FISHERIES HABITAT EVALUATION ON TRIBUTARIES OF THE COEUR D'ALENE INDIAN RESERVATION

1993,1994 ANNUAL REPORT

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Prepared for:

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Project Number. 90-044
Contract Number DE-BI79-90BP 10544

September, 1996

ABSTRACT

Bull trout and cutthroat trout are two salmonid species native to the Lake Coeur d'Alene drainage. Historically these species were a critical component of the Coeur d'Alene Tribe's annual subsistence requirements. Since 1932, the cutthroat trout population has declined significantly in the Coeur d'Alene system. The present ecosystem bears little resemblance to habitat composition, diversity and structure of the historic ecosystem.

The purpose of this study was to conduct baseline stream and biological surveys of four drainages located within the Coeur d'Alene Reservation and make recommendations on ways to increase the westslope cutthroat and bull trout populations on the Reservation.

Data indicated that habitat degradation, specifically, water quantity and lack of habitat complexity, was limiting westslope cutthroat and bull trout populations on the Reservation.

Population data indicated that cutthroat trout populations were low when compared to other similar drainages. Surveys revealed a conspicuous absence of bull trout.

Recommendations included: Conducting extensive habitat restoration in the study drainages; developing alternate harvest opportunities to reduce pressure on wild stocks; purchasing critical watershed areas for fisheries habitat protection; constructing and operating a trout production facility; and, implementing a five-year monitoring program to evaluate the program effectiveness.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the following individuals for their 'assistance in field data collection and laboratory analysis; Deanna Harper, George Aripa, Richard Allen, A.C. Sanchez, Ron Goddard, Jeff Jordan, Cody SiJohn, David SiJohn, Lyle Meshell, Sam Sanchez. Special thanks to Chris Hardy and David St.Amand, for their technical assistance in field work and in editing the final report. Carla Moore provided secretarial skills for formatting and proofing the final report. Funding was provided by the US. Department of Energy, Bonneville Power Administration, Contract Number 99-044-00. Special thank you goes to Tom Morse (BPA Project Manager), Ernie Stensgar (Chairman, Coeur d'Alene Tribal Council).

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1.0. Introduction

In 1987 the Northwest Power Planning Council amended the Columbia River Basin Fish and Wildlife Program, directing the Bonneville Power Administration (BPA) to fund "A *baseline stream survey of tributaries located on the Coeur d'Alene Indian Reservation to compile information on improving spawning habitat, rearing habitat, and access to spawning tributaries for bull trout (Salvelinus confluentus) cutthroat trout (Oncorhynchus* clarki), *and to evaluate the existing fish stocks. If justified by the results of the survey, fund the design, construction and operation of* a cutthroat *and bull trout hatchery on the Coeur d'Alene Indian Reservation; necessary habitat improvement projects; and a three year monitoring program to evaluate the effectiveness of the hatchery and habitat improvement projects. If the* baseline survey *indicates a better altemative than construction of a fish hatchery, the Coeur d'A/ene Tribe will submit an* alternative *p/an for consideration in program amendment proceeding.* In 1990, BPA contracted the Coeur d'Alene Tribe to perform this study. This report contains the results of fiscal year 1993 and 1994 data and the Coeur d'Alene Indian Tribes' final recommendations for enhancing the cutthroat and bull trout fishery on the Coeur d'Alene Indian Reservation.

1.1. Fisheries Management History of the Coeur d'Alene System.

See Graves et *a/.* (1990) for a discussion of the past history of the study area.

1.2. Summary of 1990,1991, and 1992 Findings

1.2.1. 1990

Twenty-one creeks, flowing into Lake Coeur d'Alene, and the St. Joe and St. Maries rivers, were initially identified within the study area as having habitat potentially suitable for trout species. Data obtained from an aerial survey further determined that only ten of the original twenty one creeks located within the Coeur d'Alene Indian Reservation contained potential trout habitat (Graves et *al.* 1990). These tributaries included:

Fighting	Plummer
Bellgrove	Benewah
Lake	Hell's Gulch
Squaw	Evans
Little Plummer	Alder

The Missouri method of evaluating stream reaches was modified and used to rank the ten tributaries (Fajen and Wehnes 1981). This ranking, in combination with biological information collected, was used to identify the four

streams with the best potential cutthroat and bull trout habitat (Lillengreen, et. al. 1993).

1.2.2. 1991

During 1991, biological data collected on the ten streams included; relative abundance data, trout population estimates, growth rates, and benthic macroinvertebrate densities (Lillengreen, et. al. 1993). Relative abundance data resulted in the capture of 6,138 fish from June, August and October, 1991. A total of 427 cutthroat trout were collected from all sampled tributaries. Relative abundance of cutthroat trout for all tributaries was 6.7 percent. Fighting Creek had the highest relative abundance of cutthroat trout (93.1 percent). Evans Creek, Lake Creek, Hells Gulch, Alder Creek, Benewah Creek, and Plummer/Little Plummer creeks had relative abundances of 30.8, 12.1, 11 .1, 3.3, 2.1 and 0.5 percent, respectively. No bull trout were captured in any of the surveyed tributaries. For a complete breakdown of fish relative abundance see Lillengreen, et al. (1993).

Population estimates were conducted in only four of the ten tributaries due to intermittent stream conditions found during the summer on the other six selected streams. The four streams in which population estimates were conducted included Benewah, Alder, Evans and Lake creeks. Density estimates for cutthroat trout were 1.2 fish/l 00 m^2 in Benewah Creek, 1.5 fish/l 00 m^2 in Alder Creek, 8.1 fish/l00 m^2 in Lake Creek and 18.9 fish/l00 m^2 in Evans Creek. Density estimates were also determined for eastern brook trout in Alder Creek (1 I .8 fish/l 00 m^2) No bull trout were captured in any surveyed section and are assumed to be absent from the study areas.

Growth rates and condition factors for cutthroat trout captured in each stream tended to be low in comparison to other streams in the region except for Benewah Creek (Lillengreen et *al.* 1993). Growth rates for cutthroat trout existing in Benewah Creek were comparable to other streams in the region. Eastern brook trout growth and condition factors were also comparable to those found in other streams in the region. Bull trout growth rates and condition factors could not be assessed because no bull trout were captured during the study.

Mean annual invertebrate densities in the tributaries ranged from 1,206 organisms/m^2 in Alder Creek to 2,886 organisms/m^2 in Evans Creek. Mean annual densities in the drift ranged from 21 organisms/m^2 in Alder Creek to 266 organism/m^2 in Evans Creek. Invertebrate densities were similar to other streams of the same size in the region For a more detailed breakdown of invertebrate densities, see Lillengreen et *al.* (1993).

Land use practices within each selected watershed have contributed to the degradation of the fishery resources on the Coeur d'Alene Indian Reservation. Major habitat problems associated with the area included high

sediment input from non-point sources which included agricultural (grazing and farming) and silvacultural (timber) practices. Stream systems located in low elevation drainages received their primary sources of water from snow melt run-off and rain events. Due to flow constraints (zero flow in summer) and adverse land use practices within the basins, these drainages, have limited potential for resident fish production. However, perennial drainages could have existing land-use practices modified to enhance the habitat quality and quantity for cutthroat and bull trout.

Four out of the ten tributaries, Lake, Benewah, Evans and Alder creeks were chosen for further study based on their relatively high quality fisheries habitat and potential habitat enhancement opportunities.

1.2.3. 1992

During 1992, habitat surveys, fish densities, substrate sampling, migratory patterns, discharge measurements, water quality, and predicted cutthroat trout survival were assessed in Lake, Benewah, Evans and Alder creeks.

To estimate relative species abundance, 1,881 fish were captured in May, July and October, 1992. A total of 349 cutthroat trout were collected from all sampled tributaries. Evans Creek had the highest relative abundance of cutthroat trout at 98.8 percent. Twenty-three percent of the fish collected in Alder Creek were cutthroat trout while 44 percent were eastern brook trout. Benewah and Lake creeks had relative abundance values of five percent and two percent, respectively. For a complete breakdown of fish relative abundance see Lillengreen et *a/.* (1993).

Population estimates were conducted in September, 1992. Density estimates for cutthroat trout were 1.4 fish/l 00 m^2 in Benewah Creek, 11.8 fish/l 00 m^2 in Alder Creek, 1.5 fish/l 00m^2 in Lake Creek and 33.0 fish/l 00 m^2 in Evans Creek. Density estimates were also determined for eastern brook trout in Alder Creek with densities of 6.1 fish/l 00 m^2. No bull trout were captured in any surveyed section and were assumed to be absent form the study areas.

Growth rates and condition factors for cutthroat trout captured in each stream tended to be comparable to other streams in north Idaho. Eastern brook trout growth and condition factors were also comparable to those found in other streams in the region. Bull trout growth rates and condition factors could not be assessed since no bull trout were collected in the study area.

Migration trap data in combination with age and growth analyses indicated that Lake and Benewah Creeks had remnant populations of adfluvial westslope cutthroat trout and a resident population of westslope cutthroat trout. Stocks in Alder Creek could not be determined from the data collected and Evans Creek retained only a resident population of cutthroat trout.

Habitat surveys were conducted on each of the four streams. Surveys showed that habitat was a limiting factor for cutthroat and bull trout survival in most of the watersheds.

Lake Creek

Major factors limiting habitat in Lake Cree k were the lack of pool habitat, high water temperatures and cumulative silt loading over time resulting in decreased number of pools and loss of overwintering and rearing habitat. Pools accounted for only eight percent of the total habitat in Lake Creek. Another potentially limiting factor in Lake Creek was the absence of riparian vegetation along most of the stream corridor. Lack of shade from riparian vegetation may be responsible for high summer water temperatures above the acceptable range (>21 "C) for cutthroat trout. High water temperatures create a trout thermal barrier. Substrate sampling indicates that cumulative silt loading over time, has decreased the availability of overwintering and rearing habitat. Average cutthroat trout survival, as estimated from analysis of percent fines is 66 percent.

Benewah Creek

Factors limiting production in Benewah Creek include, lack of riparian vegetation, unstable stream banks, and high siltation rates. Cattle graze 62 per cent of the riparian area, leaving unstable stream banks and little riparian vegetation. Compaction of the soil and removal of vegetation from the riparian zone by cattle grazing, and the amount of cleared uplands due to timber harvesting has increased channel derived sediment into Benewah Creek. Percent fine sediment has contributed to a 16 percent mortality in emergent cutthroat trout fry. The little riparian vegetation that was found in Benewah Creek consisted mainly of shrubs and grasses with an average canopy cover of 3.3 percent.

Trout densities for Benewah Creek were .02 trout/m^2 and .Ol trout/m^2 for 1991 and 1992, respectively. These values are far below other north Idaho c uthroat trout streams showing a similar lack of pristine cutthroat trout habitat.

Base flow below 50 percent of the annual stream flow for optimal trout habitat was partly caused by low snow pack, but also water retention time decreased due to the lack of riparian and upland L letation.

Evans Creek

Evans Creek supports a healthy population of cutthroat trout. Cutthroat trout densities in Evans Creek were high compared to all other streams surveyed and to other north Idaho streams. Densities of .43 /m^2 were calculated for 1992. The habitat data collected for Evans Creek is optimal, resulting in these high densities of cutthroat trout. Pools comprise 24 percent of the available habitat in Evans Creek. Heavy overhanging cover (53 percent mean canopy cover) and large organic debris provided sufficient in-stream habitat for westslope cutthroat trout.

Percent emergence success was calculated at 74 percent. This mean is biased based on the low survival rate that was calculated for the lower reach. In the lower reach, one hundred percent of the riparian area had been grazed by cattle. Cattle have destroyed the integrity of the stream bank and increased instream sedimentation . The lower reach of Evans Creek served only as a migratory corridor for cutthroat trout and is not used by the resident cutthroat trout population.

Along with cattle grazing, poor forest practices also contributed to the degradation in Evans Creek. Other areas of concern include future timber sales planned for the areas and the number of instream road crossings present.

Alder Creek

Overall habitat in Alder Creek is sufficient to sustain trout populations. Temperature ranges in Alder Creek are within the acceptable range for cutthroat trout survival, with maximum water temperatures of 19°C and 17°C for 1991 and 1992. Mean canopy cover averaged 34 percent. In Alder Creek, pools accounted for 26 percent of the total available habitat. This is the only stream in the study that contained side channels, with a total of 653 meters which provides lateral habitat for young-of-the-year fish and juvenile rearing. Ninety-one percent cutthroat survival from egg to swim-up fry existed in Alder Creek. Cutthroat trout densities were calculated at 0.12/m^2 for 1992. Eastern brook trout densities of .06/m^2 were calculated in 1992. Cutthroat trout densities were low compared to other cutthroat trout streams in north Idaho, while eastern brook trout densities were comparable to other north Idaho streams.

The presence of eastern brook trout in Alder Creek may also be limiting the westslope cutthroat trout population.

1.3. Study Objectives

The objectives of this study were to:

- Conduct in-depth habitat evaluations of the four primary tributaries which included; estimates of amount of habitat (i.e. pools, riffle, cascades and side channels), estimate of instream and overhang cover; mass wasting (slope failure); bank cutting; vegetative type; and seral stage along stream corridor.
- Determine the population dynamics of trout species present in each tributary.
- Determine habitat utilization
- Determine migratory behavior patterns of trout in each stream in order to assess stocks present (adfluvial, fluvial, or resident).
- Assess age, growth and condition of cutthroat and bull trout.
- Determine extent and effectiveness of cutthroat and bull trout spawning.
- Identify alternatives for restoring cutthroat and bull trout
- Establish biological objectives based on restoration alternatives.
- For each drainage, list habitat improvement opportunities and cost estimates for those improvements.

2.0. Methods and Materials

2.1. Description of the Project Area

The Coeur d'Alene Lake drainage system is located in the Idaho panhandle and extends approximately 9,583 square kilometers. It is divided into two subbasins, including the Coeur d'Alene River basin and the St. Joe River basin. The remainder of the drainage basin consists of streams flowing into Wolf Lodge, Corbin, Windy, Rockford, Mica, and Cougar bays of Lake Coeur d'Alene.

The project area included four tributaries located within the Coeur d'Alene drainage basin: Lake, Benewah, Evans, and Alder creeks.

The Lake Creek watershed (Figure 2.1) is located in southwest Kootenai County, Idaho and southeast Spokane County, Washington. Lake Creek discharges into Lake Coeur d'Alene at Windy Bay. Lake Creek is a third order stream and is approximately 21 kilometers long. Over half of the watershed is forested land while the remainder is agricultural land. Lake Creek is used as a domestic and limited livestock water source.

The Benewah Creek watershed (Figure 2.2) is located in Benewah County, Idaho and is a fourth order stream. Benewah Creek discharges into the southern portion of Benewah Lake, which since the raising of the water levels associated with the Post Falls Dam, is part of Lake Coeur d'Alene. Benewah Creek is approximately 24 kilometers long. Predominant land use practices within the watershed are grazing, timber, and residential uses.

The Evans Creek watershed (Figure 2.3) is located in Kootenai County, Idaho and is a second order stream. Evans Creek discharges into Medicine Lake, a lateral lake associated with the Coeur d'Alene River. Evans Creek is approximately ten kilometers long. Land uses associated with Evans Creek include forestry, grazing, and residential uses. Evans Creek is used as a domestic and livestock water source.

The Alder Creek watershed (Figure 2.4) is located in Benewah County, Idaho and is a fourth order stream. Alder Creek discharges into the St. Maries River and is approximately 20 kilometers long. The major land use practices within the watershed are private/industrial timber production and livestock grazing. Alder Creek is also used as a livestock and limited domestic water source.

2.2. Physical Investigations

Physical investigations were conducted on the four tributaries and included; channel typing, habitat evaluations, riffle armor stability ratings, stream reach channel stability profiles, discharge profiles, and water quality analysis.

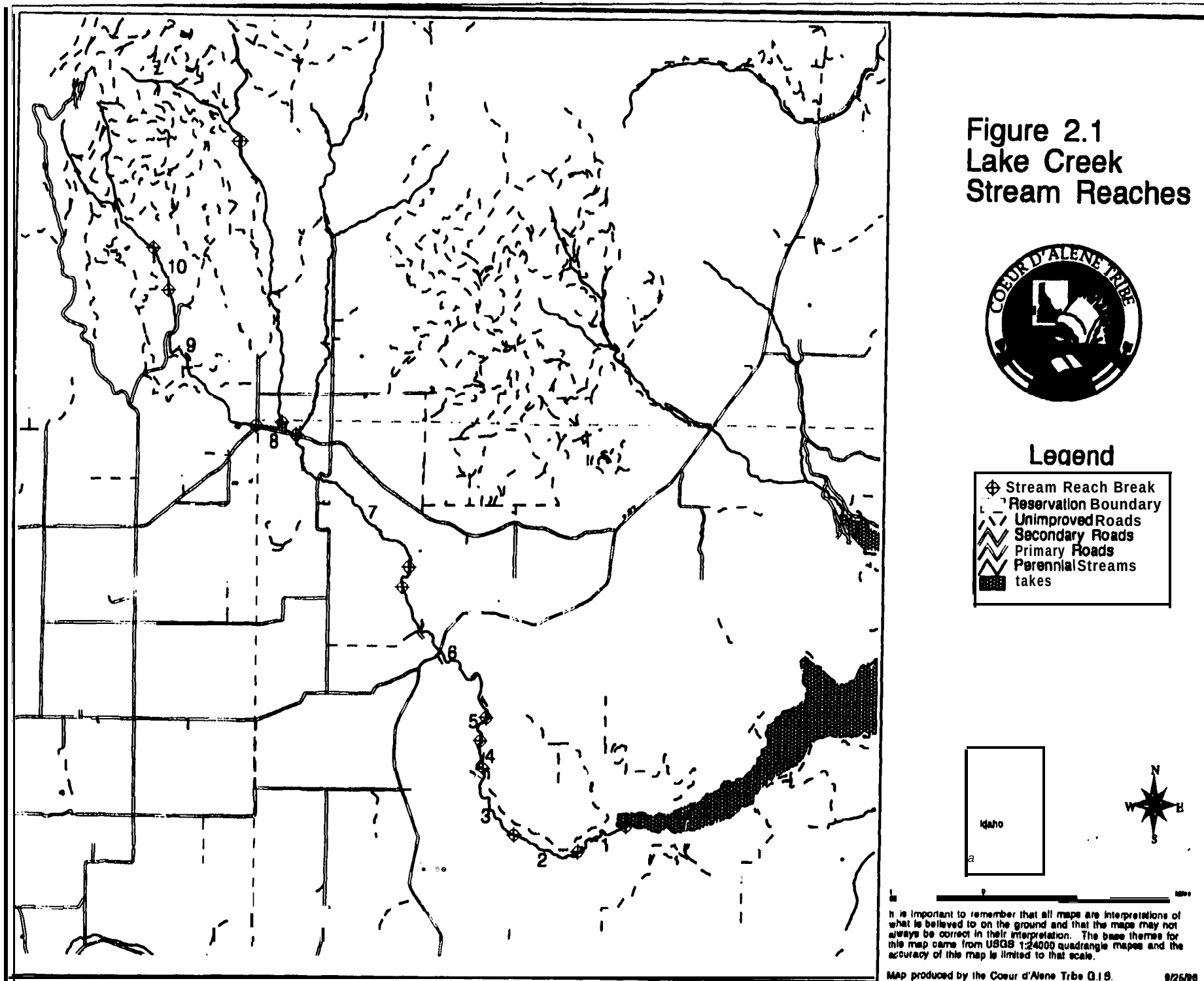
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Figure 2.1
Lake Creek
Stream Reaches
COEUR D'ALENE TRIBE
Legend
Stream Reach Break
Reservation Boundary
Unimproved Roads
Secondary Roads
Primary Roads
Perennial Streams
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Idaho
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It is important to remember that all maps are interpretations of what is believed to on the ground and that the maps may not always be correct in their interpretation. The base themes for this map came from USGS 1:24000 quadrangle maps and the accuracy of this map is limited to that scale.
Map produced by the Coeur d'Alene Tribe G.I.S.
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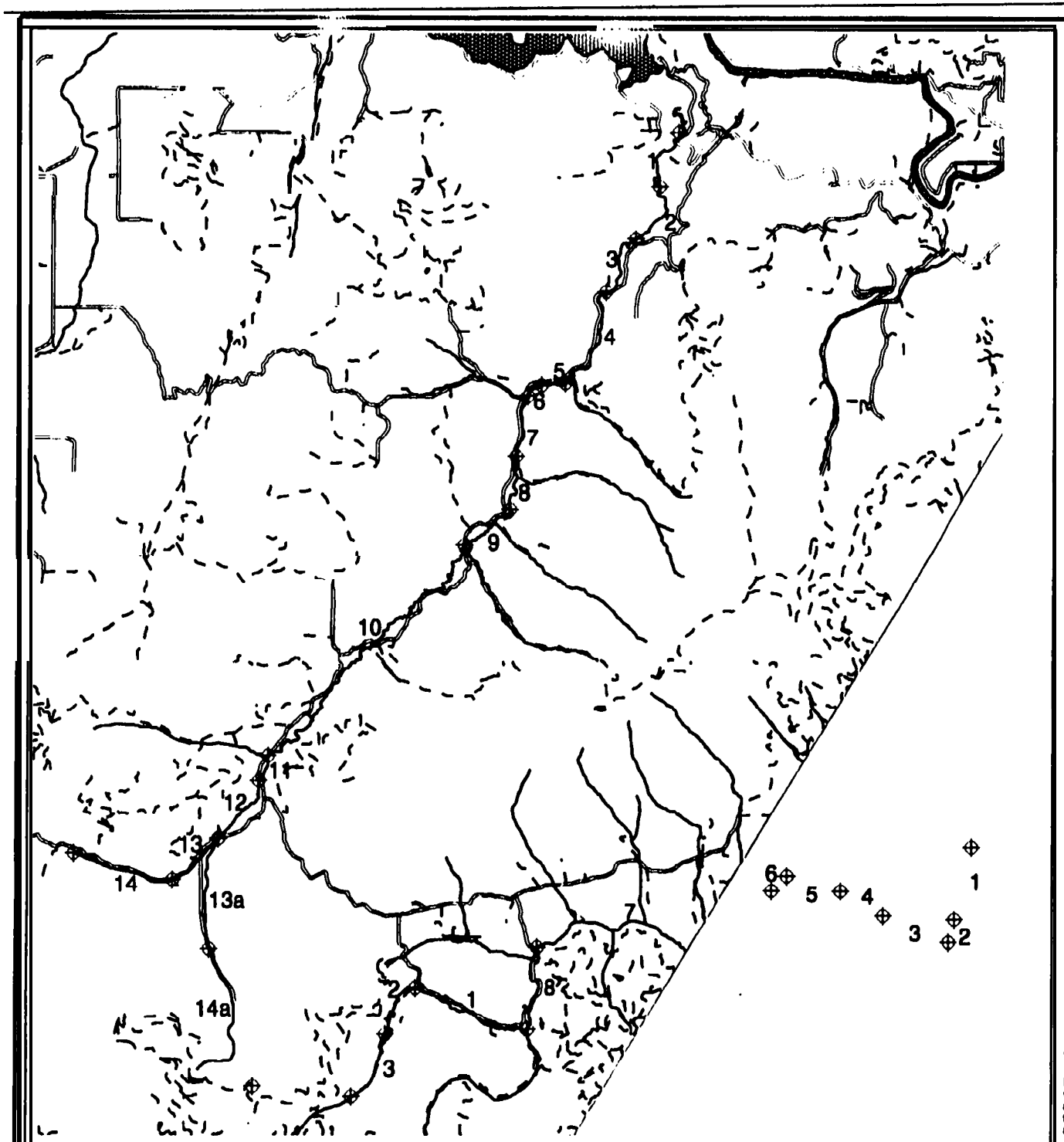

Figure 2.2
Benewah Creek
Stream Reaches

COEUR D'ALENE TRIBE

Legend

- Stream Reach Break
- Reservation Boundary
- Secondary Paved
- Gravel Roads
- Unimproved Roads
- Perennial Streams
- Rivers
- Lakes

Idaho

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Map produced by the Coeur d'Alene Tribe G I.S. 9/25/96

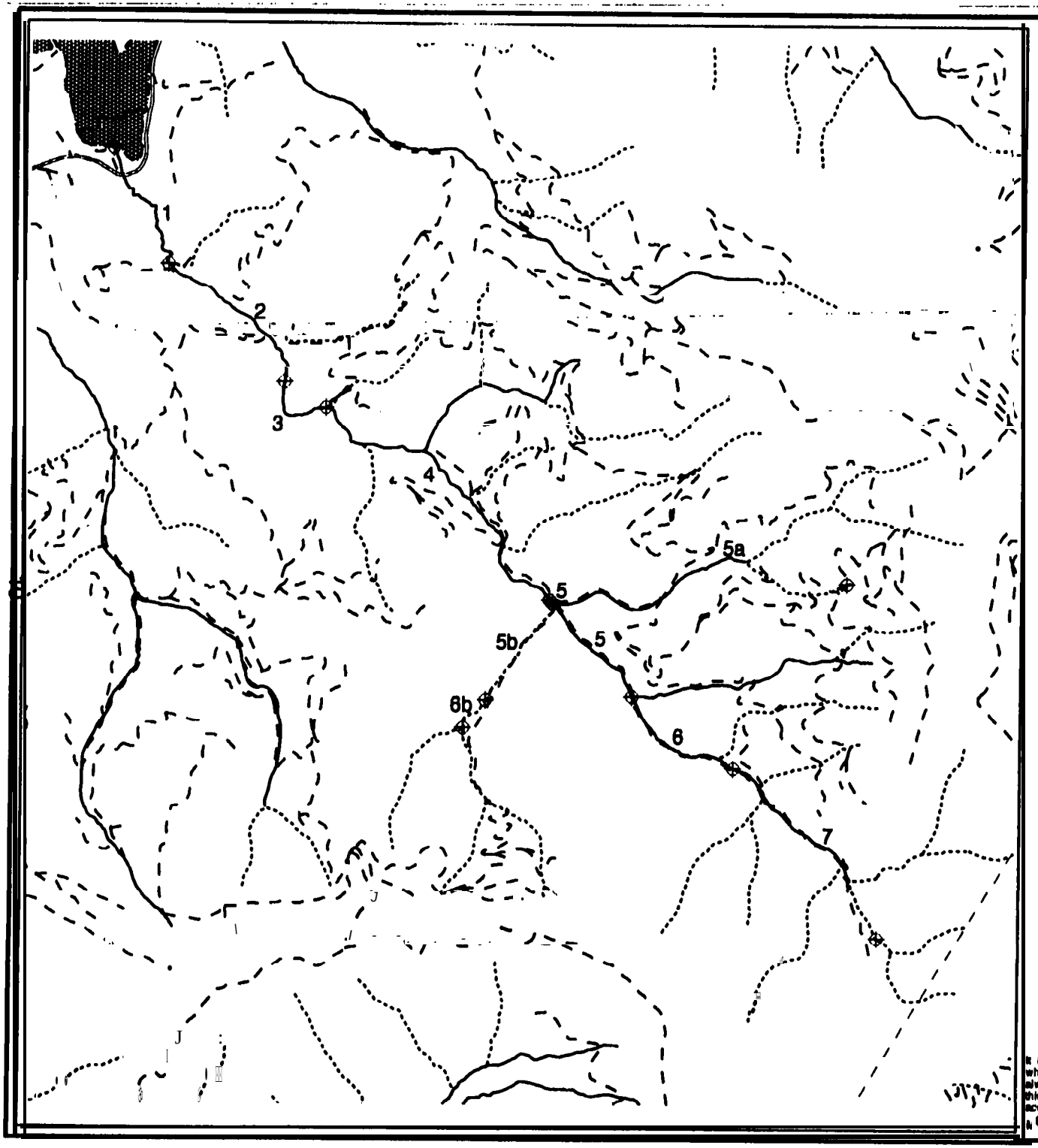
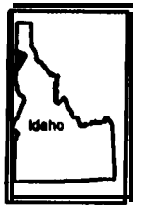


Figure 2.3
Evans Creek
Stream Reaches

COEUR D'ALENE TRIBE

Legend

- Stream Reach Break
- Reservation Boundary
- Unimproved Roads
- Secondary Roads
- Primary Roads
- Perennial Streams
- Intermittent Streams
- Lakes



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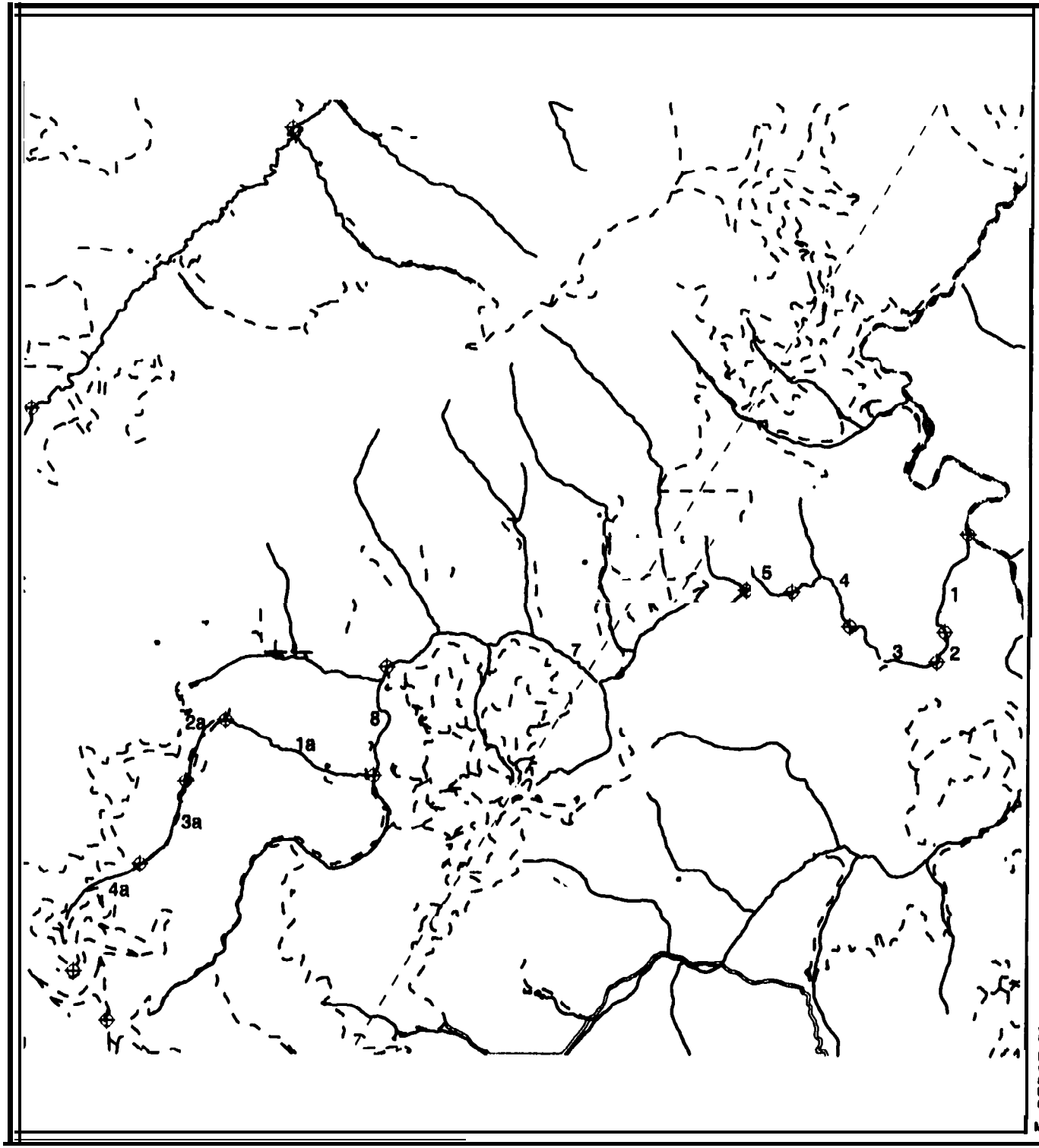
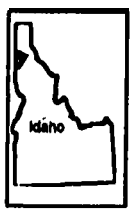


Figure 2.4
Alder Creek
Stream Reaches

Legend

- Stream Reach Break
- Reservation Boundary
- Unimproved Roads
- Secondary Roads
- Perennial Streams
- Rivers
- Lakes



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Map produced by the Coeur d'Alene Tribe G.I.S. 9/25/98

2.2.1. Channel Typing

Channel type surveys were conducted to classify stream reaches into relatively homogeneous types according to broad geomorphological characteristics of stream morphology. Geomorphic parameters were identified and classified according to Rosgen (1991). This type of reach level classification allows for the characterization of channel processes and provides a framework to examine potential channel response, define impact zones for interpreting effects on fisheries habitat, and identify areas best suited for improvement projects.

Surveys were conducted by two person crews beginning at the mouth of streams and working in an upstream direction. Reaches were numbered in ascending order from downstream to upstream. Measured parameters included: bankfull width, bankfull depth, flood-prone width, entrenchment ratio, stream gradient, sinuosity, and dominant substrate. Measurements of bankfull width and depth were determined following visual identification of channel features related to the 1.5 year recurrence interval discharge (Williams 1978). Flood-prone width was extrapolated from a flood-prone depth estimated at two times bankfull depth (Rosgen, 1994). Entrenchment ratio was calculated as the ratio of the width of the flood-prone area to the bankfull width of the channel. Stream gradient was measured to the nearest percent using a handheld clinometer. Sinuosity was determined in the office following examination of aerial photos. Dominant substrate was determined by direct measurement of particle size as described In methods for the Riffle Armor Stability Index (Section 2.2.2).
The classification scheme assigns an alphanumeric/numeric code to each stream reach based on measured parameters. Broad stream categories of A-G are assigned based on plan view morphology, entrenchment, width/depth ratio, and sinuosity. The stream types are then broken into discreet slope ranges and dominant channel-material particle sizes. The stream types are given numbers related to the median particle size diameter of channel materials (Figure 2.1). Channel types were determined following 1993 surveys. Measurements were not repeated during the 1994 field season.

2.2.2. Riffle Armor Stability Index

The Riffle Armor Stability Index (Kappesser 1992) provides a quantitative determination of existing channel stability by comparing the size classes of bed material in riffle areas with the largest sizes of material capable of movement at bankfull discharge. The index draws on the principles that stream channel stability is the product of a balance between streamflow and sediment load (Leopold et. al. 1984) and that the composition of a stable riffle is representative of bedload moved at a range of floods (Lisle 1989). Marked differences in the particle size distrioution of riffle areas and the geometric mean particle size on

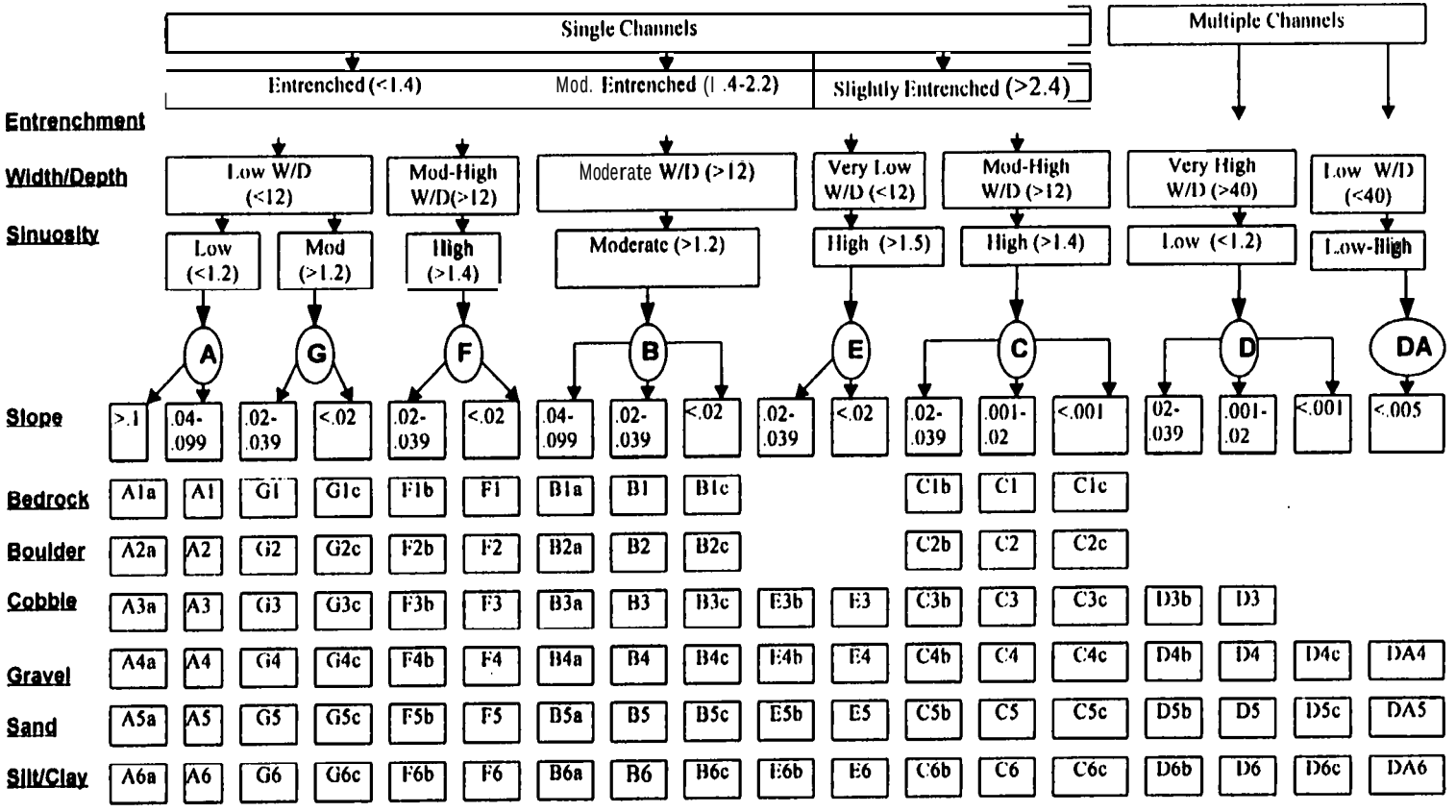

Figure 2.5. Key to channel classification (Rosgen 1994).

fresh depositional areas represents a shift in the equilibrium between streamflow and sediment supply. The index is a useful monitoring tool which provides a record of changes in channel stability over time, and an estimate of the effects of sediment transport on beneficial uses (e.g., filling of pools).

The procedure requires a set of measured field data which includes the particle size distribution of riffle material and a sample from a fresh depositional feature. Particle size distribution was determined (Wolman 1954) at three representative riffles within each of the Rosgen channel types. Sampled riffles were marked with flagging so that measurements could be repeated during 1994 surveys. In instances where channel adjustments significantly altered riffle habitats, measurements were repeated in the riffle area located immediately downstream from 1993 sample locations. Measurements of the largest particles on a fresh depositional feature were collected in close proximity to the riffles examined during each year of the survey. Channel dimensions (e.g., slope, width, depth) were taken in the same area where pebble counts were conducted so that data would be compatible for subsequent analysis. The geometric mean particle size was compared to the cumulative percent of riffle particle sizes to obtain a RASI stability number (Kappesser 1992). The RASI numbers can range from less than 50 to 100, and riffle stability is inversely related to the RASI number.

2.2.3. Stream Reach Inventory/Channel Stability Evaluation

The Stream Reach Inventory/Channel Stability Evaluation (Pfancuch 1975) provides a semi-quantitative assessment of the capacity of a stream to adjust to changes in flow and/or sediment production. The procedure assigns a stability rating of excellent to poor based on the evaluation of fifteen characteristics related to the channel and adjacent floodplain (Table 2.2). Survey crews conducted Stream Reach Inventory/Channel Stability Evaluations for each Rosgen channel type. The scoring for each of the fifteen criteria considered conditions that were representative of the entire reach in question. Scores for each of the criteria were then summed to provide an overall stability rating for the reach. Surveys were repeated during the 1994 sampling effort.

Table 2.2. Evaluating criteria for Stream Reach Inventory/Channel Stability Evaluation surveys.

Landform	Item Rated	Criteria Number
Upper Banks	Landform Slope	1
	Mass Wasting Potential	2
	Debris Jam Potential	3
	Vegetative Bank Protection	4
Lower Banks	Channel Capacity	5
	Bank Rock Content	6
	Obstructions/Flow Deflectors/Sediment Traps	7
	Bank Cutting	8
	Deposition	9
Bottom	Rock Angularity	10
	Substrate Brightness	11
	Substrate Consolidation or Particle Packing	12
	Bottom Size Distribution and Percent Stable Materials	13
	Scouring and Deposition	14
	Clinging Aquatic Vegetation	15

2.2.4. Habitat Evaluations.

Habitat surveys were conducted on primary tributaries during May-October, 1993 and 1994, as described in Lillengreen et. al. (1993) with the following modifications. Stream reaches were delineated based on Rosgen channel typing (Section 2.2.1).-Data was recorded on standardized TFW forms and entered into Microsoft Excel 4.0 software. All parameters analyzed were the same as reported in Lillengreen et. *al.* (1993) with the exception of the incorporation of residual pool depth calculations.

Residual pool depth is the maximum depth of a pool at stage zero discharge. The measurement is recorded as the difference between the thatweg depth at the hydraulic control and the deepest point in the pool. Residual pool depth was calculated following the methods in Lisle (1989) where:

$$RPD = MPD - TCD$$

Where:

MPD = Maximum pool depth
TCD = Tail crest depth

2.2.5. Stream Discharge Measurements

Stream discharge was measured monthly from March 1993 through November 1993, and March 1994 through November 1994, as described in Lillengreen et. al (1993). In March, dishcarge measurements were collected more frequently to measure runoff due to rain-on-snow events. Sampling after the month of March was completed monthly but was event orientated until base flow was established in June. Sampling was then completed the third week of the month during 1993 and 1994.

2.2.6. Water Quality Analysis

Water samples were collected and analyzed monthly and reported as seasonal averages. Spring samples were collected March through May. Summer samples were collected June through August and fa samples were collected September through November. Tests for conductivity, dissolved oxygen, pH. and temperature were conducted in the field using a Hydrolab Surveyor II. Water samples were also collected for laboratory analysis of nitrate, nitrite, phosphates, turbidity, and alkalinity using a LaMotte Chemical colorimetric test kit. Total dissolved solids were determined using a HANNA model 0661-10 dissolved solids tester.

2.3. Fisheries Surveys

2.3.1. Relative Abundance

Tributaries were sampled May through October, excluded September in 1993 and 1994, as described in Lillengreen et al (1993).

2.3.2. Trout Population/Biomass Estimates

Trout populations were estimated in October 1993 using the removal-depletion method (Seber and LeCren 1967, Zippen 1958). Population sites were located within each channel type reach as outlined in Section 2.2.1. Sites within each reach were randomly distributed to include 10 percent of each habitat type present. Block nets were placed at the upstream and downstream boundaries to prevent immigration and emigration. Each section was electrofished using the standard guidelines and procedures described by Reynolds (1983). Fish were collected by spot shocking using a Smith-Root Type VII pulsed-DC backpack electrofisher. A minimum of two electrofishing passes were made for each habitat unit. Captured fish were identified, enumerated, measured (TL to nearest mm), and weighed. Cutthroat trout of 200 mm in length and larger were tagged with a Floy FD-6B numbered anchor tag.

Population estimates were calculated using the following equation (Armor et. al. 1983):

$$N = \frac{(U_1)2}{(U_1-U_2)},$$

Where:

N = estimated population size;
u, = number of fish collected in the first pass; and,
U_2 = number of fish collected in the second pass

The standard error of the estimate was calculated as:

$$se(N)=\sqrt{\frac{(U_1)^2(U_2)^2T}{(U_1-U_2)4}}$$

where:

se(N) = standard error of the population estimates; and

T = total number of fish collected (U_1+U_2)

An approximate 95 percent confidence interval for N (true population size) was calculated as ± 2 x se(N).

The population estimates were converted into density values (# fish/100ft) by habitat type and by reach. The confidence intervals were converted in the same manner. Total standing crop of trout in each of the four drainages was arrived at by calculating the sum of population estimates for individual reaches and habitat types, respectively.

Biomass for cutthroat and eastern brook trout within each sample site was estimated as NW, where W estimates the average weight of all fish of a species that N relates to. Biomass estimates were stratified into juvenile and adult age classes. Juveniles were assumed to be less than 4 years old, while the adult age class consisted of all fish 4 years old and older. Site specific back calculations of lengths at age were used to stratify fish into age classes. Total biomass of trout in each of the four study drainages was arrived at in the same manner as described above for population estimates.

2.3.3. Habitat Use Evaluation

Habitat use in the four study drainages was evaluated through chi-square goodness of fit tests (Daniel, 1990) and comparisons of catch rates by habitat type. Analysis was conducted on 1993 electrofishing data. The null hypothesis tested by the chi-square analysis stated that trout populations do not differ in their relative frequency distribution among habitat types. It was assumed that each habitat type, by definition, constituted a unique set of morphologic and hydrologic characteristics (e.g. substrate size, cover type, average depth, average velocity). Catch rates served as a relative index of habitat selectivity. The assumption was that probability of capture is not biased towards species or habitat type.

2.3.4. Spawning Surveys

Spawning surveys were conducted in late April and early May, 1993 to assess cutthroat trout spawning success. A two member field crew walked from the mouth of the stream to the upper limit of fish habitat in each stream. Redds were located, counted, classified, and marked on topographic maps following procedures described in Lillengreen, et. a*l*. (1993).

2.3.5. Migration Trap Data

In March, 1993 and 1994 upstream and downstream migration traps were installed in Lake, Benewah, Evans, and Alder creeks as described in Lillengreen et al (1993). The traps consisted of a weir, runway and a holding box (Figure 2.6). The design was a modification of the juvenile downstream trap found in Conlin and Tuty (1979) (Lillengreen et al. 1993). Traps were installed in pairs to allow monitoring of both upstream and downstream movements of fish (Table 2.35). Paired traps were placed approximately 200 meters apart.

Traps were check twice daily during peak spawning periods from mid-March through the middle of May and once daily afterwards until late June, when traps were removed. Fishes captured in the traps were identified, counted, measured, and weighed. A scale sample was taken to assess the age growth, condition, and stock (fluvial/adfluvial/resident) of the fish.

Table 2.3.5. Location of migration traps, 1994.

Lake Creek	Benewah Creek	Alder Creek	Evans Creek
Lower Trap:	Lower Trae:	Lower Trap:	Lower Trap:
At Hwy 95 crossing	At mouth of Creek	At mouth of creek	At mouth of creek
Upper Trap:	Upper Trap:		
Upstream of con-Ruence with Bozard Creek	Upstream of confluence with SE. Benewah Creek		
Bozard Creek:	S.E. Benewah:		
At mouth of creek	At mouth of creek		
	Coon Creek:		
	At mouth of creek		
	Whitetail Creek:		
	At mouth of creek		

2.3.6. Age, Growth, and Condition

Age growth and condition were determined as described in Lillengreen et al (1993).

2.4. Macroinvertebrate Surveys

2.4.1. Benthic Macroinvertebrates

Benthic macroinvertebrate samples were collected in July, August, and October 1994. Benthic macroinvertebrate densities were collected using the methods of Waters and Knapp (1961). A modified Hess sampler, with an area of 0.1 m^2, and a net aperture of 390 µm, was pushed approximately 10 cm into the

substrate at three sites across the width of the stream. Stones found in the area were removed and cleaned of all attached material. The substrate was then disturbed by stirring to obtain any remaining macroinvertebrates. The sample was then preserved in IO percent formalin and transferred to a 70 percent alcohol solution in the lab. Samples were collected in the same areas as the fish collections for feeding habits studies during all three sampling months.

2.4.2. Drift Macroinvertebrates

Two drift samples were collected upstream from fish electroshocking areas in each tributary during each sampling month. Water depth was measured using a wading rod, while velocity measurements were measured directly in front of the sampler at 0.6 of the water depth, using a Price Pygmy current meter (Buchanan and Somers.1 980). These measurements allowed for the calculation of densities of organisms per volume of water passing through the drift. All samples were preserved in the field using IO percent formalin and transferred to a 70 percent alcohol solution in the lab.

2.4.3. Shannon-Weiner Diversity Index

To detemine if a stream was healthy or unhealthy the Shannon-Weiner diversity index We used (Perkins 1982). With this method the number of species as well as the number of individuals within each species are taken into account (Krebs 1985). The lowest value would be obtained when only one species is represented in a stream. The highest value would be obtained when each species is represented by equal numbers of individuals. This equation was:

$$H=-\sum_{i=1}^{S}(Pi)\,(\log_2 pi)\,,$$

where: H = Index of species diversity;

S = Number of species; and

Pi = Proportion of total sample belonging tc the ith species.

Values above three represent high diversity and normally indicates a healthy unpolluted community. A low diversity of less than two usually indicates an unhealthy and possibly polluted community (Her-ricks and Cairns 1974). Densities and diversities were then compared to other area streams.

2.5. Analysis of Migration Barriers

Survey information collected on culverts and stream channel geometry was used to access culvert velocity barrier potential, jumping distance, and other site characteristics. Culvert diameter, bed slope, length, as well as rust level and pipe condition were noted. Stream channel geometry measurements were taken upstream to assess discharge.

Because length and velocity are the key elements in determining barrier potential, the Mannings equation was solved for velocity as follows:

v = 1.49/n(R)0.67 (sp) 0.5

Where:

v = velocity in FPS (feet per second)

n = Roughness in culverts assumed to be 0.035

R = Hydraulic radius

sp = bed slope

The wetted perimeter is computed for circular pipes by:

P = 1/2@d

and cross section area by:

A = I/8 (@-sin@)d2

The maximum fish speed used in this passage analysis is

VF = VFB(Ffc)

Where:

VFB = Maximum burst speed as found in Bell (1987)

CFC = Coefficient of fish condition

Therefore: VF = (12.48)(.75)

VF for cutthroat trout = 9.36 (Bell, 1964)

$$Lfs = (VF-VW)TF$$

Lfs = length fish can swim

VF = fish speed +9.36

V W = Water Velocity

TF = Time to fatigue

Passage is analyzed by computing the time it would take the fish to travel the length of the culvert. Time requirement is computed by:

$$T = U(VF-Vc)$$

Where:

T = Time of passage through culvert,

L = length of culvert

vc = the velocity through culvert

Vf = fish speed

3.0. Results

Physical and biological surveys were conducted on each of the four drainages during 1993 and 1994. Physical surveys conducted on these drainages included, channel typing (Rosgen 1991) channel stability ratings, riffle armor stability index values, habitat evaluations, culvert analysis, stream discharge and water quality analysis. Biological surveys conducted on these drainages included relative abundance estimates, population estimates, biomass estimates. Other information was also derived from the above methods. Specific Information derived from each of the above procedures can be found in Appendices A through D.

3.1. Physical Investigation Summary

3.1.1. Lake Creek

Channel type surveys identified 11 distinct stream reaches in the Lake Creek drainage (Figure 2.1). The mainstem was divided into eight reaches, and three additional reaches were identified on the West Fork of Lake Creek. Physical summaries are given below for mainstem reaches l-7 and for West Fork reaches 8-10. The physical conditions of reaches 9 and 10 are combined in the summary below. Additional habitat information was collected for Bozard Creek and is described below.

Reach one was classified as a C6 channel type and extends for 2,000 feet beginning at the confluence with Windy Bay (Figure 2.1). The reach is a fourth order drainage and encompasses elevations ranging from 2,100 feet to 2,180 feet. This reach is heavily influenced by Coeur d'Alene Lake level fluctuations and has slough-like characteristics. Stream gradient is less than 1 percent and channel pattern is highly sinuous (Table 3.1). Bankfull widths varied from 30-60 feet and bankfull depths vary from 3-5 feet. Channel substrate is comprised mainly of silts. The riparian area is a dense mix of mature coniferous/deciduous trees, grasses and forbs. Channel stability rated fair in 1993 and good in 1994. RASI and habitat surveys were not conducted in this reach because of the slough type nature of the reach. No barriers were observed in this reach.

Reach two extends for 5,093 meters and encompasses elevations ranging from 2,180 feet to 2,260 feet (Figure 2.1). The reach was classified as a C4 channel type (Table 3.2.). Dominant land form in the reach was floodplain with riparian vegetation consisting of a mix of conifers and deciduous trees and shrubs. Average bankfull widths were 29.5 feet and average bankfull depths were 2.7 feet. The channel was slightly entrenched (>2.4) and highly sinuous. (Appendix A).The reach had a riffle/pool ratio of 3: 1 in 1993 and 1.5:1 in 1994.

Table 3.1. Summary table showing values for reach one, Lake Creek, 1993 and l994

PARAMETER	1993	1994
Stream order	4th	
Elevation	2,100-2,180 ft	
Soil type		
Dominant land use	Floodplain	
Riparian ecotype	Coniferous/deciduous mix mature overstory, grass & forbs	
Reach length	2,000 ft	2,000 ft
Channel type	C6	C6
Bankfull width	30-60ft	•
Bankfull depth	3-5ft	•
Width/depth ratio	11.3	*
Mean stream gradient	<l %	
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	fair (113)	good (73)
RASI values	•	•
% substrate < 4mm	*	•
mean substrate size (mm)	•	•
Mean % canopy cover	0%	•
Barriers	•	
# instream woody debris	•	
Dominant habitat complex	•	
Riffle/pool ratio	•	
Residual pool depth	•	
Total available habitat	•	
Westslope cutthroat trout densitv	•	

Table 3.2. Summary table showing values for reach two, Lake Creek, 1993 and l994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,180-2,260 ft	2,180-2,260 ft
Dominant land use	Floodplain	same
Riparian ecotype	Coniferous/deciduous mix	same
Reach length	5,093 m	6,290 m
Channel type	C4	C4
Bankfull width	29.5 ft	•
Bankfull depth	2.7 ft	•
Width/depth ratio	10.9	•
Mean stream gradient	<1 %	3.6 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	high fair (89)	fair (93)
RASI values	62;78;48	97;88
% substrate < 4mm	10.4	4.5
mean substrate size (mm)	88	141
Mean % canopy cover	11.6 %	46.7 %
Barriers	none	none
# instream woody debris	49 (0.9 /100 m^2)	53 (0.811 00m^2)
Dominant habitat complex	riffle:pool	riffle: pool
Riffle/pool ratio	3.0 : 1	1.5:l
Residual pool depth	0.6 m	0.6 m
Total available habitat	12,797 m^2	28,866 m^2

Mean residual pool depth was 0.6 meters for 1993 and 1994. Channel stability rating for this reach was fair (Table 3.2) with little variation between 1993 and 1994. Channel banks were stable and had good vegetative bank protection, however, bank cutting was observed at meander bends. Some of the channel bottom was affected by scouring and deposition. RASI index values averaged 62.7 in 1993 and 92.4 in 1994, while fine sediment (<4mm) comprised up to 34 percent of the sampled substrate in 1993 and dropped to 6 percent in 1994 (Table 3.2). Dominant habitat complex for this reach was riffle-pool. Instream woody debris remained relatively equal between 1993 and 1994 at 0.9/100 m^2 and 0.8/100 m^2, respectively. Total available habitat increased in 1994 (Table 3.2).

Reach three is 2,088 meters in length with elevations beginning at 2,260 feet and rising to 2,350 feet. (Figure 2.1). The reach was classified as a B3 type channel interspersed with short C segments (Table 3.3). Average stream gradient was 3.5 percent. Consequently, water velocities were slightly higher than in downstream reaches. Average bankfull widths were 35 feet and average bankfull depths were 2.5 feet. Riffle:pool ratio stayed relatively constant between 1993 and 1994 at 1.8:I and residual pool depths averaged 0.5 meters. Very little large woody debris within this reach. Channel stability rating for this reach was fair (Table 3.3). This reach had upland terrace gradients ranging from I0-80 perent with some rock overhangs. Numerous areas of mass wasting were identified in this reach and contributed a relatively large volume of fine sediment. The riparian area consisted mainly of small shrubs, grasses and forbs with interspersed hardwoods. Riparian vegetation provided 18 and 21 percent canopy cover over the stream during 1993 and 1994. Bank cutting was fairly common as a result of lower vigor and density of vegetative material on the lower banks. Very little instream cover was present within this reach. RASI index values averaged 66.5 and 70.1 for 1993 and 1994, respectively. Fine sediment (<4mm) averaged 17.4 and 13.8 percent of the sampled substrate (Table 3.3). The dominant habitat type within this reach was a riffle-pool complex. Total available habitat increased in 1994 (Table 3.3).

Reach four of Lake Creek extends for 1,328 meters with elevations beginning at 2,350 feet and rising to 2,410 feet (Figure 2.1). Dominant land uses included timber harvesting and residential development. The reach was classified as a C3 channel type (Table 3.4). The channel was highly sinuous and width:depth ratio was greater than 23. The channel was only slightly incised and conveyance capacity was inadequate to contain bankfull flows and flood events. Riffle/pool sequences dominated the habitat structure in this reach and riffle/pool ratio was 3:1 in 1993 and 1.6: 1 in 1994. No large organic debris was present in this reach. Channel stability rating was fair for this reach in both 1993

Table 3.3. Summary table showing values for reach three, Lake Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,260-2,350 ft	2,260-2,350 ft
Dominant land use	Floodplain	Floodplain
Riparian ecotype	Coniferous/ Deciduous mix	Coniferous/Deciduous mix
Reach length	2,088 m	4,809 m
Channel type	B3	B3
Bankfull width	35ft	•
Bankfull depth	2.5 ft	*
Width/depth ratio	15.2	*
Mean stream gradient	3 - 4 %	3.5 %
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	low fair (103)	fair (80)
RASI values	76; 58; 66	80; 78; 52
% substrate < 4mm	17.4 %	13.8 %
mean substrate size (mm)	145	131
Mean % canopy cover	18 %	21 %
Barriers	none	none
# instream woody debris	4 (CO.1 /IO0 m^2)	10 (0.2 /IO0 ft)
Dominant habitat complex	riffle / pool	riffle / pool
Riffle/pool ratio	1.8 :I	2:I
Residual pool depth	0.6 m	0.4 m
Total available habitat	12.555 m^2	341499 m^2

Table 3.4. **Summary table showing values for reach four, Lake Creek, 1993 and 1994**

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,350-2,410 ft	2,350-2,41 ft
Dominant land use	Forest/urban	Forest/urban
Riparian ecotype	Coniferous/deciduous with pole trees, grassas and forbs	< Coniferous/deciduous mix pole trees, grasses and forbs
Reach length	1,328 m	880 m
Channel type	c 3	c 3
Bankfull width	50 ft	*
Bankfull depth	2.1 ft	•
Width/depth ratio	23.8	*
Mean stream gradient	2 %	3 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	medium fair (100)	fair (86)
RASI values	78; 67; 73	70; 70
% substrate < 4mm	30.6 %	13.5 %
mean substrate size (mm)	135	141
Mean % canopy cover	0 %	10 %
Barriers	none	none
# instream woody debris	0 (CO.1 /IO0 m^2)	4 (0.2 /IO0 ft)
Dominant habitat complex	riffle / pool	riffle / pool
Riffle/pool ratio	3:I	1.6 : 1
Residual pool depth	0.5 m	0.5 m
Total available habitat	22,186 m^2	19,045 m^2

and 1994 (Table 3.4). Vegetative root mass protection ranged from 70-90 percent. The riparian area was a coniferous/deciduous mix with pole trees, grasses and forbs. Canopy cover averaged O-IO percent for this reach. This reach had significant bank cutting and sloughing and large amounts of fine sediment/gravel depositional areas. Areas of mass wasting were frequently observed and impact potential was judged to be high. Mean RASI values were 72.8 and 69.4 in 1993 and 1994, respectively (Table 3.4). Average fine sediment (4 mm) levels were as high as 31 percent in 1993 but much lower levels were observed in 1994 (13.5 percent). Residual pool depths averaged 0.5 meters for 1993 and 1994. Total available habitat decreased in 1994 (Table *3.4).*

Reach five is a B3 channel type and extends for 525 meters with elevations ranging from 2,410 feet to 2,450 feet (Figure 2.1). The reach is forested with a riparian area consisting of mature coniferous/deciduous trees mingled with grasses and forbs. Average bankfull width was 36 feet with an average bankfull depth of 2.1 feet. Riffle to pool ratio was 3:1, and mean residual pool depth was 0.4 meters in 1993. In 1994, riffle to pool ratio was 8:I with average residual pool depths of 0.5 meters. (Table 3.5). Pool depth was affected by sediment deposition. Mean riparian canopy cover was 19 percent for this reach in 1993 and increased to 26 percent in 1994. Channel stability ratings for this reach were low good (71) in 1993 and fair (101) in 1994 (Table 3.5). There is little mass wasting and bank cutting in this reach. Lower stream banks are armored with dense vegetation- There are moderate amounts of new gravel bars. Average riffle armor stability index values were 48 in 1993 and 73 in 1994 (Table 3.5). Quantities of fine sediment (< 4 mm) averaged 25 and 19 percent in 1993 and 1994, respectively. Total available habitat increased during 1994 (Table 3.5).

Reach six is a 873 meters section with elevations ranging from 2,450 feet to 2,480 feet (Figure 2.1). The reach was classified as a C4-C6 channel type (Table 3.6). Dominant land use is timber harvest with some livestock grazing. The riparian area consisted of a mature mix of coniferous/deciduous trees with grasses and forbs dominating the under-story community. Average bankfull width was 32 feet with an average bankfull depth of *2.1* feet. The channel was slightly entrenched and highly sinuous. Average residual pool depth was 0.7 meters in 1993 and 0.5 meters in 1994. Pool depth was affected by elevated levels of fine sediment (Table 3.6). Channel stability ratings for this reach were fair (101 and 95 in 1993 and 1994, respectively) primarily due to unstable stream banks (Table 3.6). Vegetative bank protection was limited to shallow rooted/seasonal vegetation. There was a significant amount of bank cutting, undercutting and sloughing at outcurves. Accelerated gravel bar development was noted in this reach. RASI index values averaged 73.5 and 81.4 in 1993 and 1994, respectivety. Fine sediment less then 4 mm averaged 48 percent of the sampled

Table 3.5. Summary table showing values for reach five, Lake Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,41 O-2,450 ft	2.41 O-2,450 ft
Dominant land use	Forested	Forested
Riparian ecotype	Coniferous/deciduous mix with grasses, forbs and mature trees	Coniferous/deciduous mix grasses, forbs and mature trees
Reach length	525 m	1,189 m
Channel type	B3	B3
Bankfull width	36 ft	*
Bankfull depth	2.1 ft	*
Width/depth ratio	17.1	•
Mean stream gradient		1.5 %
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	low good (71)	Fair (101)
RASI values	53; 59; 34	70; 83; 67
% substrate < 4mm	25 %	19%
mean substrate size (mm)	113	173
Mean % canopy cover	18.5 %	26 %
Barriers	none	none
# instream woody debris	5 (, 0.1 /100 m^2)	5 (0.1 /IO0 ft)
Dominant habitat complex	riffle / pool	riffle / pool
Riffle/pool ratio	3:I	8:1
Residual pool depth	0.4 m	0.5 m
Total available habitat	8,357 m^2	18,656 m^2

Table 3.6. Summary table showing values for reach six, Lake Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4 th	4th
Elevation	2,450-2,480 ft	2,450-2,480 ft
Soil type		
Dominant land use	Forested/agriculture	Forested/agriculture
Riparian ecotype	Conferous / decidous mix with grasses, forbs and mature trees	Conferous/decidous mix grasses, forbs and mature trees
Reach length	873 m	873 m
Channel type	C4 - C6	C4-C6
Bankfull width	32 ft	•
Bankfull depth	2.1 ft	•
Wrdth/depth ratio	16	*
Mean stream gradient	1 %	1.3 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	medium fair (101)	fair (95)
RASI values	74; 75; 72	81; 78; 85
% substrate < 4mm	48 %	26.5 %
mean substrate size (mm)	110 mm	142 mm
Mean % canopy cover	0 %	26.5 %
Barriers	none	none
# instream woody debris	18 (<.1 /IO0 m^2)	10 (0.12/100 m^2)
Dominant habitat complex	rifle / pool	riffle / ~001
Riffle/pool ratio	3:1	2.1 : 1
Residual pool depth	0.7 m	0.5 m
Total available habitat	51,031 m^2	64,171 m^2

substrate in 1993, and 27 percent in 1994 (Table 3.6).

The lower boundary of reach seven is located at the highway 95 bridge crossing and continues upstream for 5,369 meters (Figure 2.1). Most of this reach is a fourth order drainage, however, the upper 500 meters is a third order drainage. Elevations range from 2,480 feet to 2,600 feet. Reach seven was classified as a E5 channel type and was highly sinuous (Table 3.7). Average bankfull width was 18 feet and average bankfull depth was 2.2 feet. The channel capacity was considered adequate to contain bankfull flows. Dominant land use was agricutture with portions of livestock grazing and forest use. Channel stability was poor to fair (Table 3.7). The riparian area was comprised mainly of shallow rooted/seasonal species and extensive bank cutting and bank sloughing were observed throughout this reach. No instream woody debris were observed in this reach and residual pools depths were declining during 1994 (Table 3.7). The channel bottom was silt covered and in a yearlong state of flux with scouring and depositic occurring frequently. Average Riffle Armor Stability Index values were 89 and in 1993 and 1994, respectively. The highest percentages of fine sediment in the watershed were found in this reach (Table 3.7). Total available habitat increased in 1994 (Table 3.7).

Reach eight of Lake Creek extends up the West Fork of Lake Creek for 3,324 meters beginning at the confluence with the mainstern (Figure 2.1). This reach is a third order drainage with elevations beginning at 2,540 feet and rising to 2,570 feet. Dominant land type in this reach is forested with some agricutture and livestock grazing use occurring. The riparian area is a coniferous/deciduous mix of young and pole size trees with grasses, forbs, shrubs intermixed. The reach was classified as an E5 channel type interspersed with short C5 segments (Table 3.8). Average bankfull width was 16.5 feet and average bankfull depth was 2.5 feet. Channel stability rated poor (129) to fair (102) in 1993 and 1994, respectively. Channel capacity was generally adequate for carrying bankfull flows, howeve- heavy cattle use has degraded portions of the banks creating areas of overflow. There were areas in which flow deflectors caused continuous bank failures and sloughing, resulting in channel migration. RASI surveys were not conducted in this reach due to the extremely mobile nature of the channel substrate. Vegetation provided very little bank protection and the channel bottom was in a constant state of flux as a result of scouring and depositional processes. Very little instream woody debris was present in 1993 or 1994. Riffle to pool ratios were 2.4:1 in 1993 and 1.9:1 in 1994. Continuous bank failures have reduced channel capacity. Available habitat decreased in 19 (Table 3.8).

Reach nine of Lake Creek is a second order drainages which extends for 949 meters (Figure 2.1). Elevations ranged from 2,570 feet to 2,970 feet. Dominant land type was forested. The riparian area consisted mainly of young

Table 3.7. Summary table showing values for reach seven, Lake Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,480-2,600 ft	2,480-2,600 ft
Soil type		
Dominant land use	Agriculture/grazing/forest	Agriculture/grazing/forest
Riparian ecotype	Coniferous/deciduous mix With shrubs, grasses and forbs	Coniferous/deciduous mix with shrubs, grasses, and forbs
Reach length	5,369 m	5,739 m^2
Channel type	E5-E6	E5 - E6
Bankfull width	18ft	•
Bankfull depth	2.2 ft	*
Wrdth/depth ratio	8.1	•
Mean stream gradient		1.5 %
Entrenchment	slight	slight
Sinuoisity	very - high	very - high
Channel stability rating	high poor (118)	fair (79)
RASI values	80.4; 96.1; 90.6	68; 89; 96
mean substrate size (mm)	102	124
Mean % canopy cover	0 %	45.8 %
Barriers	none	none
# instream woody debris	49 (CO.1 /IO0 m2)	172 (0.9 /IO0 ft)
Dominant habitat complex	glide / pool	riffle / pool
Riffle/pool ratio	2.6 : 1	2.3 : 1
Residual pool depth	0.6 m	0.4 m
Total available habitat	49,096 m^2	77,623 m^2

Table 3.8. Summary table showing values for reach eight, (West fork) Lake Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	3rd	3rd
Elevation	2.540-2.570 ft	2540-2.570 ft
Dominant land use	Forested/agriculture/ grazing	Forested/agriculture/ grazing
Riparian ecotype	Coniferous/deciduous mix with grassesiforbs/shrubs/ young timber	Coniferous/deciduous mix with grasses/forbs/hrubs/ young timber
Reach length	3,324 m	3,265 m
Channel type	E5-C5	E5-C5
Bankfull width	16.5 ft	*
Bankfull depth	2.5 ft	*
Width/depth ratio	6.6	•
Mean stream gradient	1 %	1.2 %
Entrenchment	slight	slight
Sinuoisity	very high	very high
Channel stability rating	medium poor (129)	Fair (102)
RASI values	*	•
% substrate < 4mm	•	•
mean substrate size (mm)	⊠	•
Mean % canopy cover	0 %	35.4 %
Barriers	none	none
# instream woody debris	28 (0.8 /100 m^2)	20 (0.8/100 m^2)
Dominant habitat complex	riffle/ pool	riffle / pool
Riffle/pool ratio	2.4 : 1	1.9: 1
Residual pool depth	0.3 m	0.5 m
Total available habitat	18,443 m^2	17,003 m^2

coniferous and deciduous trees. The reach was classified as a E6 channel type and the channel was slightly entrenched and highly sinuous (Table 3.9). Average bankfull width was 12 feet and average bankfull depth was 2.6 feet. Dominant habitat type in this reach was a step pool cascade/rapid complex. Residual pool depth was 0.1 meters in 1993 and 0.9 meters in 1994. Large accumulations of woody debris were noted in this reach (Table 3.9). Channel stability was rated as fair in both 1993 and 1994 (Table 3.9). The channel capacity was adequate to contain bankfull flows. Significant bank cutting and sloughing was evident in the lower portion of this reach, while moderate bank cutting was noted in the upper portion. In the lower portion of this reach the channel bottom is silt covered and fluctuates yearlong, however, only minor amounts of channel scour were observed in the upper portion of the reach. Results of 1993 RASI surveys calculated a mean index value of 69 and an average of 22 percent fines for the reach (Table 3.9). Total available habitat increased during 1994 to 14,528 m^2.

Habitat surveys were conducted on 3,888 meters of Bozard Creek. This tributary is a third order drainage with elevation beginning at 2,540 feet and rising to 2,590 feet (Figure 2.1). Dominant land type was forested with some agriculture use occurring. The riparian area consisted of a mix of young coniferous/deciduous trees and shrubs. No channel type surveys were completed for Bozard Creek. The dominant habitat complex in this reach was riffle-glide with a riffle:pool ratio of 12:I. Mean residual pool depth was 0.3 meters (Table 3.10). Some bank cutting was observed intermittently at outcurves and constrictions. New increase in bar formation and some filling of pools contributed to the fair rating. During 1994, upper portions of this reach became subsurface and could not be utilized by fish.

3.1.2. Benewah Creek

Channel typing surveys identified 16 reaches in the Benewah Creek watershed. Reaches 1-14 are located on the mainstem of Benewah Creek, and reaches 13a and 14a comprise the South Fork of Benewah Creek (Figure 2.2). Physical surveys are described below for mainstem reaches l-l 3 and a general description of the South Fork summarizes information related to reaches 13a and 14a.

Reach one of Benewah Creek extends from the confluence of Benewah Lake upstream for approximately one mile. Habitat surveys were conducted only on the upper 487 meters. Due to the slough type nature of the lower portion of reach one (Figure 2.2). There is limited livestock grazing within this reach. Overbank flows are common in this reach. The reach was classified as a C3 channel type. The channel was slightly entrenched with an average bankfull width-depth ratio of 39 feet (Table 3.11). Mean residual pool depth was 0.8

Table 3.9. **Summary table showing values for reach nine, (West Fork) Lake Creek, 1993 and 1994**

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	2, 570-2,970 ft	2,570-2,970 ft
Dominant land use	Forested	Forested
Riparian ecotype	Coniferous/deciduous mix with young timber	Coniferous/deciduous mix with young timber
Reach length	949m	2,306 m2
Channel type	E6-B4a	E6-B4a
Bankfull width	12ft	•
Bankfull depth	2.6 ft	•
Width/depth ratio	4.6	•
Mean stream gradient	3 %	3 %
Entrenchment	slight - moderate	slight-moderate
Sinuoisity	moderate - very high	moderate-very high
Channel stability rating	moderate fair (100)	fair (98)
RASI values	63; 79; 66	•
% substrate < 4mm	22	⊠
mean substrate size (mm)	66	•
Mean % canopy cover	77 %	41 %
Barriers	none	none
# instream woody debris	119 (12.5 /IO0 m^2)	52 (2.3 /IO0 m^2)
Dominant habitat complex	step-pool cascade/rapids	cascade ; pool
Riffle/pool ratio	NA	1 : 1.7
Residual pool depth	0.1 m	0.9 m
Total available habitat	3,314 m^2	14,528 m^2

Table 3.10. Summary table showing values for Bozard, 1993 and 1994

PARAMETER	1993	1994
Stream order	3rd	3rd
Elevation	2,540-2,590 ft	2,540-2,590 ft
Dominant land use	Forested / Agriculture	Forested/Agriculture
Riparian ecotype	Coniferous/deciduous mix shrub/young timber	Coniferous/deciduous mix shrub/young timber
Reach length	3,888 m	3,870 m
Channel type	E5	E5
Bankfull width	•	•
Bankfull depth	•	*
Width/depth ratio		•
Mean stream gradient		
Entrenchment	slight-moderate	slight-moderate
Sinuoisity	moderate-very high	moderate-very high
Channel stability rating	poor (119)	poor (117)
RASI values	•	•
% substrate < 4mm	•	
mean substrate size (mm)		•
Mean % canopy cover	0.0 %	0.0 %
Barriers	none	subsurface flow
# instream woody debris	0 (O/100 m^2)	0 (O/100 m^2)
Dominant habitat complex	riffle - glide	ND
Riffle/pool ratio	12: 1	ND
Residual pool depth	0.3 m	0.0
Total available habitat	25,757 m2	0.0 m^2

Table 3.11. Summary table showing values for reach one, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,250-2,250 ft.	2.250-2.250 ft
Dominant land use	Wetland/ftoodplain	Wetland/floodplain
Riparian ecotype	Coniferous/Deciduous shrubs	Coniferous/Deciduous shrubs
Reach length	471 m	487 m
Channel type	c3	C3a
Bankfull width	158ft	•
Bankfull depth	4.0 ft	•
Width/depth ratio	39 ft	
Mean stream gradient	1.5 %	1 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	medium fair (94)	high fair (83)
RASI values	80; 69; 82	90; 69; 87
% substrate < 4mm	12	21.5
mean substrate size (mm)	133	152
Mean % canopy cover	0.0 %	29.4 %
Barriers	none	none
# instream woody debris	8 (O/100 m^2)	15 (0.4 / 100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	2:1	2 :I
Residual pool depth	0.8 m	0.7 m
Total available habitat	25,223 m^2	3,336 m^2

meters and riffle:pool ratio was 2:I. Channel stability was rated as fair in this reach (Table 3.11). Lower banks had significant cuts (up to 2 feet high) and root mat overhangs and bank sloughing was evident. No instream woody debris was evident in this reach. Mean RASI values were 77 and 82 for 1993 and 1994, respectively (Table 3.11). Mean fine sediment values were 12 and 22 percent of sampled substrate, for 1993 and 1994, respectively. Total available habitat decreased during 1994 (Table 3.11).

Reach two of Benewah Creek extends for 1,342 meters and encompasses elevations ranging from 2,250-2,330 feet (Figure 2.2). This reach is forested and dominated by large shrubs. The reach was classified as a B2a channel type (Table 3.12). Channel capacity was adequate for existing flow conditions with the channel being moderately entrenched. Average stream gradient was 4 percent with the dominant habitat complex consisting of step-pools and riffles. A riffle to pool ratio of 4:I was calculated for this reach and average residual pool depth was 0.4 meters in 1993, and 7: 1 and 0.4 meters in 1994 (Table 3.12). Channel stability rated good for both 1993 and 1994 (Table 3.12). Bank protection was adequate with both shallow and deep rooted species providing stability. Debris jam potential was minor. Lower banks were well armored with approximately 70 percent of the lower banks protected by large boulders. Very little cutting or deposition occurred in this reach. Seasonal blooms of aquatic vegetation were observed. The mean RASI index value was 43 and fine sediment (c 4 mm) comprised less than 15 percent of the sampled substrate (Table 3.12). Total available habitat declined in 1994 (Table 3.12).

Reach three was classified as a C2b channel type and extends for 724 meters (Figure 2.2). This reach was mostly forested with large shrubs dominating the riparian zone. Mean stream gradient was 2 percent. Average stream canopy cover was 29 percent in 1993 and 40 percent in 1994. The dominant habitat complex in this reach was riffle-pool with a riffle pool ratio of 1.3:1 in 1993 and 2.5:1 in 1994. Average residual pool depths of 0.7 meters (1993) and 0.4 meters (1994) were calculated (Table 3.13). Channel stability was considered good (Table 3.13). Upper bank slopes ranged from 3 to 60 percent and intermittent areas of mass wasting and unstable slopes were observed. Bank protection was comprised mainly of shallow rooted species. There was evidence that channel capacity was not adequate to contain bankfull flows. Lower banks were comprised of cobble and boulder while bank cutting occured at outcurves with new coarse gravel bar development. The channel bottom was firmly embedded, with less than five percent of the bottom affected by scouring and deposition. No instream woody debris was located in this reach. Seasonal alga blooms were observed. Mean RASI values were 51 and 44 during 1993 and 1994, respectively. Fine sediment (< 4 mm) generally comprised less than 10 percent of sampled substrate (Table 3.13). Total available habitat declined in 1994 (Table 3.13).

Table 3.12. Summary table showing values for reach two, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,250-2,330 ft	2,250-2,330 ft
Dominant land use	forested	forested
Riparian ecotype	Coniferous/ Deciduous	Coniferous/Deciduous
Reach length	1,342 m	1,415 m
Channel type	B2a	B2a
Bankfull width	35ft	*
Bankfull depth	2.7 ft	*
Width/depth ratio	13	
Mean stream gradient	4 %	
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	good (74	good (80)
RASI values	*	24.1 ; 67.1 ; 38.9
% substrate < 4mm	*	10.6 %
mean substrate size (mm)	*	109
Mean % canopy cover	80 %	37 %
Barriers	none	none
# instream woody debris	5 (O/100 m^2)	6 (O/100 m^2)
Dominant habitat complex	riffle - step pool	riffle - step pool
Riffle/pool ratio	4:1	7:1
Residual pool depth	0.4 m	0.4 m
Total available habitat	51,063 m^2	20,357 m^2

Table 3.13. Summary table showing values for reach three, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,330-2,330 ft	2,330-2,330 ft
Dominant land use	forested	forested
Riparian ecotype	Coniferous/ Deciduous	Coniferous/Deciduous
Reach length	724 m	1,154 m
Channel type	C2b	C2b
Bankfull width	41 ft	*
Bankfull depth	2.7ft	•
Width/depth ratio	15	15
Mean stream gradient	2 %	2 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	low good (67)	medium good (55)
RASI values	52; 45; 56	3; 43; 87
% substrate < 4mm	8 %	6.2 %
mean substrate size (mm)	140	141
Mean % canopy cover	29 %	40 %
Barriers	none	none
# instream woody debris	3 (O/100 m^2)	1 (O/100 m^2)
Dominant habitat complex	riffle-pool	riffle-pool
Riffle/pool ratio	1.3: 1	2.5 : 1
Residual pool depth	0.7 m	0.4 m
Total available habitat	29,541 m^2	22,856 m^2

Reach four extends for 1,349 meters with elevations ranging from 2,330 to 2,380 feet (Figure 2.2). The reach is a B3c channel type with moderate entrenchment and moderate sinuosity (Table 3.14). Dominant land type in the reach was forested with large deciduous shrubs forming the dominant riparian cover. This reach has been heavily influenced by past rain-on-snow events. Average stream gradient was 1.5 percent. Riffle/pool ratio was 1 :l in 1993 and 2:l in 1994. Residual pool depth increased from 0.3 meters in 1993 to 0.7 meters in 1994 (Table 3.14). Channel stability rated from good to fair (Table 3.14). Overbank flows were common throughout the reach. There was no evidence of mass wasting problems, and lower bank cutting was limited to outcurve areas. There was little new bar development in this reach. The channel bottom was firmly embedded, with little scouring and deposition occuring in this reach. Seasonal alga blooms were present. Average RASI values were 46 in 1993. RASI values were considerably higher in 1994 (mean = 81). Fine sediment (< 4 mm) comprised less than 13 percent of the sampled substrate in both 1993 and 1994 (Table 3.14). Total available habitat increased in 1994 (Table 3.14).

Reach five was classified as a Cl b channel type and extends for 1,056 meters (Figure 2.2). Elevations in the reach began at 2,380 feet and rose to 2,490 feet. This reach contained a small bedrock falls which was not considered a migration barrier. This reach was forested with riparian vegetation dominated by large deciduous shrubs. Average stream gradient was 4.5 percent. Riffle to pool ratio Was 1.5:1 and mean residual pool depth was 0.2 meters in 1993 and 0.6 meters in 1994. Channel stability in this reach was good (Table 3.15). Landform slope ranged from 2 to 40 percent with no evidence of mass wasting problems. Occasional overbank flows have occurred in the past. The channel area was free of debris jam materials. The lower banks were composed mainly of mostly boulder which minimized bank cutting and erosional problems. Channel substrate was predominantly bedrock with no instream woody debris. Clinging aquatic vegetation was common with both algae and moss present in pools and swifter waters. No RASI surveys were conducted in this reach because of the bedrock substrate. Total available habitat increased in 1994 (Table 3.15).

Reach six extends for 835 meters with elevations ranging from 2,490 to 2,550 feet (Figure 2.2). This reach was dominanted by small shrubs, grass and forbs and was actively utilized by livestock. The reach was classified as a C3 channel type (Table 3.16). Average stream gradient was 1 percent, the channel was slightly entrenched, and sinuosity was high. Riparian vegetation provided no canopy cover and no instream woody debris was present. Dominant habitat complex was riffle/pool with a riffle pool ratio of 1.5:1. Mean residual pool depth was 0.2 meters in 1993 and 0.6 meters in 1994 (Table 3.16). Upper banks

Table 3.14. Summary table showing values for reach four, Benewah Creek, 1993 and 1994

P	1993	1994
Stream order	4th	4th
Elevation	2,330-2,380 ft	2,330-2,380 ft
Dominant land use	forested	forested
Riparian ecotype	Coniferous/Deciduous mix with large shrubs	Coniferous/Deciduous with large shrubs
Reach length	1,349 m	1,728 m.
Channel type	B3c	B3c
Bankfull width	55ft	*
Bankfull depth	2 .Oft	*
Width/depth ratio	27.5	27.5
Mean stream gradient	1.5 %	2 %
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	medium good (60)	high fair (78)
RASI values	38; 53; 46	82; 79; 83
% substrate < 4mm	6	11.7
mean substrate size (mm)	108	111
Mean % canopy cover		17.7 %
Barriers	none	none
# instream woody debris	3 (O/100 m^2)	3 (O/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1:1	2:1
Residual pool depth	0.3 m	0.7 m
Total available habitat	32,275 m^2	44,093 m^2

Table 3.15. Summary table showing values for reach five, Benewah Creek, 1993 and 1994

PRAMETER	1993	1994
Stream order	4th	4th
Elevation	2,380-2,490 ft	2,380-2,490 ft
Dominant land use	forested	forested
Riparian ecotype	Coniferous/Deciduous mix with large srubs	Coniferous/Deciduous mix with large schrubs
Reach length	1,056 m	1,244 m
Channel type	C1b	C1b
Bankfull width		•
Bankfull depth		•
Width/depth ratio	21.3	21.3
Mean stream gradient	3 %	2 %
Ent; enchment	slight	slight
Sinuoisity	high	high
Channel stability rating	high good (48)	high good (48)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	ND	16.8 %
Barriers	none	none
# instream woody debris	0 (O/l 00 m^2)	3 (O/100 m^2)
Dominant habitat complex	riffle - pool	riffle - step pool
Riffle/pool ratio	3:1	l : o
Residual pool depth	0.2 m	0.6 m
Total available habitat	30,956 m^2	29,156 m^2

Table 3.16. **Summary table showing values for reach six, Benewah Creek, 1993 and 1994**

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,490-2,550 ft	2,490-2,550 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with small shrub, grasses, & forbs	Conferous/decidous mix small shrub/grasses/forbs
Reach length	835 m	797 m
Channel type	c3	c3
Bankfull width	38 ft	*
Bankfull depth	1.9 ft	•
Width/depth ratio	20	20
Mean stream gradient	1 %	1.5 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	low good (65)	medium good (59)
RASI values	45; 43; 62	67; 29; 86
% substrate < 4mm	11	13.7
mean substrate size (mm)	82	133
Mean % canopy cover	•	3 %
Barriers	none	none
# instream woody debris	0 (0/100 m^2)	0 (0/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.5: 1	3 : 1
Residual pool depth	0.2 m	0.6 m
Total available habitat	6.995 m^2	12,694 m^2

showed evidence of past mass wasting problems. The potential for future mass wasting problems was high, due to a lack of dense, deep rooted plant species on steeper slopes. Lower banks consisted of cobbles and boulders. Some intermittent bank cutting was observed at outcurves and new gravel bar formation was evident. The channel bottom was stable and comprised of tightly packed, well distributed particle sizes. An estimated 5 to 30 percent of the channel bottom was affected by scouring and deposition. Clinging aquatic vegetation was common throughout the reach with both seasonal algae blooms and moss in pools and swifter waters. Mean RASI values were 50 and 60 in 1993 and 1994, respectively (Table 3.16). Fine sediment (< 4 mm) comprised less than 11 percent of the sampled substrate on average for both 1993 and 1994. Total available habitat increased during 1994.

Reach seven of Benewah Creek is a C3 channel type which is 3,193 meters in length. Elevations range from 2,550 to 2,560 feet (Figure 2.2). Dominant land use was livestock grazing. Riparian areas were dominated by large shrubs which provided an average canopy cover of 45 percent. Dominant habitat complex was riffle/pool with a riffle:pool ratio of 1.2: 1 in 1993 and a riffle to pool ratio of 3.1 :1 in 1994. Mean residual pool depth was 0.7 meters. Average stream gradient was 1 percent (Table 3.17). Channel stability was rated as fair (Table 3.17). Landform slope ranged from 0 to 3 percent. There were some areas where upper bank failure had occurred. Lower banks consisted of 65 percent cobble and small boulder, with bank cutting occurring at obstructions and outcurves. The lower banks barely contained existing peak flows. Recent deposition of gravel and sand sized substrate was noted throughout the reach. The channel bottom was fairly stable with 5-30 percent of the channel bottom affected by scouring and deposition. Seasonal algal blooms were observed. Mean RASI values were 44 and 78 in 1993 and 1994, respectively (Table 3.17). Fine sediment comprised an average of 13 and 16 percent of the sampled substrate in 1993 and 1994, respectively.

Reach eight is a C6 channel type which extends for 2,753 meters and encompasses elevations ranging from 2,560 feet to 2,640 feet (Figure 4.2). The channel is slightly entrenched and highly sinuous. Mean stream gradient was 1 percent (Table 3.18). Dominant land use is livestock grazing and riparian areas are vegetated with a mix of shrubs, grasses and forbs. Average canopy cover in this reach was 21 percent with instream wood densities of less than $0.1/m^2$. The dominant habitat complex was riffle/pool with a mean residual pool depth of 1 .O meters Table 3.18). Channel stability in this reach was fair to good (Table 3.18). Overbank flows were common throughout the reach. There were continous cuts along both lower banks, and some deposition of gravel and sand on old and some new bars. Scouring and deposition affected 5 to 30 percent of the channel bottom. Seasonal algal blooms made rocks slick, and moss was present in swifter waters. RASI values were variable with mean values increasing from 49 to 72 during the one year sample interval (Table 3.18). Measured fine sediment

Table 3.17. Summary table showing values for reach seven, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,550-2,560 ft	2,550-2,560 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with large shrubs	Coniferous/deciduous mix with large shrubs
Reach length	3,193 m	3,685 m
Channel type	c 3	c 3
Bankfull width	44 ft	•
Bankfull depth	2 .5 ft	⊠
Width/depth ratio	17.6	17.6
Mean stream gradient	1.4 %	1.2 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	high fair (77)	medium fair (96)
RASI values	60; 27; 45	72; 70; 93
% substrate < 4mm	13	15.5
mean substrate size (mm)	116	109
Mean % canopy cover	49 %	43 %
Barriers	none	none
# instream woody debris	1 (0/100 m^2)	19 (0.01 /100 m^2)
Dominant habitat complex	riffle-pool	riffle-pool
Riffle/pool ratio	1.2 : 1	3.1 : 1
Residual pool depth	0.7 m	0.8 m
Total available habitat	53,556 m^2	54,177 m^2

Table 3.18. Summary table showing values for reach eight, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,560-2,640 ft	2,560-2,640 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with shrubs, grasses, & forbs	Coniferous/deciduous mix with shrubs/grasses/forbs
Reach length	2,753 m	2,796 m
Channel type	C6	C6
Bankfull width	42 ft	*
Bankfull depth	1.6 ft	•
Width/depth ratio	26.2	26.2
Mean stream gradient	1.8 %	1.8 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	high fair (82)	low good (73)
RASI values	42; 33; 72	70.5; 76.2; 68.9
, % substrate < 4mm	8 %	14.7 %
mean substrate size (mm)	108	137
Mean % canopy cover	21.4 %	26.1 %
Barriers	none	none
# instream woody debris	24 (0/100 m^2)	6 (0/100 m^2)
Dominant habitat complex	riffle- pool	riffle- pool
Riffle/pool ratio	1.3 :1	2 : 1
Residual pool depth	1.0 m	0.8 m
Total available habitat	35,793 m^2	32,007 m^2

increased from a mean of 8 percent in 1993 to 15 percent in 1994. Total available habitat decreased in 1994 (Table 3.18).

Reach nine was classified as a C5 channel type and extends for 1,032 meters (Figure 2.2). Dominant land use in the reach was livestock grazing and riparian areas were primarily vegetated with small shrubs. The channel was slightly entrenched and highly sinuous. Mean stream gradient was less than 2 percent. Mean canopy cover was 5 percent and instream woody debris densities were less than $0.1/m^2$. Riffle/pool ratios were 1.7:1 and 2.8:1 in 1993 and 1994, respectively. Mean residual pool depths were 0.8 meters for 1993 and 1994, respectively (Table 3.19). Channel stability ratings varied from poor to fair in 1993 and 1994, respectively and were generally less stable than downstream reaches (Table 3.19). Channel capacity was inadequate to contain bankfull flows. Lower banks were generally comprised of sand and gravel sized material. Scour and deposition were the dominant channel forming processes in the reach. The channel bottom was in a constant state of flux and deposition of fine sediment resulted in reduced pool volumes. No RASI surveys were completed for this reach. Total available habitat increased during 1994.

Reach ten has a total length of 2,846 meters and encompasses elevations ranging from 2,640 feet to 2,750 feet (Figure 2.2). The reach was classified as a C6 channel type with slight entrenchment and high sinuosity (Table 3.20). Dominant land use was livestock grazing with a riparian area comprised of large shrubs. The reach had instream woody debris densities of $8.5/100\ m^2$. Average residual pool depth was 0.9 meters in 1993 and 0.5 meters in 1994 (Table 3.20). Channel stability was rated as fair (Table 3.20). Landform slope ranged from zero to twenty five percent with no evidence of mass wasting. Stream bank vegetation was comprised of shallow rooted species. Debris jam potential was high for the entire reach. Channel capacity was insufficient to contain peak flows. There was evidence of frequent channel migration, and a significant amount of bank cutting and sloughing had occurred. A moderate amount of gravel and sand deposition was identified on old and new bars. The channel bottom consisted of a loose assortment of well-rounded material. Stable bottom materials occurred on 20-50 percent of the reach. Seasonal algal blooms were observed. Dominant habitat complex in this reach was riffle-pool with a riie to pool ratio of 3.5:1 for 1993 and 1994. Total available habitat decreased during 1994.

Reach eleven was classified as a E6 channel type and extended for 589 meters (Figure 2.2). Elevations ranged from 2,750 feet to 2,760 feet. Dominant land use was livestock grazing and riparian areas were primarily vegetated with large shrubs. Riparian vegetation provided 21 percent stream canopy cover and instream large woody debris densities were less than $0.1/100m^2$. The channel was slightly entrenched (width:depth ratio = 3.9) and highly sinuous (Table 3.21).

Table 3.19. Summary table showing values for reach nine, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,640-2,640 ft	2,640-2,640 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/ Deciduous mix with shrubs	Coniferous/deciduous mix with shrubs
Reach length	1,032 m	868 m
Channel type	C5	C5
Bankfull width	80 ft	•
Bankfull depth	6 ft	•
Width/depth ratio	13.3	
Mean stream gradient	1.75 %	1.3 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	poor (122)	fair (90)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	45 %	10.5 %
Barriers	none	none
# instream woody debris	29 (0/100 m^2)	74 (0/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.7: 1	2.8 : 1
Residual pool depth	0.8 m	0.8 m
Total available habitat	27,231 m^2	60,016 m^2

Table 3.20. Summary table showing values for reach ten, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,640-2,750 ft	2,640-2,750 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/ Deciduous mix with shrubs	Coniferous/deciduous mix with shrubs
Reach length	2,846 m	693 m
Channel type	C6	C6
Bankfull width	30ft	•
Bankfull depth	2ft	•
Width/depth ratio	13.3	*
Mean stream gradient	1 %	1.2 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	medium fair (100)	•
RASI values	•	•
% substrate < 4mm	•	•
mean substrate size (mm)	•	•
Mean % canopy cover	0%	0%
Barriers	none	none
# instream woody debris	242 (8.5/100 m^2)	58 (8.2/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	3.5 : 1	3.5 : 1
Residual pool depth	0.9 m	0.5 m
Total available habitat	39,637 m^2	5,689 m^2

Table 3.21. Summary table showing values for reach eleven, Benewah Creek, 1993 and 1994

PARAME~ R	1993	1994
Stream order	4th	4th
Elevation	2,750-2,760 ft	2.750-2.760 ft
Dor ·ıant land use	Livestock grazing	Livestock grazing
Ripa ran ecotype	Coniferous/Deciduous mix with shrubs	Coniferous/deciduous mix with shrubs
Reach length	589 m	1,145 m
Channel type	E6	E6
Bankfull width	27 ft	•
Bankfull depth	6.9 ft	•
Width/depth ratio	3.9	
Mean stream gradient	1 %	1.2 %
Entrenchment	slight	slight
Sinuc ity	very high	very high
Channel stability rating	high poor (125)	high poor (115)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	21.4 %	35 %
Barriers	none	none
# instream woody debris	25 (0.1/100 m^2)	32 (0.1/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	2.4 : 1	2.3 : 1
Residual pool depth	0.7 m	0.4 m
Total available habitat	6,23 · m^2	4,439 m^2

Mean stream gradient was 1 percent and mean residual pool depth was 0.7 and 0.4 meters for 1993, and 1994, respectively (Table 3.21). Channel stability was rated as poor (Table 3.21). Landform slope ranged from O-5 percent and no mass wasting was evident on the upper banks. Shallow rooted plant species provided discontinuous bank cover. Lower banks lacked a cohesive structure, resulting in continous bank cutting and extensive fine sediment deposition. Debris jam potential was estimated to be high. Channel capacity was adequate to contain peak flows. Channel substrate was comprised of a loose assemblage of fine gravels and sand and appeared to be in a constant state of flux. Dominant habitat complex was riffle pool with total available habitat declining in 1994.

Reach twelve is 1,257 meters in length and encompasses elevations ranging from 2,760 feet to 2940 feet (Figure 2.2). The reach was classified as a C5-C6 channel type (Table 3.22). This is a fourth order drainage with an average stream gradient of less than 1 percent. Dominant land use was forest production and livestock grazing. Riparian areas were dominated by large shrub species. Average canopy closure was 52 percent and instream woody debris densities were 28.1/100 m^2 in 1993. In 1994 average canopy closure was 44 percent and instream woody debris densities were 13.2/100 m^2. Riffle to pool ratios was 1.3:1 and mean residual pool depths were 0.4 meters in 1993. IN 1994 riffle-pool ratio was 2: 1 and residual pool depth was 0.4 meters. (Table 3.22). Channel stability was rated as poor (Table 3.22). Landform slope was less than one percent and no sediment sources were associated with the floodplain. Riparian vegetation showed signs of overgrazing and shallow-rooted plant species provided only discontinuous bank cover. Overbank flows were common in stream segments degraded by cattle use. Lower banks consisted primarily of gravel and smaller sized material and bank failure resulting from undercutting was common. Extensive deposition of fine sediment accelerated bar development. The channel bottom was composed of loose, well rounded sediments with evidence of scouring and deposition occurring year long. Aquatic vegetation was absent in this reach.

Reach thirteen extends 1,508 meters up the mainstem of Benewah Creek beginning at the confluence with the South Fork Benewah Creek (Figure 2.2). The reach is a second order drainage and encompasses elevations ranging from 2,940 to 3,060 feet. The dominant land type was forest with a riparian area comprised mainly of young coniferous and deciduous trees. The reach was classified as a E4 channel type characterized by very high sinuosity and slight entrenchment. Mean stream gradient was 2 percent (Table 3.23). Average stream canopy cover was 75 percent with woody debris densities of 32.4/100 m^2 in 1993. In 1994, average stream canopy cover was 84 percent with woody debris densities of 17.2/100 m^2. Mean residual pool depth was 0.4 meters in

Table 3.22. Summary table showing values for reach twelve, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,760-2,940 ft	2,760-2,940 ft
Dominant land use	Forest/Livestock grazing	Forest/Livestock grazing
Riparian ewtype	Coniferous/deciduous mix with shrubs	Coniferous/deciduous mix with shrubs
Reach length	1,257 m	1,412 m
Channel type	C5 - C6	C5 - C6
Bankfull width	NA	*
Bankfull depth	3.0 ft	*
Width/depth ratio	NA	*
Mean stream gradient	<1 %	1.2 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	mediuim poor (129)	poor (115)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	51.6 %	44 %
Barriers	none	none
# instream woody debris	355 (28.1/1 00 m^2)	186 (13.2/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.3 : 1	2 : 1
Residual pool depth	0.4 m	0.4 m
Total available habitat	10,197 m^2	12,394 m^2

Table 3.23. Summary table showing values for reach thirteen, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	2,940-3,060 ft	2,940-3,060 ft
Dominant land use	Forest	Forest
Riparian ecotype	Coniferous/Deciduous mix with young trees	Coniferous/Deciduous mix with young trees
Reach length	1,508 m	761 m
Channel type	E4	E4
Bankfull width	15ft	•
Bankfull depth	2 .5 ft	•
Width/depth ratio	6	
Mean stream gradient	2 %	3.8 %
Entrenchment	slight	slight
Sinuoisity	very high	very high
Channel stability rating	high fair (83)	fair (107)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	75.3 %	84%
Barriers	none	none
# instream woody debris	488 (32.41100 m^2)	131 (17.2/100 m^2)
Dominant habitat complex	riffle-pool /step pool rapid	riffle-step pool
Riffle/pool ratio	1 : 1.2	2 : 1
Residual pool depth	0.4 m	0.7 m
Total available habitat	13,783 m^2	6,873 m^2

1993 and 0.7 meters in 1994. This reach had a channel stability rating of fair (Table 3.23). Upper bank slope ranged from O-20 percent and included examples of historic bank failures that had stabilized over time. Debris jam potential was minimal with only small woody debris present in the channel. Vegetation covered 70-90 percent of the upper banks, but plant communities lacked the species diversity found in other reaches. The channel capacity was adequate for containing existing peak flows. Lower banks contained small cobble-sized materials with only minor cutting occurring at obstructions and outcurves. New bar development was minimal. The channel bottom was moderately stable and very little scouring and deposition was observed in the reach. The dominant habitat complex was a riffle-step pool complex. Total available habitat declined in 1994.

Reach fourteen consisted of 3,293 meters of the South Fork Benewah Creek (denoted on Figure 2.2 as reaches 13a and 14a) beginning at the confluence with the mainstem. Dominant land use is livestock grazing and riparian areas are dominated by young conifers and deciduous trees, and shrubs. The reach was classified as E3b and E4 channel types and encompassed elevations ranging from 2,647 to 3,061 feet (Table 3.24). Average stream canopy cover was 52 percent and densities of instream woody debris were 12.111 00m^2 in 1993. In 1994, mean stream canopy cover was 76 percent with densities of instream woody debris of 2.9/100m^2. The dominant habitat complex was riffle-pool/step pool rapid. Riffle to pool ratio was 1.1: 1 and 2.7: 1 in 1993 and 1994, respectively. Mean residual pool depth remained constant in 1993 and 1994 at 0.2 meters (Table 3.24). Channel stability was rated fair to good (Table 3.24). Upper bank slopes ranged from O-15 percent with no evidence of mass wasting. Debris jam potential was minimal with mostly small twigs and limbs present. Upper bank vegetation consisted mainly of shrubs and covered 50 to 70 percent of the surface area. The channel capacity was adequate for existing peak flows. Minor bank cutting was observed at obstructions and outcurves. Some fresh deposition of gravel sized material was noted on point bars. Bottom materials were moderately packed and stable. RASI surveys were conducted at one location on the South Fork Benewah Creek in 1993. The index value of 50 suggested an equilibrium had been reached between scour and depositional processes (Table 3.24). Levels of fine sediment were higher than other downstream reaches (20 percent).

3.1.3. Evans Creek

Channel typing surveys identified 10 reaches in the Evans Creek watershed. Reaches l-7 are located on the mainstem, reach 5a encompasses the North Fork drainage, and reaches 5b and 6b are located on the South Fork Evans Creek (Figure 2.3). Physical conditions are described below for reaches l-7 on the mainstem, reach 5a on the North Fork, and 5b and 6b on the South

Table 3.24. Summary table showing values for reach fourteen, Benewah Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	3rd	3rd
Elevation	2,847-3,061 ft	2,847-3,061 ft
Dominant land use	Forest /Livestock grazing	Forest/Livestock grazing
Riparian ecotype	Coniferous/Deciduous mix with shrub/young trees	Coniferous/Deciduous mix with shrub/young trees
Reach length	3,293 m	3,493 m
Channel type	E3b - E4	E3b - E4
Bankfull width	22 ft	•
Bankfull depth	2.2 ft	•
Width/depth ratio		*
Mean stream gradient	3 %	<1 %
Entrenchment	slight	slight
Sinuoisity	very high	very high
Channel stability rating	low good (76)	medium good (92)
RASI values	50	•
% substrate < 4mm	20.1	•
mean substrate size (mm)	76	•
Mean % canopy cover	51.7 %	76 %
Barriers	none	none
# instream woody debris	398 (0/100 m^2)	103 (0/1 00 m^2)
Dominant habitat complex	riffle - pool/step pool rapid	riffle / step pool
Riffle/pool ratio	1.1 : 1	2.7 : 1
Residual pool depth	0.2 m	0.2 m
Total available habitat	54,795 m^2	24,604 m^2

Fork. For general descriptions to summarize conditions, mainstem reaches 5-7 were combined and reaches 5b and 6b of the South Fork were combined.

Reach one of Evans Creek was classified as a C6 channel type with a total length of 880 meters (Figure 2.3). Evans Creek is a third order drainage at the mouth. Dominant land use within this reach was livestock grazing. The riparian area was dominated by grasses and small shrubs. The channel is highly sinuous and mean stream gradient is less than 1 percent (Table 3.25). Average canopy cover in this reach was 28 percent in 1993 and 16 percent in 1994. No instream woody debris was present. Riffle to pool ratio was 1.7:1 and mean residual pool depth was 0.4 meters (Table 3.25). This reach received a poor channel stability rating as a result of a combination of unstable conditions on the upper and lower banks and channel. Landform slope ranged from O-3 percent and no evidence of mass wasting problems were present, however, upper bank vegetation was shallow rooted and discontinuous, covering less than 50 percent of the surface area. Debris jam potential was limited to small limbs and twigs. The channel capacity had been reduced as a result of frequent bank failures and was inadequate to contain bankfull flows. The lower banks consisted mainly of highly erodible fine sediment. The channel bottom was unstable and accelerated bar development was observed throughout this reach.

Reach two extended 1,581 meters and was classified as a C3 channel type (Figure 2.3). Dominant land use within this reach was livestock grazing. The riparian area was dominated by mature trees and shrubs. Average canopy cover in this reach was 52 percent with instream woody debris loads of 1.5/100 m^2 in 1993. in 1994, average canopy cover was 34 percent with instream woody debris densities 9.4/100m^2. Residual pool depths averaged 0.2 meters in 1993 and 0.6 meters in 1994 (Table 3.26). Channel stability rated from poor to fair (Table 3.26). Upper bank slopes were generally less than 3 percent and no mass wasting was evident. Bank vegetation consisted of discontinuous, shallow rooted species with a density of less than 50 percent. Channel capacity was reduced due to channel alterations and allowed for occasional overbank flooding. There was significant amounts of bank cutting and sloughing, as well as accelerated bar development. Riffle armor stablity index values were highly variable, ranging from 39.8 to 75.2 (mean=59) in 1993 and 89.4 to 97.5 (mean=93) in 1994 (Table 3.26). Fine sediment (< 4 mm) generally comprised less than 10 percent of the sampled substrate with the exception of a single measurement (36 percent) taken in 1993 (Table 3.26). Dominant habitat complex was riffle-pool with total available habitat decreasing in 1994.

Reach three is 1,722 meters in length and encompasses elevations ranging from 2,130 to 2,270 feet (Figure 2.3). Dominant land use within this reach was forested. The riparian area was dominated by mature coniferous

Table 3.25. Summary table showing values for reach one, Evans Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	3rd	3rd
Elevation	2,130-2,130 ft	2,130-2,130 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/deciduous grasses/forbs	Coniferous/deciduous grasses/forbs
Reach length	880 m	1,583 m
Channel type	C6	C6
Bankfull width	21 ft	•
Bankfull depth	2 ft	•
Width/depth ratio	10	•
Mean stream gradient	<1 %	1.3 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	high poor (122)	high poor (125)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	28.3 %	16.0 %
Barriers	none	none
# instream woody debris	0 (0/100 m^2)	5 (0/100 m^2)
Dominant habitat complex	pool-riffle	riffle-pool
Riffle/pool ratio	1.7 : 1	1 : 1
Residual pool depth	0.4 m	0.5 m
Total available habitat	35,957 m^2	9,556 m^2

Table 3.26. Summary table showing values for reach two, Evans Creek, 1993 and l994

PARAMETER	1993	1994
Stream order	3rd	3rd
Elevation	2,130-2,130 ft	2.130-2.130 ft
Dominant land use	Forest /Livestock grazing	Forest/Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with mature trees/shrubs	Coniferous/deciduous mix with mature trees/shrubs
Reach length	1,581 m	965 m
Channel type	c3	c3
Bankfull width	25ft	*
Bankfull depth	3ft	*
Width/depth ratio	7.8	6.0
Mean stream gradient	1 %	1.3 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	high poor (119)	meduim fair (101)
RASI values	75; 40; 63	91; 98; 89
% substrate < 4mm	14 %	6.6 %
mean substrate size (mm)	66	145
Mean % canopy cover	51.8 %	34.1 %
Barriers	none	none
# instream woody debris	76 (4.0/100 m^2)	26 (O/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.2: 1	1.2: 1
Residual pool depth	0.2 m	0.6 m
Total available habitat	75,090 m^2	25,006 m^2

Table 3.27. Summary table showing values for reach three, Evans Creek, 1993 and l994

PARAMETER	1993	1994
Stream order	3rd	3rd
Elevation	2,130-2,270 ft	2,130-2,270 ft
Dominant land use	forested	forested
Riparian ecotype	Coniferous/deciduous mix mature trees/shrubs	Coniferous/deciduous mix mature trees/shrubs
Reach length	1,722 m	927 m
Channel type	E3b	E3b
Bankfull width	ft	*
Bankfull depth	ft	•
Width/depth ratio		•
Mean stream gradient	2 %	1.9 %
Entrenchment	slight	slight
Sinuoisity	very high	very high
Channel stability rating	fair (95)	fair (94)
RASI values	67; 82; 60	84; --; 92
% substrate < 4mm	19	18.9
mean substrate size (mm)	98	136
Mean % canopy cover	65.2 %	44.1 %
Barriers	none	none
# instream woody debris	56 (3.2000 m^2)	90 (9.7/100 m^2)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.6: 1	1.2: 1
Residual pool depth	1.5 m	0.5 m
Total available habitat	21.471 m^2	14.471 m^2

and deciduous trees and large shrubs. The reach was classified as a E3b channel type (Table 3.27). Mean stream gradient was 2 percent, channel entrenchment was slight (>2.4) and sinuosity was very high (>1.5). Average stream canopy cover was 65 percent and instream woody debris loads were 3.3/100m2 in 1993. In 1994, average stream canopy cover was 44% with instream woody debris densities of 9.7/100m^2. Riffle to pool ratio stayed relatively unchanged for 1993 and 1994 at 1.6: 1 and 1.2:1, respectively. Mean residual pool depths decreased in 1994 from 1.5 meters in 1993 to 0.5 meters in 1994 (Table 3.27). This decrease corresponded to a decrease in total available habitat. Channel stability rated fair (Table 3.27). Density of bank vegetation was 70-90 percent. Debris jam potential was abundant but mostly in the form of small twigs and limbs. The channel capacity was adequate to contain peak flows. Slight bank cutting occurred at flow deflectors and outcurves, and some new point bar development was noted. Mean RASI values were higher in 1994 than in 1993 (88 and 70, respectively). Mean percent fines (< 4 mm) were 17 and 19 for 1993 and 1994, respectively (Table 3.27).

Reach four is 1,800 meters in length and encompasses elevations ranging from 2,270 to 2.580 feet (Figure 2.3). Dominant land use was forested with the riparian area nsisting of a mix of mature coniferous and deciduous trees. The reach was cl, sified as a B3a channel type with moderate entrenchment and sinuosity (Table 3.28). Mean stream gradient was 3 percent. Average canopy cover was 69 percent with instream woody debris at densities of 1 X100 m^2 in 1993. In 1994, average stream canopy cover decreased to 44 percent while instream woody debris increased to 10.2/l 00 m^2. Riffle to pool ratio was 1:32 and mean residual pool depth was 0.3 meters in 1993. In 1994, the riffle to pool ratio was 1.2:1 with a mean residual pool depth of 0.3 meters. (Table 3.28). Channel stability rating fair for this reach (Table 3.28). Upper bank slopes ranged from 2040 percent with intermittent, older bank failures noted. Bank vegetation density was greater then 90 percent with high diversity of both shallow and deep rooted species. The channel capacity was adequate for existing flow conditions. There was a moderate amount of lower bank cutting at obstructions and outcurves, and some new gravel bar development in this reach. The channel bottom throughout the reach was fairly stable with approximately 5-12 percent of the bottom substrate affected by scouring and deposition. Algal blooms and moss were observed in this reach in slack and swift water. Mean RASI values were considerably higher in 1994 than in 1993 (89 compared with 41) as were the geometric mean diameters of point bar particles (164 mm compared with 84 mm). Fine sediment (< 4 mm) comprised an average of 13 and 22 percent in 1993 and 1994, respectively (Table 3.28).

Channel surveys were conducted on 990 meters of the mainstem upstream of the three forks area (Figure 2.3). This is a second order drainage

Table 3.28. Summary table showing values for reach four, Evans Creek, 1993 and l994

PARAMETER	1993	1994
Stream order	3rd	3rd
Elevation	2,270 -2,580 ft	2,270-2,580 ft
Dominant land use	Forested	Forested
Riparian ecotype	Coniferous/deciduous mix with mature trees	Coniferous/deciduous mix with mature trees
Reach length	1,800 m	1,818 m
Channel type	B3a	B3a
Bankfull width	•	•
Bankfull depth	•	•
Wrdth/depth ratio	•	⊠
Mean stream gradient	3 %	2.8 %
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	low good (77)	fair (86)
RASI values	59; 61; 57	90; 93; 85
% substrate < 4mm	13	21.8
mean substrate size (mm)	84	164
Mean % canopy cover	69.4 %	44 %
Barriers	none	none
# instream woody debris	21 (1.2/l 00 ft)	186 (10.2/l 00 linear ft)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1 : 32	1.2: 1
Residual pool depth	0.3 m	0.3 m
Total available habitat	25,541 m^2	30,505 m^2

Table 3.29. Summary table showing values for reach five, Evans Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	2,580-3,340 ft	2.580-3340 ft
Dominant land use	Forested	Forested
Riparian ecotype	Coniferous/deciduous mix with mature trees	Coniferous/deciduous mix with mature trees
Reach length	990 m	735 m
Channel typt	A2a - B3a	A2a - B3a
Bankfull widt:	•	⊠
Bankfull depth	•	*
Width/depth ratio	17.3	•
Mean stream gradient		3.1 %
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	good (67)	good (72)
RASI values	43; 52; 31	60; 62; 64
% substrate < 4mm	22 %	13.6 %
mean substrate size (mm)	75	123
Mean % canopy cover	37.5 %	59.7 %
Barriers	none	none
# instream woody debris	90 (9.1 /lo0 m^2)	191 (25.91100 m^2)
Dominant habitat complex	step - pool : rapid	step - pool : rapid
Riffle/pool ratio	1 : 1.3	1 :6
Residual pool depth	0.5 m	0.5 m
Total available habitat	10,696 m^2	17,779 m^2

with elevations beginning at 2,580 feet and rising to 3,340 feet. The reach was comprised of A and B channel types with moderate to high entrenchment ratios (< 2.2) and low to moderate sinuosity (Table 3.29). Stream gradient varied from 7 to 10 percent. Average stream canopy cover was 37.5 percent with instream woody debris densities of 9.11100 m^2 in 1993. In 1994, average stream canopy cover was 59.7 percent with instream woody debris densities of 25.9/100 m^2. Riffle to pool ratio was 1: 1.3 and mean residual pool depth was 0.5 meters. Channel stability was rated good (Table 3.29). Upper bank slopes ranged from 1 O-90 percent with no evidence of mass wasting problems. Upper bank vegetation density was greater than 90 percent with both shallow and deep rooted species represented. The channel capacity was adequate for existing peak flows. There were few obstructions or flow deflectors in this reach. Lower bank cutting was minimal with only a few areas of new gravel bar development. The channel bottom was stable with abundant moss and algal growth noted throughout the reach. The Old Rainbow Mine is located in the upper segment of reach 7 (Figure 4.3). In this area some small bank failures were observed on steeper, less stable slopes. Lower bank cutting was observed at obstructions and outcurves, with moderate amounts of new bar development from coarse gravels. Mean RASI values were 42 and 62 for 1993 and 1994, respectively. Fine sediment comprised up to 23 percent of the sampled substrate in 1993 and up to 17 percent in 1994 (Table 3.29).

Physical surveys were conducted on 977 meters of the North Fork Evans Creek encompassing elevations ranging from 2,580 to 3,170 feet (Figure 2.3). This reach is a second order stream. The dominant land use was forested with some areas of livestock grazing. The riparian area consisted of mature coniferous and deciduous trees and shrubs. This drainage included B3a and E3b channel types (Table 3.30). Average stream gradient was 10 percent. Average canopy cover in this reach was 34 percent with instream woody debris densities of 1.61100 m^2. Riffle to pool ratio was 3:1 and average residual pool depth was 0.3 meters (Table 3.30). No significant changes were reported in 1994. Channel stability ranged from fair to good (Table 3.30). Upper bank slopes ranged from 0-45 percent with no evidence of mass wasting problems. Bank vegetation density varied from 70-90 percent. Plant density was less vigorous in some areas as a result of encroachment of the north fork road. There were fair amount of debris jam potential in this reach. The channel capacity was adequate for existing peak flows. Small amounts of bank cutting occurred at obstructions and outcurves with some new bar develoment resulting from deposition of gravels. Clinging aquatic vegetation was abundant throughout this reach.

Surveys were conducted along 694 meters of the South Fork Evans Creek (Figure 2.3). This is a second order drainage with elevations beginning at 2,580 feet and rising to 3,040 feet. Dominant land use is forested with the

Table 3.30. Summary table showing values for reach six, (north fork) Evans Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	2,580-3,170 ft	2,580-3,170 ft
Dominant land use	Forested/Livestock grazing grazing	Forested/Livestock grazing
Riparian ecotype	Coniferous/Deciduous with mature timber	Coniferous/Deciduous with mature timber
Reach length	977 m	1,015 m
Channel type	B3a - E3b	B3a - E3b
Bankfull width	•	*
Bankfull depth	•	•
Width/depth ratio	6.3	•
Mean stream gradient	10%	10.8 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	good (70)	good (72)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	34%	39 %
Barriers	none	none
# instream woody debris	50 (1.6 /100 ft)	35 (1 /100 ft)
Dominant habitat complex	step-pool cascade	step-pool cascade
Riffle/pool ratio	3 : 1	5 : 1
Residual pool depth	0.3 m	0.2 m
Total available habitat	5,996 m^2	6,526 m^2

Table 3.31. Summary table showing values for reach seven, (south fork) Evans Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	2,580-3,040 ft	2,580-3,040 ft
Dominant land use	Forested	Forested
Riparian ecotype	Coniferous/deciduous mix with mature trees	Coniferous/deciduous mix with mature trees
Reach length	694 m	665 m
Channel type	A2 - A4	A2 - A4
Bankfull width	•	•
Bankfull depth	*	•
Width/depth ratio	11.1	•
Mean stream gradient	8.1 %	8.1 %
Entrenchment	high	high
Sinuoisity	low	low
Channel stability rating	fair (76)	fair (82)
RASI values	63 ; 85 ; 72	65 ; 78 ; ---
% substrate < 4mm	23 %	38.5%
mean substrate size (mm)	80	67
Mean % canopy cover	70.0 %	66 %
Barriers	none	none
# instream woody debris	86 (3.8 /100 ft)	34 (2 /100 ft)
Dominant habitat complex	step - pool : rapid	step - pool : rapid
Riffle/pool ratio	NA	5 : 1
Residual pool depth	NA	0.2
Total available habitat	2,827 m^2	7,960 m^2

riparian area consisting of mature coniferous and deciduous trees. This reach was classified as an A channel type. Average stream gradient was 8 percent with some areas in excess of 15 percent. Average canopy cover in this reach was 70 percent with instream woody debris densities of 3.81100 m^2. The dominant habitat complex in this reach was step-pool/rapid (Table 3.31). Channel stability was rated - to good (Table 3.31). Upper bank slopes ranged from 30-75 percent with sor ifrequent, small upper bank failures, and some older healed bank failures. L dbis dams were common throughout the reach with abundant recruitable sized materials located within the floodplain. Upper bank vegetation varied from a vigorous assemblage of deep and shallow rooted species with a density greater then 90 percent to less vigorous communities. The channel capacity was barely adequate to contain peak flows. Most bank cutting occurred as a result of obstructions created by debris dams. Some new gravel bar development was noted in the more sinuous segments of the reach. Increased filling of pools with silts and sands was observed in the upper reaches of this segment. There was abundant clinging aquatic vegetation throughout this reach. RASI values ranged from 63.4 to 84.6 and percent fine sediment was greater than in all downstream reaches (mean=39 percent).

3.1.4. Alder Creek

Channel surveys identified 13 reaches in the Alder Creek watershed (Figure 2.4). Nine of these reaches were located in the mainstem of Alder Creek and four reaches were located in the North Fork drainage. of the nine reaches identified in the mainstem of Alder Creek, reaches one and two were combined for general descriptions and were labeled reach one. Reaches three and four were also combined and labeled reac two. Reaches five and six were also combined and labeled reach three. In the North Fork drainage reach 2a and 3a were combined into reach two, North Fork Alder Creek.

Reach one is 881 meters in length and encompasses elevations ranging from 2,260 to 2,350 feet (Figure 2.4). The dominant land type in this reach is forested/floodplain with a riparian area consisting of young coniferous/deciduous trees, shrubs, forbs and grasses. The reach was classified as a B3a-B3c channel type (Table 3.32). Average s. am canopy cover was 32 percent with instream woody debris density of 1.61 00 m^2 for 1993. In 1994 average stream canopy was 22 percent with instream woody debris densities of 32/100 m^2. Riffle to pool ratio was l-4:1 and mean residual pool depth was 0.6 meters (Table 3.32). Channel stability was rated as fair to good (Table 3.32). Upper bank slopes ranged from 5-60 percent with no evidence of mass wasting problems. Vegetation density on the upper slopes was quite vigorous (90 percent density). Debris jam potential was moderate, consisting mostly of small twigs and limbs. The channel capacity is barely adequate to contain existing

Table 3.32. Summary table showing values for reach one, Alder Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,260-2,350 ft	2,260-2,350 ft
Dominant land use	Forested	Forested
Riparian ecotype	Coniferous/deciduous mix with young trees, shrubs & grasses	Coniferous/deciduous mix young timber/shrubs & 8 grasses
Reach length	881 m	876 m
Channel type	B3a - B3c	B3a - B3c
Bankfull width	ft	•
Bankfull depth	ft	•
Width/depth ratio		•
Mean stream gradient	2 %	5 %
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	fair (88)	good (76)
RASI values	32; 38; 29	58; 69; 39
% substrate < 4mm	7.7	9.5
mean substrate size (mm)	57	136
Mean % canopy cover	32%	22%
Barriers	none	none
# instream woody debris	14 (1.61100 m^2)	28(3.2/100 m^2)
Dominant habitat complex	riffle - pool	riffle - ~001
Riffle/pool ratio	1.4: 1	1:1
Residual pool depth	0.6 m	0.7 m
Total available habitat	28,242 m^2	18,411 m^2

peak flows. Bank cutting is limited to outcurves and constrictions with moderate amounts of sand and gravel deposition. Mean RASI values were 33 and 55 in 1993 and 1994, respectively. Fine sediment (< 4 mm) comprised less than 10 percent of the sampled substrate in both 1993 and 1994 (Table 3.32). Dominant habitat complex consisted of riffle-pool with total available habitat declining in 1994.

Reach 2 extends for 4,188 meters and encompass elevations ranging from 2,350 to 2,630 feet (Figure 2.4). The upstream end of this reach is delineated by a twenty-five foot bedrock waterfall. This waterfall acts as a fish passage barrier except for in extreme high water years. Dominant land type was forested with livestock grazing occurring on the adjacent uplands. The riparian area was dominated by mature coniferous and deciduous trees with shrubs, forbs, and grasses present. The reaches included A2 and A3 channel types. The channel was highly entrenched, had low sinuosity, and a mean stream gradient of 3 percent (Table 3.33). Average stream canopy cover was 30 percent and instream woody debris densities were 0.5/100 feet. Riffle to pool ratio was 1.2: 1 and mean residual pool depth was 0.6 meters (Table 3.33). Channel stability rated fair to good (Table 3.33). Upper bank slopes ranged from 65-86 percent and were marked by frequent bank failures and small areas of mass wasting. Vegetation density was greater then 90 percent. Debris jam potential was moderate and consisted mainly of small woody debris. The channel capacity was adequate for existing peak flows. Bank cutting occurred at obstructions and outcurves with some newly developed gravel bars noted. Clinging aquatic vegetation was common in most areas of the reach. Mean RASI values were 25 and 59 in 1993 and 1994, respectively. Fines (c 4 mm) comprised an average of 7 percent of the sampled substrate in 1993 and 11 percent in 1994 (Table 3.33).

Reach 3 of Alder Creek were classified as C3 type channel with some higher gradient areas resembling E3b type channels (Table 3.36). The reach encompasses 2,439 meters and elevations vary from 2,163 to 2,700 feet (Figure 2.4). Dominant land use in this reach was livestock grazing. The riparian area consisted of shrubs, grasses and forbes. Average canopy cover was 32 percent with very little instream woody debris present (c O.l/lOO feet). Dominant habitat complex was rif8e pool with one area of this reach consisting of a bedrock/boulder cascade area. Riffle to pool ratio was 1.3:1 and mean residual pool depth was 1.2 meters during 1993. In 1994, riie to pool ratio was 4.4:1 with a mean residual pool depth of 0.2 meters. This reach of Alder Creek had a channel stabilty rating of good (Table 3.34). Upper bank slopes were predominantly less than 30 percent, though intermittent portions had slopes up to 80 percent. Debris jam materials consisted of small limbs and twigs. Vegetation density was 70-90 percent, but consisted mostly of shallow rooted species. The channel capacity was adequate for existing peak flows. Bank

Table 3.33. Summary table showing values for reach two, Alder Creek, 1993and1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,350-2,630 ft	2,350-2,630 ft
Dominant land use	Livestock grazing/forested	Livestock grazing/forested
Riparian ecotype	Coniferous/deciduous mix with mature trees, shrubs, forbs and grasses	Coniferous/deciduous mix mature trees, shrubs, forbs and grasses
Reach length	4,188 m	4,207 m
Channel type	A2-A3	A2-A3
Bankfull width	ft	•
Bankfull depth		•
Width/depth ratio		•
Mean stream gradient	3 %	4 %
Entrenchment	high	high
Sinuoisity	low	low
Channel stability rating	slog (73)	cl& (73)
RASI values	33; 25; 16	62; 66; 50
% substrate < 4mm	7.3	10.5
Barriers	none	none
# instream woody debris	70 (0.5 /100 ft)	50 (6.4 /100 ft)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.2 : 1	4: 1
Residual pool depth	0.6 m	0.8 m
Total available habitat	30.361 m^2	96.260 m^2

Table 3.34. Summary table showing values for reach three, Alder Creek, 1993 and 1994

PARAMETER	1993	1994
Stream ord er	4th	4th
Elevation	2.1632,700 ft	2,163-2,700 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with shrubs, forbs,grasses	Coniferous/deciduous mix with shrubs,forbs,grasses
Reach length	2,490 m	2,439 m
Channel t ype	C3 - E3b	C3 - E3b
Bankfull h	ft	*
Bankfull	ft	•
Width/depth ratio	11.3	*
Mean stream gradient	2 %	2.5 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	god (68)	good (72)
RASI values	28; 40; 31	60; 46; 71
% substrate < 4mm	9.6	9.4
mean substrate size (mm)	48	162
Mean % canopy cover	32 %	32 %
Barriers	none	none
# instream woody debris	14 (0.1 /100 ft)	15 (0.2 /100 ft)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.3: 1	4.4 : 1
Residual pool depth	1.2 m	0.2 m
Total available habitat	42.423 m^2	55.005 m^2

cutting occurred at flow deflectors and outcurve areas. Some new bar development had occurred as evidenced by coarse gravel deposition. The channel bottom was fairly stable. Clinging aquatic vegetation was common throughout the reach with both algae and moss present. Mean RASI values were 33 and 59 in 1993 and 1994, respectively. Fine sediment (< 4 mm) comprised less than 10 percent of the sampled substrate in both 1993 and 1994 (Table 4.4.3).

Reach four extended for 5,053 meters and encompassed elevations ranging from 2,700 to 2,900 feet (Figure 2.4). Dominant land use in this reach was livestock grazing. The riparian area consisted of mature deciduous/coniferous trees, shrubs, grasses and forbs. The channel was classified as a C3 channel type with a mean stream gradient of 1.5 percent (Table 3.35). Average canopy cover was much lower than other reaches in the drainage (6 percent) with instream woody debris densities of 0.51100 feet. Riffle to pool ratio was 1.2:1 in 1993 and 2.6:1 in 1994. Mean residual pool depth was 0.5 meters for both 1993 and 1994. Channel stability was rated as fair (Table 3.35). Upper bank slopes ranged from 2-35 percent with no evidence of mass wasting problems. Vegetative bank protection was provided by both deep and shallow rooted species. Vegetative cover, however, was largely absent from outside meander bends, leaving these areas more susceptable to erosive action. Debris jam material consisted of small woody debris. The channel capacity was ample for existing peak flows. Significant amounts of bank cutting in this reach provided material for new bar development. There was a fair amount of algae in this reach with some areas of moss growth noted. Mean RASI values were 80 and 71 in 1993 and 1994, respectively. Fines (< 4 mm) comprised as much as 25.6 percent (mean = 20%) of the sampled substrate in 1993 and 22.3 percent (mean= 18%) in 1994 (Table 3.35).

Reach five of Alder Creek was classified as a C6 channel type with a channel bottom comprised of silt/clay and a mean stream gradient of less than 1 percent (Table 3.36). The reach extended for 1,763 meters and encompassed elevations ranging from 2,900 to 2,940 (Figure 2.4). Dominant land uses were livestock grazing and timber harvest. The riparian area consisted of mature deciduous and coniferous trees interspersed with shrubs, forbes and grasses. Average canopy cover was 18 percent for this reach in 1993 and in 1994 averaged 44 percent. Instream woody debris densities were higher than other reaches in the drainage (1.1/l 00 ft (1993) & 1.6/l 00 ft (1994)). Riffle to pool ratio was 1 :l and mean residual pool depth was 0.5 meters in 1993. In 1994, the riffle to pool ratio increased to 6.8:1 with a corresponding increase in residual pool depth 0.7 meters (Table 3.36). This reach had a channel stabilty rating of poor (Table 3.36). Upper bank slopes ranged from l-3 percent with no evidence of mass wasting associated with the floodplain. Vegetative density ranged from

Table 3.35. Summary table showing values for reach four, Alder Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2,700-2,900 ft	2,700-2,900 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with mature trees,shrubs, forbs and grasses	Coniferous/deciduous mature trees, shrubs forbs and grasses
Reach length	5,053 m	5,806 m
Channel type	c 3	c 3
Bankfull width	ft	•
Bankfull depth	ft	•
Width/depth ratio	> 12	•
Mean stream gradient	1.5 %	2.6 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	fair (79)	fair (90)
RASI values	83; 67; 91	69; 88; 56
% substrate < 4mm	20	18.0
mean substrate size (mm)	91	1 2 4
Mean % canopy cover	6.2 %	46.6 %
Barriers	none	none
# instream woody debris	77 (0.5 /100 ft)	116 (0.6 /100 ft)
Dominant habitat complex	riffle : pool	riffle : pool
Riffle/pool ratio	1.2: 1	2.6 : 1
Residual pool depth	0.5 m	0.5 m
Total available habitat	96,846 m^2	80,418 m^2

Table 3.36. Summary table showing values for reach five, Alder Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	4th	4th
Elevation	2, 900-2,940 ft	2,900-2,940 ft
Dominant land use	Forested/Livestock grazing	Forested/Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with mature trees, shrubs, forbs and grasses	Coniferous/deciduous mix with mature trees, shrubs, forbs and grasses
Reach length	1,763 m	1,465 m
Channel type	C6	C6
Bankfull width	ft	*
Bankfull depth	ft	•
Width/depth ratio	12.5	•
Mean stream gradient	1.4 %	3.6 %
Entrenchment	slight	slight
Sinuoisity	high	high
Channel stability rating	poor (128)	poor (118)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	17.7 %	43.7 %
Barriers	none	none
# instream woody debris	65 (1.1 /100 ft)	76 (1.6 /100 ft)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1 : 1	6.8 : 1
Residual pool depth	0.5 m	0.7 m
Total available habitat	37,282 m^2	45,789 m^2

50-70 percent with a shallow and discontinous root mass. Due to increased beaver activity in this reach there was increased amounts of debris jam material. There were occasional overbank flows attributable to beaver activity and cattle use. Continuous bank cutting and erosion was observed and accompanied by accelerated bar development. Most of the channel bottom is in a yearly state of flux with minimal aquatic vegetation present.

Reach six of Alder Creek was classified as a E3b type channel (Table 3.37) with elevation beginning at 2,940 feet and rising to 3,330 feet. The reach extended for 6,630 meters (Figure 2.4). The dominant land use in this reach was livestock grazing and timber harvest. The riparian area consisted of mature coniferous and deciduous trees mixed with grasses and forbs. Average canopy cover in this reach was 25 percent with instream woody debris densities of 0.6/100 feet during 1993. In 1994, average stream canopy cover was 68 percent with instream woody debris densities of 1.51100 ft. Beaver ponds and associated downstream riffles comprised the dominant habitat complex. Riffle to pool ratio was 1:1.7 and mean residual pool depths were 0.6 meters in 1993. In 1994. riffle to pool ratio was 2.4:1 with a residual pool depth of 0.4 meters (Table 3.37). The reach had a channel stability rating of fair (Table 3.37). Upper bank slopes averaged 2 percent with no mass wasting problems evident. Debris jam potential was limited to small woody debris. Vegetative cover was provided by shallow rooted species with a density of 50-70 percent. The channel capacity was adequate for peak flows. Bank cutting occurred at obstructions and outcurves. There was a moderate amount of new bar development, consisting of sand and pea sized gravel particles. RASI values could not be calculated in this reach due to the sand bottom.

Reach 1 of the North Fork Alder Creek was classified as an E3b type channel with elevations beginning at 2,940 feet and rising to 3,070 feet (Figure 2.4). Reach length was 1,260 meters. The channel was very sinuous (>1.5) and slightly entrenched (>2.4) and had a mean stream gradient of 3 percent (Table 3.38.). The dominant land use in this reach was livestock grazing with the riparian area consisting of forbs and grasses. Average canopy cover was 36 percent with instream woody debris densities of 0.6/100 feet. Dominant habitat complex was riffle/pool with a riffle to pool ratio of 1.3:1 during 1993. In 1994, the riffle to pool ratio shifted to 16:I. Mean residual pool depth was 0.4 meters in 1993 and decreased to 0.2 meters in 1994 (Table 3.38). Channel stability is this reach was good to fair (Table 3.38). The upper slopes averaged 3 percent with no mass wasting problems evident. Bank protection consisted of discontinuous and shallow root masses with a density of 70-90 percent. The channel capacity was adequate for existing peak flows. Some bank cutting and sloughing was observed at obstructions and outcurves. Little new bar development was observed in this reach. Rocks were slick throughout the reach from seasonal blooms of algae. Mean RASI values were 65 and 79 in 1993 and 1994,

Table 3.37. Summary table showing values for reach six, Alder Creek, 1993 and l994

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	2,940-3,330 ft	2,940-3,330 ft
Dominant land use	Forested/Livestock grazing	Forested/Livestock grazing
Riparian ecotype	Coniferous/deciduous mix with mature trees, forbs and grasses	Coniferous/deciduous mix mature trees, forbs and grasses
Reach length	6,630 m	6,278 m
Channel type	E3b	E3b
Bankfull width	ft	*
Bankfull depth	ft	*
Width/depth ratio	4.4	•
Mean stream gradient	1 %	1.8%
Entrenchment	slight	slight
Sinuoisity	very high	very high
Channel stability rating	fair (103)	fair (80)
RASI values	NA	NA
% substrate < 4mm	NA	NA
mean substrate size (mm)	NA	NA
Mean % canopy cover	25 %	68 %
Barriers	none	none
# instream woody debris	127 (0.6 /100 ft)	307 (1.5 /100 ft)
Dominant habitat complex	beaver ponds; riffle	riffle; pool
Riffle/pool ratio	1 : 1.7	2.4 : 1
Residual pool depth	0.6 m	0.4 m
Total available habitat	161,234 m^2	73,119 m^2

Table 3.38. Summary table showing values for reach one, North Fork Alder Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	2,940-3,070 ft	2,940-3,070 ft
Dominant land use	Livestock grazing	Livestock grazing
Riparian ecotype	Conferous / decidous mix with forbs and grasses	Coniferous/Decidous mix with forbs and grasses
Reach length	1,260 m	1,677 m
Channel type	E3b	E3b
Bankfull width	ft	•
Bankfull depth	ft	•
Width/depth ratio	4..6	•
Mean stream gradient	3 %	3.1 %
Entrenchment	slight	slight
Sinuoisity	very high	very high
Channel stability rating	good (73)	fair (91)
RASI values	55; 79; 51	64; 43
% substrate < 4mm	22 %	29.9 %
mean substrate size (mm)	53	103
Mean % canopy cover	36.3 %	8%
Barriers	none	none
# instream woody debris	24 (0.6 /100 ft)	22 (0.4 /100 ft)
Dominant habitat complex	riffle - pool	riffle - pool
Riffle/pool ratio	1.3 :l	16: 1
Residual pool depth	0.4 m	0.2 m
Total available habitat	11,206 m^2	5,651 m^2

respectively. Fine sediment (< 4 mm) comprised 22 percent of the sampled substrate in 1993, and 30 percent in 1994 (Table 3.38).

Reach two (comprising stream reaches 2a and 3a) of North Fork Alder Creek were classified as B3a type channels with isolated areas having characteristics of D3b type channels (Table 3.39). Reach length was 3,461 meters with elevations ranging from 3,070 to 3,280 feet (Figure 2.4). The dominant land type in this reach was forested wetland with the riparian area composed of mature coniferous and decidous trees interspersed with large shrubs. Average canopy cover in this reach was 30 percent with instream woody debris densities of 0.4/l 00 feet during 1993. In 1994, average canopy cover was 87 percent with instream woody debris loads of 4.8/l 00 feet. Dominant habitat complex was beaver pond/riffle with a riffle to pool ratio of 1 :1.6. Mean residual pool depth was 0.4 meters (Table 3.39). The channel stability in these reaches was fair (Table 3.39). The upper bank slopes averaged 5 percent with no mass wasting problems evident. Plant density was approximately 70 percent with some deep rooted species interspersed throughout the reach. Channel capacity was adequating for exisiting peak flows, but due to beaver activity there was evidence of some overbank flows. Frequent obstructions created sediment traps throughout the reach and bank cutting was significant. Some new gravel bar development had occurred with slight amounts of fines being deposited. Clinging aquatic vegetation was common even in swift waters. One RASI survey site was sampled in reach 2a in 1994. The RASI value was 69.3 and fine sediment (< 4 mm) comprised 36 percent of the sampled substrate (Table 3.39). Mean RASI values for reach 3a were 71 and 52 in 1993 and 1994, respectively. Fine sediment in reach 3a comprised between 26 and 30 percent of the sampled substrate on average.

Reach three of North Fork Alder Creek was classified as a B3a type channel with elevations beginning at 3,280 feet and rising to 3,620 feet. Reach length was 3,130 meters (Figure 2.4). The dominant land type within this reach was forested with the riparian area consisting of young and mature coniferous and deciduous trees interspersed with shrubs. Average canopy cover was 39 percent with instream woody debris densities of 0.4/l 00 feet. Dominant habitat complex was riffle/pool with a riffle to pool ratio of 2.3:1. Mean residual pool depth was 0.2 meters. Channel stability was rated as fair to good (Table 3.40). Upper bank slopes ranged from 2-30 percent with no evidence of mass wasting problems. Plant density in this reach was at least 90 percent with a vigorous community of both shallow and deep rooted species. There were large amounts of debris jam material located throughout the reach. Channel capacity was adequate for existing peak flows. Bank cutting occurred at outcurves with little new bar development observed. Clinging aquatic vegetation was abundant throughout the reach with both algae and moss present. The mean RASI value

Table 3.39. Summary table showing values for reach two, North Fork Alder Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	2nd	2nd
Elevation	3,070-3,280 ft	3,070-3,280 ft
Dominant land use	Forested	Forested
Riparian ecotype	Coniferous/decidous mix with mature trees & shrubs	Coniferous/decidous mix with mature trees & shrubs
Reach length	3,461 m	4,250 m
Channel type	B3a - D3b	B3a - D3b
Bankfull width	ft	*
Bankfull depth	ft	•
Width/depth ratio	> 40 , 5.6	*
Mean stream gradient	2.5 %	8.7 %
Entrenchment	moderate	moderate
Sinuoisity	moderate	moderate
Channel stability rating	fair (78)	fair (86)
RASI values	66; 77	46; 66; 46
% substrate < 4mm	29.5 %	25.7 %
mean substrate size (mm)	46	47
Mean % canopy cover	35.2 %	87.2 %
Barriers	none	none (gradient)
# instream woody debris	46 (0.4 /lOO ft)	663 (4.8 /100 ft)
Dominant habitat complex	beaver pond - riffle	riffle - beaver pond
Riffle/pool ratio	1 : 1.6	1:l
Residual pool depth	0.4 m	0.5 m
Total available habitat	99,826 m^2	69.288 ft^2

Table 3.40. Summary table showing values for reach three, North Fork Alder Creek, 1993 and 1994

PARAMETER	1993	1994
Stream order	2nd	
Elevation	3,280-3,620 ft	
Dominant land use	Forested	
Riparian ecotype	Coniferous/decidous mix with mature, young trees, & shrubs	
Reach length	3,130 m	
Channel type	B3a	
Bankfull width	ft	•
Bankfull depth	ft	•
Width/depth ratio	6	*
Mean stream gradient	5 %	
Entrenchment	moderate	
Sinuoisity	moderate	
Channel stability rating	0	
RASI values	45; 40; 38	*
% substrate < 4mm	19.6	*
mean substrate size (mm)	39	•
Mean % canopy cover	39 %	•
Barriers	none	
# instream woody debris	476 (0.4 /lOO ft)	
Dominant habitat complex	riffle - pool	
Riffle/pool ratio	2.3 : 1	
Residual pool depth	0.2 m	
Total available habitat	4,682 m^2	

was 41 in 1993 and fine sediment (< 4 mm) comprised between 15 and 22 percent (mean=20 percent) of the sampled substrate (Table 3.40).

3.2. BIOLOGICAL EVALUATION

3.2.1. Relative Abundance

3.2.1.1. 1993 Lake, Benewah, Evans, and Alder Creeks

In May, June, July, August, and October of 1993, a total of 15.8 electroshocking hours were spent collecting relative abundance information. A total of 1,625 fish were collected from Lake, Benewah, Evans, and Alder creeks (Table 3.41). In Lake Creek, a total of 257 fish were captured with sculpin *spp.* being the most abundant at 40.1 percent. In Benewah Creek, 700 fish were captured with redside shiners comprising 45.9 percent of the total catch. In Evans Creek, a total of 386 fish were captured with cutthroat trout the most abundant at 53.4 percent. A total of 293 fish were captured in Alder Creek, with sculpin *spp.* being the most abundant at 34.5 percent. Cutthroat trout densities were highest in Evans Creek at 53.4 percent followed by, Alder (22.5 percent), Lake (16.0 percent) and Benewah creeks (11 .O percent) (Table 3.42). Relative abundance data for each month, reach, and stream can be found in Appendix E.

Lake Creek

In spring, summer, and fall a total of three, one hundred seventy-two, and seventy fish were collected in Lake Creek, respectively (Table 3.43). No trout species were collected in the spring sample (Table 3.43). Of the 172 fish captured in the summer, thirty (17.4 percent) were cutthroat trout, with the remaining 82 percent being comprised of sculpin *spp,* longnose date, longnose sucker, and redside shiner (Table 3.44). Of the thirty cutthroat trout captured in the summer, two were 0+ of age, three were I+ and 2+ years of age, respectively. Ten were 3+ years of age, ten were 4+ years of age and two were 5+ years of age (Table 3.45). During Fall, eleven (15.7 percent) were cutthroat trout and one (1.4 percent) was a bull trout. The remaining 82.8 percent were comprised of sculpin *spp,* and longnose suckers. Of the eleven cutthroat captured in the fall, two were I+ years of age, four were 2+ years of age, two cutthroat trout were 3+ years of age, respectively. Two cutthroat trout 4+ years of age and one was 5+ years of age (Table 3.45).

Benewah Creek

In spring, summer and fall a total of two hundred eighty-six, three hundred thirty-one, and eighty-five fish were collected from Benewah Creek, respectively (Table 3.46). Of the 286 fish collected in spring, thirty-six (12.6 percent) were

Table 3.41. **Number of each species of fish caught by electrofishing at each Coeur d'Alene tributary during 1993.**

Tributary	Lake	Benewah	Evans	Alder
Shock time (hours)	2.7	5.3	3.9	3.9
Species				
Cutthroat trout	41	77	206	66
Eastern brook trout		1		87
Bull trout	1			
Rainbow trout		2		
Sculpin spp.	103	49	176	101
Largemouth bass		2		
Longnosesucker	48	128	3	32
Longnosedace	51	73		4
Western speckled dace	1	36		
Brown bullhead		2		3
Redside shiner	12	321		
Northern squawfish		8		
Fumpkinseed		1	1	
TOTAL	257	700	386	293

Table 3.42. Percent (%) of each species of fish caught by electrofishing at each Coeur d'Alene tributary during 1993.

Species	Lake	Benewah	Evans	Alder
Cutthroat trout	16.0	11.0	53.4	22.5
Eastern brook trout		0.1		29.7
Bull trout	0.4			
Rainbow trout		0.3		
Sculpin spp.	40.1	7.0	45.6	34.5
Largemouth bass		0.3		
Longnose sucker	18.7	18.3	0.8	10.9
Lonanose dace	19.8	10.4		1.4
Western speckled dace	0.4	5.1		
Brown bullhead		0.3		1.0
Redside shiner	4.7	45.9		
Northern squawfish		1.1		
Pumpkinseed	0.1		0.3	

Table 3.43. Number of each species of fish caught by electrofishing in Lake Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	September (October)
Shock time (min)	12.4	88.4	58.6
Cutthroat trout		30	11
Bull trout			1
Sculpin spp.	2	58	43
Longnose sucker		33	15
Longnosedace		39	
Western speckled dace	1		
Redside shiner		12	
TOTAL	3	172	70

Table 3.44. Percent (%) of each species of fish caught by electrofishing in Lake Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout		17.4	15.7
Bull trout			1.4
Largemouth bass			
Sculpin *spp.*	66.7	33.7	61.4
Longnose sucker		19.2	21.4
Longnose dace		22.7	
Western speckled dace	33.3		
Redside shiner		7.0	

Table 3.45. Electrofishing relative abundance for salmonid species by age class in Lake Creek, 1993.

	Cutthroat trout		
Age	Spring	Summer	Fall
0+	0	2	0
1+	0	3	2
2+	0	3	4
3+	0	10	2
4+	0	10	2
5+	2	2	1
6+	2	30	11

Table 3.46. Number of each species of fish caught by electrofishing in Benewah Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Shock time (min)	129.7	124.3	NA
Cutthroat trout	36	22	19
Rainbow trout			2
Eastern brook trout			1
Sculpin *spp.*	9	18	22
Long nose sucker	48	60	20
Longnosedace	12	61	
Western speckled dace	16	20	
Northern sauawfish	6	2	
Largemouth bass			2
Redside shiner	158	144	19
Pumpkinseed		3	
Brown bullhead	1	1	
TOTAL	286	331	85

cutthroat trout, one hundred fifty-eight (55.2 percent) were redside shiners, and forty-eight (16.8 percent) were longnose sucker. The other 15.3 percent consisted of western speckled dace, longnose dace, sculpin *spp,* northern squawfish and brown bullhead (Table 3.47). Of the thirty-six cutthroat captured, four were 0+ years of age, eleven were 1+ years of age, nine were 2+ years of age, six were 3+ years of age, two were 4+ years of age, one was 5+ years of age, and four were 6+ years of age. (Table 3.48). Of the 331 fish captured in summer 22 (6.6 percent) were cutthroat trout, 144 (43.5 percent) were redside shiner, sixty-one (18.4 percent) were longnose dace, sixty (18.1 percent) were longnose sucker. The other 7.2 percent consisted of sculpin *spp,* brown bullhead, northern squawfish and pumpkinseed. Of the 22 cutthroat captured; one was 0+ and 1+ years of age, respectively, nine were 2+ years of age, five were 3+ years of age, four were 4+ years of age, one was 5+ years of age and one was 6+ years of age. Of the 85 fish collected from Benewah Creek in the fall, nineteen (22.4 percent) were cutthroat trout, twenty-two (25.9 percent) were scuplin *spp,* twenty (23.5 percent) were longnose sucker, nineteen (22.4 percent) were redside shiner. The other six percent consisted of largemouth bass, rainbow trout, and eastern brook trout. Of the nineteen cutthroat trout captured in the fall one was 2+ years of age, eight were 3+ years of age, seven were 4+ years of age, two were 5+ years of age, and one was 6+ years of age (Table *3.48).*

Table 3.47. Percent (%) of each species of fish caught by electrofishing in Benewah Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout	12.6	6.6	22.4
Rainbow trout			2.4
Eastern brook trout			1.2
Sculpin *spp.*	3.1	5.4	25.9
Longnose sucker	16.8	18.1	23.5
Longnosedace	4.2	18.4	
Western speckled dace	5.6	6.0	
Northern squawfish	2.1	0.6	
Largemouth bass			2.4
Redside shiner	55.2	43.5	22.4
Pumpkinseed		0.3	
Brown bullhead	0.3	0.9	

Table 3.48. Electrofishing relative abundance for salmonid species by age class in Benewah Creek, 1993.

	Cutthroat trout		
Age	Spring	Summer	Fall
0+	4	1	0
1+	11	1	0
2+	9	9	1
3+	6	5	8
4+	2	4	7
5+	1	1	2
6+	4	1	1

Evans Creek

A total of seven, two hundred sixty-two, and one hundred sixteen fish were captured in Evans Creek during spring, summer, and fall, respectively (Table 3.49). Twenty-nine percent of the fish caught in the spring were cutthroat trout and the remaining 71 percent were sculpin *spp.* (Table 3.50). Of the 2 cutthroat trout captured in spring, one was 1+ years of age and one was 2+ years of age (Table 3.51) In summer, 135 (51.5 percent) of the fish collected were cutthroat trout, with the remainder being sculpin species, longnose sucker and pumpkinseed. Of the one hundred thirty-five cutthroat, nine were 0+ years of age, thirty were 1+ years of age, 30 were 2+ years of age, twenty-six were 3+

years of age, twenty-seven were 4+ years of age, seven were 5+ years of age and six were 6+ years of age (Table 3.51). Of the one hundred sixteen fish collected from Evans Creek in the fall sample, 69 (59.5 percent) were cutthroat trout, and 47 (40.5 percent) were sculpin species (Table 3.50). Of the sixty-nine fish captured in Evans during the fall, six were 1+ years of age, twenty-three were 2+ years of age, eighteen were 3+ years of age, twelve were 4+ years of age, five were 5+ years of age, and five were 6+ years of age (Table 3.51).

Table 3.49. Number of each species of fish caught by electrofishing in Evans Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	September (October)
Shock time (min)	49.4	117.2	74.0
(Cutthroat trout	2	135	69
Sculpin *spp.*	5	124	47
Longnose sucker		3	
Pumpkinseed		1	
/TOTAL	7	262	176

Table 3.50. Percent (%) of each species of fish caught by electrofishing in Evans Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout	28.6	51.5	59.5
Sculpin *spp.*	71.4	47.3	40.5
Longnose sucker		1.1	
Pumpkinseed		0.4	

Alder Creek

A total of forty-three, one hundred eighty-nine, and sixty-one fish were captured in Alder Creek in spring, summer and fall, respectively (Table 3.52). Of the forty-three fish collected in the spring sample, 25.6 percent were eastern brook trout, 18.6 percent were cutthroat trout and the remaining 55.8 percent were sculpin species, longnose sucker, brown bullhead, and longnose dace (Table 3.53). Of the eight cutthroat trout captured in Alder Creek during spring, five were 2+ years of age, one was 3+ years of age, one was 4+ years of age and one was 5+ years of age (Table 3.54). Of the one hundred eighty-nine fish

Table 3.51. Electrofishing relative abundance for salmonid species by age class in Evans Creek, 1993.

	Cutthroat trout		
Age	Spring	Summer	Fall
0+	0	9	0
1+	1	30	6
2+	1	30	23
3	0	26	18
4	0	27	12
5+	0	7	5
6+	0	6	5

captured from Alder Creek in July, 22.2 percent were cutthroat trout, 28.0 percent were eastern brook trout and the remaining 49.8 percent were sculpin species, longnose sucker, and longnose dace. Of the forty-two cutthroat trout captured in the summer, two were 1+ years of age, seven were 2+ years of age, thirteen were 3+ years of age, ten were 4+ years of age, eight were 5+ years of age, and two were 6+ years of age (Table 3.54). In the fall sample, sixty-one fish were collected in Alder Creek. Of those sixty-one fish, twenty-three (37.7 percent) were eastern brook trout, sixteen (26.2 percent) were cutthroat trout and sculpin species, respectively, and six (9.8 percent) were longnose sucker (Table 3.53). Of the sixteen cutthroat trout captured, one was 1+ years of age, one was 2+ years of age, five were 3+ years of age, four were 4+ years of age and six were 5+ years of age (Table 3.54).

Table 3.52. Number of each species of fish caught by electrofishing in Alder Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	September (October)
Shock time (min)	54.6	120.6	58.0
Cutthroat trout	8	42	16
Eastern brook trout	11	53	23
Sculpin spp.	14	71	16
Longnose sucker	5	21	6
Redside shiner			
Longnosedace	2	2	
Brown bullhead	3		
TOTAL	43	189	61

Table 3.53. Percent (%) of each species of fish caught by electrofishing in Alder Creek during May - October, 1993.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout	18.6	22.2	26.2
Eastern brook trout	25.6	28.0	37.7
Sculpin *spp.*	32.6	37.6	26.2
Longnose sucker	11.6	11.1	9.8
Longnosedace	4.7	1.1	
Brown bullhead	7.0		

Table 3.54. Electrofishing relative abundance for salmonid species by age class in Alder Creek, 1993.

	Cutthroat trout		
Age	Spring	Summer	Fall
0+	0	0	0
1+	0	2	1
2+	5	7	1
3+	1	13	5
4+	1	10	4
5+	1	8	6
6+	0	2	0

3.2.1.2. 1994 Lake, Benewah, Evans, and Alder Creeks

In May, June, July, August, and October of 1994, a total of 6.7 electroshocking hours were spent collecting relative abundance information. A total of 1,370 fish were collected from the four tributaries (Table 3.53). In Lake Creek, a total of two hundred twenty-four fish were captured with sculpin *spp* being the most abundant at 37.1 percent. In Benewah Creek, six hundred fifty-nine fish were captured with redside shiners comprising 72.2 percent of the total catch. In Evans Creek, a total of one hundred seventy-eight fish were captured with sculpin *spp.* the most abundant at 47.8 percent. A total of three hundred nine fish were captured in Alder Creek, with eastern brook trout the most abundant at 42.1 percent. Cutthroat trout densities were highest in Evans Creek at 43.3 percent followed by Alder (23.3 percent), Lake (15.2 percent) and Benewah (2.8 percent). Relative abundance data for each month, reach and stream can be found in Appendix E.

Table 3.55. Number of each species of fish caught by electrofishing at each Coeur d'Alene tributary during 1994.

Species	Lake	Benewah	Evans	Alder
Shock time (hours)	1.54	1.04	1.60	2.54
Cutthroat trout	34	18	77	72
Eastern brook trout				130
Sculpin spp.	83	71	85	87
Largemouth bass			5	
Longnose sucker	54	87	4	20
Western speckled dace		4		
Brown bullhead			1	
Redside shiner	49	459	6	
Northern squawfish				
TOTAL	224	659	178	309

Table 3.56. Percent of each species of fish caught by electrofishing at each Coeur d'Alene tributary during 1994

Species	Lake	Benewah	Evans	Alder
Cutthroat trout	15.2	2.8	43.3	23.3
Eastern brook trout				42.1
Sculpin spp.	37.1	11.2	47.8	28.2
Largemouth bass			2.8	
Longnose sucker	24.1	13.7	2.2	6.5
Western speckled dace		1.8		
Brown bullhead			0.6	
Redside shiner	21.9	72.2	3.4	
Northern squawfish		0.2		

Lake Creek

In spring, summer, and fall a total of fifty-three, fifty-five, and one hundred sixteen fish were collected in Lake Creek, respectively (Table 3.55). Cutthroat trout comprised 15 percent of the spring sample. The remaining 85 percent of the catch was comprised of sculpin *spp,* longnose sucker and redside shriners. Of the eight cutthroat captured, seven were 2+ fish and one was a 1+ fish (Table 3.57). Of the fifty-five fish collected in the summer sample, 32.7 percent of the

catch were cutthroat trout. The remaining 67.3 percent were comprised of sculpin, longnose sucker, redside shiner and western speckled dace (Table 3.56). All eighteen trout captured were 0+ of age (Table 3.57). Of the one hundred sixteen fish captured during the fall sample, 6.9 percent were cutthroat trout. Sculpin *spp.,* longnose sucker, and redside shriner comprised the remaining 93 percent. Of the eight cutthroat captured, five were 0+ of age and three were 1+ of age.

Table 3.57. Number of each species of fish caught by electrofishing in Lake Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	September (October)
Shock time (min)	25.7	29.6	37.2
Cutthroat trout	8	18	8
Sculpin spp.	32	10	41
Longnose sucker	11	14	29
Redside shiner	2	9	38
Western speckled dace		*4*	
TOTAL	*53*	*55*	*116*

Table 3.58. Percent (%) of each species of fish caught by electrofishing in Lake Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout	15.1	32.7	6.9
Sculpin *spp.*	*60.4*	18.2	35.3
Longnose sucker	*20.8*	*25.4*	*25.0*
Redside shiner	*3.8*	16.4	*32.8*
Western speckled dace		*7.3*	

Table 3.59. Electrofishing relative abundance for salmonid species by age class in Lake Creek, 1994.

	Cutthroat trout		
Age	Spring	Summer	Fall
0+	0	18	5
1+	1	0	3
2+	7	0	0

Benewah Creek

In Benewah Creek, ninty-five, one hundred fifty-nine, and three hundred eighty-two fish were collected during the spring, summer and fall sample, respectively (Table 3.60). Cutthroat trout comprised 13.7 percent of the spring catch, while the remaining 86 percent was made up of sculpin *spp.,* longnose sucker, northern squawfish and redside shiner. Of the twelve cutthroat captured, five were 1+ of age, three were 2+ of age, one was 3+ and 5+ of age and two were 6+ of age (Table 3.62). In the summer sample, cutthroat trout comprised 0.6 percent of the catch. Redside shiner, longnose sucker and sculpin spp. made up the remainder of the catch. The one cutthroat trout captured in the summer sample was 2+ years of age. In the fall sample, cutthroat trout comprised 1 percent of the catch with the remainder being sculpin *spp.,* longnose sucker and redside shiner. All four cutthroat trout captured were 2+ years of age (Table 3.62).

Table 3.60. Number of each species of fish caught by electrofishing in Benewah Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Shock time (min)	40.1	26.3	62.4
Cutthroat trout	13	1	4
Sculpin *spp.*	17	21	33
Longnose sucker	*46*	*6*	*35*
Northern squawfish	1		
Redside shiner	*18*	*131*	*310*
TOTAL	95	*159*	382

Table 3.61. Percent of each species of fish caught by electrofishing in Benewah Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout	13.7	0.6	1.0
Sculpin *spp.*	*17.9*	13.2	8.6
Longnose sucker	48.4	3.8	9.2
Northern squawfish	1.1		
Redside shiner	18.9	82.4	81.2

Table 3.62. Electrofishing relative abundance for salmonid species by age class in Benewah Creek, 1994.

	Cutthroat trout		
Age	Spring	Summer	Fall
1+	5	0	0
2+	3	1	4
3+	1	0	0
5+	1	0	0
6+	2	0	0

Evans Creek

In Evans Creek, sixty-three, fifty-eight, and fifty-seven fish were collected during the spring, summer and fall sample. Cutthroat trout comprised 50.8 percent of the catch during the spring sample while sculpins comprised the other 49.2 percent (Table 3.63) Of the thirty-two cutthroat trout captured, one was 0+ of age, nine were 1+ of age, fifteen were 2+ of age, six were 3+ of age and one was 4+ of age (Table 3.65). In the summer sample, cutthroat trout comprised 31 percent of the catch with sculpin *spp.,* longnose sucker, redside shiner and brown bullhead comprising the remainder of the catch. Of the twenty-one cutthroat captured, one was 0+ of age, eight were 1+ of age, seven were 2+ of age and five were 3+ of age. Cutthroat trout comprised 47 percent of the fall catch, while sculpin and largemouth bass comprised the remainder. Of the thirty cutthroat trout collected, three were 0+ years of age, sixteen were 1+ years of age, four were 2+ years of age, six were 3+ years of age, and one was 4+ years of age (Table 3.65).

Table 3.63. Number of each species of fish caught by electrofishing in Evans Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	September (October)
Shock time (min)	34.9	22.7	38.6
Cutthroat trout	32	18	27
Sculpin *spp.*	31	29	25
Longnose sucker		4	
Redside shriner		6	
Brown bullhead		1	
Largemouth bass			5
TOTAL	63	58	57

Table 3.64. Percent (%) of each species of fish caught by electrofishing in Evans Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout	50.8	31.0	47.4
Sculpin *spp.*	49.2	50.0	43.8
Longnose sucker		6.9	
Redside shiner		10.3	
Brown bullhead		1.7	
Largemouth bass			8.8

Table 3.65. Electrofishing relative abundance for salmonid species by age class in Evans Creek, 1994.

	Cutthroat trout		
Age	Spring	Summer	Fall
0+	1	1	3
1+	9	8	16
2+	15	7	4
3+	6	5	6
4+	1	0	1

Alder Creek

During the spring, summer, and fall sampling in Alder Creek, sixty-six, one hundred twenty-five, and one hundred eighteen fish were captured (Table 3.66). Cutthroat trout and eastern brook trout comprised 24.2 percent and 42.4 percent of the catch during the spring sample. Other species captured included sculpin and longnose sucker (Table 3.66). Of the sixteen cutthroat trout collected, one was 1+ years of age, twelve were 2+ years of age, and three were 3+ years of age. Of the twenty-eight eastern brook trout collected, eight were 2+ years of age, twelve were 3+ years of age and eight were 4+ years of age (Table 3.68). In the summer sample cutthroat trout comprised 20.8 percent of the catch and eastern brook trout comprised 48.8 percent of the catch. Sculpin *spp.* and longnose sucker comprised the remainder of the catch (Table 3.66). Of the twenty-six cutthroat trout collected, five were 1+ years of age, twelve were 2+ years of age, seven were 3+ years of age and two were 4+ years of age. Of the sixty-one eastern brook trout collected, eighteen were 1+ years of age, seventeen were 2+ years of age, fourteen were 3+ years of age and twelve were 4+ years of age (Table 3.68). In the fall sample cutthroat and eastern brook trout comprised 60 percent of the catch, while sculpin *spp.* comprised the remainder

(Table 3.67). Seven of the thirty cutthroat trout collected were 1+ years of age, fifteen were 2+ years of age, four were 3+ and 4+ years of age (Table 3.68). Of the forty-one eastern brook trout collected, eight were 1+ years of age, seventeen were 2+ years of age, fifteen were 3+ years of age and one was 4+ years of age (Table 3.68).

Table 3.66. Number of each species of fish caught by electrofishing in Alder Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	September (October)
Shock time (min)	38.3	43.6	70.6
Cutthroat trout	16	26	30
Eastern brook trout	28	61	41
Sculpin spp.	14	26	47
Lonanose sucker	8	12	
TOTAL	66	125	118

Table 3.67. Percent (%) of each species of fish caught by electrofishing in Alder Creek during May - October, 1994.

Species	Spring (May-June)	Summer (July-August)	Fall (October)
Cutthroat trout	24.2	20.8	25.4
Eastern brook trout	42.4	48.8	34.7
Sculpin sm.	21.2	20.8	39.8
Longnose sucker	12.1	9.6	

Table 3.68. Electrofishing relative abundance for salmonid species by age class in Alder Creek, 1994.

Cutthroat trout			
Age	**Spring**	**Summer**	**Fall**
1+	1	5	7
2+	12	12	15
3+	3	7	4
4+	0	2	4
Eastern brook trout			
Age	**Spring**	**Summer**	**Fall**
1+	0	18	8
2+	8	17	17
3+	12	14	15
4+	8	12	1

3.2.2. Trout Population and Biomass Estimates by Habitat Type

A total of 3,490 fish were caught during electrofishing surveys conducted in October, 1993. Approximately 29 percent of the catch was comprised of trout (n cutthroat= 600; n brook= 416). Population and biomass estimates for each study drainage are summarized below by reach and habitat type.

3.2.2.1. Lake Creek

Cutthroat trout populations in the Lake Creek drainage were estimated at 1,457 fish with a total biomass of 57 pounds and a mean density of 2.6 trout/100 m^2 (Table 3.69). Adult fish (4+ and older) were not represented in the population estimate. Estimated cutthroat trout densities by reach ranged from 0.3-18.2/100 m^2, with the highest densities found in reach 1 of West Fork Lake Creek. The lowest trout densities were found in mainstem reaches 6 and 7. Density estimates by habitat type ranged from 0.2-128.2/100 m^2 (Table 3.70). Cutthroat trout densities were greatest in plunge pool habitat and lowest in dammed pool and glide habitats. Total estimated biomass was greatest in low gradient riffles, which comprised 37 percent of the total habitat.

3.2.2.2. Benewah Creek

Total trout population in the Benewah Creek drainage was estimated at 1,637 fish, with cutthroat (53 percent) and brook trout (47 percent) present in almost equal proportions (Table 3.71 & 3.73). Total cutthroat trout biomass was estimated at 77.2 pounds, with adults accounting for 29 percent of the total. Total estimated brook trout biomass was considerably greater (110.4 pounds), due to a relatively higher proportion of adults in the population. Cutthroat trout

Table 3.69 Estimates of cutthroat trout abundance and biomass by reach. 1993.

TRIBUTARY/SPECIES	REACH	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs) JUVENILES	BIOMASS (lbs) ADULTS
LAKE CREEK/CTT	2	5550	50.0	0.0	0.9	7.5	0.0
	3	3060	30.0	0.0	1.0	5.2	0.0
	4	5890	90.0	0.0	1.5	5.1	0.0
	5	3090	50.0	0.0	1.6	4.8	0.0
	6	19920	50.0	0.0	0.3	5.5	0.0
	7	1890	10.0	0.0	0.5	0.8	0.0
	WFI	2860	520.5	70.9	18.2	17.0	0.0
	VW2	11570	474.0	41.8	4.1	7.6	0.0
	BOZI	1840	182.9	34.8	9.9	3.6	0.0
TOTALS		55670	1457.4	147.5	2.6	57.0	0.0

Table 3.70 Estimates of cutthroat trout abundance and biomass by habitat type, 1993.

TRIBUTARY/SPECIES	HABITAT TYPE	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs) JUVENILES	BIOMASS (lbs) ADULTS
LAKE CREEK/CTT	DMP/BVP	2820	10.0	0.0	0.4	1.1	0.0
	GLD	12920	70.0	0.0	0.5	5.4	0.0
	LGR	20610	504.3	77.6	2.4	18.7	0.0
	PKW	2400	163.3	7.8	6.8	3.2	0.0
	PLP	410	277.0	22.8	67.6	7.6	0.0
	RPD	2000	135.0	26.0	6.8	2.7	0.0
	SCH	450	20.0	0.0	4.4	2.6	0.0
	SCP	2620	80.0	0.0	3.1	11.1	0.0
	SPC	11440	197.8	26.5	1.7	4.5	0.0
TOTALS		55670	1457.4	160.7	2.6	57.0	0.0

Table 3.71 Estimates of cutthroat trout abundance and biomass by reach, 1993.

TRIBUTARY/SPECIES	REACH	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs) JUVENILES	BIOMASS (lbs) ADULTS
BENEWAH CREEK/CTT	1	13980	192	22.1	1.4	14.31	7.1
	2	11110	100	0.01	0.91	6.6	3.61
	3	3920	30	0.0	0.81	3.51	0.0
	4	4100	70	0.0	[illegible]	7.0	0.0
	5	5190	30	0.0	1.7	1.8	4.4
	6	7520	40	0.01	0.5	2.4	0.0
	7	14600	80	0.0	0.5	3.6	3.5
	8	10120	20	0.0	0.2	1.3	0.0
	9	3660	10	0.0	0.3	0.0	0.0
	10	6240	70	0.0	1.1	2.5	4.0
	11	6830	30	0.0	0.4	2.4	0.0
	12	3630	30	0.0	0.8	2.4	0.0
	13	3070	173	9.9	5.6	6.5	0.0
TOTALS		93970	875	32.1	0.9	64.5	22.7

Table 3.72 Estimates of cutthroat trout abundance and biomass by habitat type, 1993.

TRIBUTARY/SPECIES	HABITAT TYPE	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs) JUVENILES	BIOMASS (lbs) ADULTS
BENEWAH CREEK/CTT	DMP/BVP	4320	0	0.0	0.0	0.0	0.0
	GLD	15860	90	0.0	0.61	4.8	3.7
	LGR	45800	273	9.9	0.6	15.31	3.5
	PKW	11750	110	21.2	0.9	9.3	0.0
	PLP	1200	60	0.0	5.0	3.0	7.4
	SCP	5410	140	0.0	2.6	8.9	4.4
	SPC	9630	202	6.3	2.1	13.2	3.6
TOTALS		93970	875	37.5	0.9	64.5	22.7

Table 3.73 Estimates of brook trout abundance and biomass by reach, 1993.

TRIBUTARY/SPECIES	REACH	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs)	
						JUVENILES	ADULTS
BENEWAH CREEK/EBT	1	13980	0	0.0	0.0	0.0	0.0
	2	11110	0	0.0	0.0	0.0	0.0
	3	3920	0	0.0	0.0	0.0	0.0
	4	4100	0	0.0	0.0	0.0	0.0
	5	5190	0	0.0	0.0	0.0	0.0
	6	7520	0	0.0	0.0	0.0	0.0
	7	14600	30	0.0	0.2	2.2	0.0
	8	10120	20	0.0	0.2	0.0	9.9
	9	3660	20	0.0	0.5	0.0	9.3
	10	6240	30	0.0	0.5	2.0	5.5
	11	6830	362	18.4	5.3	27.0	17.3
	12	3630	190	0.0	5.2	14.4	13.6
	13	3070	110	0.0	3.6	5.9	3.1
TOTALS		93970	762	18.4	0.8	51.6	58.8

Table 3.74 Estimates of brook trout abundance and biomass by habitat type, 1993.

TRIBUTARY/SPECIES	HABITAT TYPE	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs)	
						JUVENILES	ADULTS
BENEWAH CREEK/EBT	DMP/BVP	43:20				2.6	4.2
	GLD	15860	250	10.4	1.2	26.7	3.7
	LGR	45800	170	0	0.41	6.71	24.91
	PKW	11750	0	0.0	0.0	0.0	0.0
	PLP	1200	20	0	1.7	0.1	3.1
	SCP	5410	220	0	4.1	14.8	22.9
	SPC	9630	10	0	0.1	0.7	0.0
TOTALS		93970	762	18.4	0.8	51.6	58.8

were distributed in fairly even numbers throughout the drainage, with the highest densities occurring in reach 13 (8.0 trout/l 00 m'). Cutthroat trout biomass, however, was disproportionately higher in the lower reaches (55 percent of total in reaches l-4). The highest estimates of cutthroat trout density and biomass occurred in plunge pool habitat (4.5 fish/l00 m2 and 0.78 lbs./lOO m^2). Brook trout were only found in reaches 7-13, with the highest densities occurring in the uppermost reaches (table 3.73 & 3.74). Brook trout were found in the highest densities in scour pool habitat (2.2 fish/l00 m^2).

3.2.2.3. Evans Creek

Cutthroat trout populations in the Evans Creek drainage were estimated at 2,480 fish with a total biomass of 151 pounds and a mean density of 4.7 trout/l 00 m^2 (Table 3.75). Biomass of juvenile fish was 3.7 times greater than adult biomass. Estimated cutthroat trout densities by reach ranged from 0.0-7.3/100 m^2. Density estimates were generally higher in the lower reaches of the drainage. Density estimates by habitat type ranged from O.O-24.8/100 m^2 (Table 3.76). Cutthroat trout densities were greatest in plunge pool and scour pool habitats (24.81100 m^2 and 20.7/100 m^2, respectively). The highest estimate of biomass per unit area, however, was calculated for scour pool habitat (1.8 lbs./lOO m^2).

3.2.2.4. Alder Creek

Total trout population in the Alder Creek drainage was estimated at 5,380 fish, with cutthroat trout cc prising 30 percent of the total and brook trout the remaining 70 percent (Table 3.77 & 3.79). Total cutthroat trout biomass was estimated at 102.7 pounds. Juveniles accounting for 79 percent of the total biomass. Total estimated brook trout biomass **was** 298 pounds, with juveniles and adults comprising almost equal proportions. Cutthroat trout were found in increasingly greater numbt sfrom reach 1 to 4, however, none were found upstream of reach 5. Total cutthroat trout biomass was greatest in reach 3 (45 percent of total). The highest estimates of cutthroat trout density and biomass occurred in glide habitat (2.9 fish/l00 m^2 and 0.15 lbs./100 m^2). Brook trout were found in all sample reaches except for reach 1, and densities generally ir creased in an upstream direction (Table 3.79). The highest brook trout density occurred in reach 3 of North Fork Alder Creek (61.8 fish/l00 m^2). The highest biomass estimates per unit area were found in mainstem reach 5 (0.48 lbs./lOO m^2). Brook trout were found in the highest densities and biomass in scour hole habitat (12.2 fish/l00 m^2; 1 .I lbs./lOO m^2) (Table 3.80).

Table 3.75 Estimates of cutthroat trout abundance and biomass by reach, 1993.

TRIBUTARY/SPECIES	REACH	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs)	
						JUVENILES	ADULTS
EVANS CREEK/CTT	1	3840	0	0.0	0.0	0.0	0.0
	2	5530	455	34.6	2.9	20.2	11.5
	3	21220	771	21.5	3.6	42.4	11.9
	4	22050	878	42.7	4.0	41.6	8.6
	5	5470	203	36.0	3.7	9.9	0.0
	EF1	69601	123	9.9	1.8	3.5	0.0
	WF1	3090	50	0.0	1.6	1.2	0.0
TOTALS		83160	2480	144.8	3.0	118.91	32.1

Table 3.76 Estimates of cutthroat trout abundance and biomass by habitat type, 1993.

TRIBUTARY/SPECIES	HABITAT TYPE	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs)	
						JUVENILES	ADULTS
EVANS CREEK/CTT	DMP/BVP	1720	166	12.2	9.6	8.3	4.4
	EDP	850	60	0.0	7.1	1.2	0.0
	GLD	3810	0	0.0	0.0	0.0	0.0
	LGR	16810	400	37.3	2.4	18.9	11.5
	PLP	760	209	15.4	27.5	12.4	2.9
	RPD	17630	439	13.1	2.5	15.2	0.0
	SCH	660	203	22.1	30.7	8.7	0.0
	SCP	2480	629	44.8	25.4	40.7	13.3
	SFC	100	0	0.0	0.0	0.0	0.0
	SPC	13120	374	21.0	2.8	13.7	0.0
TOTALS		57940	2480	165.9	4.3	118.9	32.1

Table 3.77 Estimates of cutthroat trout abundance and biomass by reach, 1993.

TRIBUTARY/SPECIES	REACH	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs)	
						JUVENILES	ADULTS
ALDER CREEK/CTT	1	8840	130	53.7	1.5	4.9	0.0
	2	15530	220	49.2	1.4	11.0	2.9
	3	21220	640	116.9	3.0	35.9	10.5
	4	22050	630	59.9	2.9	28.7	7.7
	5	5470	20	0.0	0.4	1.1	0.0
	6	6960	0	0.0	0.0	0.0	0.0
	NF1	3090	0	0.0	0.0	0.0	0.0
	NF2	3090	0	0.0	0.0	0.0	0.0
	NF3	2090	0	0.0	0.0	0.0	0.0
TOTALS		**88340**	**1640**	**279.8**	**1.9**	**81.6**	**21.1**

Table 3.78 Estimates of cutthroat trout abundance and biomass by habitat type, 1993.

TRIBUTARY/SPECIES	HABITAT TYPE	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs)	
						JUVENILES	ADULTS
ALDER CREEK/CTT	DMP/BVP	7390	60	34.6	0.8	3.2	0.0
	GLD	3530	210	116.8	5.9	11.0	0.0
	LGR	52240	860	37.6	1.6	42.0	10.5
	PKW	4500	100	41.1	2.2	4.2	0.0
	PLP	2720	40	0.0	1.5	2.6	0.0
	SCH	2450	30	0.0	1.2	1.2	0.0
	SCP	7070	190	41.6	2.7	11.7	7.7
	SPC	8440	150	53.7	1.8	5.7	2.9
TOTALS		**88340**	**1640**	**325.5**	**1.9**	**81.6**	**21.1**

Table 3.79 Estimates of brook trout abundance and biomass by reach, 1993.

TRIBUTARY/SPECIES	REACH	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs) JUVENILES	BIOMASS (lbs) ADULTS
ALDER CREEK/EBT	1	8640	0	0.0	0.0	0.0	0.0
	2	15530	100	6.3	0.61	2.71	16.4
	3	21220	310	115.2	1.5	19.1	36.5
	4	22050	960	81.3	4.4	31.7	43.1
	5	5470	640	30.3	11.7	39.3	20.2
	6	6960	590	44.2	8.5	30.1	9.4
	NF1	3090	390	49.1	12.6	22.8	9.3
	NF2	3090	290	0.0	9.4	11.3	0.0
	NF3	2090	460	41.3	22.0	6.1	0.0
TOTALS		883401	3740	387.8	4.2	163.0	135.0

Table 3.80 Estimates of brook trout abundance and biomass by habitat type, 1993.

TRIBUTARY/SPECIES	HABITAT TYPE	LENGTH (ft.)	POP. EST.(N)	SE(N)	#/100 ft.	BIOMASS (lbs) JUVENILES	BIOMASS (lbs) ADULTS
ALDER CREEK/EBT	DMP/BVP	7390	160	0.0	2.2	6.5	5.4
	GLD	3530	230	22.8	6.5	12.9	13.8
	LGR	52240	1340	116.9	2.6	60.8	33.7
	PKW	4500	0	0.0	0.0	0.0	0.0
	PLP	2720	270	0.0	9.9	12.2	13.6
	SCH	2450	370	34.7	15.1	27.7	6.8
	SCP	7070	900	103.1	12.7	39.1	58.9
	SPC	8440	470	30.0	5.6	3.1	2.8
TOTALS		88340	3740	307.5	4.2	182.4	135.0

3.2.3. Habitat Use Evaluation

Chi-square goodness of fit tests and analysis of catch rates indicate that cutthroat and brook trout were not distributed uniformly ($p<0.001$) among the available habitat types in the four study drainages. (Table 3.81) Drainage specific catch rates showed considerable variation in selection of habitat types, whereas combined catch rates for both cutthroat and brook trout showed a strong selective tendency for deep water habitat with slower velocities.

BVP/DMP - Combined catch rates were lower in beaver created pools (BVP) and dammed pools (DMP) than all other habitat types utilized by cutthroat and brook trout (0.14 trout/min and 0.13 trout/min, respectively). Chi-square analysis also indicated that trout generally underutilized this habitat type. Observed catch rates for cutthroat and brook trout were 2.3 and 1.7 times lower than expected if populations had been equally distributed among habitat types (Table 3.81).

EDP - Cutthroat trout were observ utilizing eddy pools (EDP) only in the Evans Creek drainage. Combined catch rates, however, were 1.3 times high than expected if populations had been equally distributed among habitat types. Chi-square analy s of the combined observed versus expected values indicated that cutthroat trout selected for eddy pool habitat (Table 3.81). No brook trout were observed in this habitat type.

GLD - Combined catch rates for cutthroat trout (0.15 trout/min) were the second lowest of all habitat types. Catch rates for brook trout fell in the median range for all habitat types (0.24 trout/min). Chi-square analysis indicated that cutthroat trout selected against glide habitats, while brook trout were found 1.1 times more frequently than expected (Table 3.81).

LGR - Combined catch rates for cutthroat trout and brook trout were similar (0.28 trout/min and 0.21 trout/min, respectively) in low gradient riffles (LGR). Chi-square analysis indicated that cutthroat and brook trout were not observed as frequently as expected if populations had been equally distributed among all habitat types (Table 3.81).

PKW - Combined catch rates for cutthroat trout were 0.28 trout/min in pocket water habitat (PKW). No brook trout were observed in this habitat type. Chi-square analysis indicated that cutthroat trout generally underutilized this habitat type. Catch rates were 1.2 t ime less than expected if populations had been equally distributed among a l habitat types (Table 3.81).

PLP - Combined catch rates for cutthroat trout were higher in plunge pools (PLP) than in any other habitat type (0.71 trout/min). Combined catch rates for brook trout were 0.34 trout/min. Chi-square analysis indicated that trout selected for this habitat type. Observed catch rates for cutthroat and brook trout were 2.2

and 1.5 times higher than expected if populations had been equally distributed among habitat types (Table 3.81).

RPD - Combined catch rates for cutthroat trout (0.55 trout/min) were second highest among all habitat types. Chi-square analysis indicated that trout selected for this habitat type. Observed catch rates were 1.7 times higher than expected if populations had been equally distributed among habitat types (Table 3.81). No brook trout were observed in rapids.

SCH - Combined catch rates for cutthroat and brook trout were 0.43 trout/min and 0.63 trouffmin, respectively. Catch rates for brook trout in scour holes (SCH) were higher than in any other habitat type. Chi-square analysis indicated that trout selected for this habitat type. Observed catch rates for cutthroat and brook trout were 1.3 and 2.8 times greater than expected (Table 3.81).

SCP - Combined catch rates for cutthroat and brook trout in scour pools (SCP) were similar (0.45 trout/min and 0.46 trout/min). Catch rates for brook trout were second highest among all habitat types. Observed catch rates were 1.4 and 2.1 times higher than expected for cutthroat and brook trout, respectively (Table 3.81). Chi-square analysis indicated that trout selected for this habitat type.

SPC - Combined catch rates for step-pool cascades (SPC) were 0.37 trouffmin for cutthroat trout and 0.20 trout/min for brook trout. Chi-square anaysis indicated that cutthroat trout selected for this habitat type, while brook trout selected against it. Observed catch rates were 1.2 times higher than expected for cutthroat and 1 .I times lower than expected for brook trout (Table 3.81).

3.2.4. Spawning Surveys

Spawning surveys were conducted on Lake, Benewah, Evans, and Alder creeks during late May. During 1993 and 1994 the entire stream length was surveyed to locate and identify redds. Because spawning surveys were conducted during spring runoff, it was difficult to see the bottom of the stream channel, especially in mainstem areas. No redds were located in any drainages.

3.2.5. Trout Migration Analysis

Traps were monitored in Lake, Benewah, Evans, and Alder creeks from mid-March through mid-May, 1994. Migration traps were not successfully installed in 1993 due to severe runoff conditions. A total of 1,348 fish were caught in all traps in 1994. Cutthroat trout comprised the greatest proportion of the catch (95 percent) with largescale sucker, redside shiner, brook trout, longnose sucker, and pumpkinseed comprising the remainder of the catch.

Table 3.81 Chl-Square analysis of combined observed and expected values for electrofishing catches by habitat type, 1993.

		CR				EBT			
Habitat Type	Effort (mln)	Obs.	Exp.	Mag.	p-Value	Obs.	Exp.	Mag.	p-Valus
BVP/DMP	160	22	51.5	-2.3		21	35.7	-1.7	
EDP	15	6	4.8	1.3		0	3.3		
GLD	203	30	65.2	-2.2		49	45.2	1.1	
LGR	668	188	214.9	-1.1		139	149.0	-1.1	
PKW	127	35	40.8	-1.2		0	28.3		
PLP	79	56	25.4	2.2		27	17.6	1.5	
RPD	100	55	32.2	1.7					
SCH	55	24	17.8	1.3		35	12.3	2.8	
SCP	216	97	69.5	1.4		99	48.2	2.1	
SFC	8	0	2.6						
SPC	234	87	75.3	1.2		46	52.2	-1.1	
TOTAL	1866	600	600		~0.001	416	416.0		<0.00l

A total of six hundred ninty-eight fish were caught in Lake Creek traps, of which 99 percent were cutthroat trout. Analysis of cutthroat trout age class structure showed that age 2+ fish were the most abundant age class followed by 6+, 5+ and 7+ (Figure 3.1). Immature trout (age 0+ through 3+) comprised 64 percent of the population and adult trout (4+ and older) made up 36 percent of the total catch.

Upstream migration of cutthroat trout in the Lake Creek drainage was concentrated within the period March 20-April23. Approximately, 71 percent of all upstream migration occurred during this period. Upstream movement past the lower Lake Creek trap consisted primarily of mature fish (age 5+ - 7+) greater than 277 mm total length (Figure 3.2). Most of these fish were thought to belong to adfluvial stocks. In contrast, upstream movement at the upper Lake Creek trap was dominated by age 2+ fish (Figure 3.3). Trap data indicated that spawning activity of adfluvial stocks occurred primarily below the confluence with Bozard Creek, in reaches l-7.

A total of five hundred eighty-seven fish were trapped in Benewah Creek, of which 90 percent were cutthroat trout and 1.7 percent were brook trout. Analysis of cutthroat trout age class structure showed that age 2+ and 3+ fish were the most abundant age classes, accounting for 56 percent of the population. Age 7+ and 5+ trout comprised 18 and 17 percent of the population, respectively (Figure 3.4).

Upstream migration of cutthroat trout in Benewah Creek conformed to a bimodal distribution, with mature fish (age 5+ - 7+) migrating past the lower trap during the period April 3 to April 30, while the number of juvenile migrants peaked during the week May 15-21 (Figure 3.5). The age distribution of upstream migrants at the lower Benewah Creek trap consisted primarily of age classes 5+ and 7+ (28 and 30 percent of the total catch, respectively). Age 2+ fish comprised 21 percent of the catch in lower Benewah Creek. The timing of adult migration into Benewah Creek generally coincided with runs into Lake Creek. A total of 48 fish were caught in the trap set at the mouth of SE. Benewah Creek. These fish were primarily age class 3+ and 2+, 50 and 19 percent of the total catch, respectively. Twenty-seven percent were mature fish (age classes 5-7). An additional nine trout were caught at the mouth of Whitetail Creek, however, only one of these fish was a mature adult.

Fish trapped in the Alder and Evans creek drainages accounted for less than 10 percent of the total catch. Thirty-nine fish were trapped in Alder Creek, of which three were mature cutthroat trout greater than 320 mm total length. A total of eighty-four fish were caught in Evans Creek, none of which were trout species.

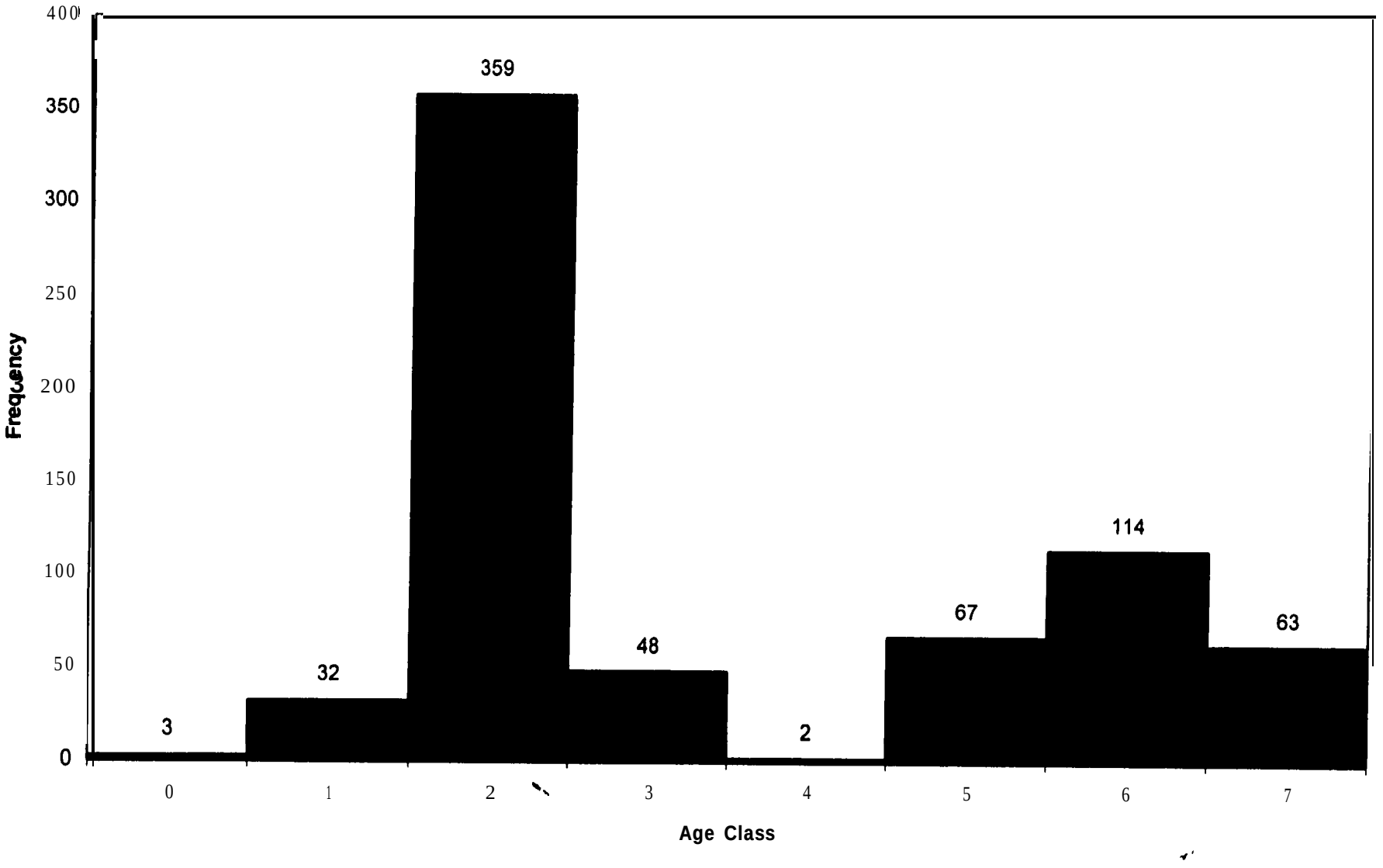

Figure 3.1 Age frequency of cutthroat trout in Lake Creek, March-May, 1994.

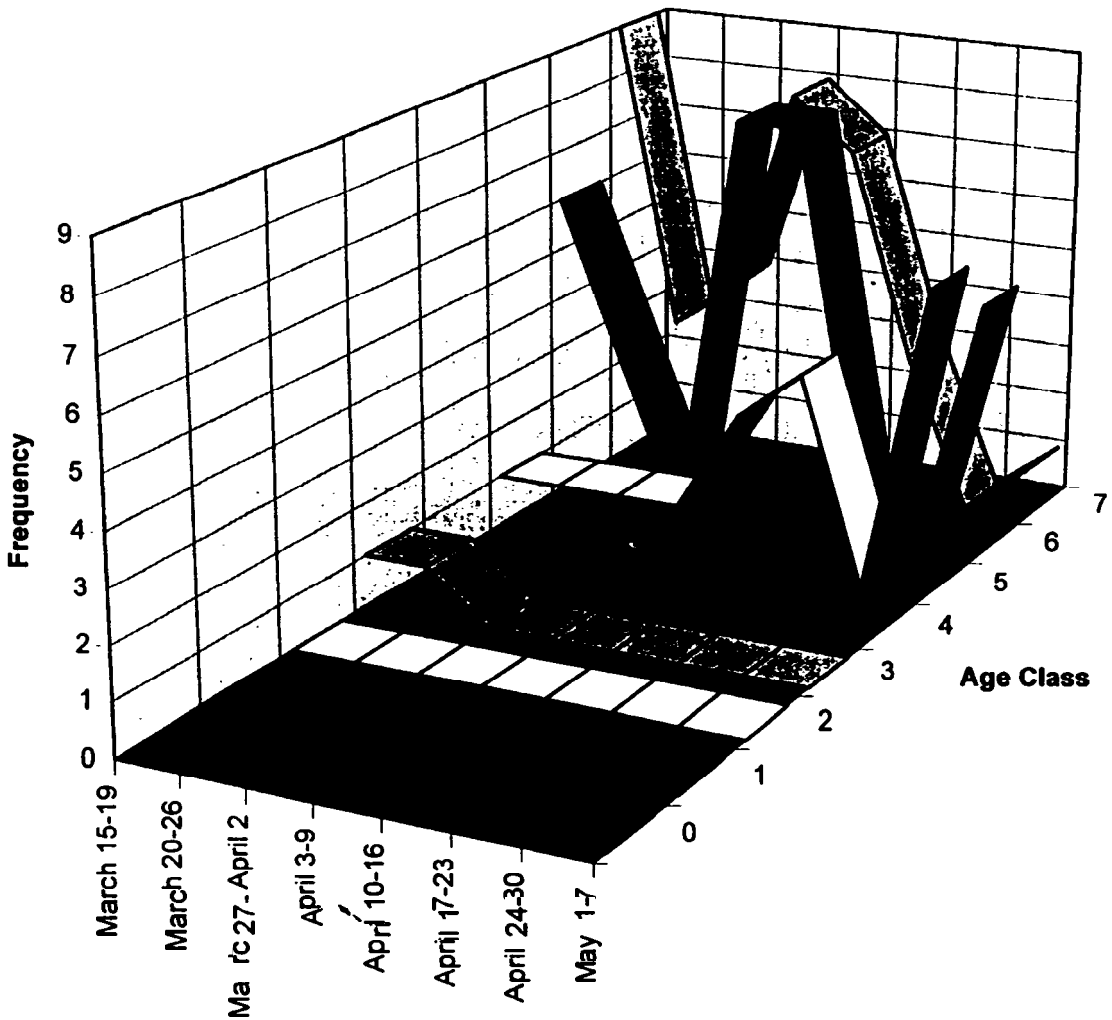

Figure 3.2 Timing of upstream migration for cutthroat trout in lower Lake Creek.

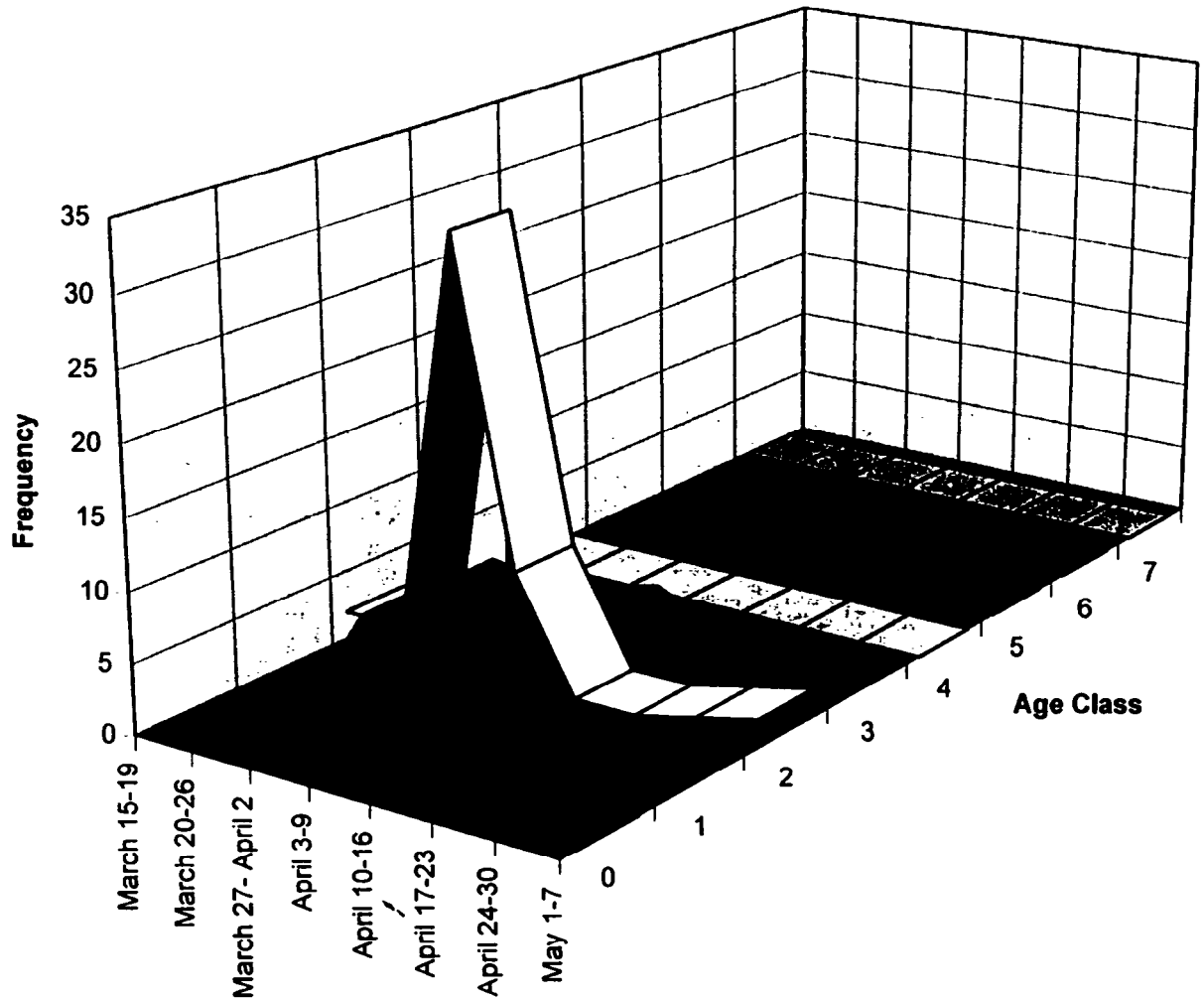

Figure 3.3 Timing of upstream migration for cutthroat trout in upper Lake Creek.

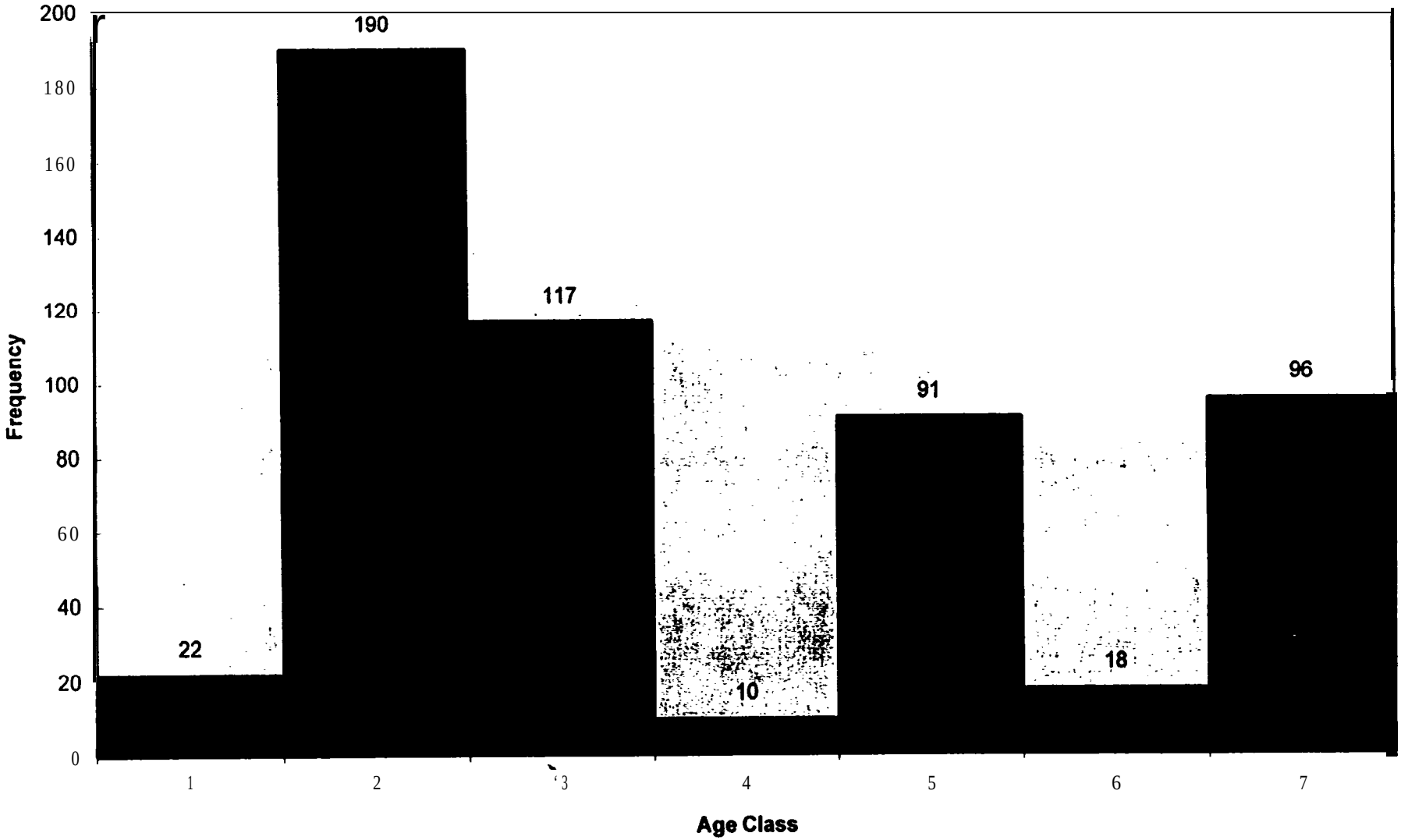

Figure 3.4 Age frequency of cutthroat trout in Benewah Creek, March-May, 1994.

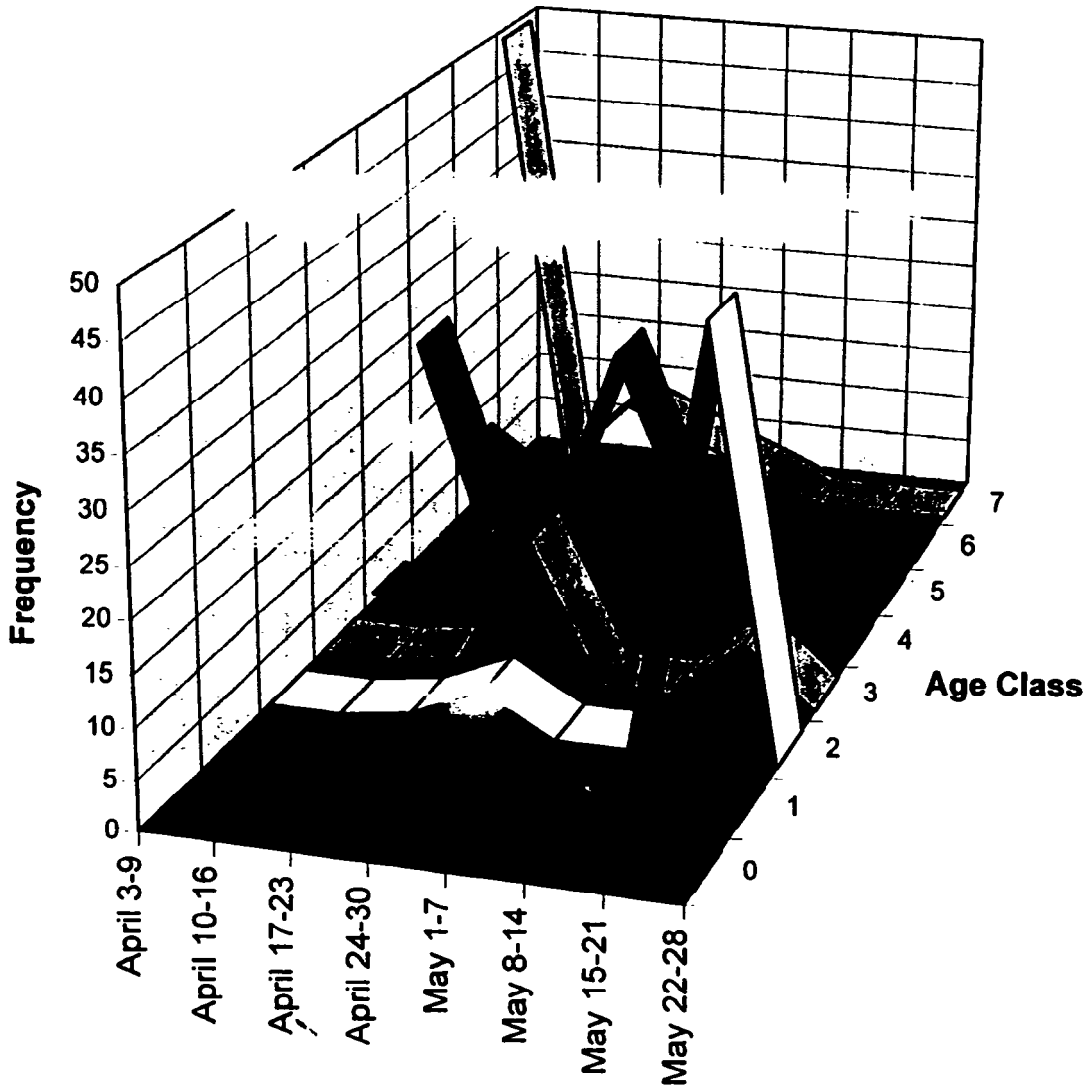

Figure 3.5 Timing of upstream migration for cutthroat trout in lower Benewah Creek.

3.2.6. Age, Growth and Condition

3.2.6.1. 1993

Lake Creek

A total of 145 **scales** were collected from cutthroat trout in Lake Creek for age determination. Back-calculated lengths for cutthroat trout at the first annulus ranged from 60 to 74 mm with a grand mean of 66.2 mm (Table 3.82). At the end of the second years growth, lengths ranged from 79 to 105 mm with a grand mean of 92 mm. At the end of the third years growth, lengths ranged from 109 to 144 mm with a grand mean of 122 mm. At the end of the fourth years growth lengths ranged from 144 to 172 mm with a grand mean of 158 mm. At the end of the fifth year of growth, lengths ranged from 163 to 198 with a grand mean of192 mm. At the end of the sixth year of growth lengths averaged 183 mm.

Mean lengths, weights and condition factors for each age class of cutthroat trout in Lake Creek are listed in Table 3.83. Mean condition factors ranged from 0.9 for 2+ and 3+ age classes to 1.2 for I+ age classes with an overall mean of 1.0.

Benewah Creek

A total of 125 scales were collected from cutthroat trout in Benewah Creek for age determination. Back-calculated lengths for cutthroat trout at the first annulus ranged from 72 to 80 mm with a grand mean of 74 mm. At the second years of growth, lengths ranged from 95 to 106 mm with a grand mean of 100 mm. At the end of the third years of growth, lengths ranged from 118 to 149 mm with a grand mean of 126 mm. At the end of the fourth years of growth, lengths ranged from 139 to 190 mm with a grand mean of 151 mm. At the end of the fifth year of growh, lengths ranged from 171 to 223 mm with a grand mean of 190 mm. Lengths at the end of six years of growth were 247 mm (Table 3.84).

Mean lengths, weights and condition factors for each age class of cutthroat trout in Benewah Creek are listed in Table 3.85. Mean condition factors ranged from 0.8 for 2+ age class to 1 .I for the 6+ **age** class with an overall mean of 1.0.

Evans Creek

A total of 365 scales were collected from cutthroat trout in Evans Creek for age determination. Back-calculated lengths for cutthroat trout at the first annulus ranged from 68 to 78 mm with a grand mean of 71 mm. At the end of the second years growth, lengths ranged from 93 to 97 mm with a grand mean of 94 mm. At the end of the third year of growth, lengths ranged from 114 to 123 mm with a grand mean of 115 mm. At the end of the fourth year of growth,

Table 3.82 Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Lake Creek, 1993.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS					
Cohort	N	1	2	3	4	5	6
1992	24	66.4 ± 8.4					
1991	40	66.9 ± 7.3	91.8 ± 12.1				
1990	37	62.1 ± 8.2	86.4 ± 13.1	109.5 ± 16.4			
1989	31	68.0 ± 24.6	95.2 ± 17.9	129.9 ± 23.7	154.9 ± 23.1		
1988	10	74.2 ± 11.8	104.9 ± 18.3	144.2 ± 27.9	171.7 ± 43.5	198.3 ± 53.6	
1987	1	59.8	79.2	124.4	143.8	163.2	182.5
GRAND MEAN	145	66.2 ± 8.9	91.9 ± 14.4	122.1 ± 22.4	158.3 ± 27.8	192.4 ± 50.4	182.5
MEAN ANNUAL GROWTH INCREMENT		66	26	30	36	34	-

Table 3.83 Mean lengths, weights and condition factors for each age class of cutthroat trout in Lake Creek, 1993.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
0+	14	58.7 ± 10.2	2.2 ± 1.2	1.0 ± 0.2
1+	23	77.3 ± 12.3	5.6 ± 2.7	1.2 ± 0.2
2+	40	108.6 ± 15.9	11.4 ± 5.0	0.9 ± 0.2
3+	37	122.5 ± 19.6	18.1 ± 11.1	0.9 ± 0.2
4+	30	171.2 ± 19.5	52.8 ± 18.5	1.0 ± 0.1
5+	10	212.3 ± 51.7	130.8 ± 18.4	1.0 ± 0.2
6+	1	189	67	1.0
Total	158			1.0 ± 0.2

Table 3.84 Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Benewah Creek (including tributaries), 1994.

	MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS						
Cohort	N	1	2	3	4	5	6
1992	7	71.6 ± 3.4					
1991	23	76.1 ± 9.4	103.9 ± 14.8				
1990	18	79.6 ± 10.9	104.9 ± 15.2	128.3 ± 17.1			
1989	42	72.7 ± 8.2	95.1 ± 11.3	117.9 ± 12.7	139.1 ± 14.9		
1988	22	72.1 ± 6.5	97.2 ± 13.9	126.9 ± 26.6	152.0 ± 35.6	170.7 ± 38.9	
1987	13	74.3 ± 9.0	105.6 ± 15.1	149.2 ± 42.6	189.7 ± 55.9	222.9 ± 68.9	247.7 ± 69.0
GRAND MEAN	125	74.3 ± 8.7	99.9 ± 14.1	126.2 ± 24.9	151.3 ± 36.0	190.1 ± 57.2	246.7 ± 69.0
MEAN ANNUAL GROWTH INCREMENT		74	26	26	25	39	57

Table 3.85 Mean lengths, weights and condition factors for each age class of cutthroat trout in Benewah Creek (including tributaries), 1994.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
0+	4	56.3 ± 3.0	1.8 ± 0.5	1.0 ± 0.4
1+	36	75.3 ± 16.8	4.6 ± 3.8	1.0 ± 0.4
2+	32	118.8 ± 17.4	14.9 ± 6.5	0.8 ± 0.3
3+	27	137.7 ± 21.0	26.6 ± 1.8	0.9 ±0.1
4+	51	147.1 ± 19.2	29.6 ± 18.3	0.9 ± 0.2
5+	31	175.4 ± 38.0	59.0 ± 49.8	1.0 ± 0.2
6+	12	253.9 ± 75.4	230.2 ± 199.7	1.1 ± 0.3
Total	193			1.0 ± 0.3

lengths ranged from 137 to 148 mm with a grand mean of 138 mm. At the end of the fifth year of growth, lengths ranged from 164 to 168 mm with a grand mean of 165 mm. At the end of the sixth year of growth, lengths were 192 mm (Table 3.86).

Mean lengths, weights and condition factors for each age class of cutthroat trout in Evans Creek are listed in Table 3.87. Mean condition factors range from 0.9 for age classes 1+,2+ and 3+, to 1 .I for 6+ fish with an overall mea 0.9.

Alder Creek

A total of 227 scales were collected from cutthroat trout in Alder Creek for age determination. Back-calculated lengths for cutthroat trout at the first annulus ranged from 58 to 77 mm with a grand mean of 65 mm. At the end of the second years growth, lengths ranged from 80 to 119 mm with **a** grand mean of 94 mm. At the end of the third year of growth, lengths ranged from 109 to 150 mm with a grand mean of 120 mm. At the end of the fourth year of growth, lengths ranged from 134 to 192 mm with a grand mean of 141 mm. At the end of the fifth year of growth, lengths ranged from 156 to 223 with a grand mean of 189. At the end of the sixth year of growth, lengths averaged 255 mm (Table 3.88).

Mean lengths, weights and condtion factors for each age class of cutthroat trout in Alder Creek are listed in Table 3.89. Mean condition factors ranged from 0.9 for 2+,3+,4+ snf 6+ fish to 1 .I for 0+ fish with an overall mean of 0.9.

A total of 357 scales were collected from eastern brook trout in Alder Creek for age determination. Back-calculated lengths for eastern brook tr out at the first annulus ranged from 54 to 63 mm with a grand mean of 60 mm. the end of the second year of growth, lengths ranged from 82 to 99 mm with a grand mean of 92 mm. At the end of the third year of growth, lengths ranged from 126 to 135 mm with a grand mean of 129 mm. At the end of the fourth year of growth, lengths ranged from 158 to 171 mm with a grand mean of 159 mm. At the end of the fifth years growth, lengths ranged from 189 to 203 mm with a grand mean of 191 mm. At the end of the sixth year of growth lengths were calculated at 239 mm (Table 3.90).

Mean lengths, weights, and condition factors for each age class of eastern brook trout in Alder Creek are listed in Table 3.91. M in condition factors ranged from 0.9 for I+ and 2+ fish to 1 .I for 0+ fish, with an overall mean of 0.9 mm.

Table 3.86 Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Evans Creek, 1994.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS					
Cohort	N	1	2	3	4	5	6
1992	74	78.2 ± 12.6					
1991	93	67.9 ± 8.5	94.4 ± 13.9				
1990	101	69.7 ± 17.3	93.6 ± 22.9	114.4 ± 22.0			
1989	78	69.9 ± 12.6	92.8 ± 16.0	114.6 ± 23.7	137.4 ± 23.1		
1988	17	71.5 ± 12.6	93.9 ± 14.2	116.3 ± 17.7	139.2 ± 22.5	164.1 ± 27.9	
1987	2	72.3 ± 17.4	97.4 ± 26.1	122.6 ± 34.8	148.0 ± 43.4	167.6 ± 44.8	192.3 ± 39.4
GRAND MEAN	365	71.1 ± 13.7	93.7 ± 18.0	114.7 ± 22.3	137.9 ± 23.1	164.5 ± 28.4	192.3 ± 39.4
MEAN ANNUAL GROWTH INCREMENT		71	23	21	23	27	27

Table 3.87 Mean lengths, weights and condition factors for each age class of cutthroat trout in Evans Creek, 1994.

Age	N	Mean weight (g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
0+	19	65.1 ± 12.6	2.9 ± 2.0	1.0 ± 0.4
1+	74	94.3 ± 12.7	7.8 ± 5.7	0.9 ± 0.1
2+	84	113.2 ± 15.4	13.4 ± 7.1	0.9 ± 0.2
3+	98	129.1 ± 21.9	21.5 ± 14.1	0.9 ± 0.1
4+	76	150.3 ± 24.8	36.2 ± 21.4	1.0 io.2
5+	17	175.8 ± 28.8	61.5k41.4	1.0 ± 0.2
6+	2	207.5 ± 47.4	112.5 ± 95.5	1.1 ± 0.3
Total	368			0.9 ± 0.5

Table 3.88 Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Alder Creek, 1994.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS					
Cohort	N	1	2	3	4	5	6
1992	14	62.2 ± 8.8					
1991	42	64.0 ± 7.8	97.9 ± 9.7				
1990	82	68.1 ± 20.9	99.7 ± 26.1	123.9 ± 22.3			
1989	72	63.9 ± 10.9	90.3 ± 14.8	118.7 ± 18.3	141.5 ± 24.8		
1988	16	58.3 ± 10.5	80.4 ± 17.4	109.1 ± 26.5	134.4 ± 30.5	155.5 ± 34.2	
1987	1	77.1	118.9	150.2	191.9	223.2	254.6
GRAND MEAN	227	65.0 ± 15.0	94.3 ± 21.0	120.4 ±21.7	140.6 ± 26.4	189.1 ± 36.7	254.6
MEAN ANNUAL GROWTH INCREMENT		65	29	26	21	48	66

Table 3.89 Mean lengths, weights and condition factors for each age class of cutthroat trout in Alder Creek, 1994.

Age	N	Mean weight(g) ±SD	Mean length (mm) ±SD	Mean K_{tl} ±SD
0+	3	64.3 ± 3.8	3.0 ± 1.0	1.1 io.3
1+	8	71.8 ± 8.2	3.5 ± 1.1	1.0 ± 0.2
2+	36	118.6 ± 12.7	15.3 ± 7.0	0.9 ± 0.3
3+	80	142.3 ± 18.9	26.4 ± 12.6	0.9 ± 0.2
4+	72	150.9 ± 27.8	34.5 i27.5	0.9 ± 0.1
5+	16	163.0 ± 33.6	51.4f41.7	1.0 ± 0.2
6+	1	265	170	0.9
Total	225			0.9 ± 0.2

Table 3.90 Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of eastern brook trout in Alder Creek, 1994.

	MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS						
Cohort	N	1	2	3	4	5	6
1992	52	54.8 ± 8.6					
1991	77	56.8 ± 13.6	81.7 ± 21.9				
1990	106	62.6 ± 16.3	99.3 ± 24.1	131.1 ± 33.3			
1989	76	61.4 ± 13.2	92.9 ± 18.0	127.2 ± 31.4	157.7 ± 28.8		
1988	38	60.0 ± 11.4	91.8 ± 14.7	126.1 ± 21.9	157.7 ± 26.0	188.6 ± 29.1	
1987	8	60.7 ± 11.9	93.4 ± 15.6	134.7 ± 19.2	170.6 ± 21.9	203.1 ± 23.0	239.1± 26.3
GRAND MEAN	357	59.6 ± 13.8	92.2 ± 21.8	129.1 ± 30.4	158.6 ± 27.6	191.4 ± 28.4	239.1± 26.3
MEAN ANNUAL GROWTH INCREMENT		60	32	37	30	32	47

Table 3.91 Mean lengths, weights and condition factors for each age class of eastern brook trout in Alder Creek, 1994.

Age	N	Mean length (mm) ±SD	Mean weight (g) ±SD	Mean K_{tl} ±SD
0+	3	30.7± 8.4	2.7i1.5	1.1 ± 0.3
1+	52	71.2 ± 9.4	3.4 ± 1.7	0.9 ± 0.3
2+	77	98.8 ± 30.6	10.8 ± 14.3	0.9 ± 0.2
3+	104	147.5 ± 31.0	35.3 k26.9	1.0 ± 0.2
4+	74	173.3 k25.4	53.9 k25.5	1.0 ± 0.2
5+	38	199.6 ± 31.4	83.8 ± 35.9	1.0 ± 0.3
6+	38	244.4 ± 19.3	150.9 ± 28.4	1.0 ± 0.2
Total	354			0.9 ± 0.2

3.2.6.2. **1994**

Lake Creek

A total of 730 scales were collected from cutthroat trout in Lake Creek for age determination. Back-calculated lengths for cutthroat trout at the first annulus ranged from 51 to 89 mm with a grand mean of 71.4 mm (Table 3.92). At the end of the second years growth. lengths ranged from 88 to 143 mm with a grand mean of 114 mm. At the end of the third years growth, lengths ranged from 121 to 211 mm with a grand mean of 152 mm. At the end of the fourth years growth lengths ranged from 175 to 258 with a grand mean of 231 mm. At the end of the fifth year of growth, leng: ranged from 261 to 321 with a grand mean of 277 mm. At the end of the sixty year of growth lengths ranged from 309 mm to 328 mm with a grand mean of 327 mm. At the end of the seventh year of growth lengths averaged 351 mm.

Mean lengths, weights and condition factors for each age class of cutthroat trout in Lake Creek are listed in Table 3.93. Mean condition factors ranged from 0.8 for 2+ age classes to 1.3 for 0+ age classes with an overall mean of 0.9.

Benewah Creek

A total of 681 scales were collected from cutthroat trout in Benewah Creek for **age** determination during 1994. Back-calculated lengths for cutthroat trout at the first annulus ranged from 62.5 mm to 68 mm with a grand mean of 65 mm. At the end of the second years growth, lengths ranged from 108 mm to 115 mm with a grand mean of 112 mm. At the end of the third years of growth lengths ranged from 149 mm to 163 mm with a grand mean of 155 mm. At the end of the fourth year of growth, lengths ranged from 184 mm to 206 mm with **a** grand mean of 199 mm. At the end of the fifth year of growth, lengths ranged from 264 mm to 280 mm with a grand mean of 279 mm. At the end of the sixth year of growth, lengths ranged from 321 mm to 337 mm with a grand mean of 337 mm At the end of the seventh year of growth lengths averaged 342 mm (Tab, 3.94)

Mean lengths, weights and condition factors for each age class of cutthroat trout in Benewah Creek are listed in Table 3.95. Mean condition factors ranged from 0.8 for 2+ **age** classes to 1 .O for 5+ **age** classes with an overall mean of 1.0.

A total of 100 s ales were collected from eastern b ook trout in Benewah Creek for age determi .ation during 1994. Back-calculated lengths for eastern brook trout at the first annulus ranged from 57 mm to 66 mm with a grand mean of 63 mm. At the end of the second year of growth, lengths ranged from 112 mm to 117 mm with an grand mean of 115 mm. At the end of the third year of

Table 3.92 Mean back-calculated lengths at the end of each years growth (**annulus** formation) for each age class of cutthroat trout in Lake Creek, 1994.

		MEAN ± S.D. BACK CALCULATED LENGTH AT **ANNULUS**						
Cohort	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1993	56	63.8±9.9						
1992	168	71.1 ±5.3	113.5 ± 9.3					
1991	273	50.9±18.2	88.4 ± 20.8	120.8 ± 18.5				
1990	20	75.3 ± 6.5	118.5 ± 9.9	154.2 ± 13.9	174.8 ± 37.6			
1989	4	89.4 ± 24.1	143.1 ± 37.3	211.2 ±46.2	258.4 ± 46.0	320.8 ± 41.5		
1988	200	76.5 ± 8.2	121.8 ± 13.2	175.0 ± 19.9	237.4 ± 131.4	277.3 ± 26.3	327.6 ± 29.7	
1987	9	71.8 ± 4.6	118.6 ± 15.8	166.4 ± 14.4	212.0 ± 13.0	260.7 ± 20.5	308.7 ± 22.7	350.8 ± 24.6
GRAND MEAN	730	71.4 ± 7.9	114.2 ± 12.3	151.9 ± 27.6	231.4 ± 123.7	277.4 ± 27.2	326.8 ± 29.7	350.8±24.6
MEAN ANNUAL GROWTH INCREMENT		71	43	38	79	46	50	24

Table 3.93 Mean lengths, weights and condition factors for each age class of cutthroat trout in Lake Creek, 1994.

Age	**N**	**Mean weight (g) ±SD**	**Mean length (mm) ±SD**	**Mean K_{tl} ±SD**
0+	3	1.7 i0.6	50.0± 6.2	1.3± 0.1
1+	58	3.8 ± 1.7	69.8 ± 13.1	1.1 ± 0.4
2+	168	14.3i3.8	118.7 ± 8.4	0.8 ● 0.2
3+	273	22.9 ± 6.1	136.6 ± 10.9	0.9 ± 0.2
4+	20	52.9 ± 19.9	182.4 f20.4	0.9 ± 0.2
5+	4	284.0 ± 93.1	325.5 ± 42.7	0.8 i0.2
6+	200	299.1 f79.2	333.4 ± 21.5	0.8 ± 0.2
7+	9	430.6 ± 142.9	359.0 ± 22.7	0.9 ± 0.2
Total	733			0.9

Table 3.94 Mean back-calculated lengths at the end of each years growth **(annulus** formation) for each age class of cutthroat trout in Benewah Creek, 1994.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS						
Cohort	N	1	2	3	4	5	6	7
1993	17	63.8 ± 9.4						
1992	214	64.6 ± 5.9	112.0 ± 10.1					
1991	218	63.9 ± 5.1	111.4 ± 8.1	148.9 ± 12.5				
1990	49	63.9 ± 7.8	110.6 ± 10.5	150.8 ± 13.1	183.6 ± 14.1			
1989	9	66.4 ± 6.2	114.5 ± 13.4	159.5 ± 17.7	199.9 ± 21.3	261.3 ± 23.2		
1988	161	67.9 ± 4.9	114.8 ± 7.7	163.4 ± 12.8	205.6 ± 16.4	279.9 ± 19.6	337.1 ± 20.54	
1987	65	62.5 ± 1.8	108.3 ± 6.9	148.9 ± 6.0	189.9 ± 7.1	264.1 ± 12.6	321.2 ± 18.2	342.26 ± 51.8
GRAND MEAN	681	65.1 ± 5.9	112.3 ± 9 1	154.6 ± 14.4	198.7 ± 17.9	278.5 ± 20.2	336.6 ± 20.6	342.3 ± 51.8
MEAN ANNUAL GROWTH INCREMENT		65	47	43	44	80	58	5

Table 3.95 Mean lengths, weights and condition factors for each age class of cutthroat trout in Benewah Creek, 1994.

Age	N	Mean length (mm) ±SD	Mean weight (g) ±SD	Mean K_{tl} ±SD
0+	2	55.5 ± 3.5	3.0 ± 0.0	1.78i0.34
1+	16	76.2 i13.3	4.5 ± 2.0	1.00 ± 0.25
2+	80	120.4 ± 11.5	14.1± 5.2	0.78 i0.17
3+	211	154.9i16.4	31.4i12.7	0.83 ± 0.21
4+	49	186.9i15.2	58.2 ± 17.4	0.87 k0.16
5+	10	271.3i25.7	191.0i56.6	1.04 ± 0.69
6+	169	339.0 ± 22.9	345.5 k65.3	0.89 k0.22
7+	5	379.4 ± 20.7	450.4 ± 137.2	0.81 f0.12
Total	542			

growth, lengths averaged 158 mm. At the end of the fourth year of growth, lengths averaged 202 mm (Table 3.96).

Mean lengths, weights and condition factors for each age class of eastern brook trout in Benewah Creek are listed in Table 3.97. Mean overall condition factors were 0.9.

Evans Creek

A total of 221 scales were collected from cutthroat trout in Evans Creek for age determination during 1994. Back-calculated lengths for cutthroat trout at the first annulus ranged from 55 mm to 61 mm with a grand mean of 56 mm. At the end of the second year of growth, lengths ranged from 109 mm to 121 mm with a grand mean of 111 mm. At the end of the third year of growth, lengths ranged from 167 mm to 171 mm with a grand mean of 163 mm. At the end of the fourth year of growth lengths averaged 221 mm (Table 3.98).

Mean lengths, weights, and condition factors for each age class of cutthroat trout in Evans Creek are listed in Table 3.99. Mean condition factors for cutthroat trout ranged from 0.7 for 3+ age classes to 1 .1 for 4+ age classes with an overall mean of 0.9.

Alder Creek

A total of 92 scales were collected from cutthroat trout in Alder Creek for age determination during 1994. Back-calculated lengths for cutthroat trout at the first annulus ranged from 60 mm to 65 mm with a grand mean of 62 mm. At the end of the second year of growth lengths ranged from 108 mm to 119 mm with a grand mean of 111 mm. At the end of the third year of growth, lengths ranged from 151 mm to 161 mm with a grand mean of 158 mm. At the end of the fourth years of growth, lengths averaged 198 mm (Table 3.100).

Mean lengths, weights, and condition factors for each age class of cutthroat trout in Alder Creek are listed in Table 3.101. Mean condition factors for cutthroat ranged from 0.8 for 2+ and 3+ age classes to 1.6 for 0+ age class with an overall mean of 0.9.

A total of 452 scales were collected from eastern brook trout in Alder Creek for age determination during 1994. Back-calculated lengths for eastern brook trout at the first annulus ranged from 54 mm to 62 mm with a grand mean of 59 mm. At the end of the second years of growth, average lengths ranged from 95 mm to 104 mm with a grand mean of 101 mm. At the end of the third years of growth lengths ranged. from 150 mm to 159 mm with a grand mean of 154 mm. At the end of the fourth years of growth, lengths averaged 199 mm (Table 3.102).

Table 3.96 Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of eastern Brook trout In Benewah Creek, 1994.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS			
Cohort	N	1	2	3	4
1993	38	66.3 ± 8.0			
1992	24	60.2 ± 6.9	117.2 ± 7.9		
1991	31	60.8 ± 5.1	114.1 ± 8.4	158.9 ± 14.0	
1990	7	57.1 ± 5.7	111.9 ± 9.4	158.2 ± 8.9	202.0 • 14.9
GRAND MEAN	100	62.5 ± 7.4	115.1 ± 8.4	158.7 ± 13.1	202.0 ± 14.99
MEAN ANNUAL GROWTH INCREMENT		71	52	43	A3

Table 3.97 Mean lengths, weights and condition factors for each age class of eastern Brook trout in Benewah Creek, 1994.

Age	N	Mean length (mm) ±SD	Mean weight (g) ±SD	Mean K_{tl} ±SD
0+	2	62 ± 16.9	3.0 ± 1.4	1.3 ± 0.4
1+	39	76.6 ± 7.6	3.3 1.3	0.9 ± 0.2
2+	23	127.7 ± 9.7		0 1
3+	32	165.3 ± 17.9	43.6 ± 17.0	0.9 ± 0.2
4+	7	210 • 19.2	94.6 ± 26.2	1.0 ± 0.2
Total	103			0.91 0.17

Table 3.98 Mean back-calculated lengths at the end of each years growth (**annulus** formation) for each age class of cutthroat trout in Evans Creek, 1994.

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS			
Cohort	N	1	2	3	4
1993	46	60.75±9.56			
1992	124	54.5 ±7.34	108.7 ± 15.9		
1991	36	57.9±4.7	117.3 ± 9.5	166.8 ± 96	
1990	15	59.4 ± 4.4	120.6 ± 11.7	171.1 ± 12.5	221.4 ± 22.3
GRAND MEAN	221	56.4± 11.2	111.0 ± 20.1	162.9 ± 29.5	221.4 ± 22.3
MEAN ANNUAL GROWTH INCREMENT		56	55	52	58

Table 3.99 Mean lengths, weights and condition factors for each age class of cutthroat trout in **EvansCreek,** 1994.

Age	N	Mean length ('mm) ±SD	Mean weight (g) ±SD	Mean Ktl ±SD
0+	14	59.1 5.8	2.1 0.7	1.03 0.31
1+	45	81.9 ± 10.0	5.1 ± 1.9	0.90 ± 0.19
2+	122	120.8 ± 17.9	16.0i8.8	0.85 ± 0.14
3+	33	169.0i14.1	45.65i15.26	0.72 it.11
4+	13	232.4 k23.8	136.1 f46.8	1.07 k0.25
Total	272			0.89 ± 0.18

Table 3.100 Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of cutthroat trout in Alder Creek, 1994.

	MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS				
Cohort	N	1	2	3	4
1993	23	62.4 ± 5.8			
1992	47	60.0 ± 4.7	108.1 ± 9.1		
1991	16	64.8 ±3.4	118.8 ± 9.4	161.0± 15.2	
1990	6	61.6 ± 1.6	110.4 ± 3.6	150.7 ± 6.2	198.0 ± 7.14
GRAND MEAN	92	61.5 ± 4.9	110.7 ± 9.8	158.2 ± 14.0	198.0 ± 7.14
MEAN ANNUAL GROWTH INCREMENT		62	49	47	40

Table 3.101 Mean lengths, weights and condition factors for each age class of cutthroat trout in Alder Creek, 1994.

Age	N	Mean length (mm) ±SD	Mean weight (g) ±SD	Mean K_{tl} ±SD
0+	5	58.0 ± 4.2	3.0 ± 0.0	1.58 ± 0.34
1+	28	76.1± 11.3	4.5 ± 2.4	0.96 ± 0.24
2+	108	121.1 ± 13.2	15.3 ± 5.6	0.83 ± 0.16
3+	41	165.7 ± 17.3	40.2 ± 16.1	0.84 ± 0.13
4+	14	204.8 ± 15.2	77.2 ± 18.7	0.89 ± 0.13
6+	1	325	326	0.95
Total	197			0.88 ± 0.21

Table 3.102 **Mean back-calculated lengths at the end of each years growth (annulus formation) for each age class of eastern Brook trout in Alder Creek, 1994.**

		MEAN ± S.D. BACK CALCULATED LENGTH AT ANNULUS			
Cohort	**N**	**1**	**2**	**3**	**4**
1993	110	53.9 ± 6.7			
1992	158	58.8 ± 6.9	95.5 ± 12.6		
1991	114	59.4 ± 6.7	94.8 ± 14.9	150.1 ± 13.6	
1990	70	61.9 ± 7.9	103.6 ± 16.6	158.9 ± 18.5	198.4 ± 20.9
GRAND MEAN	452	59.0 ± 17.3	100.9 ± 52.1	153.6 ± 16.1	198.6 ± 20.7
MEAN ANNUAL GROWTH INCREMENT		59	42	53	45

Table 3.103 **Mean lengths, weights and condition factors for each age class of eastern Brook trout in Alder Creek, 1994.**

Age	**N**	**Mean length (mm) ±SD**	**Mean weight (g) ±SD**	**Mean K_{tl} ±SD**
0+	4	53.3 ± 5.4	1.75 ± 0.5	1.15 ± 0.24
1+	108	73.02 ± 8.6	4.16 ± 1.61	1.05 ± 0.23
2+	158	127.9 ± 16.7	19.4 ± 8.3	0.9 ± 0.21
3+	114	166.0 ± 14.1	43.0 ± 13.4	0.9 ± 0.12
4+	70	213.3 ± 20.4	101.9 ± 40.7	1.02 ± 0.23
Total	454			0.96 ± 0.22

Mean lengths, weights, and condition factors for each age class of eastern brook trout in Alder Creek are listed in Table 3.103. Mean condition factors for eastern brook trout ranged from 0.9 for 2+ and 3+ ages classes to 1.2 for 0+ agt class with an overall mean of 1 .O.

3.3. Water Quality and Quantity Analysis

Stream discharge measurements, monthly temperature profiles, and seasonal water quality analysis were completed between March through November 1993 and 1994. Stream discharge measurements were collected monthly except for March. During March, discharge measurements were collected three times to account for rain-or snow events. Sampling after March was completed monthly but was event oriented until base flow was established in June. Sampling was then conducted the third week of the month. Temperature profiles were determined on same schedule as discharge measurements. Water quality samples were collected and analyzed monthly and reported as seasonal averages. Spring samples were those samples collected March through May. Summer samples were those samples collected June through August and fall samples were those samples collected September through November, 1993. Precipitation were also obtained for the months March through November and compared to recorded discharge measurements to show the relationship between precipitation and run-off. Precipitation and average maximum air temperatures were obtained from the Plummer field station and the St. Maries field station. Plummer data was used to determine Lake and Benewah creek conditions, and the St. Maries field station was used to approximate the conditions for Alder and Evans creeks, respectively.

Water quality data was analyzed monthly and reported seasonally. Spring samples were those samples collected March through May. Summer samples were those samples collected June through August, and Fall samples were those samples collected September through November, 1993. For monthly water quality values reference Appendix E.

3.3.1. 1993

Tables 3.104, 3.105, 3.106, and 3.107 shows the calculated discharge measurements, observed temperatures data, recorded precipitation data and average maximum ambient air temperature for Lake, Benewah, Evans, and Alder creeks, respectively during 1993.

The 1993 field season was more of a usual precipitation year for the panhandle of Idaho. Snow packs in higher elevation were average while snow packs in the lower elevation drainages were greater than normal percent. In March three-foot snow packs in lower elevation drainages resulted in higher than

Table 3.104 Stream Discharge, temperature, month to date precipitation values and average maximum air temperature for Lake: Creek, 1993.

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-09-93	41	1.8	33	36
03-l 6-93	57	0.2	38	46
03-26-93	700	1.0	33	48
04-1 5-93	51	0.8	43	53
05-05-93	840	2.8		55
06-22-93	4	3.7	56	73
07-23-93	6	4.1	60	64
08-23-93	1	0.7	57	79
09-23-93	2	0.8	44	71
1 o-23-93	1	1.1	36	63
11-19-93		1.0		48

Table 3.105 **Stream Discharge, temperature, month to date precipitation values and average maximum air temperature for Benewah Creek, 1993.**

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-09-93	32	1.8	38	38
03-16-93	69	0.2	40	46
03-26-93	350	1.0	33	48
04-I 5-93	86	0.8	34	53
05-05-93	676	2.8	34	55
06-22-93	3	3.7	60	73
07-23-93	12	4.1	66	64
08-23-93	1	0.7	53	79
09-23-93	<1	0.8	51	71
10-23-93	2	1.1	45	63
11-19-93	4	1.0	33	48

Table 3.106 Stream Discharge, temperature, month to date precipitation values and average maximum air temperature for Evans Creek, 1993.

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-09-93	**20**	2	37	38
03-16-93	27	1	**39**	45
03-26-93	182	1	33	50
04- 15-93	48	2.2		52
05-05-93	456	3.5	**34**	58
06-22-93	5	2.2	51	75
07-23-93	7	5.5	53	70
08-23-93	4	0.3	53	78
09-23-93	3	0.5	**48**	71. .
1 o-23-93	2	0.9	43	66
11-19-93	7	0.9	35	47

Table 3.107 Stream Discharge, temperature, month to date precipitation values and average maximum air temperature for Alder Creek, 1993.

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-09-93	12	2	36	38
03-16-93	38	1	37	45.
03-26-93	168	1	33	50
04-15 33	45	2.2	**34**	52
05-05-93	289	3.5	**34**	58
06-22-93	3	2.2	55	75
07-23-93	5	5.5	55	70
08-23-93	2	0.3	55	78
09-23-93	1	0.5	48	7 1 .
10-23-93	1	0.9	37	66
11-19-93	2	0.9	33	47

Table 3.108 Seasonal (spring) water quality parameters for selected Coeur d'Alene tributaries during 1993.

Location	pH	D.0.	Cond.	Redox	Alk.	NO2	NO3	PO4	TSS	Turbidity
Lake	6.8-7.2	11.8-13.0	.069-.104	332	30-40	.004-.03	1.03-3.58	.36-2.3	42-265	35-195
Benewah	7.0-7.2	13.0-13.5	.042-.060	308	30-50	.01-.03	0-1.28	.07-.40	1-640	40-164
Evans	7.0-7.2	14.5-22.0	.023-.056	291-302	20-30	0-.04	0	.18-.91	3.0-6.7	35->500
Alder	6.8-7.2	.041-.073	10.9-16.4	289	30-40	.02-.07	.02-1.3	.01-.7	18-5940	27-320

*Total dissolved solids and turbidity not determined.

Table 3.109 Seasonal (summer) water quality parameters for selected Coeur d'Alene tributaries during 1993.

Location	pH	D.0.	Cond.	Redox	Alk.	NO2	NO3	PO4	TSS	Turbidity
Lake	7.0-7.2	1.2-15.0	.045-.056	240-299	30	.01-.06	0.-0.0	0.23-0.44	5-280	9-75
Benewah	7.9-7.4	2.2-11.0	.042-.071	260-286	30-50	0.0-.06	0.0	0.12-1.43	2-640	12-87
Evans	266-313	6.7-7.0	10.6-13.8	.009-.035	30	0.0-0.08	0.0	0.0-0.18	2-460	0-30
Alder	270-288	6.3-7.2	9.6-15.7	.091-.092	30-60	.01-.03	0.0-0.06	.01-3.0	6-5940	18-320

*Total dissolved solids and turbidity not determined.

Table 3.110 Seasonal (fall) water quality parameters for selected Coeur d'Alene tributaries during 1993.

Location	pH	D.0.	Cond.	Redox	Alk.	NO2	NO3	PO4	TSS	Turbidity
Lake	7.0-7.2	10.4-15.1	.060-.061	469-942	40-50	0.0-0.03	0.0	0.07-1.92	10-87	18-28
Benewah	6.4-7.5	10.6-14.8	.069-.090	415-939	50	0.0-0.03	0.0	0.0-0.52	30	12-24
Evans	6.7-7.0	10.3-13.8	.000-.035	133-910	40-50	0.0-0.03	0.0	0.07-1.68	2	0-12
Alder	6.3-7.2	9.6-15.7	.091-.092	313-842	50-70	0.0-0.03	0.0-0.04	0.01-1.18	8	18-172

*Total dissolved solids and turbidity not determined.

normal spring discharge profiles. Snow melt began in March when air temperatures began to rise above freezing during daylight hours. This was excerbated by precipitation in the form of rain during the day, snow at night, which resulted in the first rain-on-snow event. The first rain-on-snow event was recorded on March 23 when discharge in all our drainages spiked to 700, 350, 182, and 168 cfs for Lake, Benewah, Evans, and Alder creeks, respectively. Corresponding drops in discharge was reported as precipitation values dropped. Air and water temperatures continued to increase, while above normal precipation was received. This resulted in a bankfull flow event for most of the drainages, except for Lake Creek, which reached flood stage. Discharge values peaked at 840, 676, 456, and 289 cfs for Lake, Benewah, Evans, and Alder creeks, respectively. Within a month, discharge values in all drainages had dropped significantly with corresponding increases in ambient air and water temperatures. Base flow was achieved in all drainages in October.

Water Quality Analysis

Table 3.108 shows water quality values for the spring sampling period. All parameters were within acceptable limits for fish except for nitrate, phosphates, total suspended sediments, and turbidity. Spring Nitrate values ranged from 0.0 mg/l in Evans Creek to 3.58 mg/l in Lake Creek. Standards for nitrate are 0.4 mg/l. Phosphate values ranged from 0.01 mg/l in Alder Creek to 2.3 mg/l in Lake Creek, EPA accepted standards for phosphate is 0.15 mg/l. Fish appear relatively indifferent to nitrate and phosphate, however both compounds are associated with eutriphication. Excess amounts of these compounds can result in algal blooms which ultimately may result in fish kills. Turbidity and TSS values ranged from 27 NTU's in Alder Creek to >500 NTU's in Evans Creek. Large quantites of suspended sediments can be carried for short periods of time without detriment to fish. However, long exposures to increased suspended sediments results in lowered primary food production. Streams with less than 25 ppm may be expected to support good fresh water fisheries, while streams with values between 80-400 should not be considered good areas for supporting fresh water fisheries.

Table 3.109 shows water quality values for the summer sampling period. All parameters were within acceptable limits for fish except for phosphate. Phosphate values were above acceptable limits in all four drainages with values ranging from 0.18 mg/l in Evans to 3.0 mg/l in Alder.

Table 3.110 shows water quality values for the fall sampling period. All parameters except for phosphate and TSS were within acceptable limits. Phosphate standards were exceeded in all drainages in the fall with values ranging from 0.52 in Benewah to 1.92 mg/l Lake Creek. Total suspended sediment values were above accepted limits of 25 NTU's in Lake Creek at 87 NTU's.

3.3.2. 1994

Table 3.11 l-3.1 14 shows the calculated discharge measurements, observed temperatures data, recorded precipitation data and average maximum ambient air temperature for Lake, Benewah, Evans, and Alder creeks, respectively during 1994.

Discharge and precipitation values for 1994 were lower than normal. This resulted in lower discharge profiles than those reported in 1993. Base flow was achieved earlier than in 1993. All streams reached base flow levels in August except Evans Creek.

Table 3.108 shows water quality values for the spring through fall sampling period. All parameters were within acceptable ranges for cutthroat trout except for phosphate in Lake Creek during the fall sampling period and turbidity values in all drainages, except Evans Creek during the spring sampling period.

3.4. MACROINVERTEBRATE SURVEYS

3.4.1. Hess and Drift Samples

A total of 102 Hess samples were collected in Alder, Benewah, Evans, and Lake Creeks in 1994. Mean annual densities of benthic macroinvertebrates ranged from a low of 181 0/m^2 in Lake Creek to a high of 3180/m^2 in Evans Creek. Mean annual densities in Alder Creek and Benewah Creek were 2270/m^2 and 2280/m^2, respectively (Table 3.118). Macroinvertebrate densities for the study streams are generally comparable or greater than other third order streams in north Idaho. Chironomidae larvae were the most abundant macroinvertebrate in Alder Creek (30.58 percent), Benewah Creek (21.51 percent), and Evans Creek (33.28 percent). Elmidae larvae were the most abundant taxon in Lake Creek (25.22 percent), while aquatic Oligochaetes were the second most abundant taxon (15.24 percent). Heptageniidae were the second most abundant taxon in Alder Creek (11.29 percent), and Evans Creek (15.25 percent), while Baetidae were the second most abundant in Benewah Creek (13.52 percent). These results are similar to those reported in 1991 (Lillengreen, et. al. 1991).

A total of 63 drift samples were collected from study streams in 1994. Mean densities of benthic invertebrates ranged from a low of 53.7/100 m^3 in Benewah Creek, to a high of 249.5/100 m^3 in Alder Creek (Table 3.118). Average densities in Benewah (53.7000 m^3), Evans (223.41100 m^3), and Lake Creek (72-O/100 m^3) were lower than in 1991 (Lillengreen, et al. 1991). while average density in Alder Creek (201.3/100 m^3) was higher. Chironomidae were the most abundant taxon collected in Alder Creek (43.46 percent) and Evans

Table 3.111 Str eam Discharge, temperature, month to date precipitation values and average maximum air temperature for Laka Creek, 1994.

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-04-94	42.5	2.7	2.0	**44**
03-21-94	38.4	2.6	2.4	**49**
04-18-94	18.9	2.0	9.9	56
05-16-94	6.0	1.1	9.6	66
06-22-94	1.8	5.1	15.9	67
07-18-94	0.3	0.8	20.1	79
08-29-94	<0.1	0.1	11.3	89
09-l 9-94	0.5	0.6	14.9	78
1 o-1 7-94	0.6	1.2	5.2	63.
11-15-94	2.9	6.9	1.0	44

Table 3.112 Stream Discharge, temperature, month to date precipition values and average maximum air temperature for Benewah Creek, 1994.

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-04-94	71.6	2.7	5.0	44
03-21-94	32.1	2.6	2.0	49
04- 18-94	2.9	2.0	16.8	56
05-16-94	7.2	1.1	17.4	66
06-22-94	2.4	5.1	28.1	67
07-18-94	2.2	0.8	23.3	79
08-29-94	<0.1	0.1	17.1	89
09-l 9-94	0.6	0.6	10.2	78
10-17-94	1.3	1.2	7.8	63.
11-15-94	7.5	6.9	1.7	44

Table 3.113 Stream Discharge, temperature, month to date precipitation values and average maximum air temperature for Evans Creek, 1994.

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-04-94	31.8	1.8	3.5	44
03-21-94	15.7	1.6	3.7	49
04-18-94	32.8	1.2	7.0	59
05-l 6-94	15.7	1.1	8.2	68
06-22-94	2.6	2.8	12.0	71
07-18-94	3.5	0.4	14.0	82
08-29-94	1.8	•	12.7	89
09-19-94	1.4	0.7	11.6	78
10-17-94	1.3	0.5	6.4	*
11-15-94	3.6	*	2.7	•

Table 3.114 **Stream Discharge, temperature, month to date precipitation values and average maximum air temperature for Alder Creek, 1994.**

Date	Discharge (cfs)	Precipitation (inches)	Average Stream Temp. °F	Average Air Temp. °F
03-04-94	36.3	1.8	32	**44**
03-21-94	19.0	1.6	1.1	**49**
04-l 8-94	14.5	1.2	41	**59**
05-l 6-94	9.0	1.1	9.8	68
06-22-94	1.8	2.8	•	71
07-18-94	•	0.4	•	a2
08-29-94	<0.5	•	16.5	89
09-l 9-94	<0.5	0.7	13.3	78
10-17-94	1.5	0.5	5.7	•
11-15-94	2.8	•	0.9	•

Table 3 115 Seasonal (spring) water quality parameters for selected Coeur d'Alene tributaries during 1994.

Location	pH	D.O.	Cond.	Redox	Alk.	NO2	NO3	PO4	TSS	Turbidity
Lake	6.5-7.4	9.4-13.8	.038-.055	357-385	3-40	0.03	0.0-0.06	0.01-0.07	7	9-40
Benewah	7.0-7.8	8.8-14.1	.040-.057	336-416	5-60	0.0-0.03	0.0-0.0	0.01-0.07	10	9-30
Evans	6.8-7.2	10.9-13.6	0.011-0.022	328-407	4-50	0.02-0.05	0.0	0.01-0.07	6	0.5
Alder	7.5-7.8	11.3-14.0	.039-.067	278-379	5-60	0.1-0.3	0.0-0.0	0.0-0.07	•	5-18

*Parameters not determined.

Table 3.116 Seasonal (summer) water quality parameters for selected Coeur d'Alene tributaries during 1994.

Location	pH	D.O.	Cond.	Redox	Alk.	NO2	NO3	PO4	TSS	Turbidity
Lake	7.3-8.9	7.7-9.7	.020-.040	176-337	40 to	0.05-0.08	0.09	0.12-0.40	•	9-15
Benewah	8.3-10.7	8.2	.059-.094	160-366	35-50	•	0.01-6.0	0.07-0.18	*	12-50
Evans	7.0-8.5	9.2-10.5	0.24-0.28	279-360	35-70	0.03-0.07	0.0	0.01-0.07	•	o-5
Alder	6.7-8.2	7.4-9.2	.076-.096	277-493	50-75	0.04	0.05-0.08	0.07-0.12	*	21-24

*Parameters not determined.

Table 3.117 Seasonal (fall) water quality parameters for selected Coeur d'Alene tributaries during 1994.

Location	pH	D.O.	Cond.	Redox	Alk.	NO2	NO3	PO4	TSS	Turbidity
Lake	7.0-7.2	8.8-11.2	.050-.080	366-455	50-60	0.03-0.060	•	0.18-0.27	•	9-18
Benewah	7.3-7.9	9.3-10.8	.062-.090	338-394	70	.	0.04-0.06	0.07-0.12	•	9-12
Evans	6.9-7.1	9.4-10.6	.030-.031	356-466	50	0.03-0.06	0.0	0.01	•	5
Alder	7.0-7.2	8.3-9.9	.093-.096	277-354	70	0.05	0.06	0.07-0.18	•	15-24

*Parameters not determined.

Table 3.118 Mean density of macroinvertebrates from Hess (#/m^2) and Drift (#/100m^3) samples, 1994. Sample size in parentheses.

Hess Samples

Date	Stream: Alder	Benewah	Evans	Lake
June	2720 (9)	2530 (9)	1990 (9)	1890 (9)
August	1850 (9)	890 (9)	3100 (9)	1100 (6)
October	2230 (9)	3420 (9)	4460 (9)	1240 (9)
Annual	2270 (27)	2280 (27)	3180 (27)	1810 (21)

Drift Samples

Date	Stream: Alder	Benewah	Evans	Lake
June	52.7 (6)	38.7 (6)	49.9 (6)	89.4 (6)
August	624.5 (6)	73.4 (4)	480.1 (6)	24.5 (1)
October	71.3 (6)	30.9 (6)	140.1 (6)	18.1 (4)
Annual	249.5 (18)	53.7 (16)	223.4 (18)	72.0 (11)

Table 3.119 Shannon-Weiner diversity index and Family-level Biotic Index(FBI) for macroinvertebrate communities, 1994.

Shannon-Weiner

	Stream: Alder	Benewah	Evans	Lake
# of Taxa	44	44	43	38
# of Individuals	6122	6155	8599	3806
Index	2.42	2.53	2.34	231

FBI

	Stream: Alder	Benewah	Evans	Lake
June	3.45	4.32	4.54	4.33
August	5.06	4.76	4.10	4.72
October	4.06		3.00	4.75
Annual	4.19	3.98	3.91	4.17

Creek (49.30 percent). Elmidae were the second most abundant taxon in Alder Creek (11.00 percent), while Baetidae were second most abundant in Evans Creek (8.64 percent). Baetidae were most abundant in Benewah Creek (27.37 percent), followed by Chironomidae (26.67 percent). The most abundant taxa in Lake Creek were Heptageniidae and Chironomidae (24.25 percent and 23.75 percent, respectively).

3.4.2. Biological Assessment

Shannon-Weiner diversity values were highest in Benewah Creek (2.53) and lowest in Lake Creek (2.31). Values for Alder and Evans Creeks were 2.42 and 2.34, respectively (Table 3.119). Shannon-Weiner diversity values for drift samples ranged from 2.1 in Evans Creek to 2.25 in Benewah Creek. These values were lower than those reported in 1991 (Lillengreen et al. 1991). Terrestrial invertebrates were not included in the 1994 index calculations and may have resulted in lower diversity values.

Average annual Family-level Biotic Index (FBI) values ranged from 3.91 in Evans Creek to 4.19 in Alder Creek. Values were 3.98 for Benewah Creek and 4.17 for Lake Creek, respectively (Table 3.119). These results suggest that water quality ranges from very good (possible slight organic pollution) to good (some organic pollution probable) in the study drainages. Values calculated from drift samples were slightly higher than those for Hess samples. These values fall within the range reported for similar streams in the region (Lester 1994).

3.5. Analysis of Migration Barriers

A total of 19 culverts were analyzed during 1993 to determine if passage barriers or velocity barriers existed. Only one passage barrier existed, while several potential velocity/distance barriers existed. In the Benewah Creek drainage, a culvert connecting a side tributary, Windfall Creek was determined to be a jumping pool distance barrier. Replacement of this culvert would access 2-3 miles of spawning/rearing habitat for westslope cutthroat trout.

4.0 Discussion

Fisheries resources are an integral part of the Coeur d'Alene Tribe's cultural heritage. Anadromous and resident salmonids were a critical component of the tribes annual subsistence requirements. The Coeur d'Alene Tribe, however, lost their salmon fishery early in the twentieth century with the construction of Chief Joseph and Grand Coulee Dams on the Columbia River. These actions taken by non-tribal entities forced the Coeur d'Alene Tribe to rely solely on the resident fish resources of Lake Coeur d'Alene.

Historical evidence suggests that cutthroat trout were an abundant and extremely important part of the Coeur d'Alene Tribe's resident fishery. Cutthroat trout were the most abundant trout species in the Coeur d' Alene system. Large numbers of cutthroat trout were harvested in Lake Coeur d'Alene by boat fishing, as well as trapping in tributaries during spring spawning runs (Walker 1977; Peltier 1975; Scott 1968). Since 1932, the cutthroat population has declined significantly. The present ecosystem bears little resemblance to habitat composition, diversity and structure of the historic ecosystem.

A literature review determined optimal habitat conditions for cutthroat and bull trout (Graves et al. 1990; Lillengreen et al, 1993). These were then compared to existing conditions reported in the study drainages. Data compiled in 1993 and 1994 included: stream discharge rates, temperature, water quality, available habitat, large woody debris densities, substrate and percentage of fine sediment. Biological data included trout population estimates, biomass estimates, stock assessment, and benthic macroinvertebrate densities. All data were combined to determine factors affecting, and ways to increase, westslope cutthroat and bull trout populations on the Reservation.

4.1 Physical Characteristics

4.1.1 Water Quantity and Quality

In the four study drainages, base flow, temperature, and water quality are limiting the quality of trout habitat. Data collected in 1993 and 1994 indicated that average annual flow values reported were considered poor for maintaining quality trout. Average annual flows of >50 percent are considered excellent for maintaining quality trout habitat, 25-50 percent is considered fair, and base flows less <25 percent is considered poor habitat (Lillengreen et al, 1993; Hickman and Raleigh 1982; Wesche 1980). Lillengreen et al, (1993) reported that average annual flows in 1991 and 1992 were also poor (e.g. Lake Creek values for 1991 and 1992 were 13.4 and 25.2 percent, respectively). Drought conditions have existed during the past four years which may have impacted water yield to streams which may have contributed to these low flow conditions. Data collected indicated that extreme peaks take place during spring run-off

followed by iods of extreme low flows. This can be associated with land use practices in rich upland and riparian land clearing results in loss of water retention, and contributes to the "flashy" nature of these drainages.

Based on water temperature data collected during 1993 and 1994 (Tables 3.103, 3.110) it appears that temperatures may be limiting cutthroat trout survival. (Lillengreen et al, 1993) reported that these conditions also existed in 1991 and 1992. Evans and Alder creeks were within acceptable temperature ranges for westslope cutthroat trout in 1993. However, in 1994, both streams exceeded optimal temperature ranges.

Based on results, water quality data is inconclusive. Phosphate, turbidity, total suspended solids, and dissolved oxygen exceeded EPA approved limits reported for optimal trout habitat conditions for short durations. These values may indicate a problem exists with water quality, however, additional data needs to be collected to determine the extent of the potential problem.

4.1.2 Habitat

Current habitat conditions for westslope cutthroat trout in Lake, Benewah, Evans and Alder creeks were determined. Parameters used for evaluation included residual pool depth, average canopy cover, number of large woody debris within wetted perimeter of the channel (instream cover); riffle:pool ratio and average percent fine sediment (< 4 mm). All habitat parameters were measured for each stream reach in each of the four drainages.

Pools are important components of fish habitat because they provide cover, protection and play a role in maintaining optimal temperature conditions for trout. Residual pool depth is defined as the depth of the pool during low flow or no flow conditions. Optimal pool depth for trout habitat can be described as pools greater than 1.5 meters in streams less than 5 meters wide or pools greater than 2 meters deep in streams greater than 5 meters wide (Hickman and Raleigh, 1981). All of the study drainages failed to meet the p ' depth requirements r optimum trout habitat (Table 4.1).

Canopy cover is an important component of fish habitat because it provides temperature regulation, controls and maintains watershed erosion and streambank integrity. Average canopy cover between 50-100 percent shade is acceptable for trout habitat in streams less than 50 feet wide (Idyll 1942; Martin et. al. 1981). Stream side buffers of approximately 33 meters in which 80 percent of the buffer is well rooted will maintain adequate erosion c rol (Raleigh and Duff 1981). All mainstem sections of the drainages lacked fficient riparian buffers for thermal regulation and bank stability, while forested headwater drainages contained sufficient ripanan buffers to maintained temperature and bank stability (Table 4.1).

The need for large woody debris is widely accepted in the scientific literature, however optimal levels of woody debris reported are variable. Woody debris plays a significant role in channel geomorphology,(i.e. stream stability/habitat diversity) as well as contributes to overwinter fish habitat and plays an important role in summer juvenile cover (Val. Crispen and Roberts, 1993) Large woody debris is also important in the production of benthic invertebrates. Large woody debris is conspicuously absent in most of the four drainages. Removal of woody debris from stream channels, forest management and agricultural practices, and road construction have all contributed to the current conditions. This results in homogeneous stream reaches dominated by riffles and degraded to boulder-bedrock substrate. (Val Crispen and Roberts, 1993). These conditions are evident throughout the four study drainages. All lower mainstem reaches are devoid of large woody debris, while smaller headwater, drainages in forested areas still retain some level of woody debris (Table 4.1).

Riffle pool ratio can be used as an indicator of habitat diversity. An optimal riffle pool ratio also provides for adequate food production. Habitat diversity (complexity) is important for westslope cutthroat trout, especially juveniles (Griffith, 1970; Rieman et al, 1989). Rieman et al (1989) reported that manipulation of stream complexity by artificially increasing the amount of lateral habitat resulted in a proportional increase in cutthroat numbers. Lere (1982) found westslope cutthroat trout densities were correlated to pool riffle periodicity. Optimal pool-riffle ratios that provide an optimal proportion of rearing and food producing areas are 1:1 (Hynes, 1970; Raleigh et. *al.* 1982; Rieman and Apperson 1989). Average riffle:pool ratio for the four study drainages did not meet this target value. Most all drainages, with the exception of Alder Creek had riffle:pool ratios of greater than 1 :1. (Table 4.1).

Substrate size and the amount of fine sediment are important to cutthroat trout for spawning success, food production, overwintering and rearing habitat. For successful spawning and reproduction, cutthroat trout require an adequate amount of gravels between 2.0 and 6.0 cm in diameter with less then 10 percent fine sediments. Substrate is also important in overwintering habitat. For optimal winter and escape cover of fry and juveniles, 10 percent of the substrate ranges between 1040 centimeters in diameter (Hickman and Raleigh, 1981). Small fish utilize substrate for hiding and in extreme environmental conditions, such as high velocities and ice formation, fry and subadults bun-ow into substrate (Everest, 1969, Bjorn et al 1982). Fine sediment also contributes to the reduction of carrying capacity of essential pool habitat and can eventually eliminate pool habitat (Bjom et al 1977; Rhodes and Jone 1991). Average percent fines for all drainages were above the recommended 10 percent fines value (Table 4.1).

Table 4.1. Current (1994) and optimal habitat conditions for westslope cutthroat trout.

Habitat Characteristic	*Lake Creek*	*Benewah Creek*	Evans *Creek*	*Alder Creek*	Optimal Condition
Average Residual Pool Depth	(1993) 0.5 m (1994) 0.5 m	0.6 m 0.6 m	0.5 m 0.4 m.	0.6 m 0.4 m	1.5 m
Average Canopy Cover	(1993) 6.9% (1994) 30.2%	30.3% 27.0%	50.9% 43.3%	24.8% 34.2%	75%
# Large Woody Debris/Lineal Distance	(1993) .3/m2 (1994) .5/m2	4.9/m2 7.6/m2	3.3/m2 6.9/m2	0.1/m2 .8/m2	
Riffle: Pool Ratio	(1993) 2.7:1 (1994) 2.8:1	1.4:1 3.2:1	1.4:1 1.5:1	1.3:1 4.2:1	1:1
Average Percent Fine Sediment	(1993)18.8% (1994)11.0%	5.6% 15.6%	13% 14.2%	12.8% 11.4%	<10%

4.2 Biological Assessment

Cutthroat trout populations within their native range are considered to be declining region wide. The range of native trout have been severely reduced in the drainages of the Coeur d' Alene Indian Reservation. Multiple drainages that historically contained westslope cutthroat trout are currently devoid of viable populations. However, viable populations of cutthroat trout currently exist within selected study drainages. Bull trout are currently classified as a Category 1 species and are being considered by the U.S. Fish and Wildlife Service for listing as threatened or endangered. Baseline surveys on the Coeur d' Alene Indian Reservation revealed a conspicuous absence of bull trout (Lillengreen 1993).

Habitat use evaluation information indicated that cutthroat trout populations were selecting for certain habitat types (i.e. plunge pool) thus, indicating that all available habitat was not being utilized. Chi-square goodness of fit tests and analysis of catch rates indicated that cutthroat and brook trout were not distributed uniformly among available habitat types in the four study drainages. Drainage specific catch rate showed considerable variation in selection of habitat types, whereas combined catch rates for both cutthroat and brook trout showed a strong selective tendency for deep water habitat with slower velocities. Cutthroat trout densities were highest in plunge pool habitat

for all drainages except Alder Creek in which densities were highest in glide habitat. Not enough information was collected to determine why cutthroat trout selected for specific habitat types. Literature reports that habitat quality is related to depth and cover components (Hickman and Raliegh, 1981). Assumptions could be made that habitat types selected by cutthroat trout in this study contained adequate depth and cover requirements. However, more data needs to be collected and will be addressed in future monitoring efforts.

Population and density estimates indicated that cutthroat trout populations and densities were below those reported in literature. Irving (1987) summarized several studies and concluded that "good" rearing habitat may support up to 200 fry/100 m^2. Mean densities may approach 20 fish /100 m^2 for age one and two fish. Mean densities in all drainages ranged from 0.4 fish/100 m^2 to 4.7 ctt/100 m^2. Some headwater reaches contained cutthroat trout densities that fell within the "good" rearing habitat range as reported by Irving (1987). However, cutthroat trout densities reported in mainstem drainages were well below those values reported by Irving (1987).

In order to assess habitat restoration alternatives, an accurate stock assessment needs to be completed. Part of this stock assessment is identifying the adfluvial, fluvial, and resident components of the population. Migratory analysis in combination with age and growth analysis indicated that an adfluvial stock of westslope cutthroat trout potentially existed in Lake Creek (Lillengreen *et. al.* 1993). Benewah Creek also contained a large number of adult westslope cutthroat trout migrants. However, determination of adfluvial or fluvial origin based on back calculated lengths was inconclusive. Fish trapped in the Alder and Evans creek drainages accounted for less than 10 percent of the total catch. No trout species were caught in the Evans Creek trap, while three mature adults were captured in Alder Creek. Stock determination was inconclusive with data collected. Further investigations need to be conducted.

4.3 Conclusion

Habitat degradation of riparian/stream ecosystems are a result of the cumulative effects of trapping, livestock grazing, dam construction, logging, mining, the introduction of exotic species, channelization, urbanization, road construction, irrigation withdrawals, etc. In many instances, these cumulative effects, over time, have harmed the native fisheries because of their potential to alter ecosystem processes (Platts, 1991; Swanston, 1991). For example, severe prolonged reduction of riparian vigor may result in loss of bank stability, creating a long term source of sediment. A shift in the equilibrium between streamflow and sediment will produce a change in bar profile and bedload transport. When transport capacity is exceeded aggradation occurs and there is a decrease in bed material size (Leopold et al. 1964; Kappesser, 1992). The relationship between aquatic communities and specific habitat parameters (e.g. stream flow,

water quality, substrate size) is such that anthropogenic disturbance, which vanes from the natural disturbance regime, can significantly alter the productivity of ecosystems by affecting species composition and diversity (Bjom et al., 19 Brusven and Prather, 1974; Hausle and Coble, 1976). Conditions currently existing in study drainages are characterized by declines in biological diversity and ecosystem productivity, and are the focus of interest for restoration efforts on the reservation.

Given this scenario and the limitations placed upon it by current management activities and conflicting economic demands, the following goals and o ectives have been identified for the Coeur d' Alene Tribe fisheries enhancement program:

- Reestablish and protect self-sustaining populations of native cutthroat and bull trout which were historically prominent in the Lake Coeur d' Alene system.

- Develop and maintain continuous, healthy riparian corridors which support the full range of ecological and hydrological processes.

- Manage the riparian/aqua tic interface for both wildlife and limited domestic use, while protecting water quality, public health, and the fisheries resource.

- Create long-term fishing opportunities for the local community.

- Develop and coordinate community and agency coalitions which would address issues related to habitat restoration.

- Develop agreements with private landholders to implement site specific restoration projects and encourage commitments to cost-sharing opportunities.

In order to achieve the above goals the Coeur d'Alene Tribe has identified the following objectives;

1. Conduct an extensive habitat restoration program in four major drainages on the Reservation which includes; Lake Benewah, Evans and Alder Creeks.

2. Develop harvest opportunities for the local community through a sustainable cutthroat trout fishery and an interim put and take rainbow trout pond program.

3. Purchase "critical watershed areas" for protection of fisheries habitat.

4. Educate and inform the public about issues related to cutthroat and bull trout habitat restoration.

5. Design, construct, operate and maintain a trout production facility on the Coeur d'Alene Reservation and

6. Implement a five-year monitoring program to evaluate the effectiveness of the above recommendations.

In order to protect stocks of westslope cutthroat trout restrictive fishing regulations have been adopted by the Coeur d'Alene Tribe. Complete stream fishing closures exist in Benewah and Lake creeks, while limited harvest opportunities exist in Alder and Evans creeks. These restrictive regulations will protect declining stocks from mortality due to angler harvest during spawning migrations. The Idaho Department of Fish and Game also has a moratorium on bull trout harvest in the Lake Coeur d'Alene Drainage as well as restrictive regulations pertaining to the harvest of westslope cutthroat trout.

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Appendix A

Appendix A.1. Summary of Lake Creek channel type survey, 1993.

Reach Num	Reach Location	Channel Type	Entrench-ment	Width/Depth Ratio	Sinuosity	Stream Gradient	Dominant Substrate
1	Mainstem	C6	Slight	Mod - High	High	1	Silt
2	Mainstem	C 4	Slight	Mod - High	High	1	Gravel
3	Mainstem	B3	Moderate	Moderate	Moderate	3-4	Cobble
4	Mainstem	C 3	Slight	High	High	2	Cobble
5	Mainstem	B3	Moderate	Moderate	Moderate	3	Cobble
6	Mainstem	C4-C6	Slight	Mod - High	High	1	Gravel-Silt
7	Mainstem	E6	Slight	Very Low	Very High	1	Silt
8	Mainstem	E5	Sliaht	Very Low	Very High	1	Sand
8b	West	E5-C5	Slight	Very Low	Very High	1	Sand
9b	west	E6	Slight	Very Low	Very High	1	Silt
10b	West	B4a	Moderate	Moderate	Moderate	5	Gravel

Appendix A.2. Summary of Benewah Creek channel type survey, 1993.

Reach Num	Reach Location	Channel Type	Entrench-ment	Width/Depth Ratio	Sinuosity	Stream Gradient	Dominant Substrate
1	Mainstem	C3	Slight	39.0	High	2	Cobble
2	Mainstem	B2a	Moderate	13.0	Moderate	4	Boulder
3	Mainstem	C2b	Slight	15.0	High	2	Boulder
4	Mainstem	B3c	Moderate	27.5	Moderate	2	Boulder
5	Mainstem	C1b	Slight	21.3	High	4-5	Bedrock
6	Mainstem	C3	Slight	20.0	High	1	Cobble
7	Mainstem	C3	Slight	17.6	High	1	Cobble
8	Mainstem	C6	Slight	26.2	High	1	Cobble

Appendix A.2. (continued): Summary of Benewah Creek channel type survey, 1993.

Reach Num	Reach Location	Channel Type	Entrench-ment	Width/Depth Ratio	Sinuosity	Stream Gradient	Dominant Substrate
9	Mainstem	C5	Slight	13.3	High	<1	Sand
10	Mainstem	C6	Slight	13.3	High	1	Silt
11	Mainstem	E6	Slight	3.9	Very High	<1	Silt
12	Mainstem	C5-C6	Slight	—	High	<1	Sand-Silt
13	Mainstem	E 4	Slight	6.0	Very High	2	Gravel
13a	West Fork	E4	Slight	10.0	Very High	2-3	Gravel
14a	West Fork	E3b	Slight	12.0	Very High	3 4	Cobble

Appendix A.3. Summary of Evans Creek channel type survey, 1993.

Reach Num	Reach Location	Channel Type	Entrench-ment	Width/Depth Ratio	Sinuosity	Stream Gradient	Dominant Substrate
1	Mainstem	C6	Slight	–	High	<1	Silt
2	Mainstem	C3	Slight	7.8	High	1	Cobble
3	Mainstem	E3b	Slight	–	Very High	3	Cobble
4	Mainstem	B3b	Moderate	–	Moderate	–	Cobble
5	Mainstem	A4	Moderate	17.3	Moderate	7	Cobble-Boulder
6	Mainstem	A2a	High	8.4	Low	10	Boulder-Cobble
7	Mainstem	B3a	Moderate	14.4	Moderate	9	Cobble
5a	North Fork	B3a	Slight	6.3	Moderate	8	Cobble-Boulder

Appendix A.3. (continued): Summary of Evans Creek channel type survey, 1993.

Reach Num	Reach Location	Channel Type	Entrench-ment	Width/Depth Ratio	Sinuosity	Stream Gradient	Dominant Substrate
5b	South Fork	A 2	High	11.1	Low	7-10	Gravel
6b	south Fork	B3a	High	6.3	Low	16	Boulder-Cobble

Appendix A.4. Summary of Alder Creek channel type survey, 1993.

Reach Numb	Reach Location	Channe l Type	Entrench-ment	Width/Depth Ratio	Sinuosity	Stream Gradient	Dominant Substrate
1	Mainstem	B3	Moderate		Moderate	2	Cobble
2,3,4	Mainstem	A2-A3	High	11.5	Low	3	Boulder-Cobble
5,6	Mainstem	E3b	Slight	11.3	High	2.5	Cobble
7	Mainstem	C3	Slight	>12	High	1.5	Cobble
8	Mainstem	C6	Slight	12.5	High	<1	Silt
9	Mainstem	E3b	Slight	4.4	Very High	1	Cobble
1a	North Fork	E3b	Slight	4.6	Very High	3	Cobble
2a,3a	North Fork	B3a-D3b	Moderate	5.6 – >40	Moderate	2.5	Cobble
4a	North Fork	B3a	Moderate	6	Moderate	5	Cobble

Appendix B

Table B.1 Lake Creek Stream Reach Inventory and Channel Stability Evaluation Summary.

	1993		1994	
Reach	Stability	Rating	Stability	Rating
1	113	Fair	73	Good
2	89	Fair	93	Fair
3	103	Fair	80	Fair
4	100	Fair	86	Fair
5	71	Good	101	Fair
6	101	Fair	95	Good
7	118	Poor	79	Fair
8	119	Poor	117	Poor
8b	129	Poor	102	Fair
9b	112	Fair	113	Fair
10b	87	Fair	83	Fair

Table B.2 Benewah Creek Stream Reach Inventory and Channel Stability Evaluation Summary.

	1993		1994	
Reach	Stability	Rating	Stability	Rating
1	94	Fair	83	Fair
2	74	Good	80	Fair
3	67	Good	67	Good
4	60	Good	78	Fair
5			48	Good
6	65	Good	59	Good
7	77	Fair	96	Fair
8	82	Fair	74	Good
9	122	Poor	90	Fair
IO	100	Fair		
11	125	Poor	I I 7	Poor
I 2	129	Poor	I I 5	Poor
I 3	83	Fair	107	Poor
13a	77	Fair	92	Fair
14a	75	Good		

Table B.3 Evans Creek Stream Reach Inventory and Channel Stability Evaluation Summary.

	1993		1994	
Reach	Stability	Rating	Stability	Rating
1	124	Poor	125	Poor
2	119	Poor	101	Fair
3	95	Fair	94	Fair
4	77	Fair	86	Fair
5	67	Good	73	Good
6	65	Good	72	Good
7	70	Good		
5a	73	Good	83	Fair
5b	86	Fair	84	Fair
6b	66	Good	80	Fair

Table B-4 Alder Creek Stream Reach Inventory and Channel Stability Evaluation Summary.

	1993		1994	
Reach	Stability	Rating	Stability	Rating
1	88	Fair	76	Good
2	82	Fair	78	Fair
3	73	Good	80	Fair
4	73	Good	65	Good
5	82	Fair	81	Fair
6	53	Good	72	Good
7	79	Fair	90	Fair
8	128	Poor	118	Poor
9	103	Fair	80	Fair
1a	58	Good	79	Fair
2a	89	Fair	102	Fair
3a	105	Fair	93	Fair
4a	51	Good	78	Fair

Appendix C

Appendix C.I. **Results of Riffle Armour Stability Surveys for Lake Creek, 1993/1994.**

Reach	Sample	Index Value		Geometric Mean		Percent < 4 mm	
Number	Number	1993	1994	1993	1994	1993	1994
2	1	62.0		69		28.4	
	2	78.1	96.8	96	142	[illegible]	3.1
	3	48.0	88.0	98	139	10.4	5.9
3	1	75.8	80.3	119	107	[illegible]	10.8
	2	58.0	77.9	150	134	19.6	11.3
	3	65.8	52.0	165	152	11.2	19.4
4	1	78.0	69.1	153	148	24.6	17.5
	2	67.4		120		26.6	
	3	72.9	69.6	133	134	40.7	9.5
5	1	52.6	69.5	94	171	37.3	15.7
	2	59.1	82.5	144	176	16.8	14.4
	3	33.6	66.9	101	173	19.9	26.9
6	1	74.2	81.4	130	151	34.5	34.0
	2	74.6	78.3	85	134	54.5	22.5
	3	71.6	84.5	115	142	55.5	23.1
7	1	80.4	68.0	123	113	46.7	43.1
	2	96.1	88.6	98	139	81.2	61.7
	3	90.6	95.8	86	121	83.7	31.7
10b	1	62.6		61		17.5	
	2	62.6		61		17.5	
	3	66.0		53		30.0	

Appendix C.2 **Results of Riffle Armour Stability Surveys for Benewah 1993/1994.**

Reach	Sample	Index Value		Geometric Mean		Percent < 4 mm	
Number	Number	1993	1994	1993	1994	1993	1994
1	1	79.5	89.8	130	130	26.4	24.8
	2	69.3	68.9	133	175	8.7	12.3
	3	82.4	87.1	136	152	1.5	27.3
2	1		24.1		129		5.3
	2		67.1		126		11.7
	3		38.9		132		14.7
3	2	52.3	2.7	126	135	11.3	2.4
		44.7	43.0	131	152	[illegible]	6.7
	3	55.5	86.7	162	138	[illegible]	9.4
4	1	38.2	82.0	97	124	2.5	11.0
	2	53.3	78.8	[illegible]	[illegible]	[illegible]	12.7
	3	45.5	83.4	[illegible]	131	6.9	11.1
6	1	44.8	66.8	127	148	10.0	15.3
	2	43.0	28.9	107	129	13.5	9.8
	3	62.3	85.7	134	122	9.0	10.6
7	1	60.2	77.0	142	94	14.5	17.2
	2	27.0	69.6	79		13.3	9.3

Appendix C.2 (continued): **Results of Riffle Armour Stability Surveys for Benewah 1993/1994.**

Reach	Sample	Index Value		Geometric Mean		Percent < 4 mm	
Number	Number	1993	1994	1993	1994	1993	1994
	3	45.1	92.7	127	117	11.2	20.0
8	1	41.6	70.5	108	164	9.8	27.5
	2	33.0	76.2	63	123	5.0	8.2
	3	72.4	68.9	154	124	9.2	8.5
13a	1	49.5		78		20.1	

Appendix C.3 **Results of Riffle Armour Stability Surveys for Evans Creek, 1993/1994.**

Reach	Sample	Index Value		Geometric Mean		Percent < 4 mm	
Number	Number	1993	1994	1993	1994	1993	1994
		75.2	91.4	44		35.7	3.5
	2	39.8	97.5	71	139	2.0	10.3
	3	62.5	89.4	82	154	4.5	6.1
3	1	67.3	84.0	87	130	11.8	24.2
	2	82.2		113		17.3	
	3	59.6	91.5	94	141	23.2	13.5
4	1	59.1	90.3	95	172	11.5	25.8
	2	61.0	92.6	76	183	10.0	22.6
	3	56.7	84.6	81	137	16.0	17.0
5	1	42.5	60.0	73	121	20.9	16.5
	2	51.8	61.9	77	113	23.3	13.1
	3	31.4	64.3	76	135	20.8	11.1
5b	1	63.4	64.8	71	54		37.9
	2	84.6	78.3	93	79		39.5
	3	71.8		75			

Appendix C.4 **Results of Riffle Armour Stability Surveys for Alder Creek, 1993/1994.**

Reach	Sample	Index Value		Geometric Mean		Percent < 4 mm	
Number	Number	1993	1994	1993	1994	1993	1994
1	1	31.9	58.0	57	135	7.7	11.3
	2	37.9	68.6	58	141	7.1	11.1
	3	28.5	39.2	62	132	11.0	6.2
3	1	33.4	62.[illegible]	66	161	13.9	10.1
	2	24.8	65[illegible]	62	163	5.1	10.3
	3	15.6	50.[illegible]	54	156	2.8	11.1
5	1	27.8	59.7	46	173	6.5	9.2
	2	40.3	46.2	52	146	11.0	11.4
	3	30.5	71.1	47	167	11.2	7.6
7	1	83.2	68.8	123	96	19.8	22.3
	2	66.6	87.8	83	154	14.6	14.9

Appendix C.4 (continued): Riffle Armour Stability Surveys for Alder Creek, 1993/l 994.

Reach	Sample	Index Value		Geometric Mean		Percent < 4 mm	
Number	Number	1993	1994	1993	1994	1993	1994
	3	90.8	55.5	66	123	25.6	16.9
1a	1	55	80.1		107		32.3
	2	79.4	85.8	64	107	23.5	26.9
	3	50.7	72.1	43	98	20.2	30.5
2a	1		69.3		58		36.1
3A	1	65.9	45.6	43	47	29.4	22.9
	2	76.7	65.6	48	43	30.1	34.6
	3		46.2		50		19.7
4A	1	45.0		42		22.0	
	2	39.5		45		15.1	
	3	37.5		30		21.6	

Appendix D

Appendix D.I. Summary report for Reach # 2 of the Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,180 - 2,260 ft	same
Total length	5,093 ft	6,260 ft
Stream order	4	4
Mean stream gradient	0.6	3.6
Riffle/pool ratio	3.0 : 1	1.6: 1
Land use		
Forest		
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain	100%	100 %
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100 %
Seal stage		
Grass/forb	45.6 %	45.6 %
Shrub		
Pole		
Young		
Mature	54.4 %	54.4 %
Old growth		
Other		
x Canopy cover	11.6	46.7
#Woody debris		
Logs	49	48
Root wads	0	5

Appendix D.2 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 2 for Lake Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater	1	2.9	275.1	2.1	
Glide	6	17.0	2,090	16.3	
Run					
Low gradient riffte	14	40.0	7,276	56.9	
Total Riffles	21	59.9	9,542.0	75.3	
Dammed pool	1	2.9	541.2	4.2	
Eddy pool					
Plunge pool					
Scour pool	12	34.3	924	7.2	0.6
Scour hole					
Beaver pond	1	2.9	1,689	13.2	0.6
Total Pools	14	40.1	3,155	24.6	
Secondary channel					
GrandTotals	35	100.0	12,792.0	99.9	

Appendix D.3 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 2 for Lake Creek during 1994.**

Habit Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	2	4.2	2.292	7.9	
Slip face cascade	1	2.1	112	0.4	
Total Cascades	3	6.3	2,404	8.3	
Pocketwater	1	2.1	1,372	4.8	
Glide	5	16.6	3,734	12.9	
Run					
Low gradient riffle	21	44.7	17,639	61.1	
Total Riffles	27	63.4	22,745	78.8	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	11	23.4	2,475	8.6	0.7
Scour hole	6	12.8	1,242	4.3	0.5
Beaver pond					
Total Pools	17	36.2			
3,717Sl29econdary	channel				
Grand Totals	47		28,866		

Appendix D.4. . Summary report for Reach ## 3 of the Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,060 - 2,350	
Total length	6,346 ft	4,809 ft
Stream order	4	4
Mean stream gradient	1.5	1.8
Riffelpoolratio	1.8:l	1.6 : 1
Land use		
Forest		
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain	100%	100%
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	loo %	100%
Seral stage		
Grass/forb		
Shrub	loo %	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	18	21
#Woody debris		
Logs	3	10
Root wads	1	0

Appendix D.5 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 3 for Lake Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	1	9.1	290.2	2.3	
Run					
Low gradie- 4e	6	54.6	11.762.2	93.7	
Total Riffle:	7	63.7	12,052.4	98.0	
Dammed poo:					
Eddy pool					
Plunge pool					
Scour pool	4	36.4	502.8	4.0	0.6
Scour hole					
Beaver pond					
Total Pools	4	35.4	502.8	4.0	
Secondary chai..iel					
Grand Totals	**11**	**.00.0**	**12,555.0**	**100.0**	

Appendix D.6 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 3 for Lake Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	3	12	1.179	3.4	
Slip face cascade					
Total Cascade	3	12	1,179	3.4	
Pocketwater	2	8	2,721	7.9	
Glide					
Run					
Low gradient riffle	12	48	28,623	83 3	
Total Riffles	14	56	31,344	90.9	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	4	16	998	2.9	0.4
Scour hole	3	12	873	2 5	0.3
Beaver pond					
Total Pools	7	28	1,871		
Secondary channel					
Grand Totals	25		34,499		

Appendix D.7.. Summary report for Reach # 4 of the Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,350 - 2,410 ft**	
Total length	**4,048 ft**	**2,583 ft**
Stream order	**4**	**4**
Mean stream gradient	**2.0**	**3.0**
Riffle/pool ratio	**2.9 : 1**	**1.6 : 1**
Land use		
Forest	92.2 %	92.2 %
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)	7.8 %	7.8 %
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb	27.5 %	27.5 %
Shrub		
Pole (shrub ?)	72.5 %	72.5 %
Young		
Mature		
Old growth		
Other		
x Canopy cover	**0.0**	**10 %**
# Woody debris		
Logs		4
Root wads		0

Appendix D.8 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 4 for Lake Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	4	12.9	2,737.l	12.3	
Slip face cascade					
Total Cascades	4	12.9	2,737.1	12.3	
Pocketwater					
Glide	5	16.1	4.737.1	21.3	
Run					
Low gradient riffle	15	48.4	13,776-l	62.1	
Total Riffles	20	64.5	18,502.3	83.4	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	6	19.4	814.7	3.7	
Scour hole	1	3.2	131.7	0.6	
Beaver pond					
Total Pools	7	22.6	946.4	4.3	
Secondary channel					
Grand Totals	31		22,185.6		

Appendix D.9 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 4 for Lake Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	2	6.7	1,652	6.7	
Slip face cascade					
Total Cascades	2	6.7	1,652	8.7	
Pocketwater					
Glide	1	6.7	643	3.4	
Run					
Low gradient riffle	7	46.0	16.003	84.0	
Total Riffles	8	52.7	16,646	87.4	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	5	33	748	3.9	0.5
Scour hole					
Beaver pond					
Total Pools	5	33	748	3.9	
Secondary channel					
Grand Totals	15		19,945		

Appendix D.10. Summary report for Reach # 5 of the Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,410 - 2,450 ft	same
Total length	1,603 ft	3,902 ft
Stream order	4	4
Mean stream gradient	1.0 %	1.5%
Riielpool ratio	2.9 : 1	8.1 : 1
Land use		
Forest	100 %	100 %
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential.right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100%
Seal stage		
Grass/forb	61.6	61.6
Shrub		
Pole		
Young		
Mature	38.4	38.4
Old growth		
Other		
x Canopy cover	18.5 %	26 %
#Woody debris		
Logs	5	4
Root wads		

Appendix D.11 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 5 for Lake Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	4	33.3	2,372.3	28.4	
Run					
Low gradient riffle	5	41.7	4,812.2	57.6	
Total Riffles	9	75.0	7,184.5	86.0	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	3	25.0	1.172.9	14.0	0.31
Scour hole					
Beaver pond					
Total Pools	3	25.0	1,172.9	14.0	
Secondary channel					
Grand Totals	12		8,357.4		

Appendix D.12 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 5 for Lake Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	7	39	5,574	29.9	
Run					
Low gradient riffle	9	50	12,456	668	
Total Riffles	16	89	18,030	96.7	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool					
Scour hole	2	11.1	626	3 4	0.5
Beaver pond					
Total Pools	2	11.1	626	3.4	
Secondary channel					
Grand Totals	18		18,656		

Appendix 0.13. . Summary report for Reach # 6 of the Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,450 - 2,480 ft	same
Total length	*8,705* ft	*8,248ft*
Stream order	4	4
Mean stream gradient	1.7	1.3
Rifflelpool ratio	2.9 : 1	2.1 : 1
Land use		
Forest	80.4	80.4
Agriculture	19.6	19.6
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100 %
Seral stage		
Grass/forb	28.8	28.8
Shrub	2.9	2.9
Pole		
Young		
Mature	68.3	68.3
Old growth		
Other		
x Canopy cover	0	26.5
# Woody debris		
Logs	16	10
Root wads	2	0

Appendix 0.14 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Lake Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	42	30.9	20,069	39.3	
Run					
Low gradient riffle	57	41.9	21,954	43.0	
Total Riffles	99	72.8	42,023	82.3	
Dammed pool	1	0.7	692	1.4	0.8
Eddy pool					
Plunge pool					
Scour pool	32	23.5	7,737	15.2	0.6
Scour hole	1	0.7	434	0.9	0.8
Beaver pond					
Total Pools	**34**	**24.9**	8,863	**17.5**	**0.7**
Secondary channel					
Grand Totals	**136**		**51,031**		

Appendix D.15 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Lake Creek during 1994.**

Habit Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	11	20.8	9,566	14.9	
Run					
Low gradient riffle	25	47.1	26,175	40.8	
Total Riffles	**36**	**67.9**	**35,741**	55.7	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	11	20.8	4,785	7.5	0.4
Scour hole	4	7.5	1,878	2.9	0.6
Beaver pond	2	3.8	21,766	33.9	0.6
Total Pools	17	32.1	28,429	44.3	
Secondary channel					
Grand Totals	53		64,171		

Appendix D.16 Summary report for Reach # 7of the Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,480 - 2,600 ft	same
Total length	16,365 ft	18,828 ft
Stream order	4	4
Mean stream gradient	1.5	same
Riffle/pool ratio	2.6 : 1	2.3 : 1
Land use		
Forest	9.1	9.1
Agriculture	82.6	82.6
Livestock grazing	8.3	8.3
Mining		
Wetland		
Floodplain		
Other (includes residential.right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100 %
Seal stage		
Grass forb	58.3	58.3
Shrub	41.7	41.7
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	0	45.8
# Woody debris		
Logs	48	168
Root wads	1	4

Appendix 0.17 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 7 for Lake Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	19	44.2	40.547.5	82.6	
Run					
Low gradient riffle	12	27.9	5,674.3	11.6	
Total Riffles	31	72.1	46,221.8	94.2	
Dammed pool	4	9.3	1,475.8	3.0	0.6
Eddy pool					
Plunge pool					
Scour pool	6	14.0	1,146.4	2.3	0.7
Scour hole	2	4.7	252.0	0.5	0.5
Beaver pond					
Total Pools	12	28.0	2,874.2	5.8	
Secondary channel					
Grand Totals	43	100.1	49,096.o	100.0	

Appendix D-18 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 7 for Lake Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater	1	2.5	181	0.2	
Glide	16	40	44,509	57.3	
Run					
Low gradient riffle	11	27.5	14,911	19.3	
Total Riffles	28	70	59,601	766	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	5	12.5	2,282	2.9	0.4
Scour hole					
Beaver pond	7	17.5	15,740	20.3	0.4
Total Pools	12	30	18,022	23.2	
Secondary channel					
Grand Totals	40		77,625		

Appendix D.19. Summary report for Reach # 1 of the West Fork Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,540 - 2,570	same
Total length	10,132 ft	10,712 m
Stream order	3	3
Mean stream gradient	1.0	1.2
Riffle/pool ratio	2.4: 1	1.9: 1
Land use		
Forest	68.7	68.7
Agriculture	19.7	19.7
Livestock grazing	11.6	11.6
Mining		
Wetland		
Floodplain		
Other (includes residential.right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100 %
Seral stage		
Grass/forb	16.2	16.2
Shrub	58.9	58.9
Pole	15.1	15.5
Young	9.9	9.9
Mature		
Old growth		
Other		
x Canopy cover	0	35.4
#Woody debris		
Logs	28	18
Root wads	0	0

Appendix D.20 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for West Fork Lake Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater	1	2.9	674	3.7	
Glide	9	26.5	3,521.4	19.1	
Run					
Low gradient rime	14	41.2	13,904.7	75.4	
Total Riffles	24	70.6	18,100.l	98.2	
Dammed pool					
Eddy pool					
Plunge pool	5	14.7	182.6	1.0	
Scour pool	5	14.7	160.3	0.9	
Scour hole					
Beaver pond					
Total Pools	10	29.4	342.9	1.9	
Secondary channel					
Grand Totals	34	100	18,443.O	100.1	

Appendix D.21 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #1 for West Fork Lake Creek during 1994.

Habitat Type	Freauencv	% Frequency	Total Area (sq. meters)	% Area	Residual ± depth (m)
Rapid					
Step pool cascade	1	1.9	366	2.1	
Slip face cascade					
Total Cascades	1	1.9	366	2.1	
Pocketwater					
Glide	125	22.6	5,384	31.7	
Run					
Low gradient riffle	22	41.5	10,220	60.1	
Total Riffles	147	64.1	15,604	91.8	
Dammed pool					
Eddy pool					
Plunge pool	1	1.9	IO	0.6	0.6
Scour pool	13	24.5	607	36	0.4
Scour hole	4	4.5	317	1.9	0.5
Beaver pond					
Total Pools	18	30.9	934	6.1	
Secondary channel					
Grand Totals	53		17,003		

Appendix 0.22 Summary report for Reach # 2 of the West Fork Lake Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,570 - 2,970 ft	same
Total length	2,893 ft	7,556 ft
Stream order	3	4.1
Mean stream gradient	4.0	4.1
Riffle pool ratio	NA	1 :1.7
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential right of way, etc.)		
Vegetative type		
Decidious		
Coniferous	6	6
Mixed	93	93
Seal stage		
Grass/forb		
Shrub		
Pole		
Young	100	100
Mature		
Old growth		
Other		
x Canopy cover	77	41
# Woody debris		
Logs	106	48
Root wads	13	4

Appendix 0.23 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth ant lolume values for Reach # 2 for West Fork Lake Creek dur ing 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	2	33.3	412.1	12.4	
Step pool cascade	3	50.0	2,892.9	87.3	
Slip face cascade					
Total Cascades	5	83.3	3,305.0	99.7	
Pocketwater					
Glide					
Run					
Low gradient riffle					
Total Riffles					
Dammed pool					
Eddy pool					
Plunge pool	1	16.7	8.3	0.3	
Scour pool					
Scour hole					
Beaver pond					
Total Pools	1	16.7	8.3	0.3	
Secondaw channel					
Grand Totals	6	100.0	3,313.8	100.0	

Appendix D.24 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 2 for West Fork Lake Creek during 1994.

Habit Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	4	22.2	517	3.6	
Step pool cascade	7	38.9	5,308	365	
Slip face cascade					
Total Cascades	11	61.1	5,825	40.1	
Pocketwater					
Glide					
Run					
Low gradient riffle	2	11.1	291	2	
Total Riffles	2	11.1	291	2	
Dammed pool					
Eddy pool					
Plunge pool	2	11.1	61	0.4	0.2
Scour pool	2	11.1	213	1.5	
Scour hole	1	5.6	8,138	56.1	1.5
Beaver pond					
Total Pools	5	67.9	8,412	58	
Secondary channel					
Grand Totals	18		14,528		

Appendix D.25 Summary report for Reach # 1 of the Bozard Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,540 - 2,590 ft	NA
Total length	3,888.3 m	
Stream order	3	
Mean stream gradient	2.0	
Riffle|pool ratio	12 : 1	
Land use		
Forest	50.5	
Agriculture	49.5	
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential.right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	
Seral stage		
Grass/forb		
Shrub	92.3	
Pole		
Young	7.7	
Mature		
Old growth		
Other		
x Canopy cover	0.0	
#Woody debris		
Logs		
Root wads		

Appendix D.26 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for Bozard Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	5	38.5	9.672.5	37.5	
Run					
Low gradient riffle	7	53.9	16,062.4	62.3	
Total Riflies	12	92.4	25,751.g	99.8	
Dammed pool					
Eddy pool					
Plunge pool	1	7.7	22.0	0.2	0.5
Scour pool					
Scour hole					
Beaver pond					
Total Pools	1	7.7	22.0	0.2	
Secondary channel					
Grand Totals	13	100.1	25,7576.9	100.0	

Appendix D.27 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #for Creek during 1994.**

Habit Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide					
Run			NA		
Low gradient riffle					
Total Riffles					
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool					
Scour hole					
Beaver pond					
Total Pools					
Secondary channel					
Grand Totals					

Appendix D.28 Summary report for Reach # 1 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,250 - 2,250 ft.	same
Total length	1,547 ft.	1598 ft
Stream order	4	4
Mean stream gradient	1.7	1.0
Riffle/pool ratio	1.7 ; 1	2 ; 1
Land use		
Forest		
Agriculture		
Livestock grazing		
Mining		
Wetland	100 %	100%
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100%
Seral stage		
Grass/forb		
Shrub	100 %	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	0 %	29.4 %
# Woody debris		
Logs	8	15
Root wads		1

Appendix D.29 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. feet)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater	1	2.9	7795.3	27.5	
Glide	5	14.3	3600.6	12.7	
Run					
Low gradient riffle	14	40.0	9494.8	33.5	
Total Riffles	20	57.2	**20891**	73.7	
Dammed pool					
Eddy pool					
Plunge pool	2	5.7	507.5	1.8	0.8
Scour pool	13	37.14	5824.4	20.6	1.0
Scour hole					
Beaver pond					
Total Pools	**15**	42.64	6332	22.4	
Secondary channel					
Grand Totals	35		27.223		

Appendix D.30. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #1 for Benewah Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	3	9.1	732	21.8	
Step pool cascade					
Slip face cascade					
Total Cascades	3	**9.1**	732	21.8	
Pocketwater	3	9.1	933	27.7	
Glide	4	12.1	573	17.0	
Run					
Low gradient riffle	13	39.4	727	21.6	
Total Riffles	20	60.6	2,233	66.3	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	10	30.3	401	11.9	0.7
Scour hole					
Beaver pond					
Total Pools	10	30.3	**401**	**11.9**	
Secondary channel					
Grand Totals	33		3,366		

Appendix D.31 Summary report for Reach # 2 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,250 - 2,330 ft.	same
Total length	4,402 ft.	4645 ft
Stream order	4	4
Mean stream gradient	2.0	2.9
Riffle/pool ratio	4.3 ; 1	7 ; 1
Land use		
Forest	100 %	100 %
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100 %
Seral stage		
Grass/forb		
Shrub	100 %	100 %
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	80%	37%
# Woody debris		
Logs	5	6
Root wads		

Appendix D.32 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 2 for Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	6	27.3	6790.6	13.3	0.3
Slip face cascade					
Total Cascades	**6**	**27.3**	**6790.6**	**13.3**	**0.3**
Pocketwater	5	22.7	11815.3	23.1	
Glide					
Run					
Low gradient riffle	8	36.4	32077.2	62.8	
Total Riffles	**13**	**59.1**	**43892.5**	**85.9**	
Dammed pool					
Eddy pool					
Plunge pool	1	4.5	108.8	0.2	0.4
Scour pool	2	9.1	271.3	0.5	0.3
Scour hole					
Beaver pond					
Total Pools	3	13.6	**380.1**	0.7	
Secondary channel					
Grand Totals	**22**		**51.063**		

Appendix D.33 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #2 for Benewah Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	4	33.3	5591	27.5	
Step pool cascade					
Slip face cascade					
Total Cascades	**4**	33.3	5.59	27.5	
Pocketwater	5	41.7	10,538	51.8	
Glide					
Run					
Low gradient riffle	2	16.6	3721	18.3	
Total Riffles	**7**	58.3	**14,259**	**70.1**	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	1	8.3	507	2.5	0.4
Scour hole					
Beaver pond					
Total Pools	**1**			**2.5**	
Secondary channel					
Grand Totals	12		**507**		

Appendix D.34 Summary report for Reach # 3 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,330 - 2,330 ft.**	**same**
Total length	**2,376 ft.**	**3,788 ft.**
Stream order	**4**	**4**
Mean stream gradient	**2.5**	**2.0**
Riffle/pool ratio	**1.3 ; 1**	**2.5 ; 1**
Land use		
Forest	100%	100%
Agticutture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub	100%	loo %
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	**28.5 %**	**40 %**
# Woody debris		
Logs	3	1
Root wads	0	0

Appendix D.35 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 3 for Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater	1	6.25	1408	4.8	
Glide	1	6.25	583	1.97	
Run					
Low gradient riffle	7	43.75	24311	82.29	
Total Riffles	9	58.25	26302	89.06	
Dammed pool					
Eddy pool	1	6.3	109.7	0.4	0.79
Plunge pool					
scour pool	6	37.5	3129	10.6	0.56
Scou hole					
Beave pond					
Total Pools	7	43.8	3239	**11.0**	
Sewn? ary channel					
Grand otals	**16**		**29,541**		

Appe dix D.36 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #3 for Benewah Cree during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	1	7.7	1746	7.7	
Slip face cascade					
Total Cascades	**1**	7.7	1,748	7.7	
Pocketwater	2	15.4	1597	7.1	
Glide					
Run					
Low gradient rime	6	46.2	18,429	81.6	
Total Riffles	8	**61.6**	20,026	88.7	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	4	44.2	814	3.6	0.4
Scour hole					
Beaver pond					
Total Pools	4	44.2	**814**	**3.6**	
Secondary channel					
Grand Totals	**13**			**22,856**	

Appendix D.37 Summary report for Reach # 4 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,330 - 2,360 ft.	same
Total length	4,425 ft.	5,670 ft.
Stream order	4	
Mean stream gradient	1.5	2.0
Riffle/pool ratio	1 ;1	1.8 ; 1
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub	100%	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	-ND-	17.7 %
# Woody debris		
Logs	3	3
Root wads	0	0

Appendix D.38 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # for Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide					
Run					
Low gradient riffle	6	50.0	30768.3	95.3	
Total Riffles	6	60.0	30768.3	95.3	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	6	50.0	1506.9	4.7	0.33
Scour hole					
Beaver pond					
Total Pools	6	60.0	1506.9	4.7	
Secondary channel					
Grand Totals	12	100.0	32275.2	100.0	

Appendix D.39 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 4 for Benewah Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	4	26.7	9845	22.3	
Slip face cascade					
Total Cascades	4	26.7	**9,845**	22.3	
Pocketwater	5	33.3	26,163	59.3	
Glide					
Run					
Low gradient riffle	2	13.3	6040	13.7	
Total Riffles	7	46.6	32,203	73.0	
Dammed pool					
Eddy pool	1	6.7	55	0.1	0.2
Plunge pool					
Scour pool	3	20.0	1,990	4.5	1.1
Scour hole					
Beaver pond					
Total Pools	4	26.7	**2,045**	4.6	
Secondary channel					
Grand Totals	15		44,093		

Appendix D.40 Summary report for Reach # 5 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,380 -2,490 ft.	same
Total length	3,467 ft.	4,081 ft.
Stream order	4	4
Mean stream gradient	3 %	2.0
Riffle/pool ratio	3 ; 1	1 ; 0
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub	100 %	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	-ND-	16.8 %
# Woody debris		
Logs		3
Root wads	0	0

Appendix D.41 Frequency of occurrence, total percent occurence, total area, perce area, residual pool depth and volume values for Reach # 5 for Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	3	27.3	2114	6.8	0.3
Slip face cascade					
Total Cascades	3	27.3	**2114**	6.8	0.3
Pocketwater					
Glide					
Run					
Low gradient riffle	6	54.6	28,530	92.2	
Total Riffles	6	64.6	28630	92.2	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	2	18.2	312	1.0	0.21
Scour hole					
Beaver pond					
Total Pools	2	18.2	312	**1.0**	
Secondary channel					
Grand Totals	**11**		**30,956**		

Appendix D.42 Frequency of occurrence, total percent occurenc total area, percent area, residual pool depth and volume values for Reach # 5 for Benewah Creek during 1994.

Habitat Type	Frequency	% Freqconcy	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	7	45.8	5.134	17.6	
Slip face cascade					
Total Cascades	7	43.8	5,134	17.6	
Pocketwater	1	6.3	358	1	
Glide					
Run					
Low gradient rime	8	50	23,664	81.2	
Total Riffles	9	66.3	24,022	82.4	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool					
Scour hole					
Beaver pond					
Total Pools					
Secondary channel					
Grand Totals	I 6		**29,156**		

Appendix D.43 Summary report for Reach # 6 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,490 - 2,550 ft.	same
Total length	2,741 ft.	2,618 ft
Stream order	4	4
Mean stream gradient	1.0 %	1.5 %
Riffle/pool ratio	1.5 ; 1	3 ; 1
Land use		
Forest		
Agriculture		
Livestock grazing	100 %	100%
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100 %
Seral stage		
Grass/forb		
Shrub	100 %	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	-NA-	3 %
# Woody debris		
Logs		0
Root wads	0	0

Appendix D.44 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocket-water					
Glide					
Run					
Low gradient rime	3	60.0	6,651	95.1	
Total Riffles	3	60.0	**6,651**	**95.1**	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	2	40.0	345	49	0.23
Scour hole					
Beaver pond					
Total Pools	2	40.0	**345**	**49**	
Secondary channel					
Grand Totals	5		6,995		

Appendix D.45 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Benewah Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	1	20	2,019	15.9	
Slip face cascade					
Total Cascades	**1**	20	**2,019**	**15.9**	
Pocketwater					
Glide	1	20	2,347	18.5	
Run					
Low gradient riffle	2	40	8,032	63.3	
Total Riffles	**3**	50	**10,379**	**81.8**	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	1	20	296	23	0.6
Scour hole					
Beaver pond					
Total Pools	I	20	296	23	
Secondary channel					
Grand Totals	6		**12,694**		

Appendix D.46 Summary report for Reach # 7 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,550 - 2,660	same
Total length	10,477 ft.	12,090 ft
Stream order	4	4
Mean stream gradient	1.4 %	1.2 %
Riffle/pool ratio	1.2 ; 1	3.1 ; 1
Land use		
Forest Agriculture Livestock grazing Mining Wetland Floodplain Other (includes residential,right of way, etc.)	100 %	100%
Vegetative type		
Decidious Coniferous Mixed	100%	100%
Seral stage		
Grass/forb Shrub Pole Young Mature Old growth Other	100%	100 %
x Canopy cover	48.7 %	43 %
# Woody debris		
Logs	1	10
Root wads	0	9

Appendix D.47 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 7 for Benewah Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	9	12.3	10,212	19.1	
Run					
Low gradient riffle	31	42.5	38.191	71.3	
Total Riffles	40	54.8	48,403	90.4	
Dammed pool	1	1.4	1,262	2.3	0.9
Eddy pool					
Plunge pool					
Scour pool	32	43.8	3891	7.3	0.6
Scour hole					
Beaver pond					
Total Pools	33	45.2	**5,153**	**9.6**	
Secondary channel					
Grand Totals	73		53,557		

Appendix D.48 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #7 for Benewah Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	2	2.6	917	1.7	
Slip face cascade					
Total Cascades	2	2.6	**917**	**1.7**	
Pocketwater					
Glide	23	29.9	19,339	35.7	
Run					
Low gradient rime	34	44.2	25,112	46.4	
Total Riffles	57	74.1	**44,451**	**82.1**	
Dammed pool	1	1.3	5.121	9.5	0.5
Eddy pool	1	1.3	292	0.5	1.4
Plunge pool					
Scour pool	16	20.8	3,396	6.3	0.6
Scour hole					
Beaver pond					
Total Pools	**18**	23.4	8,809	16.3	
Secondary channel					
Grand Totals	**77**		**54,177**		

Appendix D.48 Summary report for Reach # 8 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,560 -2,640 ft.**	**same**
Total length	**9,035 ft.**	**9,174 ft.**
Stream order	**4**	
Mean stream gradient	**1.8 %**	**1.8 %**
Riffle/pool ratio	**1.3 ; 1**	
Land use		
Forest		
Agriculture		
Livestock grazing	100%	100%
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	loo %	100 %
Seral stage		
Grass/forb		
Shrub	100%	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	**21.4 %**	**26.1 %**
# Woody debris		
Logs	.21	6
Root wads	2	0

Appendix D.49 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 8 for Benewah Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	17	19.8	13,162	35.8	
Run					
Low gradient rime	33	38.4	9,717	26.4	
Total Riffles	**50**	58.2	2,288	62	
Dammed pool	1	1.2	21,800	5.9	1.13
Eddy pool					
Plunge pool					
Scour pool	35	40.7	11,705	31.8	0.77
Scour hole					
Beaver pond					
Total Pools	**36**	**41.9**	33,505	37.7	
Secondary channel					
Grand Totals	86		35,793		

Appendix D.50 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #8 for Benewah Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	16	19.0	12,482	39	
Run					
Low gradient riffle	40	47.6	9.646	30.1	
Total Riffles	**56**	66.6	**22,128**	**69.1**	
Dammed pool	1	1.2	1,668	5.2	0.8
Eddy pool					
Plunge pool					
Scour pool	27	32.1	8.212	25.7	0.7
Scour hole					
Beaver pond					
Total Pools	28	33.3	9,880	30.9	
Secondary channel					
Grand Totals	**84**		32,007		

Appendix D.51 Summary report for Reach # 9 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,640 - 2,640 ft.**	**same**
Total length	**3,386 ft.**	**12,850 ft**
Stream order	**4**	**0**
Mean stream gradient	**1.75 %**	**1.3 %**
Riffle/pool ratio	**1.7 ; 1**	**2.8 ; 1**
Land use		
Forest		
Agriculture		
Livestock grazing	100 %	100 %
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100 %
Seral stage		
Grass/forb		
Shrub	100%	100 %
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	**45 %**	**10.5 %**
# Woody debris		
Logs	29	71
Root wads		3

Appendix D.52 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 9 for Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	11	31.4	6,317	23.3	
Run					
Low gradient riffle	11	31.4	26,650	9.8	
Total Riffles	22	62.8	8,982	33.0	
Dammed pool	3	8.6	14,715	54.0	0.83
Eddy pool					
Plunge pool					
Scour pool	10	28.6	3,535.4	12.9	0.88
Scour hole					
Beaver pond					
Total Pools	13	37.2	18,250	66.9	
Secondary channel					
Grand Totals	35		27,232		

Appendix D.53 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #9 for Benewah Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade	2	3.3	390	0.7	
Total Cascades	2	3.3	390	0.7	
Pocketwater					
Glide	17	28.3	13,149	21.9	
Run					
Low gradient riffle	26	43.3	9346	15.6	
Total Riffles	43	71.6	22,495	37.5	
Dammed pool	4	6.7	35170	58.6	1.0
Eddy pool					
Plunge pool	2	3.3	433	0.7	0.7
Scour pool	9	15.0	1528	2.5	0.7
Scour hole					
Beaver pond					
Total Pools	15	25	37,131	61.8	
Secondary channel					
Grand Totals	60		60,016		

Appendix D.54 Summary report for Reach # 10 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,640 - 2,750 ft.**	**same**
Total length	**9,339 ft.**	**2,275 ft**
Stream order	**4**	**4**
Mean stream gradient	**1.75 %**	**1.2 %**
Riffle/pool ratio	**3.5 ; 1**	**3.5 ; 1**
Land use		
Forest		
Agriculture		
Livestock grazing	100%	100%
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub	100%	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover		
# Woody debris		
Logs	24.2	NA
Root wads	0	

Appendix D.55 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 10 for Benewah Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Packetwater					
Glide	22	34.9	13,253	3.4	
Run					
Low gradient riffle	27	42.8	8,144	20.6	
Total Riffles	49	77.7	21,397	64.0	
Dammed pool	2	3.2	16.070	40.5	1.22
Eddy pool					
Plunge pool	1	1.6	57	0.1	0.76
Scour pool	11	17.5	2.113	3.3	0.73
Scour hole					
Beaver pond					
Total Pools	14	22.3	18,240	44	
Secondary channel					
Grand Totals	63		39,637		

Appendix D.56 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #10 for Benewah Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	4	44.4	2337	41.1	
Run					
Low gradient riffle	3	33.3	3171	55.7	
Total Riffles	7	77.7	5,508	96.8	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	2	22.2	18.1	3.2	0.5
Scour hole					
Beaver pond					
Total Pools	2	22.2	18.1	3.2	
Secondary channel					
Grand Totals	9		5,689		

Appendix D.57 Summary report for Reach # 11 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,750 - 2,760 ft.**	**same**
Total length	**1,935 ft.**	**3758 ft**
Stream order	**4**	
Mean stream gradient		**1.2 %**
Riffle/pool ratio	**2.4 ; 1**	**2.3 ; 1**
Land use		
Forest Agriculture Livestock grazing Mining Wetland Floodplain Other (includes residential,right of way, etc.)	100 %	100%
Vegetative type		
Decidious Coniferous Mixed	100 %	100%
Seral stage		
Grass/forb Shrub Pole Young Mature Old growth Other	100%	100%
x Canopy cover	**21.4 %**	**35 %**
# Woody debris		
Logs Rwt wads	25	32

Appendix D.58 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth volume values for Reach # 11 for Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	7	22.6	1,824	29.3	
Run					
Low gradient riffle	15	48.4	2,677	42.9	
Total Riffles	**22**	**71.0**	**4,501**	72.2	
Dammed pool					
Eddy pool					
Plunge pool	1	3.2	429	6.9	1.1
Scour pool	8	25.8	1.302	20.89	0.4.
Scour hole					
Beaver pond					
Total Pools	9	29.0	**1,731**	**27.79**	
Secondary channel					
Grand Totals	**31**		6,232		

Appendix D.59 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #11 for Benewah Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	2	20	587	13.2	
Run					
Low gradient riffle	5	50	3,447	77.7	
Total Riffles	7	70	4,034	90.9	
Dammed pool					
Eddy pool					
Plunge pool	1	10	55	1.2	0.4
Scour pool	2	20	350	7.9	0.4
Scour hole					
Beaver pond					
Total Pools	3	30	495	**9.1**	
Secondary channel					
Grand Totals	**10**		**4,439**		

Appendix D.60 Summary report for Reach # 12 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,760 -2,940 ft.**	**same**
Total length	**4,127 ft.**	**4,633 ft**
Stream order	**4**	**4**
Mean stream gradient	**2.3 %**	**1.3 %**
Riffle/pool ratio	**1.3 ; 1**	**2 :1**
Land use		
Forest	100%	100 %
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub	100%	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	**51.6 %**	**44 %**
# Woody debris		
Logs	335	186
Root wads		

Appendix D.61 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 12 for Benewah Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	2	9.5	525	5.2	
Run					
Low gradient riffle	10	47.6	8530	83.65	
Total Riffles	**12**	**57.1**	**9055**	88.85	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	9	42.9	1,142	11.2	0.4
Scour hole					
Beaver pond					
Total Pools	**9**	**42.9**	**1,142**	**11.2**	
Secondary channel					
Grand Totals	**21**		**10,197**		

Appendix D.62 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #12 for Benewah Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	3	20	418	3.4	
Run					
Low gradient riffle	7	46.7	11,204	90.4	
Total Riffles	**10**	66.7	**11,622**	**93.8**	
Dammed pool	2	13.3	205	1.7	0.4
Eddy pool					
Plunge pool	1	6.7	20.1	0.2	0.2
Scour pool	2	13.3	547	4.4	0.7
Scour hole					
Beaver pond					
Total Pools	5	33.3	**772.1**	6.3	
Secondary channel					
Grand Totals	**15**		**12,394**		0.4

Appendix D.63 Summary report for Reach # 13 of the Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,940 - 3,060 ft.**	**same**
Total length	**4,948 ft.**	**2498 ft**
Stream order	2	2
Mean stream gradient	6.0 **%**	3.8 **%**
Riffle/pool ratio	**1 : 1.2**	**2 : 1**
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub	100%	100%
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	75.3 **%**	**84 %**
# Woody debris		
Logs	48.8	131
Root wads	**0**	

Appendix D.64 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 13 for Benewah Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	6	17.65	3.153	22.87	
Step pool cascade Slip face cascade	4	11.76	885	6.42	0.3
Total Cascades Pccketwater	**10**	**29.41**	4,038	29.29	
Glide Run	1	2.94	293	2.1	
Low gradient riffle	10	29.4	4,321	31.35	
Total Riffles	**11**	32.34	4,614	33.45	
Dammed pool Eddy pool	3	8.8	4666	33.85	0.6
Plunge pool Scour pool	5	14.7	152	1.1	0.3
Scour hole Beaver pond	5	14.7	314	2.28	0.3
Total Pools Secondary channel	**13**	38.20	5,132	37.23	
Grand **Totals**	**34**		13,784		

Appendix D.65 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #13 for Benewah Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step po. de Slip face .e	4	40	1,946	28.3	
Total Ca: es Pocketwater	4 1	40 IO	**1,946** 245	28.3 3.6	
Glide Run	1	10	138	2.0	
Low gradient riffle	2	20	1,042	15.2	
Total Riffles	4	40	**1,423**	20.8	
Dammed po: Eddy pool	1	10	3,414	49.7	1.1
Plunge pool Scour pool	1	10	91	1.3	0.4
Scour hole Beaver pond					
Total Pools Secondary channel	2	20	**3,5**	**51.0**	
Grand Totals	**10**		6,873		0.7

Appendix D.66 Summary report for Reach # 1 of the S.E. Benewah Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,847 - 3,061 ft.**	**same**
Total length	**10,807 ft.**	**11,463 ft.**
Stream order	**3**	**3**
Mean stream gradient	**7.5 %**	**7.5 %**
Riffle/pool ratio	**1.1 : 1**	**2.7 : 1**
Land use		
Forest	50 %	50 %
Agriculture		
Livestock grazing	50 %	50 %
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100%
Seral stage		
Grass/forb		
Shrub	50 %	50 %
Pole		
Young		
Mature	50 %	50 %
Old growth		
Other		
x Canopy cover	**51.7 %**	**76 %**
# Woody debris		
Logs	392	103
Root wads	6	

Appendix D.67 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for S. E. Benewah Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	9	25.6	26,086	47.6	
Step pool cascade	14	36.8	13,892	25.4	0.19
Slip face cascade					
Total Cascades	23	60.4	39,978	73.0	
Pocketwater					
Glide					
Run					
Low gradient riffle	8	21.1	12,268	22.4	
Total Riffles	8	21.1	12,268	22.4	
Dammed pool					
Eddy pool					
Plunge pool	4	10.5	1.008	1.8	0.28
Scour pool	3	7.9	1,541	2.8	0.24
Scour hole					
Beaver pond					
Total Pools	7	18.5	2,549	4.6	
Secondary channel					
Grand Totals	38		54,795.3		

Appendix D.68 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #1 for S. E. Benewah Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	2	4.3	2,831	11.5	
Step pool cascade	15	32.6	11,568	47	
Slip face cascade					
Total Cascades	17	36.9	14,399	58.5	
Pocketwater	2	4.2	296	1.2	
Glide	1	2.1	47	0.2	
Run					
Low gradient riffle	19	40.4	9,515	38.7	
Total Riffles	22	46.7	9,862	40.1	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	8	17.4	348	1.4	0.2
Scour hole					
Beaver pond					
Total Pools	8	17.4	348	1.4	0.2
Secondary channel					
Grand Totals	46		24,804		

Appendix D.69 Summary report for Reach # 1 of the Evans Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,130 - 2,130 ft.	same
Total length	2,886 ft.	5,194 ft
Stream order	3	3
Mean stream gradient	1.0 %	1.3 %
Riffle/pool ratio	1 : 1.5	1 : 1
Land use		
Forest		
Agriculture		
Livestock grazing	100%	100%
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious	100%	loo %
Coniferous		
Mixed		
Seral stage		
Grass/forb		
Shrub	100%	100 %
Pole		
Young		
Mature	59.5 %	59.5 %
Old growth		
Other		
x Canopy cover	28.3 %	6.0%
# Woody debris		
Logs	0	5
Root wads	0	0

Appendix D.70 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for Evans Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	2	7.1	1,523	4.2	
Run					
Low gradient riffle	11	39.3	23.951	66.6	
Total Riffles	**13**	**46.4**	**25,474**	**70.8**	
Dammed pool					
Eddy pool	5	17.9	1,553	4.3	0.5
Plunge pool					
Scour pool	10	35.7	8,930	24.8	0.4
Scour hole					
Beaver pond					
Total Pools	**15**	**53.6**	**10,483**	**29.1**	
Secondary channel					
Grand Totals	**28**		**35,957**		

Appendix D.71 **Frequency of occurrenc total percent occurence, total area, percent area, residual pool depth and volume values fo Reach #1 for Evans Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	1	25	8323	87.1	
Run					
Low gradient riffle	1	25	858	9.0	
Total Riffles	**2**	**50**	**9,181**	**96.1**	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	2	50	357	3.9	0.5
Scour hole					
Beaver pond					
Total Pools	**2**	**50**	**357**	**3.9**	
Secondary channel					
Grand Totals	**4**		**9,556**		

Appendix D.72 Summary report for Reach # 2 of the Evans Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,130 - 2,130**	**same**
Total length	**5,189 ft.**	**3,166 ft**
Stream order	**3**	**3**
Mean stream gradient	**1.5 %**	**1.3 %**
Riffle/pool ratio		**1.2 : 1**
Land use		
Forest	60.3 %	60.3 %
Agriculture		
Livestock grazing	39.7 %	39.7 %
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious	60 %	60 %
Coniferous		
Mixed	40 %	40 %
Seral stage		
Grass/forb		
Shrub	40.5 %	40.5 %
Pole		
Young		
Mature	59.5 %	59.5 %
Old growth		
Other		
x Canopy cover	**51.8 %**	**34.1 %**
# Woody debris		
Logs	59	18
Root wads	17	8

Appendix D.73 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 2 for Evans Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	3	4.1	359		
Step pool cascade					
Slip face cascade	4	5.5	1.589		
Total Cascades	7	9.6	**1,947**	2.6	
Pocketwater					
Glide					
Run					
Low gradient riffle	34	46.6	84,956		
Total Riffles	**34**	46.6	64,956	86.5	
Dammed pool	3	4.1	701		0.3
Eddy pool					
Plunge pool	2	2.7	201		0.2
Scour pool	22	30.1	6,425		0.1
Scour hole	5	6.8	834		0.3
Beaver pond					
Total Pools	32	43.7	8,188	**10.9**	
Secondary channel					
Grand Totals	73		75,090		

Appendix D.74 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #2 for Evans Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	5	7	1,900	7.6	
Run					
Low gradient riffle	34	47.9	18,531	74.1	
Total Riffles	**39**	**52.9**	**20,431**	81.7	
Dammed pool					
Eddy pool					
Plunge pool	1	1.4	549	2.2	0.7
Scour pool	24	33.8	2,949	11.8	0.5
Scour hole	7	9.9	1,077	4.3	0.6
Beaver pond					
Total Pools	32	45.1	4,575	18.3	
Secondary channel					
Grand Totals	**71**		25,006		

Appendix D.75 Summary report for Reach # 3 of the Evans Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,130 - 2,270 ft.**	**same**
Total length	**5,652 ft.**	**3,041** n
Stream order	**3**	**3**
Mean stream gradient	**2.0 %**	**1.9 %**
Riffle/pool ratio	**1 : 1.6**	**1.2 : 1**
Land use		
Forest	100 %	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential-right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub		
Pole		
Young		
Mature	100 %	100%
Old growth		
Other		
x Canopy cover	**65.2 %**	**10.5 %**
# Woody debris		
Logs	49	71
Root wads	7	19

Appendix D.76 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 3 for Evans Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	20	17.5	4,643	21.6	
Step pool cascade	1	0.9	25	0.1	
Slip face cascade	1	0.9	43	0.2	
Total Cascades	**22**	**19.3**	**4,711**	**21.9**	
Pocketwater					
Glide					
Run					
Low gradient riffle	35	30.7	11,946	55.6	
Total Riffles	**35**	**30.7**	**11,946**	**55.6**	
Dammed pool	4	3.5	605	2.8	1.4
Eddy pool	2	1.8	19	0.08	1
Plunge pool	13	11.4	804	3.7	
Scour pool	36	31.6	3,299	15.4	
Scour hole	2	1.8	88	0.4	1.2
Beaver pond					
Total Pools	57	50.1	4,815	22.4	
Secondary channel					
Grand Totals	**114**		**21,471**		

Appendix D.77 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #3 for Evans Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	3	6.8	1065	7.4	
Slip face cascade	1	2.3	90	0.6	
Total Cascades	4	**9.1**	**1,155**	8.0	
Pocketwater					
Glide	1	2.3	176	1.2	
Run					
Low gradient riffle	21	47.7	9,942	68.7	
Total Riffles	22	60.0	**10,118**	69.9	
Dammed pool					
Eddy pool					
Plunge pool	2	4.5	270	1.9	0.6
Scour pool	9	20.4	2,061	14.2	0.5
Scour hole	7	15.9	867	6.0	0.5
Beaver pond					
Total Pools	**18**	48.8	**3,198**	**22.1**	
Secondary channel					
Grand Totals	**44**		**14,471**		

Appendix D.78 Summary report for Reach # 4 of the Evans Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,270 - 2,580 ft.**	**same**
Total length	**5,906** ft.	5,966
Stream order	**3**	**3**
Mean stream gradient	**3.0 %**	**2.3 %**
Riffle/pool ratio	**1.3 : 1**	**1.9 : 1**
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub		
Pole		
Young		
Mature	100%	100%
Old growth		
Other		
x Canopy cover	69.4 %	**47.7 %**
# Woody debris		
Logs	16	168
Root wads	5	18

Appendix D.79 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 4 for Evans Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	34	45.9	21,698	84.9	
Step pool cascade	8	10.8	1,651	6.6	
Slip face cascade					
Total Cascades	42	55.2	23,348	**91.5**	
Pocketwater					
Glide					
Run					
Low gradient riffle	1	1.4	203.4	0.8	
Total Riffles	**1**	**1.4**	203.4	0.8	
Dammed pool	1	1.4	27.8	0.1	
Eddy pool	2	2.8	51.6	0.2	
Plunge pool	11	14.9	726	2.8	
Scour pool	17	22.9	1,192	4.7	
Scour hole					
Beaver pond					
Total Pools	32	41.9	1,997	7.8	
Secondary channel					
Grand Totals	75	99.5	25,541	**100.1**	

Appendix D.80 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #4 for Evans Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	4	4.4	1,771	5.8	
Step pool cascade	18	20	12,733	41.7	
Slip face cascade					
Total Cascades	**22**	24.4	**14,504**	47.5	
Pocketwater					
Glide					
Run					
Low gradient riffle	36	40	12.574	41.2	
Total Riffles	36	40	12,574	41.2	
Dammed pool					
Eddy pool					
Plunge pool	12	13.3	1,038	3.4	0.3
Scour pool	18	20	2.182	7.2	0.3
Scour hole	1	1.1	98.8	0.3	0.4
Beaver pond					
Total Pools	**31**	34.4	**3,319**	**10.9**	
Secondary channel	1	1.1	109.7	0.4	
Grand Totals	**90**		30,505		

Appendix D.81 Summary report for Reach # 5 of the Evans Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,580 - 3,340 ft.**	**same**
Total length	**3,247 ft.**	**2,412 ft**
Stream order	**2**	**2**
Mean stream gradient	**10.8 %**	**3.1 %**
Riffle/pool ratio	**3.8 : 1**	**4.1 : 1**
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100%
Seral stage		
Grass/forb		
Shrub		
Pole		
Young		
Mature	100 %	100%
Old growth		
Other		
x Canopy cover	**37.5 %**	**59.7%**
# Woody debris		
Logs	90	191
Root wads		9

Appendix D.82 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 5 for Evans Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	5	26.3	2,688	25.1	
Step pool cascade	7	36.8	4,095	38.3	
Slip face cascade					
Total Cascades	**12**	**63.1**	**6,783**	**63.4**	
Pocketwater					
Glide					
Run					
Low gradient rime	3	15.8	755	7.1	
Total Riffles	**3**	**15.8**	**755**	**7.1**	
Dammed pool					
Eddy pool					
Plunge pool	4	21.1	316	29.5	0.5
Scour pool					
Scour hole					
Beaver pond					
Total Pools	**4**	**21.1**	**316**	**29.5**	
Secondary channel					
Grand Totals	**19**	**100**	**10,696**	**100**	

Appendix D.83 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 5 for Evans Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	12	38.7	4,069	22.9	
Step pool cascade	I2	38.7	12,937	72.8	
Slip face cascade					
Total Cascades	**24**	**77.4**	**17,006**	**95.7**	
Pocketwater					
Glide					
Run					
Low gradient riffle	I	3.2	185	1.0	
Total Riffles	**1**	**3.2**	**185**	**1.0**	
Dammed pool					
Eddy pool					
Plunge pool	3	9 7	333	1.9	0.5
Scour pool	3	9	254	I .4	0.5
Scour hole					
Beaver pond					
Total Pools	**6**	**19.4**	**587**	**3.3**	
Secondary channel					
Grand Totals	**31**		**17,779**		

Appendix D.84 Summary report for Reach # 6 of the Evans Creek (right fork) Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,680 - 3,040 ft.	same
Total length	2,278 ft.	2,183 ft
Stream order	2	2
Mean stream gradient	12.5 %	8.1 %
Riffle/pool ratio	NA	5 : 1
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100%
Seral stage		
Grass/forb		
Shrub		
Pole		
Young		
Mature	100 %	100%
Old growth		
Other		
x Canopy cover	70.0 %	66 %
# Woody debris		
Logs	86	51
Root wads		3

Appendix D.85 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Evans Creek (right fork) during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	5	50	728	25.8	
Step pool cascade	5	50	2,099	74.2	
Slip face cascade					
Total Cascades	**10**	**100**	2,827	**100**	
Pocketwater					
Glide					
Run					
Low gradient riffle					
Total Riffles					
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool					
Scour hole					
Beaver pond					
Total Pools					
Secondary channel					
Grand Totals	**10**	**100**	2,827	**100**	

Appendix D.86 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Evans Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	5	38.5	2,363	44.6	
Step pool cascade	6	46.2	2,695	50.8	
Slip face cascade					
Total Cascades	**11**	04.7	5,058	95.4	
Pocketwater					
Glide					
Run					
Low gradient riffle	I	7.7	191	3.4	
Total Riffles	**1**	7.7	**191**	3.4	
Dammed pool					
Eddy pool					
Plunge pool	1	7.7	55	1.0	0.2
Scour pool					
Scour hole					
Beaver pond					
Total Pools	**1**	7.7	55	**1.0**	
Secondary channel					
Grand Totals	**13**		**7,960**		

Appendix D.87 Summary report for Reach # 1 of the Evans Creek (left fork) Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,580 - 3,170 ft.	same
Total length	3,205 ft.	3,331 ft.
Stream order	2	2
Mean stream gradient	10.7 %	10.8 %
Riffle/pool ratio	3 : 1	5 : 1
Land use		
Forest	91.2 %	91.2 %
Agriculture		
Livestock grazing	8..8 %	8.8 %
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb		
Shrub		
Pole		
Young		
Mature	100 %	100 %
Old growth		
Other		
x Canopy cover	34.0 %	39 %
# Woody debris		
Logs	50	31
Root wads		4

Appendix D.88 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for Evans Creek (left fork) during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	3	17.6	863	14.4	
Step pool cascade	6	35.3	2,184	36.4	
Slip face cascade					
Total Cascades	**9**	**52.9**	**3,047**	**50.8**	
Pocketwat					
Glide					
Run					
Low gradient riffle	6	35.3	1,781	29.7	
Total Riffles	**6**	**35.3**	**1,781**	**29.7**	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	2	11.8	1,169	19.5	0.3
Scour hole					
Beaver pond					
Total Pools	**2**	**11.8**	**1,169**	**19.5**	
Secondary channel					
Grand Totals	**17**	**100**	**5,996**	**100**	

Appendix D.89 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #5a for Evans Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	5	27.8	1,462	22.4	
Step pool cascade	7	38.9	3,356	51.4	
Slip face cascade					
Total Cascades	**12**	**66.7**	**4,818**	**73.8**	
Pocketwater					
Glide					
Run					
Low gradient riffle	5	27.8	1,665	25.5	
Total Riffles	**5**	**27.8**	**1,665**	**25.5**	
Dammed pool					
Eddy pool					
Plunge pool	1	5.6	43	0.7	0.2
Scour pool					
Scour hole					
Beaver pond					
Total Pools	**1**	**5.6**	**43**	**0.7**	
Secondary channel					
Grand Totals	**18**		**6,526**		

Appendix D.90 Summary report for Reach # 1 of the Alder Creek Watershed, data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,260 - 2,366 ft	same
Total length	2,892 ft	2,874 ft
Stream order	4	4
Mean stream gradient	1.5 %	5 %
Riffle/pool ratio	1.4 : 1	1 : 1
Land use		
Forest	100 %	same
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100%
Seral stage		
Grass/forb	7.1 %	7.1 %
Shrub	35.7 %	35.7 %
Pole	37.5 %	37.5 %
Young	12.5 %	12.5 %
Mature	7.1 %	7.1 %
Old growth		
Other		
x Canopy cover	32 %	22 %
# Woody debris		
Logs	I 4	28
Root wads	0	0

Appendix D.91 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for Alder Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	I	3.6	110		
Slip face cascade					
Total Cascades	1	3.6	**110**		
Pocketwater	4	14.3	10,269		
Glide					
Run					
Low gradient riffle	11	39.3	15,380		
Total Riffles	**15**	53.6	25,649		
Dammed pool	I	3.6	274		0.9
Eddy pool					
Plunge pool	4	14.3	945		0.4
Scour pool	6	21.4	1.047		0.4
Scour hole					
Beaver pond					
Total Pools	**1**	**39.3**	2,266		
Secondary channel	I	3.6	217		
Grand Totals	28	**100.1**	28,242		

Appendix D.92 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #1 for Alder Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	2	14.3	1,064	5.8	
Slip face cascade					
Total Cascades	2	**14.3**	**1,064**	5.8	
Pocketwater	4	28.6	14.073	76.4	
Glide					
Run					
Low gradient riffle	2	14.3	1,606	8.7	
Total Riffles	6	42.9	**15,679**	**85.1**	
Dammed pool					
Eddy pool					
Plunge pool	2	14.3	750	4.1	0.8
Scour pool	3	21.4	650	3.5	0.4
Scour hole					
Beaver pond	I	7.1	268	1.5	0.8
Total Pools	6	42.8	**1,668**	**9.1**	
Secondary channel					
Grand Totals	**14**		**18,411**		

Appendix D.93 Summary report for Reach # 2 of the Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,350 - 2,630 ft**	**same**
Total length	**13,739 ft**	**13,803 ft**
Stream order	**4**	**4**
Mean stream gradient	**1.5 %**	**4.5 %**
Riffle/pool ratio	**1.2 : 1**	**4 : 1**
Land use		
Forest	50 %	50 %
Agriculture		
Livestock grazing	50 %	50 %
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Deciiious		
Coniferous		
Mixed	100 %	100 %
Seral stage		
Grass/forb	25.8 %	25.8 %
Shrub	9.7 %	9.7 %
Pole		
Young	6.4 %	6.4 %
Mature	56.5 %	56.5 %
Old growth	1 . 6 %	I.6 %
Other		
x Canopy cover	**30 %**	**34 %**
# Woody debris		
Logs	70	49
Root wads	0	I

Appendix D.94 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 2 for Alder Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	5	8.8	10,884	35.8	
Slip face cascade					
Total Cascades	**5**	**8.8**	**10,884**	**35.8**	
Pocketwater	2	3.5	1,315	4.3	
Glide	I	I.7	373	I.2	
Run					
Low gradient riffle	25	43.9	10,452	34.4	
Total Riffles	**28**	**49.1**	**12,141**	**39.9**	
Dammed pool	2	3.5	274	0.9	0.5
Eddy pool					
Plunge pool	12	21.1	4,819	15.9	0.8
Scour pool	9	15.9	2,098	6.9	0.5
Scour hole	1	I.7	146	0.5	0.7
Beaver pond					
Total Pools	24	**42.1**	**7,337**	**24.2**	
Secondary channel					
Grand Totals	57		**30,361**		

Appendix D.95 **·requency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #2 for Alder Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	I7	40.5	34.185	355	
Slip face cascade					
Total Cascades	**17**	40.5	**34,185**	**35.5**	
Pocketwater	17	40.5	59,363	61.7	
Glide	2	48	7,476	0.8	
Run					
Low gradient riffle	I	2.4	16€	0.2	
Total Riffles	**20**	90.9	**67,005**	62.7	
Dammed pool					
Eddy pool					
Plunge pool	4	9.5	1,540	I.6	1.3
Scour pool	1	2.4	260	0.3	0.2
Scour hole					
Beaver pond					
Total Pools	**5**	**11.9**	**1,800**	**1.9**	
Secondary channel					
Grand Totals	**42**		**96,260**		

Appendix D.96 Summary report for Reach # 3 of the Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,630 - 2,700 ft	same
Total length	8,172 ft	8,003 ft
Stream order	4	4
Mean stream gradient	1.6 %	2.5 %
Riffle/pool ratio	1.3 : 1	4.4 ; 1
Land use		
Forest		
Agriculture		
Livestock grazing	100 %	100%
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb	24.7 %	24.7 %
Shrub	62.4 %	62.4 %
Pole		
Young		
Mature	12.9 %	12.9 %
Old growth		
Other		
x Canopy cover	32 %	32 %
# Woody debris		
Logs	I 3	I 5
Root wads	I	0

Appendix D.97 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 3 for Alder Creek during 1993.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	3	6.4	1,454	3.4	
Slip face cascade					
Total Cascades	3	6.4	**1,454**	3.4	
Pocketwater					
Glide	I	2.1	376	0.9	
Run					
Low gradient riffle	24	51.1	36,032	84.9	
Total Riffles	25	53.2	**36,401**	85.8	
Dammed pool					
Eddy pool					
Plunge pool	5	IO.6	I.368	3.2	I.2
Scour pool	I4	29.8	3,200	7.5	1.2
Scour hole					
Beaver pond					
Total Pools	**19**	48.4	4,588	10.7	
Secondary channel					
Grand Totals	47		42,423		

Appendix D.98 **Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach #3 for Alder Creek during 1994.**

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	3	IO	1,293	2.4	
Slip face cascade					
Total Cascades	3	**10**	**1,293**	24	
Pocketwater	3	10.0	16,185	29.4	
Glide	5	16.7	3,039	5.5	
Run					
Low gradient riffle	I4	46.7	33,567	61.0	
Total Riffles	22	73.4	**52,791**	95.9	
Dammed pool					
Eddy pool					
Plunge pool	1	3.3	307	0.6	0.3
Scour pool	4	13.3	605	1.1	0.2
Scour hole					
Beaver pond					
Total Pools	5	**16.6**	**912**	1.7	
Secondary channel					
Grand Totals	30		55,005		

Appendix D.99 Summary report for Reach # 4 of the Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,700 - 2,900 ft	same
Total length	16,579 ft	19,049 ft
Stream order	4	4
Mean stream gradient	1.8 %	2.6 %
Riffle/pool ratio	1.2 : 1	2.6 : 1
Land use		
Forest		
Agriculture		
Livestock grazing	100%	100%
Mining		
Wetland		
Floodplain		
Other (includes residential.right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb	5.9 %	5.9 %
Shrub	26.7 %	26.7 %
Pole		
Young		
Mature	67.3 %	63.7 %
Old growth		
Other		
x Canopy cover	6.2 %	46.6 %
# Woody debris		
Logs	71	IO6
Root wads	6	IO

Appendix D.100 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 4 for Alder Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	1	1.0	1,723	1.8	
Slip face cascade					
Total Cascades	**1**	**1.0**	**1,723**	**1.8**	
Pocketwater					
Glide	2	2.0	1,033	1.1	
Run					
Low gradient rime					
Total Riffles	**52**	**54**	**76,823**	**79.4**	
Dammed pool	2	2.0	4,750	4.9	
Eddy pool					
Plunge pool	5	5.0	1,292	1.3	0.4
Scour pool	37	37.0	12,150	12.5	0.4
Scour hole	1	1	107	0.1	0.7
Beaver pond					
Total Pools	**45**	**45**	**18,299**	**18.8**	
Secondary channel					
Grand Totals	**100**	**100**	**96,846**	**100**	

Appendix D.101 Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 4 for Alder Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	IO	6.4	6,217	7.7	
Slip face cascade					
Total Cascades	**10**	**6.4**	**6,217**	**7.7**	
Pocketwater					
Glide	39	24.8	14,391	17.9	
Run					
Low gradient riffie	67	42.7	46,686	58.1	
Total Riffles	**106**	**67.5**	**61,077**	**76.0**	
Dammed pool	I	0.6	493	0.6	0.5
Eddy pool					
Plunge pool	3	I.9	683	0.9	0.4
Scour pool	33	21.0	6,086	7.8	0.4
Scour hole					
Beaver pond	3	I.9	5,863	7.7	0.6
Total Pools	**40**	**25.4**	**13,125**	**17.0**	
Secondary channel					
Grand Totals	**157**		**80,418**		

Appendix D.102 Summary report for Reach # 5 of the Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,900 - 2,940	same
Total length	5,768 ft	4,807 ft
Stream order	4	4
Mean stream gradient	1.4 %	3.6 %
Riffle/pool ratio	1 : 1	6.8 : 1
Land use		
Forest	83.8 %	83.8 %
Agriculture		
Livestock grazing	16.2 %	16.2 %
Mining		
Wetland		
Floodplain		
Other (includes residential.right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100 %	100%
Seral stage		
Grass/forb	29.6 %	29.6 %
Shrub	28.4 %	28.4 %
Pole		
Young		
Mature	6.2 %	6.2 %
Old growth	35.8 %	35.8 %
Other		
x Canopy cover	17.7 %	43.7 %
# Woody debris		
Logs	64	76
Root wads	1	0

Appendix D.103. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 5 for Alder Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	1	2.5	218	0.6	
Run					
Low gradient rime	19	47.5	19,627	52.6	
Total Riffles	20	50.0	**19,844**	53.2	
Dammed pool					
Eddy pool					
Plunge pool	1	2.5	214	0.6	0.4
Scour pool	14	35	1,902	5.1	0.4
Scour hole	1	2.5	101	0.3	0.3
Beaver pond	4	IO	15,221	40.8	0.8
Total Pools	20	50.0	**17,483**	46.8	
Secondary channel					
Grand Totals	**40**		37,282		

Appendix D.104. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 5 for Alder Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	1	3.1	259	0.6	
Slip face cascade					
Total Cascades	**1**	3.1	259	0.6	
Pocketwater					
Glide	12	37.5	3,635	7.9	
Run	15	46.9	6,036	13.2	
Low gradient riffle					
Total Riffles	27	84.4	**9,671**	21.1	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	3	9.4	41	0.9	0.7
Scour hole					
Beaver pond	1	3.1	35,454	77.4	0.8
Total Pools	**4**	12.5	35,495	78.3	
Secondary channel					
Grand Totals	32		45,789		

Appendix D.105. Summary report for Reach # 6 of the Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	2,946 - 3,330 ft	same
Total length	21,754 ft	20,596 ft
Stream order	2	2
Mean stream gradient	1.8 %	5.3 %
Riffle/pool ratio	1 : 1.7	2.4 : 1
Land use		
Forest	95.1 %	95.1 %
Agriculture		
Livestock grazing	4.9 %	4.9 %
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb	21.0 %	21.0 %
Shrub	3.7 %	3.7 %
Pole		
Young		
Mature	75.3 %	75.3 %
Old growth		
Other		
x Canopy cover	25 %	68 %
# Woody debris		
Logs	127	307
Root wads	0	0

Appendix D.106. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Alder Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapic					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide					
Run					
Low gradient riffle	30	36.6	20,923	13.0	
Total Riffles	30	36.6	**20,923**	**13.0**	
Dammed pool					
Eddy pool					
Plunge pool	1	1.2	91.4	0.5	0.8
scour pool	9	11.0	757	0.5	0.3
Scour hole	12	14.6	1,674	1.0	0.3
Beaver pond	30	36.6	136,992	85.0	0.9
Total Pools	52	63.4	**140,311**	87.0	
Secondary channel					
Grand Totals	82	**100**	**161,234**	**100**	

Appendix D.107. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 6 for Alder Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area sq. meters)	% Area	Residual pool depth (m)
Rapid	3	13.0	1.217	1.7	
Step pool cascade	3	13.0	3,890	5.3	
Slip face cascade					
Total Cascades	6	26.0	5,107	7.0	
Pocketwater					
Glide	5	21.7	1,542	2.1	
Run					
Low gradient riffle	7	30.4	2.809	3.8	
Total Riffles	12	52.1	4,351	5.9	
Dammed pool					
Eddy pool					
Plunge pool	1	4.4	67	0.09	0.4
Scour pool	1	4.4	61	0.08	0.2
Scour hole					
Beaver pond	3	13.0	63.534	86.9	0.5
Total Pools	5	21.8	63,662	87.1	
Secondary channel					
Grand Totals	23		**73,119.2**		

Appendix D.108. Summary report for Reach # 1 of the North Fork Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	**2,940 - 3,070 ft**	**same**
Total length	**4,134 ft**	**5,502.00 ft**
Stream order	**2**	**2**
Mean stream gradient	**3 %**	**3.1 %**
Riffle/pool ratio	**1.3 : 1**	**16 : 1**
Land use		
Forest		
Agriculture		
Livestock grazing	loo %	100%
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	loo %
Seral stage		
Grass/forb	100 %	100%
Shrub		
Pole		
Young		
Mature		
Old growth		
Other		
x Canopy cover	**36.3 %**	**68 %**
# Woody debris		
Logs	24	22
Root wads	0	0

Appendix D.109. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for North Fork Alder Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide					
Run					
Low gradient riffle	9	56.3	10,666	95.3	
Total Riffles	**9**	66.3	10,666	**95.2**	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool	4	25	385	3.4	0.5
Scour hole	3	18.8	155	1.4	0.4
Beaver pond					
Total Pools	7	43.8	**540**	4.8	
Secondary channel					
Grand Totals	**16**	**100**	**11,206**	**100**	

Appendix D.110. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 1 for North Fork Alder Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide	8	47.1	1,122	**19.9**	
Run					
Low gradient riffle	8	47.1	**4.441**	78.6	
Total Riffles	16	94.2	5,563	**98.5**	
Dammed pool					
Eddy pool					
Plunge pool	1	**5.9**	87.2	1.5	
Scour pool					
Scour hole					
Beaver pond					
Total Pools	**1**	**5.9**	87.2	1.5	
Secondary channel					
Grand Totals	17		5,651		

Appendix D.111. Summary report for Reach # 2 of the North Fork Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	3,070 - 3,280 ft	same
Total length	11,355 ft	13,946.00
Stream order	2	2
Mean stream gradient	1.9 %	8.7 %
Riffle/pool ratio		
Land use		
Forest	100%	100%
Agriculture		
Livestock grazing		
Mining		
Wetland		
F l o o d p l a i n		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	100%
Seral stage		
Grass/forb	1.5 %	11.5 %
Shrub		
Pole		
Young		
Mature	88.5 %	88.5 %
Old growth		
Other		
x Canopy cover	35.2	87.2 %
# Woody debris		
Logs	46	663
Root wads	0	

Appendix D.112. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and lume values for Reach # 2 for North Fork Alder Creek du: g 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide					
Run					
Low gradient riffle	**16**	62	32,824	**32.9**	
Total Riffles	**16**	62	32,824	**32.9**	
Dammed pool					
Eddy pool					
Plunge pool	1	3.8	14.6	**0.1**	0.2
Scour pool	2	7.7	**221**	0.2	0.3
Scour hole	2	7.7	218	0.2	0.5
Beaver pond	5	**19.3**	66,548	66.7	0.6
Total Pools	**10**	36.4	67,002	**67.1**	
Secondary channel					
Grand Totals	26	**99.9**	**9,826**	**100**	

Appendix D.113. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 2 for North Fork Alder Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid	8	40	3.251	4.7	
Step pool cascade	**6**	30	**3,986**	5.8	
Slip face cascade					
Total Cascades	**14**	70	7,237	**10.6**	
Pocketwater					
Glide					
Run					
Low gradient riffle	**3**	15	**997**	1.4	
Total Riffles	3	15	**997**	1.4	
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool					
Scour hole					
Beaver pond	3		61,054	88.1	0.5
Total Pools	3	.5	61,064	88.1	
Secondary channel					
Grand Totals	20		**59,288**		

Appendix D.114. Summary report for Reach # 3 of the North Fork Alder Creek Watershed data collected during 1993 and 1994.

Parameter	1993	1994
Elevation	3,280 - 3,620 ft	
Total length	10,271	
Stream order	2	
Mean stream gradient	7.1 %	
Riffle/pool ratio	2.3 : 1	
Land use		
Forest	100%	
Agriculture		
Livestock grazing		
Mining		
Wetland		
Floodplain		
Other (includes residential,right of way, etc.)		
Vegetative type		
Decidious		
Coniferous		
Mixed	100%	
Seral stage		
Grass/forb		
Shrub	11.5 %	
Pole		
Young	29.3 %	
Mature	70.8 %	
Old growth		
Other		
x Canopy cover	39.0 %	
# Woody debris		
Logs	47	
Root wads	0	

Appendix D.115. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 3 for Norht Fork Alder Creek during 1993.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade	1	7.1	17.0	0.4	
Slip face cascade					
Total Cascades	1	**7.1**	**17.0**	**0.4**	
Pocketwater					
Glide					
Run					
Low gradient riffle	9	64.3	4,580	97.4	
Total Riffles	**9**	**64.3**	**4,560**	**97.4**	
Dammed pool					
Eddy pool					
Plunge pool	1	7.1	17.1	0.4	0.2
Scour pool	3	21.4	87.5	1.9	0.2
Scour hole					
Beaver pond					
Total Pools	**4**	**28.5**	**105**	**2.2**	
Secondaw, channel					
Grand Totals	**14**	**99.9**	**4,682**	**100**	

Appendix D.116. Frequency of occurrence, total percent occurence, total area, percent area, residual pool depth and volume values for Reach # 3 for North Fork Alder Creek during 1994.

Habitat Type	Frequency	% Frequency	Total Area (sq. meters)	% Area	Residual pool depth (m)
Rapid					
Step pool cascade					
Slip face cascade					
Total Cascades					
Pocketwater					
Glide					
Run					
Low gradient riffle					
Total Riffles					
Dammed pool					
Eddy pool					
Plunge pool					
Scour pool					
Scour hole					
Beaver pond					
Total Pools					
Secondary channel					
Grand Totals					

Appendix E

Appendix E.I. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Alder Creek during Spring (May, June), 1993.

Site	Lower	Middle	Upper
Shock time (min)	24.3	13.6	18.5
Cutthroat trout		8 (44.4)	
Eastern brook trout		2 (11.1)	9 (100)
Sculpin spp.	14 (87.5)		
Longnosesucker		5 (27.8)	
Longnosedace	2 (11.1)		
Brown bullhead		3 (16.7)	
TOTAL	16	18	9

Appendix E.2. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Evans Creek during Spring (May, June), 1993.

Site Lower	Middle	Upper	
Shock time (min)	t	ii.6	27.8
Cutthroat trout		2 (66.7)	
Sculpin spp.		1 (33.3)	4 (100)
TOTAL		3	4

Appendix E.3 Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Lake Creek during Spring (May, June), 1993.

Site Lower	Middle	Upper	
Shock time (min)	•	12.4	•
Sculpin spp.		2 (66.7)	
Western speckled date		1 (33.3)	
TOTAL		3	

Appendix E.4. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during Spring (May, June), 1993.

Site	Lower	Middle	Upper	
Shock time (min)		16.4	16.7	21.7
Cutthroat trout		4 (16.0)	2 (6.3)	6 (4.2)
Sculpin spp.			1 (3.1)	
Lonanose sucker		15 (60.0)	7 (21.9)	18 (12.7)
Longnose dace				12 (8.4)
Western speckled date			14 (43.8)	1 (0.7)
Redside shiner			8 (25.0)	105 (73.9)
Northern Squawfish		6 (24.0)		
TOTAL		25	32	142

Appendix E5. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Coon Creek[1] during Spring (May, June), 1993.

Site	Lower	Upper	
Shock time (min)		13.5	11.8
Cutthroat trout		3 (12.0)	7 (100.0)
Lonanose sucker		3 (12.0)	
Western speckled dace		1 (4.0)	
Redside shiner		18 (72.0)	
TOTAL		25	7

Appendix E.6. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Cow Creek[1] during Spring (May, June), 1993.

Site	Lower
Shock time (min)	6.4
Longnose sucker	5 (15.2)
Redside shiner	27 (81.8)
Brown bullhead	1(3.0)
TOTAL	33

Appendix E.7. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Harmony Creek[1] during Spring (May, June), 1993.

Site Lower	
Shock time (min)	7.4
Cutthroat trout	6 (42.9)
Sculpin spp.	8 (57.1)
TOTAL	14

Appendix E.8. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Whitetail Creek[1] during Spring (May, June), 1993.

Site Lower	Upper	
Shock time (min)	10.6	5.1
Cutthroat trout	2 (66.7)	2 (100)
Eastern brook trout	1 (33.3)	
TOTAL	3	2

Appendix E.9. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Windfall Creek[1] during Spring (May, June), 1993.

Site Lower	Upper	
Shock time (min)	13.9	6.2
Cutthroat trout	2 (100)	2 (100)
TOTAL	2	2

* site could not be accessed because of deep water

1 Tributaries to Benewah Creek

Table E.10. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Alder Creek during Summer (August), 1993.

Site Lower	Middle	Upper	
Shock time (min)	14.0	14.9	22.3
Cutthroat trout	2 (5.9)	12 (48.0)	6 (15.8)
Eastern brook trout		7 (28.0)	28 (73.7)
Sculpin spp.	30 (88.2)		4 (10.5)
Lonanose sucker		6 (28.0)	
longnose dace	2 (5.9)		
Brown bullhead			
TOTAL	34	25	38

Table E.11. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Evans Creek during Summer (August), 1993.

Site Lower	Middle	Upper	
Shock time (min)	20.0	20.0	18.8
Cutthroat trout	1 (4.5)	30 (48.4)	56 (57.1)
Sculpin spp.	18 (81.8)	32 (51.6)	42 (42.9)
Longnose sucker	3 (13.6)		
TOTAL	22	62	98

Table E.12. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Lake Creek during Summer (August), 1992.

Site Lower	Middle	Upper	
Shock time (min)	12.6	17.1	11.6
Cutthroat trout	6 (10.3)	9 (37.5)	6 (60.0)
Sculpin spp.	17 (29.3)	9 (37.5)	2 (20.0)
longnose sucker	1 (1.7)		2 (20.0)
Redside shiner		1 (4.2)	
Longnosedace	34 (58.6)		
TOTAL	58	24	10

Table E.13. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during Summer (August), 1993.

Shock time (min)	Middle	Upper	
Cutthroat trout	10.4	22.3	26.8
		4 (6.4)	11 (8.0)
Sculpin spp.	7 (53.1)	3 (4.8)	
Longnose sucker	3 (10.3)	12 (19.4)	10 (7.3)
longnose dace	5 (17.2)	24 (38.7)	32 (23.4)
Redside shiner	14 (48.3)	19 (30.6)	84 (61.3)
TOTAL	29	62	137

Table E.14. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during fall (October), 1993.

Site	Lower	Middle	Upper
Shock time (min)	15.5	18.7	32.0
Cutthroat trout	(13.3)	6 (31.6)	9 (25.0)
Eastern brook trout			1 (2.8)
Rainbow trout	2 (6.7)		
Sculpin spp.	33.3)	3 (15.8)	9 (25.0)

Table E.14. (continued):Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during fall (October), 1993.

	Lower	Middle	Upper
Shock time (min)	15.5	18.7	32.0
Longnose sucker	8 (26.7)	6 (31.6)	6 (16.7)
Largemouth bass	2 (6.7)		
Redside shiner	4 (13.3)	4 (21.1)	11 (30.6)
TOTAL	30	19	36

Table E.15. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Lake Creek during fall (October), 1993.

Site Lower	Middle	Upper	
Shock time (min)	29.7	15.2	13.7
Cutthroat trout	11 (31.4)		
Sculpin spp.	14 (40.0)	22 (100.0)	7 (53.8)
Bull trout	1 (2.9)		
Longnosesucker	9 (25.7)		6 (46.2)
TOTAL	35	22	13

Table E.16. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Evans Creek during fall (October), 1993.

Site Lower	Middle	Upper	
Shock time (min)	8.4	33.2	32.4
Cutthroat trout		38 (71.7)	31 (54.4)
Sculpin spp.	6 (100.0)	15 (28.3)	26 (45.6)
TOTAL	6	53	57

Table E.17. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Alder Creek during fall (October), 1993.

Site Lower	Middle	Upper	
Shock time (min)	11.4	28.1	18.7
Cutthroat trout		14 (56.0)	2 (8.7)
Eastern brook trout		2 (8.0)	21 (91.3)
Sculpin spp.	11 (64.6)	5 (20.0)	
Longnosesucker	2 (15.4)	4 (16.0)	
TOTAL	13	25	23

Table E.18. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Alder Creek during Spring (May, June), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)		11.4	13.6	13.3
Cutthroat trout	3 (12.0%)	13 (43.3%)		
Eastern brook trout	4 (16.0%)	13 (43.3%)		11 (100.0%)
Sculpin spp.	11 (44.0%)	3 (10.0%)		
Longnose sucker	7 (28.0%)	1 (3.3%)		
TOTAL	**25**	**30**		**11**

Table E.19. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Evans Creek during Spring (May, June), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)		9.9	13.3	11.7
Cutthroat trout			8 (34.8%)	24 (82.8%)
Sculpin spp.		11 (100%)	15 (65.2%)	5 (17.2%)
TOTAL		**11**	**23**	**29**

Table E.20. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Lake Creek during Spring (May, June), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)		13.0	*	12.7
Cutthroat trout	5 (16.7%)	1 (7.1%)		2 (22.2%)
Sculpin	14 (46.7%)	11 (78.6%)		7 (77.8%)
Redside shiner		2 (14.3%)		
Longnose sucker	11 (36.7%)			
TOTAL	**30**	**14**		**9**

Table E.21. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during Spring (May, June), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)		13.7	14.2	12.2
Cutthroat trout	6 (15.8%)	4 (16.7%)		3 (9.1%)
Sculpin spp.	12 (31.6%)	3 (12.5%)		2 (6.1%)
Longnose sucker	16 (42.1%)	9 (37.5%)		21 (63.6%)
Redside shiner	3 (7.9%)	8 (33.3%)		7 (21.2%)
Northern Squawfish	1 (2.6%)			
TOTAL	**38**	**24**		**33**

Table E.22. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Alder Creek during Summer (August), 1994.

Site	Lower	Middle	Upper	
Shock time (min)		14.7	14.8	14.1
Cutthroat trout		2 (6.4%)	21 (44.7%)	3 (6.4%)
Eastern brook trout			18 (36.3%)	43 (93.5%)
Sculpin spp.		25 (80.7%)		1 (2.1%)
Longnose sucker		4 (12.9%)	8 (17.0%)	
TOTAL		31	47	47

Table E.23. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Evans Creek during Summer (August), 1994.

Site	Lower	Middle	Upper	
Shock time (min)		10.7	6.8	5.2
Cutthroat trout		0	17 (100%)	1 (11.1%)
Sculpin spp.		21 (65.6%)		8 (88.9%)
Longnose sucker		4 (12.5%)		
Redside shiner		6 (18.8%)		
Brown bullhead		1 (3.1%)		
TOTAL		32	17	9

Table E.24. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Lake Creek during Summer (August), 1994.

Site	Lower	Middle	Upper	
Shock time (min)		7.9	10.9	10.8
Cutthroat trout			18 (51.4%)	
Sculpin spp.			2 (5.7%)	8 (61.5%)
longnose sucker		4 (57.1%)	5 (14.3%)	5 (38.5%)
Redside shiner		3 (42.9%)	6 (17.1%)	
Western speckled dace			4 (11.4%)	
TOTAL		7	35	13

Table E.25. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during Summer (August), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)	8.0	9.2	9.1	
Cutthroat trout		1.0 (3.3%)		
Sculpin spp.	15 (51.7%)	6 (20.0%)		
Longnose sucker	4 (13.8%)	2 (6.7%)		
Redside shiner	10 (34.5%)	21 (70.0%)	100 (100.0%)	
TOTAL	**29**	**30**	**100**	

Table E.26. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Benewah Creek during fall (October), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)	16.5	22.9	23.0	
Cutthroat trout	3 (7.7%)	1 (2.1%)		
Sculpin spp.	6 (15.4%)	15 (31.2%)	12 (4.1%)	
Longnose sucker	7 (18.0%)	13 (27.1%)	15 (5.1%)	
Redside shiner	23 (59.0%)	19 (39.6%)	268 (90.9%)	
TOTAL	**39**	**48**	**295**	

Table E.27. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Lake Creek during fall (October), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)	17.8	*	19.4	
Cutthroat trout		8 (18.2%)		
Sculpin spp.	9 (22.5%)	27 (61.4%)	5 (15.6%)	
Longnose sucker	16 (40.0%)	9 (20.5%)	4 (12.5%)	
Redside shiner	15 (37.5%)		23 (71.9%)	
TOTAL	**40**	**44**	**32**	

Table E.28. **Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Evans Creek during fall (October), 1994.**

Site	Lower	Middle	Upper	
Shock time (min)	12.0	*	26.6	
Cutthroat trout	1 (12.5%)		26 (53.1%)	
Sculpin spp.	2 (25.0%)		23 (46.9%)	
Largemouth bass	5 (62.5%)			
TOTAL	**8**		**49**	

Table E.29. Total number and relative abundance (%) of each species caught during relative abundance electrofishing surveys on Alder Creek during fall (October), 1994.

Site **Lower**	**Middle**	**Upper**	
Shock time (min)	23.9	25.6	21.1
Cutthroat trout	2 (10.5%)	21 (63.6%)	7 (10.6%)
Eastern brook trout	2 (10.5%)	12 (36.4%)	27 (40.9%)
Sculpin spp.	15 (78.9%)		32 (48.5%)
TOTAL	**19**	**33**	**66**

Appendix F

APPENDIX F.I: Water Quality Data collected using a price pygmy meter (discharge) and Hydrolab in selected tributaries during 1993.

LOCATIO	DATE	pH	Q (cfs)	(°C)	K (mmhoslcm)	DO (ppm)	REDOX (mV)
ALDER	3/11/93		11.62	2.3	0.880	16.89	298
ALDER	3/16/93	7.2	38.16	2.6	0.073	16.39	289
ALDER	3/23/93		168.10	36			
ALDER	4/14/93	7.2	44.70	7.5	0.069	10.93	
ALDER	5/4/93	6.8	289.00	41F	0.041		
ALDER	6/28/93	7.2	2.82	12.5	0.081	8.88	288
ALDER	7/27/93	6.9	4.69	13.0	0.071	8.29	273
ALDER	8/24/93	6.7	1.68	12.8	0.092	1.54	270
ALDER	9/20/93	7.2	1.09	7.8	0.092	9.57	313
ALDER	10/28/93	7.2		2.9	0.091	14.66	842
ALDER	11/19/93	6.3	1.94	0.5	0.091	15.68	
BENEWAI	1/20/93			31			
BENEWAI	3/11/93		31.98	3.1	0.840	14.24	309
BENEWAI	3/16/93	7.2	68.88	4.2	0.080	13.01	308
BENEWAI	3/23/93		350.10	37			
BENEWAI	4/14/93	7.2	85.94	41	0.060	13.47	
BENEWAI	5/4/93	7.0	676.00	44F	0.042		
BENEWAI	6/28/93	7.4	2.60	15.6	0.057	11.02	278
BENEWAI	7/28/93	7.4	11.48	18.8	0.060	8.23	260
BENEWAI	8/24/93	6.9	0.83	11.9	0.071	2.15	286
BENEWAI	9/20/93	7.3	0.35	10.8	0.069	10.60	415
BENEWAI	10/28/93	7.5	1.98	7.2	0.090	11.45	874
BENEWAI	11/19/93	6.4	3.78	0.7	0.070	14.77	939
EVANS	1/20/93		6.47	30			
EVANS	3/11/93		19.60	2.8	0.054	14.48	302
EVANS	3/16/93	7.0	26.55	3.9	0.068	14.45	302
EVANS	3/23/93		181.70	38			
EVANS	4/15/93	7.2	47.85	39	0.050	22.00	291
EVANS	5/4/93	7.0	456.00	42F	0.026		
EVANS	6/28/93	6.6	5.11	10.6	0.030	9.93	313
EVANS	7/28/93	6.6	'6.80	11.8	0.034	8.45	312
EVANS	8/24/93	7.0	3.56	11.6	0.039	1.33	266
EVANS	9/20/93	7.0	3.05	7.9	0.000	10.79	446
EVANS	10/28/93	6.9	2.27	6.2	0.009	10.30	910
EVANS	11119193	6.7	6.49	1.8	0.035	13.80	133

Appendix F.I: (cont.)

LAKE	1/25/93	6.7	4.51	18.0	0.107	14.60	
LAKE	3/11/93	7.0	41.17	0.8	0.136	13.07	311
LAKE	3/16/93	6.8	57.06	3.3	0.104	11.78	332
LAKE	3/23/93		700.00	36			
LAKE	4/14/93	7.2	51.35	5.9	0.091	13.02	
LAKE	5/4/93	7.0	840.00		0.070		
LAKE	6/28/93	7.2	3.97	13.4	0.045	15.00	240
LAKE	7/28/93	7.0	6.18	15.6	0.056	7.36	275
LAKE	8/24/93	7.1	1.34	14.1	0.059	1.21	299
LAKE	9/20/93	7.2	1.48	6.9	0.060	10.38	469
LAKE	10/28/93	7.0	0.82	2.4	0.061	15.09	942
LAKECONTROL	3/23/93						
LAKE-DOWNSTREAM		3/16/93					
LAKE-DOWNSTREAM		3/23/93					

APPENDIX F.2: Monthly Water Quality Parameters for selected Coeur d'Alene tributaries during 1993.

LOCATION	DATE	TURB (NTU)	TSS (mg/l)	NO3 (ppm)	NO3 (ppm)	NO2 (ppm)	NO2 (ppm)	TOT N (mg/l)	TKN (mg/l)	PO4 (ppm)	IRON (ppm	ALK (ppm)	Cl (mg/l)	Total P (mg/l)
ALDER	3/11/93													
ALDER	3/16/93	27	18	0.29	1.28	0.07	0.23			0.70	0.94	30		
ALDER	3/23/93	75	100											
ALDER	4/14/93	9	7.5	0.04	0.18	0.02	0.07			0.01	0.29	40		
ALDER	5/4/93	320	5940					0.01	6.50				2	1.50
ALDER	6/28/93	18	2.75	0.00		0.03				0.01	0.60			
ALDER	7/27/93	24	66	0.08		0.01				0.81		30		
ALDER	8/24/93	24	6	0.00		0.03				3.00		60		
ALDER	9/20/93	38	8							0.07		70		
ALDER	10/28/93	18		0.04		0.03				1.18		50		
ALDER	11119193	172		0.00		0.00				0.01		70		
BENEWAH	1/20/93													
BENEWAH	3/11193													
BENEWAH	3/16/93	46	26.7	0.29	1.28	0.01	0.03			0.44	1.98	30		
BENEWAH	3/23/93	164	1093.3											
BENEWAH	4/14/93	40	12	0.00		0.01	0.03			0.07	0.80	50		
BENEWAH	5/4/93	87	640					0.04	0.87				1	0.72
BENEWAH	6/28/93	12	1.25	0.00		0.00				1.43	0.60			
BENEWAH	7/28/93	24	8	0.00		0.01				0.12		30		
BENEWAH	8/24/93	12	2	0.00		0.06				1.11		50		
BENEWAH	9/20/93	24	30							0.00		50		
BENEWAH	10/28/93	12		0.00		0.03				0.52		50		
BENEWAH	11/19/93	12		0.00		0.00				0.00		50		
EVANS	1/20/93													
EVANS	3/11/93													
EVANS	3/16/93	>500	6.7	0.00		0.00				0.18	0.60	30		
EVANS	3/23/93	35	106.7											
EVANS	4/15/93	30	2.25	0.00		0.04	0.13			0.91	0.29	20		
EVANS	5/4/93	30	460					0.01	0.25				2	0.18
EVANS	6/28/93	0	2.5	0.00		0.03				0.00	0.34			
EVANS	7/28/93	0	2	0.00		0.00				0.00		30		
EVANS	8/24/93	5	10	0.00		0.08				0.18		30		
EVANS	9/20/93	5	2							0.07		40		
EVANS	10/28/93	12		0.00		0.03				1.68		40		
EVANS	11/19/93	0		0.00		0.00				0.40		50		
LAKE	1/25/93													
LAKE	3/11193													

Appendix F.2. (cont.)

LOCATION	DATE	T URB (NTU)	TSS (mg/l)	NO3 (ppm)	NO3 (ppm)	NO2 (ppm)	NO2 (ppm)	TOT N (mg/l)	TKN (mg/l)	PO4 (ppm)	IRON (ppm	ALK (ppm)	Cl (mg/l)	Total P (mg/l)
LAKE	3/16/93	35		>3.58	15.75	0.04	0 . 1 3			0.36	0 . 8 5	30		
LAKE	3/23/93		286.7											
LAKE	4/14/93	195	265	1.03	4.53	0.03	0.10			2.30	3.12	40		
LAKE	5/4/93	75	280					1.00	0.56				2	0.22
LAKE	6/28/93	9	9.25	0.00		0.01				0.23	0.94			
LAKE	7/28/93	24	19	0.00		0.04				0.44		30		
LAKE	8/24/93	18	5	0.00		0.08				0.27		30		
LAKE	9/20/93	21	10							0.07		40		
LAKE	10/28/93	18		0		0.03				1.92		50		
LAKE CONTROL	3/23/93	286												
LAKE-DOWNSTREAM	3/16/93		86.7											
LAKE-DOWNSTREAM	3/23/93	>500												

Appendix F.3: Water Quality data collected using price pygmy meter (discharge) and Hydrolab multi-meter in selected tributaries during 1994.

LOCATION	DATE	Q (cfs)	(C°)	CONDUCTIVITY (mmhos/cm)	DO (ppm)	REDOX (mV)	STAGE
ALDER	3/22/94	19.01	1.13	0.0386	13.98	379	1.48
ALDER	4/22/94	14.48	5				1.4
ALDER	5/18/94	9.03	9.76	0.0671	11.31	278	1.2
ALDER	6/22/94	1.8		0.0761	9.15	277	1.1
ALDER	8/29/94	<.5	16.48	0.0964	7.38	493	
ALDER	9/20/94	<.5	13.33	0.095	8.32	277	
ALDER	10/18/94	1.46	5.7	0.0935	8.75	347	
ALDER	11116194	2.79	0.87	0.0963	9.93	354	1.16
BENEWAH	3/22/04	32.09	2.04	0.0408	14.08	416	0.57
BENEWAH	4/18/94	2.93	16.83	0.0424	8.82	336	0.68
BENEWAH	5/16/94	7.18	17.35	0.0569	9.45	345	0.1
BENEWAH	6/22/94	2.38	28.07	0.059	8.18	177	
BENEWAH	7/18/94	2.24	23.31	0.069	9.14	160	
BENEWAH	8/29/94	<.5	17.07	0.0938	9.62	368	
BENEWAH	9/19/94	0.56	10.2	0.0904	10.2	378	0
BENEWAH	10/18/94	1.34	7.79	0.0758	9.33	394	0
BENEWAH	11/16/94	7.48	1.72	0.0615	10.81	338	0.24
EVANS	3/21/94	15.68	3.66	0.0221	13.56	407	
EVANS	4/19/94	32.79	6.97	0.0156	10.94	328	
EVANS	5/16194	15.74	8.24	0.0117	11.5	336	3.11
EVANS	6/20/94	2.61	12.03	0.0248	10.45	326	3.05
EVANS	7/18/94	3.49	13.99	0.0282	10.02	279	3.1
EVANS	8/29/94	1.77	12.67	0.0289	9.18	360	
EVANS	9/19/94	1.4	11.6	0.0396	9.6	356	
EVANS	10119194	1.25	6.41	0.0314	9.44	466	
EVANS	11115194	3.57	2.74	0.0303	10.55	412	
LAKE	1/4/94	63.82	0.17	0.0544	8.15	339	
LAKE	2/18/94	12.26	0				
LAKE	3/21/94	38.41	2.35	0.0553	13.8	385	1
LAKE	4/18/94	18.96	9.94	0.0376	9.43	367	
LAKE	5/16/94	6.02	9.63	0.0404	11.05	357	0.3
LAKE	6/22/94	1.78	15.92	0.9431	9.71	227	
LAKE	7/18/94	0.32	20.06	0.0912	8.58	176	
LAKE	8/29/94	<.01	11.33	0.0233	7.67	337	
LAKE	9/19/94	0.5	14.86	0.0833	8.8	337	
LAKE	10117/94	0.57	5.19	0.0613	9.95	366	
LAKE	11/15/94	2.88	1.02	0.0514	1118	455	

Appendix F.4: Monthly Water Quality Parameters for selected Coeur d' Alene tributaties in 1994.

LOCATION	DATE	pH	TUR (NTU)	TSS (mg/l)	NO^3(ppm)	NO^2 (ppm)	PHOSPHATE (ppm)	IRON (ppm)	ALKALINITY (ppm)
ALDER	3/22/94	7.48	15		0	0.03	0		55
ALDER	4/22/94		5			0.01			5
ALDER	5/18/94	7.75	18		0	0.01	0.07		60
ALDER	6/22/94	8.24	21		0.04	0.08	0.12		75
ALDER	8/29/94	6.69	24			0.05	0.07		50
ALDER	9/20/94	7	24			0.08	0.18		70
ALDER	10/18/94	6.99	15		0.05		0.07		70
ALDER	11/16/94	7.16							
BENEWAH	3/22/04	7.69	30		0	0.03	0.07		40
BENEWAH	4/18/94	7.78	9	10		0.01	0.01		5
BENEWAH	5/16/94	7.08	24		0	0	0.07		60
BENEWAH	6/22/94	10.33	15			0.08	0.18		50
BENEWAH	7/18/94	IO.68	50			6	0.12		50
BENEWAH	8/29/94	8.26	12			0.01	0.07		35
BENEWAH	9/19/94	7.86	12			0.08	0.12		70
BENEWAH	10/18/94	7.69	9			0.04	0.07		70
BENEWAH	11/16/94	7.35							
EVANS	3/21/94	7.2	5		0	0.05	0.01		40
EVANS	4/19/94	6.92	3	6			0.07		4
EVANS	5/16/94	6.88	0		0	0.02	0.01		50
EVANS	6/20/94	8.07	5			0.07	0.07		70
EVANS	7/18/94	8.51	5			0.04	0.01		50
EVANS	8/29/94	7.01	0			0.03	0.01		35
EVANS	9/19/94	7.05	5		0	0.03	0.01		50
EVANS	10/19/94	6.87	5		0	0.08	0.01		50
EVANS	11/15/94	7.01							
LAKE	1/4/94	8	54		0.98	0.03	0.27		40
LAKE	2/18/94			43					
LAKE	3/21/94	7.36	40		0.61	0.03	0.07		30
LAKE	4/18/94	7.21	9	7			0.01		3
LAKE	5/16/94	6.54	21		0	0.03	0.07		40
LAKE	6/22/94	8.93	9		0.09	0.09	0.32		45
LAKE	7/18/94	8.51	15			0.07	0.4		50
LAKE	8/29/94	7.33	12			0.05	0.12		40
LAKE	9/19/94	7.24	18			0.03	0.27		50
LAKE	10/17/94	7.1	9			0.08	0.18		60
LAKE	11/15/94	7.09							