft River	Lake Fork	Lower	4	10/6/2000	331658	4689547
624	Raft River	Left Fork Johnson Creek	Upper (UT)	UT	7/2/2001	290860	4640160
269	Raft River	Left Fork Johnson Creek	Only (UT)	UT	6/13/2001	289628	4640040
252	Raft River	Mahogany Creek	Only (UT)	UT	5/16/2001	265370	4641538
619	Raft River	New Canyon Creek	Only	4	9/20/2001	279209	4682412
311	Raft River	New Canyon Creek	Only	4	6/28/2001	279814	4682436
303	Raft River	North Creek	Only	4	6/19/2001	276426	4662674
66	Raft River	North Fork Sublett Creek	Upper	4	10/6/2000	336199	4689053
67	Raft River	North Fork Sublett Creek	Lower	4	10/6/2000	335719	4688180
289	Raft River	Onemile Creek	Lower	4	6/18/2001	299013	4653757
296	Raft River	Quaking Asp Creek	Lower	4	6/18/2001	290019	4680265
290	Raft River	Quaking Asp Creek	Middle	4	6/18/2001	290911	4677867
271	Raft River	Raft River	Lower	4	6/17/2001	304808	4664139
256	Raft River	Raft River	Upper (UT)	UT	6/12/2001	276285	4647090
261	Raft River	Raft River	Lower (UT)	UT	6/12/2001	279635	4649330
286	Raft River	Raft River	Middle	4	6/17/2001	297634	4660139
274	Raft River	Rice Creek	Lower	4	6/17/2001	314355	4653168
614	Raft River	Rosevere Fork of Clear Creek	Only (UT)	UT	9/17/2001	307246	4644881
278	Raft River	Sandrock Canyon	Only	4	6/17/2001	316846	4671584
623	Raft River	Sawmill Canyon Fk of One Mile Ck	Upper (UT)	UT	8/23/2001	298035	4648113
281	Raft River	Shirley Creek	Lower	4	6/17/2001	320952	4693637
282	Raft River	Shirley Creek	Upper	4	6/17/2001	327620	4692737
75	Raft River	Sixmile Creek	Grunder's 80's site	4	8/17/2000	321424	4665451
304	Raft River	South Creek	Only	4	6/19/2001	276147	4661779
65	Raft River	South Fork Sublett Creek	Only	4	10/7/2000	336137	4688024
72	Raft River	South Heglar Canyon	Lower of 2	4	10/6/2000	326476	4701666
257	Raft River	South Junction Creek	Lower (UT)	UT	6/6/2001	272441	4644091
258	Raft River	South Junction Creek	Upper (UT)	UT	6/6/2001	273556	4636626
262	Raft River	South Junction Creek	Middle (UT)	UT	6/5/2001	272621	4640211
61	Raft River	Stinson Creek	Lower	4	9/20/2000	279916	4679727

Appendix 1. Continued

Stream Loc ID Number	Subbasin	Stream Name	Stream Site	Region	Sample Date	UTM East	UTM North
73	Raft River	West Dry Canyon	Only	4	10/5/2000		
277	Raft River	West Dry Canyon	Middle	4	6/17/2001	321825	4670351
265	Raft River	Wildcat Creek	Upper (UT)	UT	6/16/2001	284284	4643958
625	Raft River	Wildcat Creek	Upper (UT)	UT	8/23/2001	282907	4642070
266	Raft River	Wildcat Creek	Lower (UT)	UT	6/16/2001	284803	4645704
447	Willow Creek	(Alley) Lyons Creek	Middle	6	7/29/2001	431892	4786669
448	Willow Creek	(Alley) Lyons Creek	Upper	6	7/29/2001	431229	4786323
352	Willow Creek	Birch Creek	Only (old Corsi site)	6	7/27/2001	435955	4798368
460	Willow Creek	Birch Creek	Lower	6	7/30/2001	432834	4795925
461	Willow Creek	Birch Creek	Upper	6	7/30/2001	431232	4795403
462	Willow Creek	Bridge Creek	Lower	6	7/30/2001	470753	4764247
379	Willow Creek	Brockman Creek	Upper	6	7/26/2001	467703	4784009
437	Willow Creek	Brockman Creek	Upper-upper	6	7/27/2001	467139	4782755
438	Willow Creek	Brockman Creek	Lower	6	7/27/2001	465985	4784586
452	Willow Creek	Butler Spring	Only	6	7/29/2001	435881	4781614
473	Willow Creek	Clark Creek	Middle	6	7/31/2001	463670	4778156
474	Willow Creek	Clark Creek	Lower	6	7/31/2001	463414	4778095
80	Willow Creek	Corral Creek	1	6	10/24/2000	463166	4785905
81	Willow Creek	Corral Creek	2	6	10/24/2000	463257	4786240
481	Willow Creek	Gravel Creek	Middle	6	8/13/2001	469072	4753929
430	Willow Creek	Gravel Creek	Lower	6	8/11/2001	466664	4759643
467	Willow Creek	Hancock Creek	Lower	6	7/31/2001	438408	4784757
466	Willow Creek	Hancock Creek	Middle	6	7/31/2001	439920	4783497
350	Willow Creek	Hell Creek	Upper	6	7/27/2001	446439	4798208
354	Willow Creek	Hell Creek	Lower (80's repeat)	6	7/27/2001	444493	4797488
475	Willow Creek	Hell Creek	Only	6	8/1/2001	446449	4798193
456	Willow Creek	Homer Creek	Upper	6	7/30/2001	453570	4778351
468	Willow Creek	Homer Creek	Lower	6	7/31/2001	447585	4790689
455	Willow Creek	Homer Creek	Middle	6	7/30/2001	446557	4789097
449	Willow Creek	Indian Fork Tex Creek	Upper	6	7/29/2001	452199	4807925
450	Willow Creek	Indian Fork Tex Creek	Middle	6	7/29/2001	449970	4808374
451	Willow Creek	Indian Fork Tex Creek	Lower	6	7/29/2001	449278	4808638
463	Willow Creek	Little Valley Creek	Only	6	7/30/2001	459921	4770991
351	Willow Creek	Mill Creek	Only	6	7/26/2001	435639	4785148
442	Willow Creek	Mill Creek	Middle	6	7/28/2001	431991	4785024
443	Willow Creek	Mill Creek	Lower	6	7/28/2001	433559	4786228
458	Willow Creek	Mud Creek	Middle	6	7/30/2001	433651	4792993
459	Willow Creek	Mud Creek	Upper	6	7/30/2001	431562	4792884
439	Willow Creek	North Fork Lava Creek	Upper	6	7/27/2001	458900	4791994
440	Willow Creek	North Fork Lava Creek	Middle	6	7/27/2001	458369	4791913
431	Willow Creek	Peterson Creek	Middle	6	7/26/2001	454431	4802674
432	Willow Creek	Peterson Creek	Lower	6	7/26/2001	453976	4803314
469	Willow Creek	Rock Creek	Only	6	7/31/2001	434739	4802455
434	Willow Creek	Sawmill Creek	Middle	6	7/26/2001	459925	4787655
435	Willow Creek	Sawmill Creek	Lower	6	7/26/2001	460473	4787757
433	Willow Creek	Sawmill Creek	Upper	6	7/26/2001	459426	4787352
348	Willow Creek	Sellars Creek	Lower	6	7/26/2001	437919	4791025
441	Willow Creek	Sellars Creek	Middle	6	7/28/2001	435406	4789611
446	Willow Creek	Sellars Creek	Upper-upper	6	7/29/2001	432745	4789395
457	Willow Creek	Sellars Creek	Upper	6	7/29/2001	434234	4788722
465	Willow Creek	Shirley Creek	Only	6	7/30/2001	459391	4782693
436	Willow Creek	South Fork Sellars Creek	Upper	6	7/27/2001	428345	4789449
444	Willow Creek	South Fork Sellars Creek	Middle	6	7/28/2001	430894	4789437
445	Willow Creek	South Fork Sellars Creek	Lower	6	7/28/2001	431789	4790038
453	Willow Creek	Squaw Creek	Lower	6	7/30/2001	435338	4800119
454	Willow Creek	Squaw Creek	Upper	6	7/30/2001	433920	4799858
349	Willow Creek	Tex Creek	Upper	6	7/27/2001	447652	4806745
353	Willow Creek	Tex Creek	Lower	6	7/25/2001	441954	4808908
470	Willow Creek	Unnamed trib. into GLO	Upper	6	7/31/2001	466293	4776864
464	Willow Creek	Unnamed trib. Into GLO	Only	6	7/30/2001	460055	4774642
471	Willow Creek	Unnamed trib. Into GLO	Middle	6	7/31/2001	465130	4775743
472	Willow Creek	Unnamed trib. Into GLO	Lower	6	7/31/2001	464584	4775442
124	Willow Creek	Willow Creek	Section 2 (above GLO)	6	10/19/2000	438862	4803225
125	Willow Creek	Willow Creek	Section 3 (High Bridge)	6	7/25/2000	437008	4795659

Appendix 1. Continued

Stream Loc ID Number	GPS Zone	Stream Order 1:24,000	Stream Order 1:100,000	Map Elevation (M)	Land Ownership	Quad Map	Rosgen Stream Type	Dominant Riparian Left Bank	Dominant Riparian Right Bank	Map Gradient (%)
395	12	2	3	6420	Private	Upper Valley				
518	12	2	3	6516	Public	Upper Valley	C	2	2	0.5
478	12	2	2	6600	Public	Lower Valley	C	4	4	3.3
500	12	2	2	6840	Public	Diamond Flat	B	2	2	5.8
501	12	2	2	6740	Public	Upper Valley		2	2	3.4
399	12	2	1	6810	Public	Stewart Flat				
411	12	1	1	6140	Private	Reservoir Mountain				
494	12	2	2	7095	Public	Wayan East		4	4	1.4
495	12	2	2	7000	Public	Wayan East	B	4	4	1.4
482	12	3	3	5810	Public	Paradise Valley	C	2	4	0.6
43	12	4	3	5670	Public	Dunn Basin	B	2	2	2.9
45	12	3	2	5700	Private	Dunn Basin	E	2	2	0.4
44	12	3	2	6320	Public	Paradise Valley	C	2	2	0.2
28	12	2	2	4800	Private	Higham Peak	B	1	1	2.3
36	12	1	1	6110	Private	Reservoir Mountain	E	2	2	0.6
476	12	2	3	6560	Private	Wayan East	F	2	2	0.3
524	12	1	3	6620	Public	Wayan West		2	2	0.6
396	12	1	2	6900	Public	Harrington Peak				
412	12	1	2	6160	Private	Henry				
33	12	4	3	6030	Public	Grizzly Creek	C	2	2	0.5
516	12	2	4	6100	Public	Grizzly and Reservoir	C	2	2	0.0
517	12	2	4	6110	Public	Reservoir Mountain	C	2	2	0.9
34	12	2	3	6090	Public	Reservoir Mountain	E	2	2	0.1
398	12	1	1	6720	Public	Diamond Flat				
31	12	2	2	5770	Private	Dunn Basin	B	2	2	1.9
51	12	3	2	6570	Public	Upper Valley	C	2	4	0.5
52	12	3	2	6550	Public	Upper Valley	C	2	2	0.6
53	12	3	2	6700	Public	Stewart Flat	B	4	4	0.9
54	12	2	2	7350	Public	Stewart Flat	B	2	2	1.6
55	12	3	2	6850	Public	Stewart Flat	C	3	3	0.4
56	12	3	2	6880	Public	Stewart Flat	C	3	3	1.3
57	12	3	2	6760	Public	Stewart Flat	C	3	3	0.6
58	12	3	2	6770	Public	Stewart Flat	C	3	3	0.6
413	12	0	2	6410	Private	Dry Valley				
394	12	3	2	5960	Private	Chesterfield				
408	12	3	3	5865	Private	Dunn Basin				
490	12	3	3	5990	Private	Chesterfield Reservoir		2	2	0.4
37	12	3	2	6110	Private	Grizzly Creek	DA	2	2	0.1
38	12	2	1	5950	Private	Poison Creek	B	2	2	1.8
479	12	1	2	6120	Public	Poison Creek	C	2	2	0.9
515	12	2	2	6050	Public	Poison Creek		2	2	1.2
27	12	2	2	5110	Private	Wolverine	B	3	3	2.5
496	12	2	2	5200	Private	Wolverine		3	3	6.0
497	12	2	2	5930	Private	Wolverine	F	2	2	2.9
46	12	1	1	6620	Public	Upper Valley	B	2	2	3.6
48	12	1	1	6840	Private	Stump Peak	C	2	2	2.0
397	12	1	1	7160	Public	Dry Valley				
491	12	4	4	6220	Public	Henry		2	3	0.0
39	12	3	2	5700	Private	Miner Creek	C	1	1	1.4
40	12	3	2	5560	Public	Miner Creek	B	2	2	1.6
487	12	3	3	5550	Private	Miner Creek	F	4	4	1.7
512	12	3	2	6060	Public	Poison Creek	C	2	2	2.7
513	12	3	2	6215	Public	Poison Creek	F	1	1	1.1
35	12	2	2	6140	Public	Meadow Creek Mountain	B	4	4	3.1
41	12	2	2	5980	Private	Poison Creek	C	2	2	1.1
42	12	3	2	5860	Private	Dunn Basin	C	2	2	1.0
480	12	0	2	5990	Private	Poison Creek	C	2	2	1.1
514	12	0	2	6050	Private	Poison Creek	C	2	2	1.5
32	12	2	2	6190	Public	Grizzly Creek	B	2	2	1.2
47	12	2	2	6490	Private	Upper Valley	C	2	2	1.0
522	12	1	3	6720	Public	Upper Valley/Wayan West	C	4	2	3.1
521	12	2	3	6530	Public	Upper Valley	C	4	4	1.6
488	12	1	3	6380	Private	Johnson Creek	E	2	2	0.1
519	12	1	3	6680	Public	Harrington Peak	C	2	2	1.3

Appendix 1. Continued

Stream Loc ID Number	GPS Zone	Stream Order 1:24,000	Stream Order 1:100,000	Map Elevation (M)	Land Ownership	Quad Map	Rosgen Stream Type	Dominant Riparian Left Bank	Dominant Riparian Right Bank	Map Gradient (%)
520	12	1	3	6440	Public	Dry Valley	E	2	2	0.6
400	12	1	1	7040	Public	Stewart Flat				
477	12	1	1	7320	Public	Stewart Flat	A	4	4	7.6
409	12	3	2	6110	Private	Grizzly Creek				
523	12	2	1	6900	Public	Stewart Flat	C	4	4	1.6
49	12	1	1	6600	Private	Upper Valley	B	2	2	2.2
50	12	1	1	6760	Public	Diamond Flat	B	2	2	2.5
493	12	1	2	7150	Public	Diamond Flat		3	3	6.8
489	12	3	2	6410	Public	Johnson Creek		2	2	0.6
410	12	2	1	6240	Public	Grizzly Creek				
29	12	2	2	5270	Public	Wolverine	B	4	4	2.3
30	12	2	2	5700	Private	Wolverine	B	2	2	4.3
768	11	3	2	4720	Public	Buckhorn Canyon	B	4	4	1.5
364	11	1	2	6880	Public	Trapper Peak	C	4	4	1.9
365	11	1	2	6860	Public	Trapper Peak	C	4	4	12.1
370	11	3	3	4940	Public	Buckhorn Canyon	B	3	3	1.8
371	11	3	3	6420	Public	Trapper Peak	C	4	4	3.3
371	11	3	3	6420	Public	Trapper Peak	B	3	3	3.3
769	11	1	1	7265	Public	Trapper Peak	B	4	4	2.7
364	11	1	2	6880	Public	Trapper Peak	C	4	4	1.9
365	11	1	2	6860	Public	Trapper Peak	B	4	4	12.1
360	11	1	2	6440	Public	Severe Spring	A	2	4	7.4
232	12	3	2	6150	Public	Pole Creek	B	3	3	7.0
323	12	2	3	5630	Private	Basin	C	4	4	7.6
253	12	2	2	6660	Private	Cotton Thomas Basin	G	2	2	3.2
255	12	3	2	5800	Public	Pole Creek	B	2	2	2.3
260	12	3	3	5000	Public	Blue Hill	F	2	2	1.3
767	12	3	2	5600	Public	Pole Creek	C	2	2	3.0
608	11	2	2	5381	Public					
618	11	1	1	5250	Public			3	3	1.6
338	12	0	2	4760	Public	Blue Hill				
609	11	3	1	6300	Public					
611	11	3	1	6278	Public					
332	12	3	3	5080	Public	Blue Hill	B	2	4	3.5
333	12	2	2	6440	Public	Lymann Pass	E	4	4	4.2
358	11	0	1	5100	Public	Severe Spring				
359	11	0	2	5440	Public	Severe Spring				
607	11	3	3	5742	Public					
344	11	0	1	6920	Public	Trapper Peak		4	4	9.4
345	11	1	2	6750	Public	Trapper Peak	B	2	3	4.8
344	11	0	1	6920	Public	Trapper Peak	A	4	4	9.4
345	11	1	2	6750	Public	Trapper Peak	A	4	4	4.8
283	12	0	2	6320	Private	Lyman Pass				
307	12	0	1	6620	Public	Almo				
284	12	0	2	6440	Private	Almo				5.4
285	12	0	1	6680	Public	Almo				
331	12	0	1	5800	Public	Blue Hill				
329	12	0	2	5020	Public	Blue Hill				
330	12	0	1	5550	Public	Blue Hill	B	2	2	
231	12	4	4	4950	Private	Pole Creek	E	2	2	0.2
337	12	4	4	4880	Private	Blue Hill	C	2	2	0.0
590	11	3	4	5479	Public		C	4	4	0.5
594	11	3	4	4987	Private		C	2	2	0.4
771	11	2	1	6710	Public	Pike Mountain	C	4	4	2.2
772	11	2	1	6520	Public	Pike Mountain	B	4	4	1.4
773	11	3	4	5750	Public	Mahogany Butte	C	4	4	1.0
775	11	3	4	5995	Public	Timber Butte	C	4	4	0.5
774	11	3	3	6110	Public	Timber Butte	B-C	4	4	1.4
339	12	3	3	5560	Private	Pole Creek				
610	11	3	3	5249	Public	Nile Spring, NV				
355	11	0	1	5160	Public	Buckhorn Canyon				
356	11	0	1	5120	Public	Buckhorn Canyon				
357	11	0	2	4780	Public	Buckhorn Canyon				
342	11	1	1	6738	Public	Severe Spring				

Appendix 1. Continued

Stream Loc ID Number	GPS Zone	Stream Order 1:24,000	Stream Order 1:100,000	Map Elevation (M)	Land Ownership	Quad Map	Rosgen Stream Type	Dominant Riparian Left Bank	Dominant Riparian Right Bank	Map Gradient (%)
770	11	1	1	6315	Public	Severe Spring	B	4	4	6.0
341	12	0	2	5120	Public	Oakley	F	3	3	5.9
343	11	1	1	6780	Public	Severe Spring				
620	11	1	1	5512	Public		E	2	2	1.3
334	12	0	2	5180	Public	Oakley				
335	12	0	2	4900	Public	Oakley				
377	11	1	1	6820	Public	Trapper Peak				
378	11	1	1	6920	Public	Trapper Peak				
254	12	3	2	5380	Public	Pole Creek	G	2	2	3.2
315	12	2	1	5340	Private	Mount Harrison	G	3	3	6.8
316	12	2	1	5740	Public	Mount Harrison		4	4	10.6
362	11	1	1	7130	Public	Trapper Creek				
361	11	2	2	6730	Public	Trapper Peak	B	4	4	4.6
361	11	2	2	6730	Public	Trapper Peak	A	4	4	4.6
363	11	1	1	6940	Public	Trapper Peak	C	2	2	2.0
314	12	0	1	4630	Private	Mount Harrison				5.0
317	12	1	1	5250	Public	Mount Harrison	A	2	2	12.1
245	12	1	1	6900	Public	Basin	Aa+	4	4	19.2
340	11	2	2	4960	Public	Severe Spring				
372	11	2	1	6200	Public	Severe Spring				
373	11	2	1	6100	Public	Severe Spring				
336	11	2	1	5300	Public	Severe Spring	B	2	2	2.5
346	11	2	1	5540	Private	Severe Spring	B	2	2	3.8
347	11	2	1	5620	Public	Severe Spring	B	2	2	5.7
777	11	2	2	5760	Public	Mahogany Butte	B	4	4	2.1
376	11	3	2	5980	Public	Trapper Peak	A	4	4	8.6
328	11	3	2	5260	Public	Severe Spring	C	2	2	0.8
374	11	3	3	4960	Public	Severe Spring		4	4	0.4
375	11	3	3	5030	Public	Severe Spring	C	3	4	0.7
621	11	2	1	5184	Private		E	2	2	0.8
776	11	2	2	6590	Public	Mahogany Butte	C	2	2	1.0
59	11	2	2	5950	Public	Mahogany Butte	B	2	2	1.1
319	12	2	2	4970	Private	Mount Harrison	A	2	2	8.8
320	12	1	1	5980	Public	Mount Harrison	Aa+	2	2	13.5
300	12	2	2	6100	Public	Cache Peak				
766	12	2	2	6420	Public	Cache Peak	B	4	4	1.0
250	12	2	2	6480	Private	Cotton Thomas Basin	C	2	2	1.1
251	12	3	3	6400	Private	Cotton Thomas Basin	C	4	3	1.0
263	12	3	3	6400	Private	Cotton Thomas Basin	C	4	2	0.9
279	12	2	2	5260	Public	Sandrock Canyon				
248	12	1	1	6083	Public	Nibbs Creek				
249	12	1	1	6040	Public	Nibbs Creek				
291	12	0	3	4920	Private	Connor Ridge				
62	12	3	3	5950	Public	Mount Harrison	B	4	2	1.6
305	12	3	3	5955	Public	Mount Harrison	C	2	2	1.9
312	12	4	4	4920	Private	Connor Ridge	C	4	4	1.0
616	12	3	2	5971	Public	Mount Harrison	C	2	2	1.6
617	12	4	4	5906	Private	Oakley	C	4	4	
298	12	2	2	5780	Private	Almo				
275	12	3	1	5282	Private	Naf				
613	12	1	1	8432	Public	Standrod	B	2	2	6.9
802	12	3	2		Public	Rosevere Point				
803	12	2	1		Public	Rosevere Point				
324	12	2	2	6200	Public	Mount Harrison	B	2	2	16.7
324	12	2	2	6200	Public	Mount Harrison	B	2	2	16.7
326	12	2	2	5800	Private	Mount Harrison	C	4	2	3.2
326	12	2	2	5800	Private	Mount Harrison	C	2	4	3.2
60	12	3	2	5690	Public	Blue Hill	B	4	4	5.5
280	12	3	2	5510	Public	Sublett Reservoir				
247	12	2	2	5360	Public	Conner Ridge	B	4	3	5.8
287	12	1	2	6160	Public	Connor Ridge	B	2	2	7.7
297	12	1	2	6440	Public	Connor Ridge	B	2	2	10.4
63	12	3	3	5950	Public	Connor Ridge	B	4	4	5.9
299	12	2	3	5730	Private	Conner Ridge	B	4	4	3.6

Appendix 1. Continued

Stream Loc ID Number	GPS Zone	Stream Order 1:24,000	Stream Order 1:100,000	Map Elevation (M)	Land Ownership	Quad Map	Rosgen Stream Type	Dominant Riparian Left Bank	Dominant Riparian Right Bank	Map Gradient (%)
310	12	1	1	7360	Public	Mount Harrison	Aa+	4	2	12.7
313	12	3	3	5640	Public	Elba	B	4	4	3.0
318	12	2	1	5960	Public	Elba	A	4	4	9.8
327	12	1	1	7690	Public	Cache Peak		3	3	10.6
302	12	1	2	6080	Private	Cache Peak	B	4	4	6.5
294	12	1	2	5540	Private	Cache Peak				
74	12	2	1	6020	Public	Sandrock Canyon	B	2	2	4.1
70	12	1	1	5470	Public	Sublett Reservoir	B	4	2	4.0
71	12	1	1	5560	Public	Sublett Reservoir	B	2	2	4.2
276	12	3	1	5230	Public	Sandrock Canyon				
309	12	2	2	6000	Public	Mount Harrison	B	2	2	1.9
309	12	2	2	6000	Public	Mount Harrison		2	2	1.9
308	12	1	1	6210	Public	Mount Harrison				
288	12	0	2	5480	Private	Jim Sage Canyon				
612	12	3	1	7710	Public	Grouse Creek	B	2	2	4.3
615	12	3	1	8954	Public	Grouse Creek	A	2	2	9.6
622	12	3	1	5794	Private	Grouse Creek	C	4	4	3.4
295	12	1	2	5505	Private	Almo				
301	12	1	2	6240	Private	Almo	B	4	4	7.2
292	12	0	3	5140	Public	Jim Sage Canyon				
293	12	0	1	5440	Private	Elba				
264	12	0	1	6200	Public	Elba	B	2	2	2.3
321	12	2	1	7910	Public	Cache Peak	Aa+	4	4	13.3
322	12	2	2	5900	Public	Elba	Aa+	4	4	20.4
270	12	0	1	5970	Public	Jim Sage Canyon				
267	12	3	2	6120	Public	Yost	F	2	2	1.8
268	12	3	2	6600	Public	Yost	B	4	4	2.6
259	12	3	3	5700	Private	Buck Hollow	C	2	2	0.1
306	12	0	2	5930	Private	Lyman Pass				
246	12	0	2	5920	Public	Elba				
272	12	3	2	5645	Private	Strevell				
76	12	2	2	6150	Public	Strevell	B	2	2	4.8
273	12	3	2	5900	Public	Strevell	F	2	2	
68	12	2	1	5600	Public	Sublett Reservoir	B	2	2	2.8
69	12	2	2	5380	Public	Sublett Reservoir	B	2	2	1.1
624	12	1	1	6480	Public	Grouse Creek	A	3	3	8.9
269	12	2	2	6760	Public	Yost	B	4	2	5.2
252	12	3	1	6500	Private	Cotton Thomas Basin	F	3	3	1.2
619	12	1	2	6152	Public	Mount Harrison		4	4	4.8
311	12	1	2	6160	Public	Mount Harrison	B	2	2	3.6
303	12	1	1	6020	Public	Almo				
66	12	1	1	5050	Public	Sublett Troughs	B	2	2	1.1
67	12	1	1	5420	Public	Sublett Troughs	C	2	2	0.8
289	12	0	3	5500	Private	Chokecherry Canyon				
296	12	1	2	5210	Private	Elba				
290	12	1	1	5580	Public	Elba				
271	12	4	5	4790	Private	Naf				
256	12	4	4	5600	Public	Buck Hollow	C	2	2	0.4
261	12	4	4	5475	Private	Buck Hollow	C	2	2	0.2
286	12	4	5	4940	Public	Chokecherry Canyon	F	2	2	0.4
274	12	2	2	5220	Private	Strevell				
614	12	2	2	7152	Public	Rosevere Point	A	4	4	9.3
278	12	2	1	5280	Public	Sandrock Canyon				
623	12	1	1	6582	Public	Standrod	A	4	4	8.0
281	12	3	3	4880	Private	South Chapin Mountain				
282	12	2	1	5560	Public	Sublett Reservoir				4.9
75	12	2	1	5550	Public	Strevell	B	2	2	3.5
304	12	1	1	5960	Public	Almo				5.6
65	12	1	1	5440	Public	Sublett Troughs	B	2	2	1.1
72	12	3	2	5040	Private	North Heglar Canyon	B	2	2	2.0
257	12	3	3	5760	Private	Buck Hollow	C	2	2	0.3
258	12	2	2	6070	Private	Lynn Reservoir, UT	C	2	2	0.3
262	12	3	3	5870	Private	Buck Hollow	C	2	2	0.3
61	12	1	1	6290	Public	Cache Peak	A	2	2	8.2

Appendix 1. Continued

Stream Loc ID Number	GPS Zone	Stream Order 1:24,000	Stream Order 1:100,000	Map Elevation (M)	Land Ownership	Quad Map	Rosgen Stream Type	Dominant Riparian Left Bank	Dominant Riparian Right Bank	Map Gradient (%)
73	12	0	2		Public	Sandrock Canyon				
277	12	3	2	6080	Public	Sandrock Canyon				
265	12	2	2	6120	Public	Yost	F	2	2	0.8
625	12	2	2	6726	Public	Grouse Creek	E	2	2	3.9
266	12	2	2	5920	Private	Yost	G	2	2	0.7
447	12	2	1	6570	Public	Poison Creek	C	2	2	1.7
448	12	2	1	6770	Public	Poison Creek	B	2	4	2.7
352	12	2	2	5780	Private	Bone	B	3	2	1.6
460	12	1	1	6160	Private	Bone	C	2	2	2.7
461	12	1	1	6420	Private	Bone	C	2	2	4.5
462	12	0	2	6410	Private	Caribou Mountain				
379	12	2	1	6510	Public	Herman		4	4	6.0
437	12	1	1	6620	Public	Herman	C	4	4	6.0
438	12	3	2	6400	Public	Herman		4	4	0.8
452	12	1	1	6437	Private	Poison Creek				
473	12	2	2	6420	Private	Herman	F	2	2	1.4
474	12	2	2	6407	Private	Herman	F	2	2	1.4
80	12	2	2	6350	Public	Herman	B	2	2	1.3
81	12	2	2	6370	Public	Herman	B	2	2	1.4
481	12	1	1	6600	Public	Wayan West	C	3	2	2.1
430	12	2	3	6391	Private	Wayan West				
467	12	1	1	6240	Private	Poison Creek	C	2	2	2.4
466	12	1	1	6370	Private	Long Valley				
350	12	3	3	5140	Public	Jumpoff Hill		3	3	
354	12	3	3	5840	Private	Jumpoff Hill				
475	12	3	3	5950	Private	Jumpoff Hill				
456	12	5	4	6355	Private	Homer Valley				
468	12	5	4	5960	Public	Jumpoff Hill				
455	12	5	4	6110	Public	Jumpoff Hill		4	4	
449	12	2	1	6260	Public	Point Lookout				
450	12	2	2	5960	Public	Point Lookout				
451	12	2	2	5820	Public	Lone Pine Ridge				
463	12	3	2	6455	Private	Bear Island				
351	12	2	3	6320	Private	Poison Creek		2	2	0.9
442	12	2	2	6560	Private	Poison Creek	E	2	2	2.1
443	12	2	3	6520	Private	Poison Creek		4	4	1.1
458	12	1	1	6380	Private	Bone	C	2	2	1.5
459	12	1	1	6640	Private	Bone	F	2	2	4.2
439	12	2	2	6960	Public	Castle Rock	E	4	4	4.1
440	12	2	2	6930	Public	Castle Rock	E	2	4	2.4
431	12	2	2	6220	Public	Point Lookout				
432	12	3	3	6180	Public	Point Lookout				
469	12	1	1	6760	Private	Bone				
434	12	1	1	6550	Public	Herman	B	4	2	10.9
435	12	1	1	6480	Public	Herman	B	4	4	6.7
433	12	1	1	6780	Public	Herman				
348	12	3	3	6100	Private	Bone	B	2	4	2.6
441	12	2	3	6235	Private	Bone		2	2	0.6
446	12	2	3	6320	Public	Bone	C	2	4	0.8
457	12	2	3	6280	Private	Bone	C	4	4	0.6
465	12	2	2	6310	Private	Homer Valley				
436	12	2	1	6720	Private	Wolverine	B	2	2	1.9
444	12	2	2	6435	Private	Bone	B	2	2	1.2
445	12	2	2	6420	Private	Bone	B	2	2	1.2
453	12	3	2	5790	Private	Bone		2	2	1.3
454	12	3	2	6110	Private	Bone	F	2	2	1.7
349	12	3	2	5400	Public	Lone Pine Ridge		4	4	
353	12	4	3	5200	Public	Lone Pine Ridge	B	3	3	4.8
470	12	1	1	6520	Private	Herman	B	4	4	7.8
464	12	1	1	6410	Public	Bear Island				
471	12	2	2	6395	Public	Herman				
472	12	2	2	6390	Public	Herman				
124	12	5	4	5490	Public	Ozone	C	4	4	0.3
125	12	4	4	5890	Private	Bone	C	1	1	4.2

Appendix 1. Continued.

Stream Loc ID Number	Stream Flow Condition	Sum Of LWD Pieces	Sum Of LWD Jams	Sum Of Pocket-Water Pockets	Percent Fines Rating	Percent Sand Rating	Percent Gravel Rating	Percent Cobble Rating	Percent Boulder Rating	Percent Bedrock Rating	LWD Trout Cover Rating	Boulder Trout Cover Rating
395	Dry											
518	Low	0	0	0	4.4	0.7	1.8	0.2	0.0	0.0	0.0	0.0
478	Moderate	0	0	0	4.5	0.9	2.1	0.1	0.1	0.0	0.2	0.0
500	Moderate	7	6	5	1.4	1.5	2.6	2.1	1.4	0.0	0.6	0.9
501	Moderate	7	3	4	1.1	1.1	3.8	1.2	0.9	0.2	0.4	0.7
399	Dry											
411	Dry											
494	Moderate	7	6	4	1.5	1.1	3.0	2.4	0.6	0.0	0.7	0.5
495	Moderate	7	2	4	1.7	2.3	2.1	1.6	0.1	0.0	1.7	0.2
482	Low	0	0	2	4.1	0.8	0.2	2.1	0.8	0.0	0.8	0.6
43	Moderate	5	0	17	1.9	1.9	2.3	2.8	2.4	0.0	0.6	0.8
45	Moderate	0	0	2	3.4	1.6	2.4	1.3	0.3	0.0	0.0	0.0
44	Puddled	0	0	0	5.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
28	Low	0	0	0	5.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
36	Moderate	0	0	0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
476	Low	0	0	0	2.8	0.0	3.5	0.3	0.0	0.0	0.0	0.0
524	Low	0	0	0	4.0	0.9	1.3	2.1	0.2	0.3	0.0	0.0
396	Puddled											
412	Puddled											
33	Low	0	0	0	4.5	1.5	1.5	0.5	0.5	0.0	0.0	0.0
516	Low	0	0	0	5.0	1.0	2.0	1.0	0.0	0.0	0.0	0.0
517	Low	0	0	0	4.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0
34	Moderate	0	0	0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
398	Dry											
31	Low	0	0	0	4.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
51	Low	0	0	0	2.6	1.3	3.1	2.1	0.0	0.0	0.3	0.0
52	Low	0	0	0	1.9	1.0	3.4	2.3	0.0	0.0	0.0	0.0
53	Low	9	0	0	3.4	1.0	2.4	0.9	0.3	0.0	0.3	0.0
54	Low	0	0	0	4.5	1.3	1.4	0.0	0.0	0.0	0.0	0.0
55	Low	1	0	0	2.5	1.0	1.8	1.8	0.7	0.0	0.1	0.0
56	Low	0	0	0	3.2	1.1	2.2	1.1	0.0	0.0	0.0	0.0
57	Low	0	0	0	2.8	1.1	1.6	1.9	0.2	0.0	0.0	0.0
58	Low	2	0	0	2.6	1.0	2.4	1.0	0.9	0.0	0.0	0.0
413	Dry											
394	Dry											
408	Dry											
490	Low	0	0	0	2.9	0.4	1.9	0.0	0.0	0.0	0.0	0.0
37	Moderate											
38	Moderate	0	0	18	2.0	2.0	4.0	1.0	1.0	0.0	0.7	1.0
479	Moderate	0	0	2	3.9	1.0	2.7	0.9	0.9	0.0	1.0	0.3
515	Moderate	1	0	0	4.9	1.0	0.6	0.0	0.0	0.0	0.4	0.0
27	Moderate	0	0	0	3.0	3.0	3.0	1.0	0.0	0.0	0.0	0.0
496	Moderate	0	0	3	2.0	1.0	3.0	3.0	1.0	0.0	0.0	1.0
497	Moderate	2	1	2	1.0	2.0	3.0	2.0	1.0	0.0	1.0	1.0
46	Moderate	4	1	0	1.6	1.8	3.8	1.1	0.0	0.0	0.8	0.0
48	Low	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
397	Dry											
491	Low	0	0	1	3.0	0.0	1.0	2.0	3.0	0.0	0.0	1.0
39	Low	0	0	0	3.7	1.9	2.3	0.0	0.0	0.0	0.4	0.0
40	Low	0	1	0	2.4	2.2	3.5	0.0	0.0	0.0	0.0	0.0
487	Moderate	0	3	0	1.5	0.6	3.4	0.0	0.0	0.0	1.0	0.0
512	Low	0	0	0	2.1	1.8	3.6	0.8	0.4	0.1	0.5	0.3
513	Low	0	0	0	3.1	2.0	2.9	0.6	0.3	0.0	0.0	0.0
35	Moderate	0	2	3	3.7	0.3	1.6	2.7	0.8	0.0	0.3	0.8
41	Moderate	0	1	1	2.1	1.8	3.7	0.6	0.0	0.0	0.1	0.0
42	Low	5	1	4	1.8	1.7	3.6	0.9	0.7	0.3	0.4	0.5
480	Low	6	0	5	2.0	1.0	4.0	1.0	1.0	0.0	1.0	1.0
514	Low	0	1	7	1.3	0.0	2.6	3.0	1.0	0.0	0.0	1.0
32	Low	0	0	5	4.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
47	Low	0	0	0	2.6	1.0	3.0	1.2	0.1	0.0	0.0	0.0
522	Low	2	0	2	1.7	0.9	3.4	2.3	0.6	0.0	0.0	0.4
521	Moderate	4	1	8	1.8	0.0	2.3	2.6	1.0	0.0	0.4	0.8
488	Low	0	0	0	5.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
519	Low	0	0	0	5.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0

Appendix 1. Continued.

Stream Loc ID Number	Stream Flow Condition	Sum Of LWD Pieces	Sum Of LWD Jams	Sum Of Pocket-Water Pockets	Percent Fines Rating	Percent Sand Rating	Percent Gravel Rating	Percent Cobble Rating	Percent Boulder Rating	Percent Bedrock Rating	LWD Trout Cover Rating	Boulder Trout Cover Rating
520	Low	0	0	0	5.0	1.0	1.3	0.4	0.0	0.0	0.0	0.0
400	Dry											
477	Moderate	0	1	13	1.0	1.6	3.5	3.0	2.0	0.0	1.0	1.0
409	Dry											
523	Moderate	0	1	1	2.8	1.0	2.7	0.7	0.2	0.0	0.1	0.2
49	Low	2	0	15	1.1	1.0	3.0	2.5	0.7	0.0	0.1	0.9
50	Low	16	2	0	1.7	1.1	2.9	1.2	0.3	0.0	0.6	0.0
493	Low	3	2	3	1.7	2.3	2.7	1.9	0.9	0.0	1.1	0.7
489	Moderate	0	1	1	4.4	1.0	1.9	0.7	0.2	0.0	0.9	0.2
410	Puddled											
29	Low	0	1	10	2.6	1.3	2.8	2.1	0.9	0.0	0.3	0.5
30	Low	8	3	9	1.0	2.3	3.0	2.3	0.6	0.0	0.5	0.6
768	Low	0	3	1	2.3	1.0	3.4	2.0	1.0	0.0	1.2	1.0
364	Low	4	3	2	3.2	1.0	2.1	1.5	0.3	0.0	1.0	0.2
365	Low	0	0	1	1.6	1.7	1.8	2.7	1.2	0.0	0.4	0.9
370	Low	8	4	13	1.1	1.0	2.8	3.1	1.8	0.0	0.9	1.0
371	Low	0	0	5	1.3	1.6	2.8	3.2	1.8	0.0	0.6	1.1
371	Low	0	0	10	1.0	1.0	3.9	3.0	1.1	0.0	0.0	1.9
769	Low	3	6	0	1.7	1.0	4.8	1.0	1.0	0.0	1.2	1.0
364	Moderate	1	3	0	3.0	1.0	1.9	1.9	0.2	0.0	0.8	0.2
365	Moderate	1	1	4	1.4	1.0	2.8	3.2	1.2	0.0	0.4	0.8
360	Low	7	6	5	1.0	1.0	4.0	3.0	1.0	0.0	1.0	1.0
232	Low	1	0	29	3.3	1.3	1.7	1.0	0.0	0.0	0.0	0.0
323	Low	0	1	3	2.3	2.7	2.4	1.8	0.5	0.0	1.6	0.1
253	Moderate	0	0	10	2.6	1.1	2.8	1.0	0.4	0.0	0.0	0.4
255	Moderate	2	0	14	1.7	1.1	2.8	1.6	1.0	0.0	0.4	0.7
260	Moderate	0	0	2	1.4	1.0	3.7	1.9	0.4	0.3	0.0	0.4
767	Moderate	0	0	10	2.8	1.3	3.0	3.0	1.0	0.0	1.0	1.0
608	Dry											
618	Low	0	0	0	5.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
338	Dry											
609	Dry											
611	Dry											
332	Low	2	0	10	2.9	2.2	2.2	1.1	2.0	0.0	0.9	0.9
333	Moderate	0	0	0	1.8	0.9	3.8	1.0	0.0	0.0	0.0	0.0
358	Dry											
359	Dry											
607	Dry											
344	Low	6	7	13	1.4	1.0	3.3	2.2	1.4	0.0	1.6	0.9
345	Low	4	0	5	1.8	1.0	2.8	1.9	1.4	0.0	0.9	1.0
344	Moderate	4	7	6	0.8	1.0	4.1	1.9	0.7	0.0	1.3	0.2
345	Moderate	2	0	15	1.0	1.0	4.4	1.3	1.2	0.0	0.4	1.0
283	Dry											
307	Dry											
284	Puddled											
285	Puddled											
331	Dry											
329	Puddled											
330	Puddled	0	0	2	1.0	3.0	3.0	1.0	1.0	0.0	0.0	0.0
231	Low	0	0	0	4.1	1.9	1.9	0.0	0.0	0.0	0.0	0.0
337	Low	0	0	0	3.5	2.0	2.0	1.3	0.0	0.0	0.0	0.0
590	Low	0	0	1	1.4	1.0	4.6	1.2	1.0	0.0	0.0	1.0
594	Low	0	0	0	2.2	1.9	3.8	2.0	0.0	0.0	0.0	0.0
771	Low	0	0	0	3.5	1.1	2.5	1.6	1.0	0.0	1.0	1.0
772	Low	0	0	0	2.7	1.0	3.0	1.9	1.1	0.0	1.0	1.0
773	Low	0	1	0	3.3	1.0	3.1	2.4	1.0	0.0	1.0	1.0
775	Low	0	2	0	2.5	1.2	2.7	2.8	1.0	0.0	1.2	1.0
774	Moderate	0	0	0	1.8	1.0	2.8	3.4	1.4	0.0	1.0	1.0
339	Puddled											
610	Puddled											
355	Dry											
356	Dry											
357	Dry											
342	Dry											

Appendix 1. Continued.

Stream Loc ID Number	Stream Flow Condition	Sum Of LWD Pieces	Sum Of LWD Jams	Sum Of Pocket-Water Pockets	Percent Fines Rating	Percent Sand Rating	Percent Gravel Rating	Percent Cobble Rating	Percent Boulder Rating	Percent Bedrock Rating	LWD Trout Cover Rating	Boulder Trout Cover Rating
770	Low	0	2	2	1.1	1.6	3.6	2.1	1.3	0.0	1.0	1.0
341	Moderate	0	0	5	3.0	1.0	3.0	2.0	0.0	0.0	0.0	0.0
343	Puddled											
620	Low	1	0	0	1.0	1.0	5.0	0.0	0.0	0.0	0.0	0.0
334	Dry											
335	Dry											
377	Dry											
378	Dry											
254	Moderate	0	0	18	2.7	1.0	1.9	2.3	1.0	0.0	0.0	0.9
315	Low	1	0	0							1.0	0.0
316	Low	8	3	13	1.0	3.0	3.0	2.0	1.0	0.0	2.0	1.0
362	Dry											
361	Low	9	4	12	1.2	1.3	2.8	1.8	1.8	0.0	2.0	0.9
361	Moderate	3	10	15	1.2	1.1	4.0	1.8	1.7	0.0	1.0	0.8
363	Moderate	1	0	0	3.1	0.7	3.0	0.6	0.6	0.0	0.1	0.4
314	Dry											
317	Low	0	1	8	1.0	2.0	3.0	3.0	2.0	0.0	1.0	1.0
245	Moderate	2	0	7	1.0	1.0	3.5	2.1	1.4	1.0	0.4	1.4
340	Dry											
372	Dry											
373	Dry											
336	Low	0	2	0	1.0	1.0	3.0	3.0	0.0	0.0	1.0	0.0
346	Low	0	1	5	1.0	1.0	4.0	2.7	0.8	0.1	0.8	0.3
347	Low	0	3	7	1.0	1.0	4.0	2.0	1.0	0.0	1.0	0.0
777	Low	0	0	0	1.0	1.0	4.0	2.9	1.0	0.0	1.0	1.0
376	Low	3	2	12	0.8	1.0	3.9	2.5	1.9	0.1	0.4	1.1
328	Moderate	0	0	0	1.0	1.3	4.1	1.9	0.7	0.0	0.4	0.7
374	Moderate	0	0	3	2.2	0.8	4.0	0.8	0.4	0.0	0.2	0.1
375	Moderate	2	2	2	1.5	1.9	4.0	1.7	0.2	0.0	0.6	0.0
621	Low	0	0	1	2.4	1.5	3.4	0.0	0.0	0.0	0.0	0.0
776	Low	0	2	0	3.9	2.1	1.0	1.0	0.7	0.0	1.2	1.0
59	Moderate	3	0	4	3.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0
319	Moderate	1	1	8	0.0	1.0	3.0	3.0	2.0	0.0	0.6	1.0
320	Moderate	6	5	6	0.1	2.1	3.0	3.6	1.3	0.0	1.3	0.9
300	Dry											
766	Low	0	2	8	1.0	1.0	2.0	3.5	2.8	0.0	1.0	1.3
250	Low	0	0	0	1.8	1.9	4.0	0.3	0.0	0.0	0.0	0.0
251	Moderate	0	0	0	3.4	1.1	3.2	0.0	0.0	0.0	0.0	0.0
263	Moderate	0	0	10	1.5	1.1	3.1	2.0	1.7	0.0	0.7	0.9
279	Dry											
248	Dry											
249	Dry											
291	Puddled											
62	Low	13	2	0	3.9	1.8	2.8	0.2	0.0	0.0	0.7	0.0
305	Low	4	2	1	2.5	1.1	3.5	0.7	0.3	0.0	0.9	0.1
312	Low	0	0	0	2.6	1.3	3.0	2.8	0.3	0.0	0.9	0.0
616	Low	1	3	2	2.9	1.3	2.6	0.5	0.2	0.0	0.2	0.0
617	Moderate	0	1	2	2.7	1.7	3.1	2.2	0.5	0.0	1.4	0.1
298	Puddled											
275	Dry											
613	Low	8	1	3	1.3	1.4	2.7	2.9	2.0	0.0	0.5	1.1
802												
803												
324	Low	1	7	7	1.4	1.4	3.8	2.7	1.4	0.0	1.3	1.0
324	Low	10	8	9	1.0	1.0	3.1	2.6	1.0	0.0	1.4	0.9
326	Low	1	4	6	1.8	1.2	3.1	2.3	0.5	0.0	0.9	0.4
326	Moderate	3	3	10	2.1	1.1	2.6	1.6	0.7	0.0	1.1	0.6
60	Low	0	0	0	2.9	1.9	1.9	2.5	1.2	0.0	0.2	0.3
280	Dry											
247	Moderate	0	0	16	1.1	1.0	2.9	2.4	1.9	0.0	0.0	0.9
287	Moderate	2	6	9	1.1	1.1	3.3	2.5	1.3	0.0	3.1	0.8
297	Moderate	3	1	4	1.1	1.0	4.4	1.2	0.9	0.0	1.1	0.4
63	Low	10	4	6	1.1	1.2	3.9	1.8	1.3	0.0	0.7	0.5
299	Moderate	10	7	20	1.1	1.0	3.1	2.4	1.5	0.0	1.2	1.2

Appendix 1. Continued.

Stream Loc ID Number	Stream Flow Condition	Sum Of LWD Pieces	Sum Of LWD Jams	Sum Of Pocket-Water Pockets	Percent Fines Rating	Percent Sand Rating	Percent Gravel Rating	Percent Cobble Rating	Percent Boulder Rating	Percent Bedrock Rating	LWD Trout Cover Rating	Boulder Trout Cover Rating
310	Moderate	0	0	7	1.0	1.0	3.0	2.9	2.8	0.0	0.0	1.0
313	Moderate	11	4	11	0.0	1.0	1.9	4.0	3.0	0.0	1.0	2.9
318	Moderate	2	7	18	0.1	1.0	3.3	2.4	2.4	0.0	1.0	1.2
327	Moderate											
302	Low	0	0	5	1.0	2.0	3.2	1.8	1.5	0.0	0.4	0.9
294	Puddled											
74	Low	0	0	0	1.0	1.0	4.0	1.5	1.0	0.0	0.0	0.0
70	Low	0	0	0	3.0	2.0	3.0	1.0	1.0	0.0	0.0	0.0
71	Moderate	2	0	0	1.0	0.0	4.0	1.8	0.0	0.0	0.0	0.0
276	Dry											
309	Low	2	0	11	2.3	1.1	3.2	1.3	1.3	0.0	0.7	0.5
309	Moderate	0	0	9	2.4	1.7	2.5	0.7	1.5	0.0	0.0	1.5
308	Puddled											
288	Dry											
612	Low	5	3	6	1.0	1.1	2.3	3.3	2.3	0.0	0.4	1.5
615	Low	3	0	5	1.4	1.2	2.7	2.8	2.6	0.0	0.3	1.2
622	Moderate	5	3	7	1.8	0.9	2.9	1.6	1.2	0.0	1.4	0.6
295	Dry											
301	Low	3	3	1	1.5	2.5	3.1	1.6	0.8	0.0	0.9	0.1
292	Dry											
293	Dry											
264	Moderate	7	1	5	1.0	2.0	3.0	2.9	1.8	0.0	0.9	0.9
321	Moderate	5	7	13	1.0	1.6	1.0	1.2	4.9	0.0	0.8	0.9
322	Moderate	16	10	13	1.0	1.0	3.0	3.0	2.0	0.0	1.0	1.0
270	Dry											
267	Moderate	1	1	12	1.0	1.2	3.6	2.3	0.8	0.1	0.9	0.8
268	Moderate	0	0	8	1.0	1.0	4.0	3.0	1.0	0.0	1.0	1.0
259	Low	0	0	0	4.2	2.0	1.8	0.1	0.0	0.0	0.0	0.1
306	Puddled											
246	Dry											
272	Dry											
76	Low	1	0	0	3.3	0.0	1.4	1.9	0.1	0.0	0.0	0.0
273	Puddled	0	0	0	4.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0
68	Low	2	0	0	2.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
69	Moderate	0	1	0	2.9	0.0	3.1	0.0	0.0	0.0	0.9	0.0
624	Low	0	0	11	1.1	1.0	3.0	2.8	2.6	0.0	0.2	1.1
269	Moderate	1	1	10	1.0	1.1	3.1	3.3	0.9	0.0	1.0	0.9
252	Low	0	0	0	2.3	2.0	2.6	1.5	0.0	0.0	0.0	0.0
619	Low	3	2	3	1.0	0.6	4.3	1.6	0.8	0.1	0.8	0.1
311	Moderate	6	3	7	1.0	1.0	4.0	0.8	0.7	0.3	1.0	0.3
303	Puddled											
66	Low	0	0	0	3.0	3.0	4.0	0.0	0.0	0.0	0.0	0.0
67	Low	1	0	0	2.0	3.0	4.0	1.0	0.0	0.0	0.0	0.0
289	Dry											
296	Dry											
290	Puddled											
271	Dry											
256	Low	0	1	2	2.1	1.9	2.8	2.4	0.8	0.0	0.1	0.2
261	Low	0	0	2	2.9	1.8	2.1	1.4	0.7	0.0	0.5	0.3
286	Moderate	1	0	7	4.1	1.0	1.0	1.9	0.0	0.0	0.0	0.0
274	Dry											
614	Low	11	6	6	1.0	1.0	2.9	3.1	2.3	0.0	0.7	1.0
278	Dry											
623	Low	5	9	4	1.8	1.1	3.6	1.7	1.0	0.0	0.9	0.6
281	Dry											
282	Low											
75	Low	1	0	0	1.0	1.0	4.0	2.0	1.0	0.0	1.0	0.0
304	Low											
65	Low	2	1	0	2.0	3.0	4.0	1.0	0.0	0.0	0.0	0.0
72	Low	0	0	0	3.5	0.0	1.8	1.7	0.5	0.0	0.0	0.0
257	Low	1	0	0	2.9	2.3	3.0	1.3	0.0	0.0	0.0	0.0
258	Moderate	0	0	0	2.4	1.8	2.6	1.8	0.7	0.0	0.1	0.3
262	Moderate	0	0	0	3.6	1.3	1.9	1.1	0.5	0.0	0.2	0.3
61	Low	5	3	6	0.9	0.7	3.0	2.6	1.7	0.0	0.8	0.6

Appendix 1. Continued.

Stream Loc ID Number	Stream Flow Condition	Sum Of LWD Pieces	Sum Of LWD Jams	Sum Of Pocket-Water Pockets	Percent Fines Rating	Percent Sand Rating	Percent Gravel Rating	Percent Cobble Rating	Percent Boulder Rating	Percent Bedrock Rating	LWD Trout Cover Rating	Boulder Trout Cover Rating
73	Dry											
277	Dry											
265	Low	0	0	0	2.9	1.5	2.6	0.3	0.2	0.0	0.3	0.1
625	Low	4	5	0	2.5	1.3	3.4	0.1	0.0	0.0	1.1	0.0
266	Moderate	0	0	0	5.0	1.0	1.0	0.0	0.0	0.0	1.0	0.0
447	Low	0	0	0	2.9	1.0	3.0	0.7	0.0	0.0	0.0	0.0
448	Low	0	0	0	3.7	0.9	2.2	0.6	0.0	0.0	0.0	0.0
352	Low	0	0	1	4.7	0.6	0.8	0.7	0.5	0.0	0.1	0.5
460	Low	0	0	0	3.3	1.0	2.4	1.2	0.2	0.0	0.1	0.0
461	Low	3	2	0	3.0	1.0	3.0	2.0	1.0	0.0	1.0	0.0
462	Dry											
379	Low	0	0	0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
437	Low	3	1	0	4.8	0.5	0.7	0.6	0.1	0.0	0.6	0.0
438	Low	0	0	0	5.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
452	Puddled											
473	Low	0	0	0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
474	Low	0	0	0	5.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
80	Low	0	0	0	3.1	0.7	3.1	0.1	0.0	0.0	0.0	0.0
81	Low	0	1	1	2.7	1.3	3.0	0.4	0.0	0.0	0.4	0.0
481	High	9	3	2	1.0	1.3	3.8	1.1	0.0	0.0	1.0	0.2
430	Puddled											
467	Low	0	0	1	3.5	0.4	0.9	0.8	0.4	0.0	0.0	0.1
466	Puddled											
350	Puddled											
354	Puddled											
475	Puddled											
456	Dry											
468	Dry											
455	Puddled											
449	Dry											
450	Dry											
451	Dry											
463	Dry											
351	Low	0	0	1	2.4	1.0	3.0	2.3	0.7	0.0	0.0	0.5
442	Low	5	3	0	3.7	1.0	2.2	0.1	0.1	0.0	0.9	0.0
443	Moderate	1	0	0	5.0	1.0	0.0	0.0	0.0	0.0	0.5	0.0
458	Low	0	0	0	3.5	1.0	2.0	1.5	0.3	0.0	0.0	0.0
459	Low	3	0	0	5.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0
439	Low	7	5	0	3.9	1.0	2.1	0.0	0.0	0.0	0.5	0.0
440	Low	0	0	0	3.8	1.0	2.1	0.7	0.1	0.0	0.0	0.0
431	Dry											
432	Dry											
469	Dry											
434	Low	4	3	0	4.5	1.0	1.5	0.1	0.0	0.0	0.7	0.0
435	Low	0	2	0	4.4	1.0	1.6	0.0	0.0	0.0	1.0	0.0
433	Puddled											
348	Low	1	0	18	3.2	0.1	1.5	1.8	1.9	0.0	0.5	1.2
441	Low	1	0	3	5.0	0.8	0.6	0.0	0.0	0.0	0.8	0.0
446	Low	1	0	1	3.5	0.1	2.9	0.3	0.2	0.0	0.3	0.1
457	Moderate	2	5	0	4.2	0.1	2.1	0.0	0.0	0.0	1.0	0.0
465	Dry											
436	Low	5	5	3	2.3	1.6	3.9	0.0	0.0	0.0	1.6	0.0
444	Low	3	7	5	3.0	1.0	3.1	2.2	0.4	0.1	0.8	0.4
445	Low	3	2	0	1.8	1.8	1.9	1.7	0.7	0.0	0.4	0.1
453	Low	0	0	0	1.0	5.0	1.0	1.0	0.0	0.0	1.0	0.0
454	Moderate	0	0	0	5.0	1.0	0.0	0.8	1.0	0.0	0.2	0.8
349	Dry											
353	Low	0	0	1	3.8	0.4	1.1	1.8	0.1	0.0	0.0	0.1
470	Moderate	7	2	3	2.0	1.0	3.0	2.0	1.0	0.0	1.0	1.0
464	Dry											
471	Puddled											
472	Puddled											
124	Low	0	0	8	1.7	0.9	1.8	3.9	1.6	0.0	0.0	0.6
125	Low											

Appendix 1. Continued.

Stream Loc ID Number	Undercut Bank Trout Cover Rating	Aquatic Plants Trout Cover Rating	Overhanging Veg Trout Cover Rating	Sum Of Trout Cover Ratings	Sum Of Trout Cover Ratings W/O Aquatic Plants	Percent Shading Rating	Percent Unstable Banks Rating	Reach Length (M)	Total Trout (>100 mm) Abundance	Lower 95% CI (>100 mm)
395										
518	0.0	1.6	1.0	2.6	1.0	1.0	3.1	100		
478	0.9	1.4	1.1	3.6	2.1	1.8	1.3	97.4	5	5
500	0.9	0.0	1.0	3.3	3.3	1.1	0.0	92	4	4
501	1.1	1.3	0.9	4.3	3.0	1.1	0.0	95	6	5
399										
411										
494	1.2	0.1	1.0	3.5	3.4	1.7	1.0	100	23	23
495	0.2	0.0	0.9	2.9	2.9	2.2	0.2	190	45.2	40
482	0.8	3.2	1.1	6.6	3.4	1.3	2.0	100	11	11
43	0.1	0.5	0.7	2.7	2.2	1.4	1.0	101.1	40	40
45	0.3	0.0	0.0	0.3	0.3	0.2	4.3	117.3	37.3	33
44	0.0	2.0	1.0	3.0	1.0	0.0	2.0	76		
28	0.0	0.0	0.0	0.0	0.0	2.0	5.0	100		
36	0.0	5.0	0.0	5.0	0.0	0.0	5.0	100		
476	0.5	2.0	0.8	3.3	1.4	0.8	2.5	100		
524	0.6	2.3	1.0	3.9	1.6	1.0	2.2	100	1	1
396										
412										
33	0.5	2.0	0.0	2.5	0.5	0.5	3.0	146		
516	0.0	5.0	0.0	5.0	0.0	0.0	1.0	100		
517	0.0	3.0	0.0	3.0	0.0	1.0	4.0	100		
34	0.0	4.0	0.0	4.0	0.0	0.0	3.0	100		
398										
31	0.0	5.0	2.0	8.0	3.0	2.0	4.0	100		
51	1.0	0.4	0.9	2.6	2.2	1.4	0.2	147	101	101
52	0.2	0.0	0.4	0.6	0.6	0.7	2.1	180	18	18
53	0.5	0.3	1.0	2.1	1.8	1.2	0.1	150	100	100
54	1.3	0.0	0.9	2.2	2.2	2.0	0.0	100	10	
55	1.0	0.0	3.3	4.4	4.4	3.3	1.5	66	37	31
56	0.8	0.0	2.3	3.2	3.2	2.6	0.3	160	77	71
57	1.1	1.1	1.1	3.4	2.2	1.1	0.9	164.6	117	116
58	0.9	0.4	1.3	2.6	2.2	1.2	1.1	87	43	43
413										
394										
408										
490	0.7	1.9	0.9	3.5	1.6	1.0	1.2	100		
37								100	NA	NA
38	1.0	0.0	0.0	2.7	2.7	0.0	0.3	100	2	
479	0.3	3.7	1.0	6.2	2.5	1.3	1.0	100	24.9	22
515	1.0	1.2	0.8	3.5	2.3	1.0	1.3	100		
27	0.0	0.0	0.0	0.0	0.0	0.0	5.0	100	0	
496	0.0	0.0	3.0	4.0	4.0	3.0	4.0	100		
497	0.0	1.0	1.0	4.0	3.0	1.0	3.0	100	0	
46	0.9	0.8	1.0	3.5	2.7	1.7	0.7	100	12	12
48	0.8	0.0	0.5	1.2	1.2	0.8	1.0	63	11	11
397										
491	1.0	5.0	0.0	7.0	2.0	0.0	1.0	100		
39	0.2	0.0	0.4	1.0	1.0	0.6	3.6	105	74	74
40	0.1	1.1	0.5	1.7	0.6	0.8	0.8	100.3	52	46
487	0.5	0.1	0.5	2.1	2.0	1.7	1.6	100	9	9
512	0.8	0.1	1.2	3.0	2.9	2.1	1.0	100	33	33
513	0.0	0.0	0.2	0.2	0.2	0.0	5.0	50	1.1	1
35	0.0	2.7	0.2	4.0	1.3	0.2	0.0	102		
41	0.7	0.0	0.1	0.9	0.9	0.2	1.9	107	90	90
42	0.9	2.5	0.9	5.3	2.8	1.9	1.0	100	44	42
480	1.0	1.0	1.0	5.0	4.0	1.0	1.0	100	9	9
514	0.8	2.3	1.0	5.2	2.9	1.1	2.0	100	14	14
32	1.0	0.0	0.0	2.0	2.0	1.0	3.0	100		
47	0.8	0.7	0.9	2.4	1.7	0.9	0.3	154	11	11
522	1.5	0.0	1.0	2.9	2.9	1.3	0.4	100	20	20
521	0.8	0.0	1.0	2.9	2.9	1.7	0.5	100	52	52
488	0.0	3.0	0.0	3.0	0.0	1.0	0.0	100		
519	1.0	0.0	3.0	4.0	4.0	4.0	0.0	100		

Appendix 1. Continued.

Stream Loc ID Number	Undercut Bank Trout Cover Rating	Aquatic Plants Trout Cover Rating	Over-Hanging Veg Trout Cover Rating	Sum Of Trout Cover Ratings	Sum Of Trout Cover Ratings W/O Aquatic Plants	Percent Shading Rating	Percent Unstable Banks Rating	Reach Length (M)	Total Trout (>100 mm) Abundance	Lower 95% CI (>100 mm)
520	1.5	0.0	0.9	2.4	2.4	2.2	1.5	100	0	
400										
477	1.0	0.0	1.0	4.0	4.0	2.1	0.0	75		
409										
523	0.7	0.1	0.4	1.5	1.4	1.9	0.0	100	16	16
49	1.0	0.0	0.9	2.9	2.9	1.0	1.4	125	24	23
50	1.1	0.0	1.0	2.7	2.7	1.5	0.4	101	9	9
493	1.1	0.0	1.1	3.9	3.9	3.3	0.0	100	11	11
489	1.2	0.0	1.2	3.5	3.5	1.9	0.0	98	6	6
410										
29	0.0	0.0	1.0	1.8	1.8	4.9	0.0	102	89.4	79
30	0.0	0.3	1.4	2.9	2.6	1.5	2.0	103.2	35	35
768	1.0	0.0	1.0	4.2	4.2	1.7	1.2	113		
364	0.9	0.0	1.9	4.0	4.0	2.7	0.6	100	34	34
365	0.3	0.0	1.5	3.1	3.1	1.9	0.0	100	23	23
370	0.6	1.7	0.6	4.8	3.2	1.6	0.1	97	3.7	3
371	0.6	1.6	1.0	4.8	3.3	2.9	0.2	100	50	50
371	1.0	1.1	1.0	5.0	3.9	4.7	0.0	100	75	5
769	1.0	0.0	1.1	4.3	4.3	2.6	1.0	100		
364	1.1	0.0	1.4	3.6	3.6	2.5	0.3	100	44.1	36
365	0.5	0.0	1.6	3.2	3.2	3.5	0.0	100	46	46
360	1.0	0.0	2.0	5.0	5.0	3.0	0.0	100		
232	0.0	3.6	0.0	3.6	0.0	0.0	4.5	102	30	30
323	0.0	0.0	3.8	5.5	5.5	4.2	0.4	100	15	15
253	1.2	0.0	1.4	3.0	3.0	1.7	3.6	95	143	98
255	0.3	0.0	0.9	2.3	2.3	1.3	3.5	100	75	75
260	1.2	0.9	1.0	3.5	2.6	1.0	3.3	100	0	
767	1.0	0.0	1.0	4.0	4.0	1.8	4.0			
608										
618	0.0	4.0	0.0	4.0	0.0	0.0	0.0	100		
338										
609										
611										
332	0.8	2.7	1.0	6.3	3.7	1.8	0.2	100	0	
333	0.8	0.1	1.2	2.0	1.9	3.2	2.8	96		
358										
359										
607										
344	0.3	0.0	0.8	3.6	3.6	3.0	2.7	92	1	
345	0.5	0.0	2.3	4.7	4.7	5.0	0.5	100	10	
344	0.3	0.0	0.8	2.5	2.5	2.8	0.0	92	10	10
345	1.0	0.0	2.1	4.5	4.5	4.5	0.3	95.5	15.9	13
283										
307										
284										
285										
331										
329										
330	0.0	2.0	2.0	4.0	2.0	1.0	0.0	50		
231	0.4	0.0	0.0	0.4	0.4	0.0	3.7	109.7	4.9	4
337	0.4	0.5	0.0	0.9	0.4	0.0	1.3	160		
590	0.0	1.7	1.3	4.0	2.3	2.3	1.3	105	1.2	1
594	0.0	3.7	0.0	3.7	0.0	0.0	1.0	115		
771	2.0	0.0	1.0	5.0	5.0	1.8	1.2	100		
772	1.4	0.0	1.3	4.7	4.7	3.3	1.0	100		
773	1.0	0.0	1.0	4.0	4.0	1.2	1.4	133.5		
775	1.0	0.0	2.4	5.6	5.6	2.5	1.2			
774	1.0	0.0	1.3	4.3	4.3	3.3	1.0			
339										
610										
355										
356										
357										
342										

Appendix 1. Continued.

Stream Loc ID Number	Undercut Bank Trout Cover Rating	Aquatic Plants Trout Cover Rating	Over-Hanging Veg Trout Cover Rating	Sum Of Trout Cover Ratings	Sum Of Trout Cover Ratings W/O Aquatic Plants	Percent Shading Rating	Percent Unstable Banks Rating	Reach Length (M)	Total Trout (>100 mm) Abundance	Lower 95% CI (>100 mm)
770	1.1	0.0	1.7	4.9	4.9	2.9	1.5	100		
341	0.0	1.0	1.0	2.0	1.0	2.0	1.0	100		
343										
620	1.0	3.0	1.0	5.0	2.0	1.0	1.0	100		
334										
335										
377										
378										
254	0.7	0.8	0.7	3.1	2.3	0.3	3.4	100	15	15
315	1.0	0.0	1.0	3.0	3.0	2.0	1.0	100		
316	1.0	0.0	1.0	5.0	5.0	4.0	1.0	100		
362										
361	0.6	1.6	1.2	6.4	4.8	2.7	0.1	80	2	
361	0.9	1.1	1.0	4.9	3.8	3.4	0.0	80	10	10
363	1.5	1.7	2.1	5.7	4.1	4.0	0.2	75.5	17.2	14
314										
317	0.0	0.0	2.0	4.0	4.0	3.0	0.0	100		
245	1.5	0.6	3.2	7.0	6.4	3.3	0.0	100		
340										
372										
373										
336	1.0	0.0	1.0	3.0	3.0	2.0	1.0	100	1.2	1
346	1.0	0.0	1.2	3.3	3.3	1.4	0.5	100	12	
347	0.0	0.0	1.0	2.0	2.0	2.0	1.0	80	14.7	12
777	1.4	0.0	1.0	4.5	4.5	3.0	1.2	74.4		
376	0.1	0.0	1.1	2.7	2.7	3.6	0.0	60	25.7	21
328	0.5	1.0	1.8	4.4	3.4	3.5	0.2	95	118	110
374	1.0	0.5	1.0	2.8	2.3	2.0	1.2	100	24	24
375	0.8	0.0	1.3	2.6	2.6	1.5	0.5	100	42	41
621	0.2	1.3	0.5	2.0	0.7	0.5	1.0	100		
776	2.0	0.0	1.0	5.2	5.2	1.0	1.0			
59	1.0	4.0	1.0	6.0	2.0	1.0	4.0	115	9	9
319	0.4	0.0	1.6	3.6	3.6	3.3	0.0	100	40	40
320	0.0	0.0	1.0	3.2	3.2	3.9	0.0	98		
300										
766	1.0	0.0	1.2	4.5	4.5	3.8	1.0			
250	0.7	0.0	0.8	1.5	1.5	1.5	1.0	100	13	12
251	0.3	0.0	0.8	1.0	1.0	1.7	1.7	100	27	27
263	0.5	0.0	1.0	3.0	3.0	2.1	1.0	100	31	31
279										
248										
249										
291										
62	0.3	0.1	0.5	1.6	1.5	1.0	2.9	73.5	39	39
305	0.8	0.3	1.3	3.4	3.1	1.2	2.3	100	16	16
312	0.3	0.3	1.2	2.7	2.4	2.3	1.0	103	11	11
616	0.3	0.8	1.4	2.7	1.9	1.5	2.1	100	13	13
617	0.6	0.7	1.6	4.4	3.7	2.0	0.8	100	21	21
298										
275										
613	0.4	0.0	0.0	2.1	2.1	1.9	0.6	103	23	22
802								100	111	100
803								102	118	113
324	0.6	0.0	1.0	3.9	3.9	2.1	2.4	95	20	20
324	0.6	0.0	1.0	3.8	3.8	1.8	1.2	100	36.3	29
326	0.3	0.0	0.6	2.2	2.2	2.2	2.5	100	24	24
326	0.7	0.0	0.9	3.3	3.3	2.5	3.1	100	40	40
60	0.0	0.0	1.3	1.8	1.8	3.6	1.1	78.5	5	5
280										
247	0.6	0.0	1.0	2.5	2.5	1.6	1.2	95	62	62
287	1.0	0.0	1.7	6.5	6.5	4.0	0.3	100	49	46
297	0.4	0.0	0.8	2.7	2.7	1.1	0.1	60	42	42
63	0.8	0.0	2.2	4.1	4.1	2.7	1.7	85.1	38	36
299	1.0	0.0	1.0	4.4	4.4	3.6	1.4	100	45	45

Appendix 1. Continued.

Stream Loc ID Number	Undercut Bank Trout Cover Rating	Aquatic Plants Trout Cover Rating	Over-Hanging Veg Trout Cover Rating	Sum Of Trout Cover Ratings	Sum Of Trout Cover Ratings W/O Aquatic Plants	Percent Shading Rating	Percent Unstable Banks Rating	Reach Length (M)	Total Trout (>100 mm) Abundance	Lower 95% CI (>100 mm)
310	0.6	0.0	0.2	1.8	1.8	1.2	0.3	58	4	
313	0.1	0.0	1.1	5.1	5.1	3.1	0.0	70.8	28.8	23
318	0.9	0.1	0.9	4.0	3.9	1.9	0.0	62	12	
327								100		
302	0.9	0.0	0.9	3.1	3.1	2.8	0.7	74.4	5	
294										
74	1.0	0.0	1.0	2.0	2.0	1.1	1.6	82	19	19
70	0.0	4.0	1.0	5.0	1.0	0.0	2.0	100	36.3	29
71	0.0	2.0	0.0	2.0	0.0	0.0	4.0	100		
276										
309	1.1	1.0	1.2	4.4	3.4	3.4	0.4	82	0	
309	1.1	0.7	1.0	4.3	3.6	1.6	0.3	82	5	5
308										
288										
612	0.3	0.0	0.1	2.3	2.3	4.3	0.6	83	69	69
615	0.0	0.0	0.1	1.6	1.6	1.9	0.2	100	30	30
622	0.6	0.0	0.0	2.6	2.6	2.7	2.5	100	57	56
295										
301	0.7	0.0	1.1	2.8	2.8	3.1	0.7	59.7		
292										
293										
264	1.0	0.0	0.9	3.7	3.7	2.0	1.0	49	13.8	11
321	0.2	0.0	0.0	1.9	1.9	4.9	0.0	76		
322	1.0	0.0	1.0	4.0	4.0	3.0	0.0	80	17.5	14
270										
267	0.9	0.0	1.0	3.6	3.6	3.9	0.7	100	58	58
268	0.0	0.0	1.0	3.0	3.0	5.0	0.0	100	80	78
259	0.3	2.1	0.0	2.5	0.4	0.5	1.9	98	24	24
306										
246										
272										
76	0.1	0.8	0.3	1.1	0.4	0.5	1.4	100.8		
273	0.0	0.0	0.0	0.0	0.0	3.0	1.0	100		
68	0.0	4.0	0.0	4.0	0.0	0.0	3.0	110	1.3	1
69	0.9	2.9	0.0	4.8	1.9	1.0	1.9	100	92.7	80.4
624	0.1	0.0	0.0	1.4	1.4	1.2	0.7	100		
269	1.0	0.0	1.0	3.9	3.9	2.0	0.9	96	43	43
252	0.5	0.0	0.5	1.0	1.0	0.7	4.5	100	28	28
619	0.6	1.2	1.1	3.9	2.7	2.4	0.5	100	6	6
311	1.0	0.0	1.0	3.3	3.3	1.2	1.2	100	25	25
303										
66	1.0	4.0	1.0	6.0	2.0	2.0	1.0	100	4	4
67	0.0	4.0	0.0	4.0	0.0	4.0	0.0	96	53	53
289										
296										
290										
271										
256	0.5	0.5	1.5	2.8	2.3	2.1	0.8	200	6	6
261	0.4	1.7	1.4	4.3	2.5	1.2	0.8	200	6	6
286	0.9	0.8	1.3	3.0	2.2	1.3	2.5	100		
274										
614	0.0	0.0	0.7	2.4	2.4	2.5	0.7	100	42	42
278										
623	1.1	0.0	0.3	3.0	3.0	3.3	3.2	100	14	
281										
282										
75	1.0	0.0	1.0	3.0	3.0	2.0	1.0	39	20	20
304										
65	0.0	4.0	1.0	5.0	1.0	4.0	1.0	100	8.8	7
72	0.0	0.1	2.2	2.3	2.2	2.2	0.0	100		
257	0.9	0.3	0.0	1.2	0.9	0.8	1.1	100	3	
258	0.8	0.4	0.8	2.4	2.0	1.5	2.9	100	5	
262	0.6	0.3	2.0	3.4	3.1	2.5	1.9	100	6	
61	0.3	0.0	0.4	2.1	2.1	1.4	1.5	74.8	22	22

Appendix 1. Continued.

Stream Loc ID Number	Undercut Bank Trout Cover Rating	Aquatic Plants Trout Cover Rating	Over-Hanging Veg Trout Cover Rating	Sum Of Trout Cover Ratings	Sum Of Trout Cover Ratings W/O Aquatic Plants	Percent Shading Rating	Percent Unstable Banks Rating	Reach Length (M)	Total Trout (>100 mm) Abundance	Lower 95% CI (>100 mm)
73										
277										
265	1.0	0.8	1.0	3.1	2.4	1.9	0.5	97		
625	1.8	0.0	1.4	4.3	4.3	4.6	0.3	96	1	
266	0.0	1.0	0.0	2.0	1.0	1.0	4.0	100		
447	0.2	0.0	0.1	0.3	0.3	1.0	1.8	100	1	1
448	0.0	0.0	0.5	0.5	0.5	2.0	2.3	89.5	9	9
352	0.2	0.9	2.0	3.7	2.8	2.1	3.2	186	14	14
460	0.2	0.0	0.0	0.3	0.3	1.9	0.0	100		
461	0.0	0.0	0.0	1.0	1.0	2.0	0.0	100		
462										
379	1.0	3.0	2.0	6.0	3.0	2.6	0.0	67.5		
437	1.1	1.2	2.1	4.9	3.7	3.8	0.1	88.5	4.6	4
438	1.0	4.0	3.0	9.0	5.0	3.0	0.0	100	NA	NA
452										
473	1.0	5.0	2.0	8.0	3.0	2.0	0.0	70		
474	0.0	4.0	1.0	6.0	2.0	1.0	0.0	100		
80	0.9	0.0	0.4	1.3	1.3	1.0	2.0	79	5	5
81	0.5	2.8	0.2	3.8	1.0	1.6	3.8	137	20	20
481	0.7	0.5	1.4	3.7	3.3	2.3	0.5	100	52	52
430										
467	0.6	1.9	0.8	3.5	1.6	1.4	0.0	102		
466										
350										
354										
475										
456										
468										
455								100		
449										
450										
451										
463										
351	1.1	1.8	2.6	6.0	4.2	2.7	0.5	74	5.8	5
442	0.0	0.7	0.0	1.6	0.9	0.3	0.5	100	15	15
443	0.6	1.8	1.5	4.3	2.6	3.3	0.0	60	1.2	1
458	0.2	2.0	0.0	2.2	0.2	0.9	0.2	100		
459	0.0	0.0	0.0	0.0	0.0	1.0	2.0	100		
439	1.6	0.0	1.3	3.3	3.3	1.2	0.4	96	6	6
440	0.8	0.0	0.4	1.2	1.2	1.4	0.0	48.3	3	3
431										
432										
469										
434	0.0	0.1	0.9	1.7	1.6	1.5	0.2	100	3	3
435	0.4	0.4	1.0	2.8	2.4	2.8	0.0	100		
433										
348	0.5	1.6	1.2	5.0	3.5	1.6	2.4	237.6	19	19
441	0.4	2.0	1.2	4.4	2.4	2.0	0.6	95	4	4
446	0.6	0.1	1.3	2.4	2.3	1.6	3.1	100	64	64
457	0.5	0.0	1.8	3.3	3.3	2.5	0.8	85	9.2	8
465										
436	0.5	0.0	0.1	2.1	2.1	1.5	3.4	100	17	17
444	0.2	0.0	0.9	2.4	2.4	1.3	1.5	102	53	48.7
445	0.3	0.1	0.4	1.2	1.1	0.3	0.8	111	12.7	11
453	1.0	3.0	1.5	6.5	3.5	1.5	1.0	100		
454	1.0	2.5	1.2	5.7	3.2	1.0	2.7	93		
349										
353	0.7	1.8	2.8	5.4	3.6	2.5	0.5	172	6	6
470	0.0	1.0	2.0	5.0	4.0	3.0	0.0	100		
464										
471										
472										
124	0.6	1.1	0.7	2.9	1.8	1.4	1.8	837		
125								570	143	117

Appendix 1. Continued.

Stream Loc ID Number	Upper 95% CI (>100 mm)	Total Trout (<100 mm) Abundance	Lower 95% CI (<100 mm)	Upper 95% CI (<100 mm)	Trout/M^2 (>100 mm)	YCT/M^2 (>100 mm)	Trout/M^2 (<100 mm)	YCT/M^2 (<100 mm)	YCT >100 mm
395									
518									
478	5	1	1	1	0.036	0.036	0.007	0.001	5
500	4	8	8	8	0.017	0.017	0.034	0.068	4
501	17.1	17.7	14	97.2	0.019	0.019	0.056	0.156	5
399									
411									
494	23.9	349	312	387	0.143	0.131	2.174	8.694	21
495	56.7	69.4	55	148.8	0.134	0.107	0.205	0.353	32
482	11	0			0.032	0.000	0.000	0.000	
43	42	1			0.064	0.058	0.002	0.000	36
45	48.8	3.8	3	83.4	0.054	0.054	0.005	0.000	33
44									
28									
36									
476									
524	1	0			0.004	0.004	0.000	0.000	1
396									
412									
33									
516									
517									
34									
398									
31									
51	103	85	83	89	0.125	0.112	0.105	0.096	91
52	20	10	10	11	0.021	0.021	0.011	0.005	18
53	102	104	103	107	0.165	0.150	0.171	0.194	91
54		0			0.036	0.036	0.000	0.000	10
55	51	159	140	179	0.238	0.184	1.023	2.216	24
56	87	382	358	407	0.174	0.108	0.865	2.652	44
57	120	462	414	511	0.209	0.189	0.824	0.337	105
58	43	93	87	102	0.151	0.137	0.326	0.477	39
413									
394									
408									
490									
37	NA	NA	NA	NA	NA	0.000	NA	0.000	
38		80	70	87	0.014	0.014	0.576	21.871	2
479	36.3	0			0.093	0.093	0.000	0.000	22
515									
27		1.3	1	80.9	0.000	0.000	0.009	0.009	
496									
497		19	19	19.5	0.000	0.000	0.154	0.000	
46	13	43	41	48	0.046	0.027	0.165	0.968	7
48	12	25	25	26	0.063	0.063	0.143	0.324	11
397									
491									
39	75	85	84	89	0.345	0.293	0.396	0.528	63
40	63.5	31.6	25	111.1	0.262	0.262	0.159	0.086	46
487	10.8	0			0.054	0.048	0.000	0.000	8
512	34.2	68	68	72.4	0.170	0.170	0.350	0.720	33
513	12.6	167.9	133	247.3	0.011	0.011	1.625	55.237	1
35									
41	90	1095	1083	1108	0.297	0.280	3.611	5.395	85
42	49	158	130	187	0.153	0.073	0.548	3.510	20
480	9.9	7	7	9.3	0.032	0.032	0.025	0.019	9
514	14	122	118	129	0.054	0.054	0.468	1.203	14
32									
47	13	NA	NA	NA	0.026	0.026	NA	#VALUE!	11
522	20.5	6	6	7.7	0.121	0.109	0.036	0.012	18
521	53	46	45	49.1	0.197	0.197	0.174	0.151	52
488									
519									
520		1.3	1	80.9	0.000	0.000	0.012	0.000	

Appendix 1. Continued.

Stream Loc ID Number	Upper 95% CI (>100 mm)	Total Trout (<100 mm) Abundance	Lower 95% CI (<100 mm)	Upper 95% CI (<100 mm)	Trout/M^2 (>100 mm)	YCT/M^2 (>100 mm)	Trout/M^2 (<100 mm)	YCT/M^2 (<100 mm)	YCT >100 mm
400									
477									
409									
523	16.6	1	1	1	0.096	0.042	0.006	0.000	7
49	29	87	74	106	0.067	0.061	0.243	0.265	21
50	10	112	98	130	0.033	0.018	0.411	4.032	5
493	11	7	7	7	0.046	0.046	0.029	0.019	11
489	8.6	5	5	5.5	0.029	0.000	0.024	0.000	
410									
29	101.1	78.3	62	157.7	0.418	0.418	0.366	0.287	79
30	37	228	222	235	0.154	0.154	1.004	3.152	36
768									
364	34.3	30	30	32.2	0.182	0.182	0.160	0.141	34
365	25	30	30	33	0.138	0.138	0.180	0.235	23
370	16.6	1.5	1	39.9	0.012	0.004	0.005	0.000	1
371	50.6	20	20	21.7	0.205	0.205	0.082	0.033	50
371	77	61	61	63	0.326	0.326	0.265	0.209	76
769									
364	56.9	89.9	59	128	0.231	0.231	0.470	0.771	36
365	48	72	71	75	0.261	0.261	0.408	0.617	47
360									
232	32	235	221	249	0.208	0.000	1.631	0.000	
323	17				0.071	0.000		0.000	
253	196.2	55	11	579.4	1.067	0.000	0.410	0.000	
255	75.5	16	13	27.8	0.507	0.000	0.108	0.000	
260		4.6	3	42.9	0.000	0.000	0.037	0.000	
767									
608									
618									
338									
609									
611									
332		1.5	1	39.9	0.000	0.000	0.011	0.000	
333									
358									
359									
607									
344		16	16	18	0.010	0.010	0.152	2.438	1
345		134	133	138	0.067	0.067	0.894	4.993	12
344	12	20	20	21	0.065	0.065	0.130	0.260	10
345	28.8	47.2	31	85.1	0.101	0.101	0.300	0.716	13
283									
307									
284									
285									
331									
329									
330									
231	17.8	0			0.009	0.007	0.000	0.000	3
337									
590	14.2	0			0.002	0.002	0.000	0.000	1
594									
771									
772									
773									
775									
774									
339									
610									
355									
356									
357									
342									
770									
341									

Appendix 1. Continued.

Stream Loc ID Number	Upper 95% CI (>100 mm)	Total Trout (<100 mm) Abundance	Lower 95% CI (<100 mm)	Upper 95% CI (<100 mm)	Trout/M^2 (>100 mm)	YCT/M^2 (>100 mm)	Trout/M^2 (<100 mm)	YCT/M^2 (<100 mm)	YCT >100 mm
343									
620									
334									
335									
377									
378									
254	15.6	1			0.089	0.000	0.006	0.000	
315									
316									
362									
361		47	47	49	0.013	0.013	0.314	7.384	2
361	11	51	50	54	0.054	0.054	0.274	1.372	10
363	30	6.1	4	44.4	0.254	0.254	0.090	0.026	14
314									
317									
245									
340									
372									
373									
336	14.2	0			0.015	0.000	0.000	0.000	
346					0.106	0.000		0.000	
347	27.5	0			0.156	0.000	0.000	0.000	
777									
376	38.5	89.9	59	128	0.241	0.000	0.844	0.000	
328	129	19	15	33.5	0.321	0.000	0.052	0.000	
374	26.5	0			0.072	0.000	0.000	0.000	
375	45.2	8	8	9.2	0.116	0.000	0.022	0.000	
621									
776									
59	10	23	23	24	0.025	0.022	0.063	0.182	8
319	41	5			0.168	0.000	0.021	0.000	
320									
300									
766									
250	18.6	2			0.119	0.119	0.018	0.003	12
251	28.3	3			0.125	0.125	0.014	0.002	27
263	31.4				0.135	0.135	0.000	0.000	31
279									
248									
249									
291									
62	40	24	23	29	0.309	0.262	0.190	0.090	33
305	17	27	25	33	0.094	0.076	0.158	0.014	13
312	12	3			0.020	0.006	0.006	0.000	3
616	13.4	6	6	6	0.094	0.065	0.043	0.003	9
617	22.2	0			0.045	0.002	0.000	0.000	1
298									
275									
613	27	32	29	39.8	0.135	0.135	0.187	0.247	22
802	124.7	19	15	33.5					
803	125.3	71	54	99.4					
324	21	92	91	95	0.109	0.027	0.502	1.351	5
324	47.6	52.2	38	90.9	0.166	0.063	0.239	0.095	11
326	25	41	40	45	0.122	0.041	0.208	0.069	8
326	41	107	60	198	0.153	0.058	0.411	0.078	15
60	7	146	146	147	0.042	0.000	1.214	0.000	
280									
247	64	NA	NA	NA	0.325	0.000	NA	0.000	
287	55	16	14	24	0.207	0.000	0.068	0.000	
297	43	17	10	53	0.439	0.000	0.178	0.000	
63	43	NA	NA	NA	0.208	0.087	NA	#VALUE!	15
299	47	72	56	96	0.167	0.089	0.267	0.062	24
310					0.031	0.000	0.000	0.000	
313	40	0			0.089	0.019	0.000	0.000	5
318					0.046	0.004		0.000	1

Appendix 1. Continued.

Stream Loc ID Number	Upper 95% CI (>100 mm)	Total Trout (<100 mm) Abundance	Lower 95% CI (<100 mm)	Upper 95% CI (<100 mm)	Trout/M^2 (>100 mm)	YCT/M^2 (>100 mm)	Trout/M^2 (<100 mm)	YCT/M^2 (<100 mm)	YCT >100 mm
327									
302		10	10	12	0.075	0.075	0.151	0.301	5
294									
74	20	53	45	68	0.180	0.180	0.502	1.189	19
70	47.6	326.8	238	387.4	0.242	0.000	2.179	0.000	
71									
276									
309		31	31	33	0.000	0.000	0.264	0.028	
309	7	33	29	44	0.046	0.018	0.303	1.040	2
308									
288									
612	70.8	18	18	20.4	0.353	0.082	0.092	0.020	16
615	31.7	58	52	68.8	0.111	0.111	0.216	0.374	30
622	60.5	16	14	24.3	0.233	0.021	0.066	0.017	5
295									
301									
292									
293									
264	25	0			0.134	0.134	0.000	0.000	11
321									
322	28.8	15.1	11	53.9	0.031	0.013	0.027	0.000	6
270									
267	59.1	16	11	38.4	0.285	0.025	0.079	0.011	5
268	84.7	19	18	23.7	0.396	0.071	0.094	0.031	14
259	24.4	0			0.098	0.000	0.000	0.000	
306									
246									
272									
76									
273									
68	12.6	0			0.004	0.000	0.000	0.000	
69	105.1	585	488.8	681.3	0.444	0.000	2.800	0.000	
624									
269	44.7	34	34	36	0.281	0.189	0.222	0.260	29
252	28.8	16	16	17.2	0.215	0.215	0.123	0.070	28
619	6	52	52	53.6	0.059	0.059	0.508	4.404	6
311	27	3			0.227	0.227	0.027	0.003	25
303									
66	9	19	19	21	0.034	0.000	0.164	0.000	
67	55	46	43	53	0.138	0.000	0.120	0.000	
289									
296									
290									
271									
256	7.2	0			0.008	0.000	0.000	0.000	
261	7.2	0			0.008	0.000	0.000	0.000	
286									
274									
614	44.1	35	27	54.8	0.195	0.000	0.162	0.000	
278									
623		40	29	66.4	0.117	0.117	0.333	0.690	14
281									
282									
75	22	31	31	33	0.466	0.000	0.723	0.000	
304									
65	20	0			0.070	0.000	0.000	0.000	
72									
257		0			0.015	0.000	0.000	0.000	
258		0			0.022	0.022	0.000	0.000	5
262		1			0.027	0.027	0.005	0.001	6
61	25	NA	NA	NA	0.130	0.101	NA	#VALUE!	17
73									
277									
265									
625		3			0.012	0.012	0.036	0.108	1

Appendix 1. Continued.

Stream Loc ID Number	Upper 95% CI (>100 mm)	Total Trout (<100 mm) Abundance	Lower 95% CI (<100 mm)	Upper 95% CI (<100 mm)	Trout/M^2 (>100 mm)	YCT/M^2 (>100 mm)	Trout/M^2 (<100 mm)	YCT/M^2 (<100 mm)	YCT >100 mm
266									
447	1	0			0.010	0.010	0.000	0.000	1
448	9	4	4	5.9	0.105	0.105	0.047	0.021	9
352	15				0.039	0.039		#VALUE!	14
460									
461									
462									
379									
437	8.7	0			0.084	0.084	0.000	0.000	4
438	NA	NA	NA	NA	NA		NA		
452									
473									
474									
80	6	5	5	6	0.054	0.054	0.054	0.054	5
81	22	25	25	27	0.072	0.072	0.090	0.113	20
481	53.2	176	168	186	0.304	0.000	1.027	0.000	
430									
467									
466									
350									
354									
475									
456									
468									
455									
449									
450									
451									
463									
351	9.9	3.9	3	7.7	0.041	0.025	0.028	0.000	3
442	15	3	3	3	0.119	0.071	0.024	0.000	9
443	5.3	1.3	1	5.1	0.006	0.000	0.007	0.000	
458									
459									
439	6	0			0.082	0.082	0.000	0.000	6
440	3	0			0.051	0.051	0.000	0.000	3
431									
432									
469									
434	3	0			0.032	0.032	0.000	0.000	3
435									
433									
348	20				0.018	0.018		#VALUE!	19
441	4	0			0.015	0.015	0.000	0.000	4
446	65.1	39	39	40.9	0.227	0.227	0.139	0.084	64
457	13.3	6.4	5	10.2	0.032	0.032	0.022	0.014	8
465									
436	18.1	57	55	61.7	0.137	0.137	0.460	1.487	17
444	57.4	78.5	74.7	82.2	0.200	0.200	0.296	0.392	46
445	16.8	27	23.3	30.7	0.052	0.052	0.111	0.185	12
453									
454									
349									
353	9				0.022	0.022		#VALUE!	6
470									
464									
471									
472									
124									29
125	171	4	4	6					107

Appendix 1. Continued.

Stream Loc ID Number	YCT <100 mm	YCT Total Captured	RBT >100 mm	RBT <100 mm	RBT Total Captured	Hybrid >100 mm	Hybrid <100 mm	Hybrid Total Captured	BKT >100 mm	BKT <100 mm
395										
518										
478	1	6								
500	8	12								
501	14	19								
399										
411										
494	84	105							2	
495	55	87							8	
482									11	
43	1	37	3		3	1		1		
45	3	36								
44										
28										
36										
476										
524		1								
396										
412										
33										
516										
517										
34										
398										
31										
51	83	174	2		2	8		8		
52	9	27								1
53	103	194	1		1	8		8		
54		10								
55	52	76				7		7		
56	144	188				27	3	30		
57	43	148	3		3	8		8		
58	57	96	2		2	2		2		
413										
394										
408										
490										
37									5	
38	76	78								
479		22								
515										
27	1	1								
496										
497										18
46	41	48							5	
48	25	36								
397										
491										
39	84	147				11		11		
40	25	71								
487		8							1	
512	68	101								
513	34	35								
35										
41	127	212				5		5		
42	128	148	2		2	20		20		
480	7	16								
514	36	50								
32										
47	Na	11								
522	6	24							2	
521	45	97								
488										
519										
520										1

Appendix 1. Continued.

Stream Loc ID Number	YCT <100 mm	YCT Total Captured	RBT >100 mm	RBT <100 mm	RBT Total Captured	Hybrid >100 mm	Hybrid <100 mm	Hybrid Total Captured	BKT >100 mm	BKT <100 mm
400										
477										
409										
523		7				9	1	10		
49	24	45	1		1				1	1
50	49	54				4		4		
493	7	18								
489									6	5
410										
29	62	141								
30	113	149								
768										
364	30	64								
365	30	53								
370		1				2	1	3		
371	20	70								
371	60	136								
769										
364	59	95								
365	71	118								
360										
232									30	218
323			15		15					
253									98	11
255									75	13
260										3
767										
608										
618										
338										
609										
611										
332										1
333										
358										
359										
607										
344	16	17								
345	67	79								
344	20	30								
345	31	44								
283										
307										
284										
285										
331										
329										
330										
231		3	1		1					
337										
590		1								
594										
771										
772										
773										
775										
774										
339										
610										
355										
356										
357										
342										
770										
341										

Appendix 1. Continued.

Stream Loc ID Number	YCT <100 mm	YCT Total Captured	RBT >100 mm	RBT <100 mm	RBT Total Captured	Hybrid >100 mm	Hybrid <100 mm	Hybrid Total Captured	BKT >100 mm	BKT <100 mm
343										
620										
334										
335										
377										
378										
254									15	1
315										
316										
362										
361	47	49								
361	50	60								
363	4	18								
314										
317										
245										
340										
372										
373										
336			1		1					
346			7		7				5	
347			4		4				8	
777										
376			4		4				17	59
328			61	15	76					
374			12		12					
375			42	7	49					
621										
776										
59	23	31				1		1		
319			40	5	45					
320										
300										
766										
250	2	14								
251	3	30								
263		31								
279										
248										
249										
291										
62	18	51							6	5
305	3	16							3	22
312		3	5		5	3		3		3
616	1	10							4	5
617		1	16		16				4	
298										
275										
613	29	51								
802			46	3	49	3		3	15	9
803			37	5	42	7	3	10	69	46
324	70	75							15	21
324	14	25							18	24
326	12	20							16	28
326	12	27	1		1				24	48
60			2		2				3	146
280										
247									62	10
287									46	14
297									42	10
63	Na	15	3		3	1	65	66	17	10
299	15	39							21	41
310									4	
313		5							18	
318		1							11	

Appendix 1. Continued.

Stream Loc ID Number	YCT <100 mm	YCT Total Captured	RBT >100 mm	RBT <100 mm	RBT Total Captured	Hybrid >100 mm	Hybrid <100 mm	Hybrid Total Captured	BKT >100 mm	BKT <100 mm
327										
302	10	15								
294										
74	45	64								
70			29	238	267					
71										
276										
309	3	3								28
309	24	26							3	5
308										
288										
612	6	22	17	1	18	36	11	47		
615	52	82								
622	4	9	4		4	47	10	57		
295										
301										
292										
293										
264		11								
321										
322		6							8	11
270										
267	2	7							53	9
268	8	22							64	10
259										
306										
246										
272										
76										
273										
68			1		1					
69			68	423	491	5	3	8		
624										
269	34	63							14	
252	16	44								
619	52	58								
311	3	28								
303										
66			4	19	23					
67			53	43	96					
289										
296										
290										
271										
256										
261										
286										
274										
614			41	27	68	1		1		
278										
623	29	43								
281										
282										
75						20	31	51		
304										
65			7		7					
72										
257										
258		5								
262	1	7								
61	Na	17							5	4
73										
277										
265										
625	3	4								

Appendix 1. Continued.

Stream Loc ID Number	YCT <100 mm	YCT Total Captured	RBT >100 mm	RBT <100 mm	RBT Total Captured	Hybrid >100 mm	Hybrid <100 mm	Hybrid Total Captured	BKT >100 mm	BKT <100 mm
266										
447		1								
448	4	13								
352		14								
460										
461										
462										
379										
437		4								
438										
452										
473										
474										
80	5	10								
81	25	45								
481									46	48
430										
467										
466										
350										
354										
475										
456										
468										
455										
449										
450										
451										
463										
351		3							2	3
442		9							6	3
443									1	1
458										
459										
439		6								
440		3								
431										
432										
469										
434		3								
435										
433										
348		19								
441		4								
446	39	103								
457	5	13								
465										
436	55	72								
444	61	107								
445	20	32								
453										
454										
349										
353		6								
470										
464										
471										
472										
124		29	2		2					
125		107								

Appendix 1. Continued.

Stream Loc ID Number	BKT Total Captured	BNT >100 mm	BNT <100 mm	BNT Total Captured	Mottled Sculpin Captured	Longnose Dace Captured	Leatherside Chub Captured	Bluehead Sucker Captured	Mountain Sucker Captured	Piute Sculpin Captured
395										
518					2					
478										
500										
501										
399										
411										
494	2									
495	8									
482	11								8	
43									14	
45									30	
44										
28										
36										
476						14				
524					27	26				
396										
412										
33					25					
516										
517										
34										
398										
31										
51										
52	1				30					1
53										
54										
55										
56					29					
57										
58					14					
413										
394										
408										
490									6	
37	5									
38										
479									4	
515									20	
27										
496										
497	18		1	1						
46	5									
48					23					
397										
491						12				
39										
40										
487	1								1	
512										
513										
35					13					
41									1	
42									4	
480										
514										
32										
47					25					
522	2				25					
521					25					
488									3	
519										
520	1				12		3			

Appendix 1. Continued.

Stream Loc ID Number	BKT Total Captured	BNT >100 mm	BNT <100 mm	BNT Total Captured	Mottled Sculpin Captured	Longnose Dace Captured	Leatherside Chub Captured	Bluehead Sucker Captured	Mountain Sucker Captured	Piute Sculpin Captured
400										
477										
409										
523					4					
49	2									
50										
493										
489	11									
410										
29										
30										
768										
364										
365										
370					25					
371										
371										
769										
364										
365										
360										
232	248									
323					11					
253	109									
255	88									
260	3							1		
767										
608										
618										
338										
609										
611										
332	1									
333										
358										
359										
607										
344										
345										
344										
345										
283										
307										
284										
285										
331										
329										
330										
231					29	13	31		1	
337					20	15	8	8		
590					1	10	3			
594					31	19	2		4	
771										
772										
773										
775										
774										
339										
610										
355										
356										
357										
342										
770										
341										

Appendix 1. Continued.

Stream Loc ID Number	BKT Total Captured	BNT >100 mm	BNT <100 mm	BNT Total Captured	Mottled Sculpin Captured	Longnose Dace Captured	Leatherside Chub Captured	Bluehead Sucker Captured	Mountain Sucker Captured	Piute Sculpin Captured
343										
620										
334										
335										
377										
378										
254	16									
315										
316										
362										
361										
361										
363										
314										
317										
245										
340										
372										
373										
336										
346	5									
347	8									
777										
376	76									
328					25	7		12		
374						47		32		
375					13	34		27		
621					4	3				
776										
59										
319										
320										
300										
766										
250										
251										
263										
279										
248										
249										
291										
62	11				45					
305	25				20					
312	3				23	22				
616	9				25					
617	4				25	18				
298										
275										
613										
802	24	36	3	39						
803	115									
324	36									
324	42									
326	44				23					
326	72				26					
60	149									
280										
247	72									
287	60									
297	52									
63	27				19					
299	62				12					
310	4									
313	18									
318	11									

Appendix 1. Continued.

Stream Loc ID Number	BKT Total Captured	BNT >100 mm	BNT <100 mm	BNT Total Captured	Mottled Sculpin Captured	Longnose Dace Captured	Leatherside Chub Captured	Bluehead Sucker Captured	Mountain Sucker Captured	Piute Sculpin Captured
327										
302										
294										
74										
70										
71										
276										
309	28				54					
309	8				13					
308										
288										
612										
615										
622										
295										
301										
292										
293										
264										
321										
322	19									
270										
267	62									
268	74									
259		24		24						
306										
246										
272										
76										
273										
68					9					
69		1		1	30					
624										
269	14									
252										
619										
311										
303										
66					10					
67					29					
289										
296										
290										
271										
256		6		6						
261		3		3						
286					25	25			19	
274										
614										
278										
623										
281										
282										
75										
304										
65					30					
72										
257		3		3						
258										
262										
61	9									
73										
277										
265										
625										

Appendix 1. Continued.

Stream Loc ID Number	BKT Total Captured	BNT >100 mm	BNT <100 mm	BNT Total Captured	Mottled Sculpin Captured	Longnose Dace Captured	Leatherside Chub Captured	Bluehead Sucker Captured	Mountain Sucker Captured	Piute Sculpin Captured
266										
447					26					
448										
352					6					
460										
461										
462										
379					7				18	
437										
438										
452										
473										
474										
80					30					
81										
481	94									
430										
467										
466										
350										
354										
475										
456										
468										
455										
449										
450										
451										
463										
351	5				15					
442	9									
443	2				1					
458										
459										
439					8					
440										1
431										
432										
469										
434										
435					6					
433										
348										
441					29				25	
446					27				3	
457					6				3	
465										
436					1					
444										26
445										55
453					1				5	
454					12					
349										
353										
470										
464										
471										
472										
124		3		3	8	18			1	
125		10	4	14	15	14			3	

Appendix 1. Continued.

Stream Loc ID Number	Redside Shiner Captured	Speckled Dace Captured	Utah Chub Captured	Utah Sucker Captured
395				
518				
478		7		
500				
501				
399				
411				
494				
495				
482				
43		25		
45		8		
44		24		
28				
36			30	
476			16	
524	12	16		
396		23		
412				
33				14
516	30	17	3	
517		23	10	
34		25	22	
398	3	20		
31				
51		3		
52				
53				
54				
55				
56				
57				
58				
413				
394				
408				
490				
37		8		
38		14		
479				
515				
27				
496				
497				
46				
48				
397		4		
491				
39	20	21		
40				
487				
512				
513				
35				
41				
42				
480		9		
514				
32				
47				
522				
521				
488			25	11
519				
520				

Appendix 1. Continued.

Stream Loc ID Number	Redside Shiner Captured	Speckled Dace Captured	Utah Chub Captured	Utah Sucker Captured
400				
477				
409				
523				
49				
50				
493				
489				
410				
29				
30				
768				
364				
365				
370				
371				
371				
769				
364				
365				
360				
232				
323				
253				
255				
260				
767		12		
608				
618				
338				
609				
611				
332				
333				
358				
359				
607				
344				
345				
344				
345				
283				
307				
284				
285				
331				
329				
330				
231				1
337	33	7		11
590	20	20		
594	1			
771	20	27		
772				
773				
775				
774				
339				
610				
355				
356				
357				
342				
770				
341				

Appendix 1. Continued.

Stream Loc ID Number	Redside Shiner Captured	Speckled Dace Captured	Utah Chub Captured	Utah Sucker Captured
343				
620				
334		20		
335				
377				
378				
254				
315				
316				
362				
361				
361				
363				
314				
317				
245				
340				
372				
373				
336				
346				
347				
777				
376				
328				
374			21	
375		1	26	
621				
776	12	17		
59				
319		53		
320				
300				
766				
250				
251		1		
263		5		
279				
248				
249				
291				
62				
305				
312				
616	16			
617			1	13
298	6			
275				
613				
802				
803				
324				
324				
326				
326				
60				
280				
247				
287				
297				
63				
299				
310				
313				
318				

Appendix 1. Continued.

Stream Loc ID Number	Redside Shiner Captured	Speckled Dace Captured	Utah Chub Captured	Utah Sucker Captured
327				
302				
294				
74				
70				
71				
276				
309				
309				
308				
288				
612				
615				
622				
295				
301				
292				
293				
264				
321				
322				
270				
267				
268				
259				
306				
246				
272				
76				
273				
68				
69				
624				
269				
252				
619				
311				
303				
66				
67				
289				
296				
290				
271				
256				
261				
286				5
274	14	7		
614				
278				
623				
281				
282				
75				
304				
65				
72				
257				
258				
262				
61				
73				
277				
265				
625				

Appendix 1. Continued.

Stream Loc ID Number	Redside Shiner Captured	Speckled Dace Captured	Utah Chub Captured	Utah Sucker Captured
266				
447				
448				
352				
460				
461				
462				
379				
437	23	25		
438				
452	15	24		
473				
474	1			
80	2			
81	1	1		
481	24	10		
430				
467				
466	2	8		
350				
354				
475				
456				
468				
455				
449				
450				
451				
463				
351				15
442	20	19		
443				
458				
459				
439				
440				
431				
432				
469				
434				
435				
433		1		
348				
441			9	
446	23			
457				
465				
436				
444				
445				
453				
454				
349				
353				34
470				
464				
471				
472				
124				4
125	31	31		13
	13	14		

PART #II: A COMPARISON OF THE COST OF USING SCALES VERSUS OTOLITHS TO AGE TROUT

ABSTRACT

The cost (in terms of time expenditure) of aging brook trout *Salvelinus fontinalis* and Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* with scales and otoliths was compared to assess whether otolith aging was less cost effective than scales. For age-1 and older cutthroat trout and brook trout, total time spent estimating age with scales was 120% and 13% longer than for whole otoliths, respectively. For age-0 brook trout, there was no difference between the time it took to age fish using scales or whole otoliths. Otoliths gave older age readings more often than scales, and thus were presumably more accurate. Our results suggest that, in addition to the growing body of literature demonstrating that otoliths typically provide more accurate accounts of fish age, it takes less time to age fish using whole otoliths compared to scales.

Author:

Kevin A. Meyer
Fisheries Research Biologist

INTRODUCTION

Age and growth information is extremely important for the management of fish populations. Scales and otoliths are two of the most frequently examined calcified structures for aging salmonids. Scales are often preferred because of their relative ease of collection and preparation, but the use of scales for aging often results in an underestimation of age because scales frequently lack first-year annuli (Lentsch and Griffith 1987), annuli become crowded and indistinguishable as fish become older and growth slows (Johnson 1976), and because scales may actually be resorbed (Chilton and Bilton 1986) or regenerated after damage or removal. The use of otoliths typically provides a more precise and accurate estimate of age and growth (Chilton and Beamish 1982; Casselman 1987). One disadvantage of using otoliths is that fish must be sacrificed, although at the population level such sacrifice probably does not affect the population appreciably.

Nevertheless, scales continue to be frequently used for aging freshwater fish, not only because of the nonlethality of obtaining scales (Devries and Frie 1986), but also because otolith removal is more complicated and difficult (Casselman 1983) than for scales, and because of the perceived added cost (in terms of time expenditure) of obtaining, preparing, and reading otoliths. However, in our experience, whole otoliths are easier to obtain and read than scales. Our objective in this study was to compare the cost (in terms of time expenditure) of aging fish with scales and whole otoliths.

METHODS

Scale and otolith aging comparisons were made for brook trout *Salvelinus fontinalis* and Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri*. For both species, fish were retained in the field and transported to a laboratory freezer before being thawed to obtain length (mm), weight (g), scales and otoliths, and other population dynamics data not presented in this report. We collected paired scale and otolith samples from 44 age-1+ cutthroat trout (i.e., age-1 and older), 52 age-1+ brook trout, and 19 age-0 brook trout.

Time required for age estimation included collection, preparation, and reading. Scale collection included picking up the fish, scraping scales from the fish from the area immediately dorsal to the lateral line and posterior to the dorsal fin, wiping the scales onto a paper strip, folding and placing the strip into an envelope, and labeling the envelope. Scale preparation included removing the paper strip from the envelope, scraping the scales onto an acetate slide, pressing the slide between metal plates with a heat press at 10,000 PSI and 110°C for about 30 s, scraping the slide clean of scales, and returning it and the paper strip to the labeled envelope. Scale reading was the time required to remove the slide from the envelope, insert it into a microfiche reader, locate a readable scale on the slide, estimate age, record the age on a datasheet, and return the slide to the envelope.

For otoliths, collection consisted of picking up the fish, removing both otoliths by cutting longitudinally through the top of the skull and across the head, removing the membranous sac surrounding the otolith, placing the otoliths into a dry vial, and labeling the vial. There was no preparation time for otoliths. Reading time was the number of seconds required to remove the otoliths from the vial, place them into a dry petri dish or one filled with saline solution (depending on readability), estimate age under a dissecting microscope, record the results, and return the otoliths to the vial. Age was assessed using reflected and/or transmitted light.

Time was recorded with a stopwatch, which was stopped at the end of each individual step. Because age-0 fish can usually be distinguished by length-frequency analysis, scale or otolith readings are often unnecessary for young-of-year trout. Consequently, we compared age-0 fish separately from age-1+ in our analysis. Cost for each method was defined as the total time required to collect, prepare, and read the aging structure. Differences between scales and otoliths were assessed using a *t*-test. Differences between methods in the costs of materials needed to prepare samples and determine age (i.e., acetate slides, vials, saline solution, etc.) were considered negligible.

Because comparing the precision and accuracy of age determination between methods was not an objective of this study, we did not have multiple readers read each structure for comparison. However, we do report the results of the reader that was timed. The reader had no knowledge of fish length during readings.

RESULTS AND DISCUSSION

For age-1 and older fish, it was more costly (in terms of time expenditure) to collect, prepare, and read scales than otoliths (Table 9). For age-1+ cutthroat trout and brook trout, total time spent estimating age with scales was 120% and 13% longer than time spent estimating age with otoliths, respectively. For age-0 brook trout, there was no difference between the amount of time it took to age scales (256 s) and otoliths (254 s). Collection time was longer for otoliths than for scales, and reading times were similar, but preparation time for scales averaged 110 s, whereas there was no preparation time for whole otoliths.

Age agreement between structures was 43% for age-1+ cutthroat trout, 67% for age-1+ brook trout, and 100% for age-0 brook trout. For age-1+ cutthroat trout, older ages were estimated by scales 14% of the time and by otoliths 43% of the time. For age-1+ brook trout, older ages were estimated by scales 12% of the time and by otoliths 21% of the time.

These results suggest that, in addition to the growing body of evidence suggesting that otoliths provide more accurate estimates of age than scales (Casselman 1983; Beamish and McFarlane 1987; Hining et al. 2000), they are a more cost effective aging structure as well. It should be noted that our results involve aging of whole otoliths, and that if grinding or sectioning is necessary for larger, more opaque otoliths from older fish (Beamish 1979; Beamish and Chilton 1982; Barber and McFarlane 1987; Hining et al. 2000), preparation time would increase and cost comparisons would be different. Nevertheless, in light of our results and the fact that the number of fish that must be sacrificed for otolith aging is probably miniscule at the population level under most conditions, we recommend that otoliths be used for fish aging unless the sensitivity of the species being sampled precludes such harvest.

LITERATURE CITED

Barber, W. E., and G. A. McFarlane. 1987. Evaluation of three techniques to age Arctic char from Alaskan and Canadian waters. Transactions of the American Fisheries Society 116:874-881.

Beamish, R. J. 1979. Differences in the age of Pacific hake *Mercuccius productus* using whole otoliths and sections of otoliths. Journal of the Fisheries Research Board of Canada 36:141-151.

Beamish, R. J., and D. E. Chilton. 1982. Preliminary evaluation of a method to determine the age of sablefish *Anoplopoma fimbria*. Canadian Journal of Fisheries and Aquatic Sciences 39:277-287.

Beamish, R. J., and G. A. McFarlane. 1987. Current trends in age determination methodology. Pages 15-42 *in* R. C. Summerfult and G. E. Hall, editors. Age and growth of fish. Iowa State University Press, Ames, Iowa.

Casselman, J. M. 1983. Age and growth assessment of fish from their calcified structures—techniques and tools. Pages 1-17 *in* E. D. Prince and L. M. Pulos, editors. Proceedings of the international workshop on age determination of oceanic pelagic fishes: Tunas, billfishes, and sharks. NOAA Tech. Rep. NMFS 8.

Casselman, J. M. 1987. Determination of growth and age. Pages 209-242 *in* A. H. Weatherley and H. S. Gill, editors. The Biology of Fish Growth. Academic Press, London, England.

Chilton, D. E., and R. J. Beamish. 1982. Age determination methods for fishes studied by the groundfish program at the Pacific Biological Station. Canadian Special Publication of Fisheries and Aquatic Sciences 60. 102 p.

Chilton, D. E., and H. T. Bilton. 1986. New method for aging chinook salmon *Oncorhynchus tshawytscha* using dorsal fin rays and evidence of its validity. Canadian Journal of Fisheries and Aquatic Sciences 43:1588-1594.

Devries, D. R., and R. V. Frie. Determination of age and growth. Pages 483-512 in B. R. Murphy and D. W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Hining, K. J., J. L. West, M. A. Kulp, and A. D. Neubauer. 2000. Validation of scales and otoliths for estimating age of rainbow trout from southern Appalachian streams. North American Journal of Fisheries Management 20:978-985.

Johnson, L. 1976. Ecology of arctic populations of lake trout *Salvelinus namaycush*, lake whitefish *Coregonus clupeaformis*, and associated species in unexploited lakes of the Canadian Northwest Territories. Journal of the Fisheries Research Board of Canada 33:2459-2488.

Lentsch, L. D., and J. S. Griffith. 1987. Lack of first-year annuli on scales: frequency of occurrence and predictability in trout of the western United States. Pages 177-188 *in* R. C. Summerfelt and G. E. Hall, editors. Age and growth of fish. Iowa State University Press, Ames, Iowa.

Table 9. Comparison of the time (s) required to collect, prepare, and read scales and otoliths. Ninety-five percent confidence intervals are reported for total time.

Species	Age	*n*	Aging structure	Time (s) needed for: collection	preparation	reading	Total time (s)
Cutthroat	1+	44	Scale	25	183	155	362 ± 23
trout			Otolith	104	0	60	164 ± 12
Brook	1+	52	Scale	57	130	114	303 ± 14
trout			Otolith	153	0	116	269 ± 19
	0	19	Scale	65	118	72	256 ± 17
			Otolith	140	0	114	254 ± 18

Prepared by:

Kevin A. Meyer
Fisheries Research Biologist

James A. Lamansky, Jr.
Senior Fisheries Technician

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Virgil K. Moore, Chief
Bureau of Fisheries

Steve Yundt
Fishery Research Manager