Coeur d'Alene Tribe
Fisheries Program

Implementation of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation

Coeur d'Alene Tribe Department of Natural Resources
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Fisheries Program

Implementation of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation

Annual Report, 1999 - 2001
With Review of Annual Scopes of Work 1995 - 2001

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1.0 INTRODUCTION

In 1994, the Northwest Power Planning Council adopted the recommendations set forth by the Coeur d'Alene Tribe to improve the Reservation fishery. These recommended actions included: 1.) Implement habitat restoration and enhancement measures in Lake, Benewah, Evans, and Alder Creeks; 2.) Purchase critical watershed areas for protection of fisheries habitat; 3.) Conduct an educational/outreach program for the general public within the Coeur d'Alene Indian Reservation to facilitate a "holistic" watershed protection process; 4.) Develop an interim fishery for tribal and non-tribal members of the reservation through construction, operation and maintenance of five trout ponds; 5.) Design, construct, operate and maintain a trout production facility; and 6.) Implement a five-year monitoring program to evaluate the effectiveness of the hatchery and habitat improvement projects. The principles, priorities, and objectives for this mitigation are described in the 1995 Program, Section 10, Resident Fish, specifically Sections: 10.8B; 10.8B.1; and 10.8B.20.

Since that time, much of the mitigation activities occurring within the Coeur d'Alene subbasin have had a connection to the project entitled "Implement of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation", which is sponsored and implemented by the Coeur d'Alene Tribe Fisheries Program and is the subject of this report. These activities provide partial mitigation for the extirpation of anadromous fish resources from usual and accustomed harvest areas and Reservation lands.

This report summarizes previously unreported data collected to fulfill the contractual obligations for this project (BPA Project #90-044-00). Sections 1-4 provide the materials and methods, results and discussion related to data collected from 1999-2001. Section 5 provides a review of the annual scopes of work from 1995-2001 for the principle components of this project, including: 1) restoration/enhancement activities; 2) construction and management of trout ponds; and 3) education and outreach.

STUDY AREA

The study area addressed by this report consists of the southern portion of Coeur d'Alene Lake and four 3rd – 4th order tributaries which feed the lake. These areas are part of the larger Coeur d'Alene subbasin, which lies in three north Idaho counties Shoshone, Kootenai and Benewah. The basin is approximately 3840 square miles and extends from the Coeur d'Alene Lake upstream to the Bitterroot Divide along the Idaho-Montana border. Elevations range from 2,120 feet at the lake to over 7,000 feet along the divide. This area formed the heart of the Coeur d'Alene Tribe's aboriginal territory, and a portion of the subbasin lies within the current boundaries of the Coeur d'Alene Indian Reservation.

Coeur d'Alene Lake is the principle waterbody in the subbasin. The lake is the second largest in Idaho and is located in the northern panhandle section of the state. The lake lies in a naturally dammed river valley with the outflow currently controlled by Post Falls Dam. The lake covers 129 square kilometers at full pool with a mean depth of 22 meters and a maximum depth of 63.7 meters.

The four tributaries currently targeted by the Tribe for restoration are located almost exclusively on the Reservation and have a combined basin area of 34,853 hectares and include 529

kilometers of intermittent and perennial stream channels (*Figure 1*). The climate and hydrology of the target watersheds are similar in that they are influenced by the maritime air masses from the pacific coast, which are modified by continental air masses from Canada. Summers are mild and relatively dry, while fall, winter, and spring brings abundant moisture in the form of both rain and snow. A seasonal snowpack generally covers the landscape at elevations above 1,372 m from late November to May. Snowpack between elevations of 915 and 1,372 m feet falls within the "rain-on-snow zone" and may accumulate and deplete several times during a given winter due to mild storms (US Department of Agriculture, 1998). The precipitation that often accompanies these mild storms is added directly to the runoff, since the soils are either saturated or frozen, causing significant flooding.

2.0 MATERIALS AND METHODS

LAKE STUDIES

WATER QUALITY

Coeur d'Alene Tribe Fisheries and Water Resources Programs staff monitored stations in the southern section of Coeur d'Alene Lake from Rockford Bay south to the St. Joe River. Selection of sample stations was based on representative geomorphology, visual habitat characteristics, and the potential for changing water quality conditions during the course of the year. Thirteen sample stations were selected to encompass all four water quality management zones identified in the Coeur d'Alene Lake Management Plan (*Figure 2*). These sites were not randomly selected and do not include a majority of the deep open water zone, which is a major factor in controlling the water quality of the outflow leaving Coeur d'Alene Lake.

There are five distinct habitat areas in the southern third of Coeur d'Alene Lake that can be distinguished based on geomorphologic condition. The first of these areas is shallow water created entirely by inundation from Post Falls Dam. There are two monitored stations within this shallow water area. This area is dry during the winter drawdown period and wetted at full pool. The second habitat area is comprised of the three shallow, southern chain lakes along the St. Joe River: Benewah Lake, Chatcolet Lake and Hidden Lake. These lakes were separated from the Coeur d'Alene Lake system until the completion of Post Falls Dam. The third area consists of three deep, open water sections within the main body of Coeur d'Alene Lake. These areas are considered pelagic in nature. The fourth habitat area consists of three semi-isolated shallow bay areas located in the main Coeur d'Alene Lake. The fifth area is riverine habitat inundated by waters from Post Falls Dam. Monitoring stations have been established in each of the separate locations (*Table 1*). Lake data reported herein are aggregated by these habitat types (see Results and Discussion sections below).

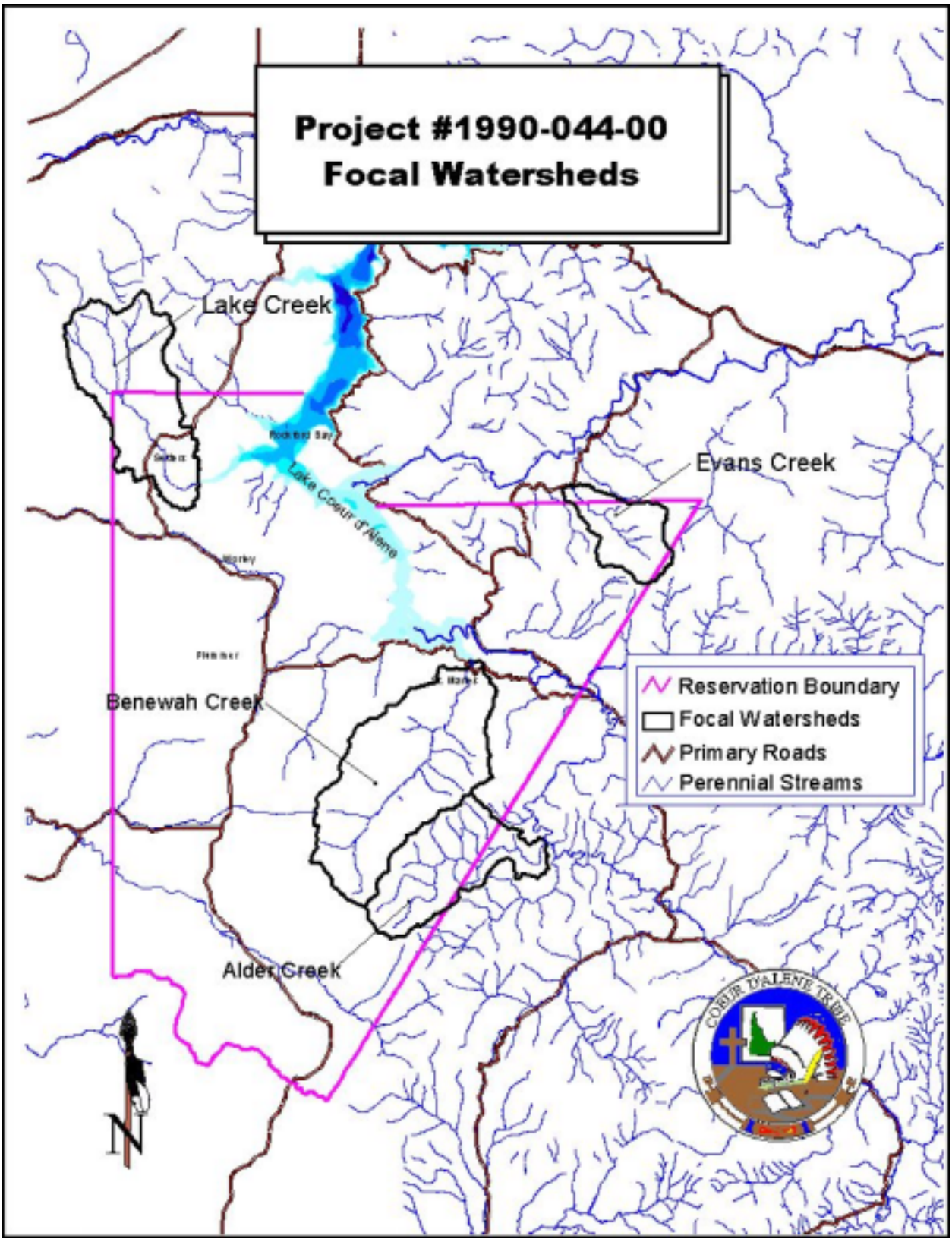


Figure 1. Locations of focus watersheds on the Coeur d'Alene Reservation.

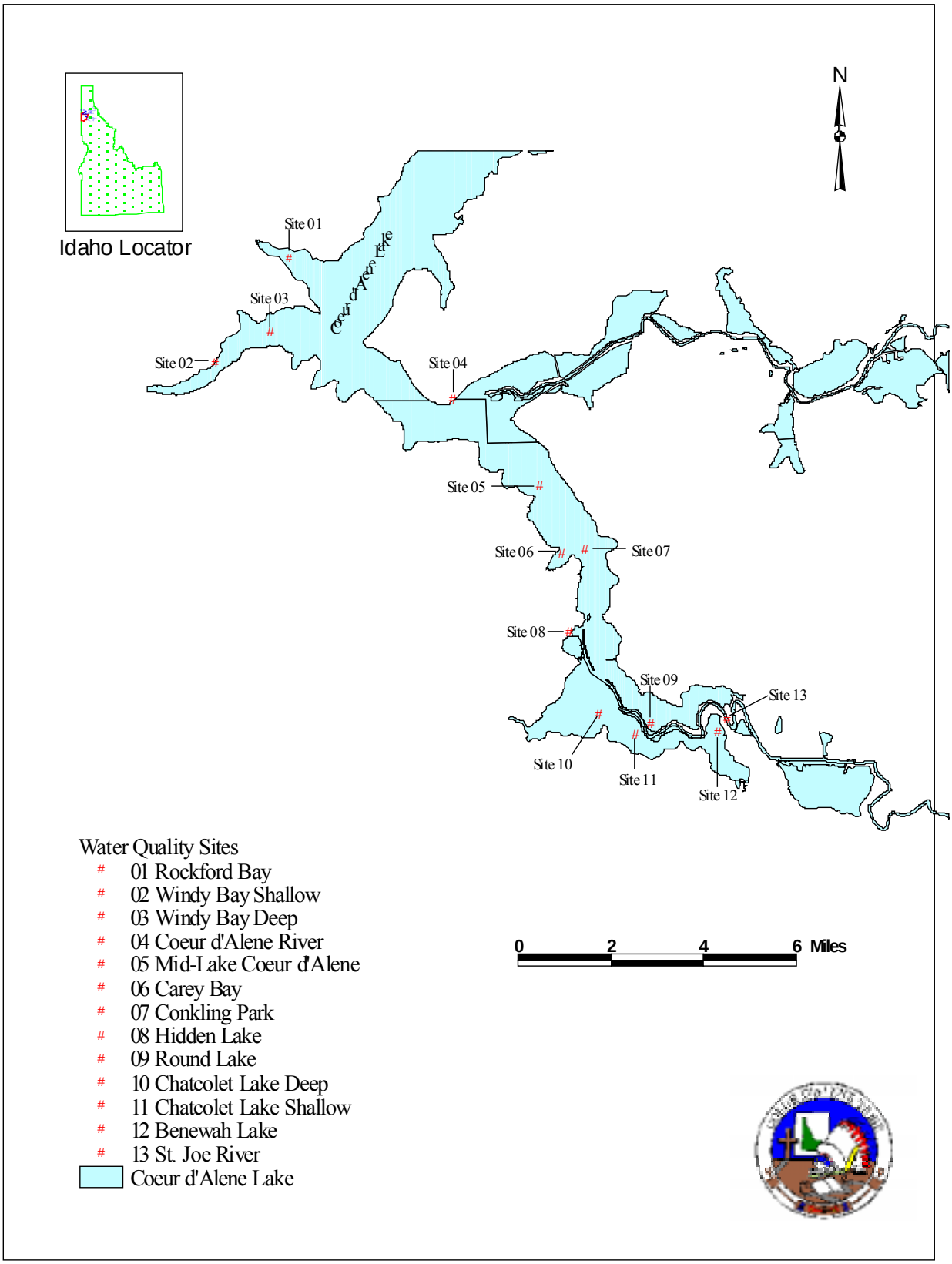


Figure 2. Water quality sample sites on Coeur d'Alene Lake.

Table 1. Water quality sample sites on Coeur d'Alene Lake grouped by habitat area.

Habitat Area	Stations
Shallow Water	09 Round Lake
	11 Chatcolet Lake Shallow
Shallow Chain Lakes	12 Benewah Lake
	10 Chatcolet Lake Deep
	08 Hidden Lake
Shallow Bays	06 Carey Bay
	02 Windy Bay Shallow
	01 Rockford Bay
Deep Open Water	07 Conkling Park
	05 Mid Lake
	03 Windy Bay Deep
Rivers	04 Coeur d'Alene River
	13 St. Joe River

Monitored Parameters

Temperature, dissolved oxygen, pH, and conductivity were monitored at each station using a Hydrolab H20 multi-probe transmitter. Quality control was maintained through strict adherence to the standard operating procedures outlined in the Hydrolab manual (Hydrolab Corporation, 1997). Instrument calibration took place at the beginning of each day of monitoring. A calibration log was used to record the date and time of calibration, analyst performing calibration, calibration parameters, and other comments. At the end of the monitoring run the instrument was checked for drift. All readings were recorded in the calibration log. All standards used for calibration were traceable to NIST or other comparable standards. Reagents used for calibration were accompanied by the following documentation: manufacturer, lot numbers, expiration dates, and date opened. A logbook was kept which contains all information related to preparation of reagents and standards. Field measurements were completed by lowering the instrument by cable to the bottom and bringing it back up in one or two meter intervals pausing at each interval to allow the readings to stabilize then recording the values. This step was repeated until the instrument reached the surface.

A standard 20 cm Secchi disk was used to estimate the transparency of water. Transparency measured in this way is the mean of the depth at which the Secchi disk disappears when viewed from the shaded side of the boat and at which it reappears upon raising after it has been lowered beyond visibility. Secchi readings are used to empirically estimate euphotic zone depth; the depth at which 99% of the surface radiation has dissipated. Secchi disk readings only represent a portion of the total euphotic zone depth that is more rigorously defined by a submersible photometer. The euphotic zone can also be defined as the depth at which gross photosynthesis exceeds respiration. The relationship between euphotic zone depth and Secchi disk readings varies from lake to lake depending on factors which influencing euphotic zone depth. However, a general equation (EZD= 2.2302 + 1.4914(SD) r^2 = .78), which we use, has been developed by the ADFG (1987). Secchi disk readings are taken at all sites during the sampling run.

Water samples submitted for laboratory analysis were collected using a certified water collection device and transferred to the appropriate containers for transportation to the contract laboratory. All samples were handled according to Standard Methods for the Examination of Water and Wastewater, 18th Ed. (APHA, 1992), procedure 1060: Collection and preservation of samples.

Strict chain of custody procedures was followed, as outlined in section 1060.B.1: Chain of custody procedures (APHA). All containers used were specially cleaned and prepared by the contract laboratory.

Total Suspended Solids was analyzed using EPA method 160.2: Gravimetric determination of Total Suspended Solids (USEPA, 1983). TSS is defined as the residue left on a filter paper of 2μm or smaller pore size after a portion of sample has been filtered and dried.

A qualified analytical laboratory completed turbidity analysis in accordance with standard method 2130B: Nephelmetric determination of turbidity (APHA, 1992) and/or EPA method 180.1 (USEPA, 1993). Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines (APHA, 1992). Turbidity in water is caused by suspended matter including clay, silt, and finely divided organic and inorganic matter. The clarity of a natural body of water is a major determinant of the condition and productivity of that system (APHA, 1992).

All metals samples were handled as described previously for collection of water for laboratory analysis. Metals samples were preserved by acidification to 2% HNO_3 as soon as possible after collection. Metals samples were analyzed using EPA method 200.7/200.8: Inductively Coupled Plasma scan (USEPA 1994) by a qualified contract analytical laboratory. The following trace elements were analyzed: zinc, silica, antimony, barium, beryllium, magnesium, arsenic, sodium, aluminum, calcium, copper, silver, lead, cadmium, cobalt, nickel, manganese, iron, chromium.

Water samples for analysis of nutrient content were collected in the same manner as for turbidity and metals. Nutrient sampling consisted of a euphotic zone composite sample determined by Secchi disk and temperature analysis, and a hypolimnetic composite sample with the upper portion of the stratum determined by the temperature profile. Composite sampling was in accordance with APHA method 1060.A.3.B: Composite sample collection procedure 1060 collection and preservation of samples (APHA 1992). The contract laboratory analyzed nutrient samples with an ion chromatograph (IC) using EPA method 300.0 (USEPA 1983). The following nutrient compounds were tested for using this method: ortho-phosphate, nitrate, and nitrite. Other ions looked at were fluoride, chloride, and sulfate.

Chlorophyll *a* samples for primary productivity determinations were collected in amber colored bottles and placed directly on ice. Samples were collected at the same locations as nutrients. A contract laboratory completed sample analysis. The method used was procedure 10200 parts 1: pigment extraction and 2: spectrophotometric determination of chlorophyll (APHA 1992).

Monitoring Timing and Schedule

The monitoring schedule was designed to capture data related to significant changes in the water quality throughout the year. This included physical/chemical characteristics, nutrient characteristics, and phytoplankton and macrophyte growth. Sampling was initiated just prior to the onset of the growing season in the spring and continued until the lake turned over in the fall, marking the end of the growing season. Limited sampling was completed after fall turnover because adverse weather usually prohibited any extensive sampling. Outside of the growing season, however, very little natural change has been observed. A representative sample was taken during the winter and applied to the rest of the winter season.

The following parameters were monitored at all sites on a bi-weekly basis throughout the growing season: temperature, pH, dissolved oxygen, and conductivity. Turbidity was monitored at all sites on a monthly basis. Trace heavy metals were monitored at only three sites on a monthly basis. Surface to bottom depth profiles were taken for temperature, pH, dissolved oxygen, and conductivity. Composite samples were taken in the euphotic zone and the hypolimnion for turbidity and trace heavy metals. Five nutrient samples were taken at all sites on a monthly basis from July to November. The following parameters were monitored: Phosphate, Nitrate, Nitrite, Sulfate, Chloride, and Fluoride. Composite nutrient samples were taken in the euphotic zone and the hypolimnion. $Chlorophyll_a$ samples were taken at the same time and frequency as the nutrients. Composite samples were taken in the euphotic zone and the hypolimnion.

HABITAT SUITABILITY

The lacustrine habitat suitability index model developed by Hickman and Raleigh (1982) was used to predict suitable habitat for cutthroat trout in Coeur d'Alene Lake. The model consists of water quality and reproduction components but only the water quality component was used in this evaluation. The lacustrine water quality component uses three variables: "average maximum water temperature", "average minimum dissolved oxygen" and "annual maximal or minimal pH". Individual Suitability Index (SI) values were calculated for each variable using curves published in Hickman and Raleigh (1982). Note that the SI graphs are based on the premise that it is the extreme, rather than the average, values of a variable that most oftern limits the carrying capacity of the habitat. Thus, measurement of extreme conditions, e.g. maximum temperature, minimum dissolved oxygen and maximum pH, are used in this assessment. No other parameters are considered in the assessment of habitat suitability.

HSI values were calculated using data from early May of each year, to estimate 'best case' conditions (within the period that data is available), and used early August data for three depth intervals (epilimnion, metalimnion and hypolimnion) to estimate worst case conditions. Data used to generate the Suitability Index values were maximum temperature, maximum pH and minimum dissolved oxygen levels. Hickman & Raleigh call for using either minimum or maximum pH but no observed values were below the pH 6 lower limit of optimum so only maximum values were used. Dissolved oxygen values were obtained from one of two graphs depending on the temperature (greater than or less than-equal to 15 °C); temperature values used were those used for the maximum temperature SI.

The following equation was used to ascertain the final SI values:

$$C_{wq} = (V_1 x V_3 x V_{13})^{1/3}$$

Where C_{wq} = HSI for the water quality component and V_1, V_3 and V_{13} = suitability indices for water quality variables (maximum daily temperature, minimum dissolved oxygen and maxumum pH, respectively).

For purposes of interpretation, HSI with values ranging from 0 - 0.25 were considered very poor; 0.25 – 0.4 were poor; 0.4 – 0.6 were good; and 0.6 – 1.0 were very good.

LAKE FISHERIES

The southern section of Coeur d'Alene Lake from Windy Bay south is divided into twelve sampling areas (referred to as "transects") based on similar geomorphology (*Figure 3*). Each transect is broken into one to four sample reaches that encompass all habitat types within the transect. The reach locations are based on clearly visual habitat characteristics and transect length. These reaches were chosen in order to best represent the shoreline habitat within the transect area and neither the transects nor the reaches are randomly selected. The collective submerged habitat within the reaches in a transect spans the range of conditions within that transect area (Peters et al., 1999). Work is currently underway to describe each fish sampling reach in terms of habitat characteristics (water depth, slope, substrate, submersed vegetation, overhanging vegetation etc.) which will allow for the future aggregation of fisheries data based on actual habitat variables.

Detecting changes in fish community composition and size/age distribution requires uniform, standardized capture gear and deployment. Fish population sampling performed by the Coeur d'Alene Tribe follows standard protocols and uses standard equipment in a consistent manner. Further, the sampling schedule for electroshocking and gill netting is designed to capture data related to significant changes in relative abundance and catch-per-unit-effort of various fish species throughout the summer growing season.

Shoreline Electroshocking

A custom-built aluminum boat equipped with a Smith Root 7.5 GPP electroshock unit was used to conduct shoreline (littoral zone) fish sampling. This technique is most effective in water less than 2.4 meters (8 feet) deep. Each reach was sampled for 5-10 minutes, depending on fish density. Electroshocking results are standardized by presenting data as catch per unit effort (typically per hour). After completion of the shocking effort, all captured fish were measured for total length, weighted, had scale samples taken (only from game species) and were released. Data was recorded on the scale sample envelopes as well as being entered immediately into a datalogger.

Gill Net Sampling

Nets were used to sample areas that could not be efficiently sampled using the electrofishing technique, and helped examine species composition as well as seasonal usage in the littoral and limnetic zones of the lake. Two different types of nets were used for sampling fish in different habitat areas. Vertical gill nets were used in areas with water depths greater than 9 meters (ie pelagic zones), while horizontal gill nets were used in shallow areas (less than 9 meters deep). The vertical gill nets were 1.8 meters wide and 36 meters in length with mesh sizes of 63 mm, 76 mm, 102 mm, and 127 mm. Horizontal gill nets were made of graded mesh monofilamant and came in three sizes: 2.4 m x 61 m, 3 m x 61 m and 3.7 m x 46 m. Both types of gill nets were typically deployed for 12 hour periods. Gill netting results are standardized by presenting data as catch per unit effort (typically per minute). Data recorded following the sample effort included depth of capture, total length, weight and scale samples.

Beach Seining

Starting in September 1999 the Tribe instituted a beach seining program to suppliment the electrofishing effort. Beach seining was performed using a 60 m long variable width net with a 1.9 cm polyfoam float line along the top and 0.6 cm lead core rope along the bottom and a 0.6

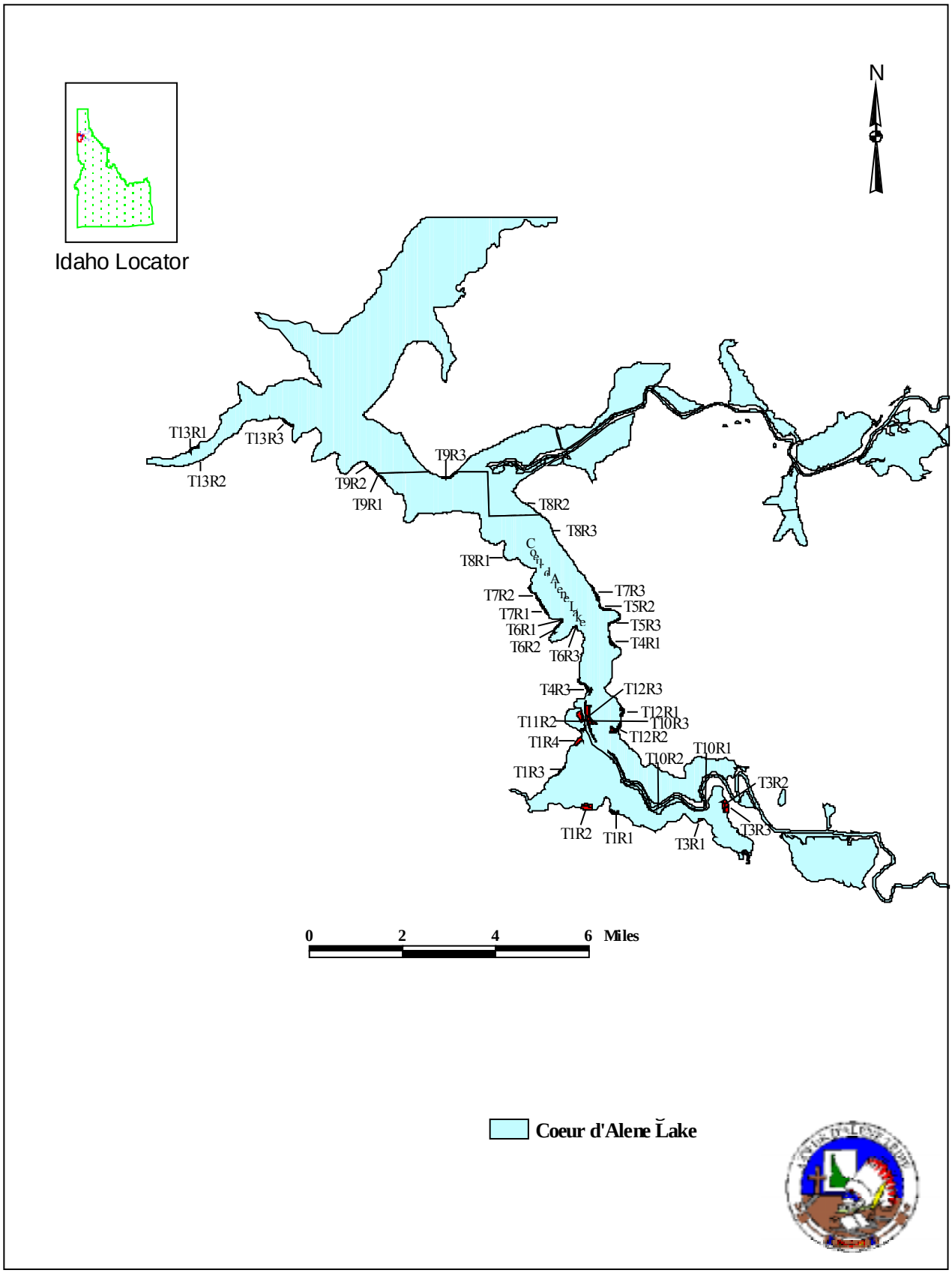


Figure 3. Fisheries sample sites on Coeur d'Alene Lake.

cm nylon mesh. The net was typically attached to the shore and deployed in a semicircle and back to shore by the electrofishing boat. The surface area enclosed within the deployed net was 6,366 square feet. When the second end of the net reached the shore the work crew worked to pull both ends steadily onto the shore and all entrapped fish were removed and placed in 5-gallon buckets from which they were measured, weighted, scales taken (if appropriate) and released. Data from beach seining efforts was standardized by the sampled area and catch data is reported in density of fish per unit area.

Age Analysis

Age was determined for all game species captured using methods described by Jearld (1983). This procedure involves examining collected scales on a microfiche reader and counting growth rings (annuli). Consistency and Quality Control in this process to date has been achieved by having one single individual, who has been trained to identify the circuli patterns for the various fish species, perform all of the scale readings for the lake-captured fish scales (a second individual has read all of the stream-captured scales to date). At such time as the scale reader(s) change, it is planned to have the new reader(s) re-read a statistically significant number of previously read scales so that a comparison can be made.

Age-frequency distributions were plotted for Cutthroat Trout to describe the status of successive cohorts. By examining age-frequency over time, instances of mortality as well as overall population trends may be identifiable.

Mark / Recapture Method

The Coeur d'Alene Tribe performs a limited tagging program in conjunction with the fish population sampling. The goals of this program are to provide information on growth and movement (both time and distance) of key fish species.

Numbered "floy" tags are placed on certain species that meet specific criteria for length and/or weight. Specifically, the Salmonids (Chinook Salmon, Cutthroat Trout, Kokanee and Bull Trout), Largemouth and Smallmouth Bass and Northern Pike are tagged when over 300 mm length and/or 300 grams weight. Occasionally smaller fish (to 250 mm length) of these species will be tagged if low numbers of these species are being seen on a given day. Tag numbers are recorded on a scale sample envelope as well as in a datalogger, along with date/species/length/weight and location information. The recapture data from floy-tagged fish (from both the lake and streams) is then tabulated and graphed to determine time and distance between captures.

Tagged fish recaptures are recorded with other data during the electrofishing, gill netting and beach seining efforts. In addition, tag returns are solicited from anglers through signs that are posted at all access areas along the lakeshore. Angler tag return information is logged into a spreadsheet through the completion of a Tag Return form and these results are compared with any tagged fish that are recaptured through the routine fish population sampling. Anglers returning tagged fish information are mailed summary information of that iinitial capture of that fish through the Education and Outreach Program (see below).

STREAM STUDIES

WATER QUALITY

Water quality monitoring was conducted on 15 stream sites during 1999-2001 (*Table 2*). Each stream was sampled for the same parameters as described above for lake studies, except for chlorophyll$_a$. Additional monitoring parameters are described below. In addition, 10 of the stream sites had 'RL 100' continuous temperature monitoring devices placed during the April through October period.

Table 2. Stream water quality sites and monitoring parameters.

Location	Discharge	Temperature	DO	pH	Conductivity	Turbidity	TSS	Nutrients
Alder Creek	X	X	X	X	X	X	X	X
North Fork Alder Creek	X	X	X	X	X	X	X	X
Upper Benewah Creek	X	X	X	X	X	X	X	X
3 Mile Benewah Creek	X	X	X	X	X	X	X	X
9 Mile Benewah Creek	X	X	X	X	X	X	X	X
West Fork Benewah Creek	X	X	X	X	X			
School House Creek	X	X	X	X	X	X	X	X
Whitetail Creek	X	X	X	X	X	X	X	X
Windfall Creek	X	X	X	X	X	X	X	X
Evans Creek	X	X	X	X	X	X	X	X
Upper Evans Creek	X	X	X	X	X	X	X	X
East Fork Evans	X	X	X	X	X	X	X	X
Bozard Creek	X	X	X	X	X	X	X	X
Lower Lake Creek	X	X	X	X	X	X	X	X
Upper Lake Creek	X	X	X	X	X	X	X	X

For streams with permanent gauging stations (Upper and Lower Lake Creek sites) stream flow was calculated based on an established stage - discharge relationship and on manual or automatic readings of stage (water surface height). Discharge measurements were taken in accordance with standard IFIM methodologies (Bovee, 1982). The wetted stream channel was divided into 20 equal cells and water velocity was measured in each cell using a Price model 622 digital flow meter. Discharge for each cell was calculated by multiplying the cell width by depth and velocity. All individual cell discharges were summed to determine total discharge in cubic feet per second. Channel profiles were measured to evaluate changing flow dynamics over time.

Habitat Suitability

A modified habitat suitability index (HSI) model was used to evaluate the effect of water quality parameters on cutthroat trout populations within and among the target watersheds. A HSI was calculated for the water quality subcomponent of the model described by Hickman and Raleigh (1982). Model variables included: maximum water temperature (V_1); minimum dissolved oxygen (V_3); maximal pH (V_{13}); and annual base flow as a percentage of the average annual daily flow (V_{14}). Individual Suitability Index (SI) values were determined for each variable using curves published in Hickman and Raleigh (1982). The following equation was used to calculate the final HSI score:

$$C_{OQ} = (V_1 x V_3 x V_{13} x V_{14})^{1/4}$$

Where; C_{OQ} = HSI for water quality component, and V_n = suitability index for water quality parameters.

Water quality data collected in 1999 through 2001, when available, were used as input variables. The following modifications were made to address site-specific conditions: the calculated annual maximum 7-day running average of the daily maximum temperature was used when available (otherwise seasonal maximum instantaneous temperatures were used); and minimum dissolved oxygen was determined for the period of highest water temperatures. Continuous discharge measurements were only available for the two sample sites on Lake Creek. For the remaining sites, average annual daily flow was calculated based on all available measurements taken during the year, and annual base flow was determined as the minimum recorded flow.

For purposes of interpretation, HSI with values ranging from 0 - 0.25 were considered very poor; 0.25 – 0.4 were poor; 0.4 – 0.6 were good; and 0.6 – 1.0 were very good.

STREAM FISHERIES

Population Estimates

The channel types delineated during previous surveys (Lillengreen, 1996) served as the basic geomorphic units for selecting sample sites for conducting fish population surveys. In these early channel type surveys, stream reaches were stratified into relatively homogeneous types according to broad geomorphologic characteristics of stream morphology, such as channel slope and shape, channel patterns and channel materials, as defined by Rosgen (1994). Stream reaches were further stratified by basin area to ensure that both mainstem and tributary habitats were represented in the stratification scheme. Sample locations within each strata were randomly selected in proportion to the total reach length (*Table 3*). The length of each sample unit was defined as twenty times the average stream width, with a minimum sample distance of 65 meters, so that all representative habitat types would be included in the sample.

A total of 101 sites were sampled annually in the summer to quantify the abundance and distribution of fishes during base flow conditions occurring between July and September. Trout populations were estimated using the removal-depletion method (Seber and LeCren, 1967; Zippen, 1958). Blocknets were placed at the upstream and downstream boundaries to prevent immigration and emigration during sampling. Each sample site 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 electroshocker. Two electroshocking passes were made for each sample site as the standard procedure. If the capture probability during the initial passes was less than or equal to 50 percent, then a third and fourth pass were generally made to increase the precision of the population estimate. Salmonid species, including cutthroat trout, brook trout, and bull trout, were the target species for this study. Captured fish were identified, enumerated, measured (TL to nearest mm), and weighed. Cutthroat trout greater than 200 mm in length were tagged with a Floy FD-6B numbered anchor tag. Other species such as longnose dace, redside shiner, longnose sucker, and sculpin (sp.) were considered incidental catch and were only counted.

Table 3. Proximal characteristics of 101 fish population sample sites in four watersheds on the Coeur d'Alene Reservation.

Watershed	Site	Channel Type	Valley Segment Type	Riparian Cover Group	Elevation	Basin Area (sq. km)
Alder	1	B3	E1	Forested	2280	70.9
Alder	2	B2	E1	Forested	2320	70.6
Alder	3	A2	E2	Forested	2440	69.4
Alder	4	B2	E3	Forested	2560	66.3
Alder	5	B2	E1	Forested	2560	65.8
Alder	6	C1	E3	Forested	2680	62.8
Alder	7	C1	E1	Forested	2680	61.0
Alder	8	C1	E1	Forested	2680	60.9
Alder	9	C4	E1	Forested	2760	54.8
Alder	10	C4	E3	Forested	2760	48.6
Alder	11	C4	E3	Forested	2800	40.8
Alder	12	C1	E3	Forested	2880	32.5
Alder	13	C1	C4	Meadow	2920	30.4
Alder	14	C6	C4	Meadow	2920	23.5
Alder	15	E4	C4	Forested	3000	7.2
Alder	16	E6	G1	Forested	3080	6.4
Alder	17	E6	G1	Forested	3120	5.7
N. Fork Alder	1	E4	C4	Meadow	2960	10.8
N. Fork Alder	2	E4	C4	Meadow	3000	9.0
N. Fork Alder	3	B5	E3	Forested	3080	8.4
N. Fork Alder	4	B6	E3	Forested	3120	8.2
N. Fork Alder	5	B6	G1	Forested	3120	5.9
N. Fork Alder	6	B6	G1	Forested	3240	4.7
N. Fork Alder	7	B4	G1	Forested	3320	3.8
N. Fork Alder	8	B4	G1	Forested	3520	1.5
Benewah	1	C3	C4	Forested	2160	141.7
Benewah	2	C4	B2	Forested	2160	140.7
Benewah	3	B2	E1	Forested	2240	139.1
Benewah	4	B3	E1	Forested	2280	138.2
Benewah	5	B3	E3	Meadow	2360	130.1
Benewah	6	B2	E3	Forested	2400	129.4
Benewah	7	C2	E3	Meadow	2520	115.1
Benewah	8	B1	D1	Forested	2560	114.8
Benewah	9	C3	B2	Meadow	2640	101.5
Benewah	10	C4	E3	Meadow	2640	94.4
Benewah	11	C3	B2	Meadow	2640	93.2
Benewah	12	C4	B2	Meadow	2680	88.2
Benewah	13	C3	B2	Meadow	2680	81.2
Benewah	14	C4	B2	Meadow	2680	62.9
Benewah	15	C5	C4	Meadow	2720	47.1
Benewah	16	C5	B2	Meadow	2760	10.3
Benewah	17	C4	B2	Meadow	2760	28.3
Bull	1	F4	C4	Meadow	2680	6.7
Bull	2	C4	C4	Meadow	2760	6.0
Coon	1	B2	E1	Meadow	2720	9.3
Coon	2	C4	C4	Meadow	2760	5.4
Coon	3	C4	C4	Meadow	2760	3.4
S. Fork Benewah	1	E4	C4	Forested	2880	8.6
S. Fork Benewah	2	E3	E3	Meadow	2920	7.9

Watershed	Site	Channel Type	Valley Segment Type	Riparian Cover Group	Elevation	Basin Area (sq. km)
S. Fork Benewah	3	E4	G1	Forested	3040	7.3
School House	1	C5	B2	Meadow	2800	7.9
School House	2	E5	C4	Forested	2840	6.5
W. Fork Benewah	1	C4	C4	Forested	2960	3.7
W. Fork Benewah	2	C4	E3	Forested	3040	3.1
Whitetail	1	C4	B2	Meadow	2720	7.4
Whitetail	2	C4	C4	Meadow	2880	4.9
Windfall	1	C4	B2	Meadow	2760	11.4
Windfall	2	C4	C4	Forested	2840	9.7
Evans	1	C6	B2	Meadow	2160	34.3
Evans	2	C3	E3	Meadow	2160	32.3
Evans	3	C3	E3	Meadow	2200	32.1
Evans	4	E3	D1	Forested	2280	30.7
Evans	5	E3	E3	Forested	2280	29.4
Evans	6	E3	E3	Forested	2320	29.2
Evans	7	E3	E3	Forested	2360	26.1
Evans	8	B3	E1	Forested	2480	23.8
Evans	9	B3	D2	Forested	2600	21.6
Evans	10	B2	E2	Forested	2640	12.2
Evans	11	B2	E1	Forested	2800	11.8
Evans	12	B3	E1	Forested	3080	8.2
Evans	13	A4	G2	Forested	3240	5.8
Evans	14	A4	G2	Forested	3400	4.2
Evans	15	A4	G2	Forested	3480	2.0
Evans	16	A4	G2	Forested	3520	1.9
E. Fork Evans	1	B3	G2	Forested	2680	4.9
Rainbow Fork	1	A3	G2	Forested	3200	1.4
S. Fork Evans	1	A4	G2	Forested	2800	4.0
S. Fork Evans	2	A4	G2	Forested	3000	3.3
Lake	1	C4	B2	Meadow	2240	93.4
Lake	2	B3	E3	Meadow	2440	86.2
Lake	3	B3	E3	Meadow	2440	86.1
Lake	4	C3	E3	Meadow	2480	80.4
Lake	5	C3	E3	Meadow	2480	79.9
Lake	6	C3	C4	Meadow	2480	70.8
Lake	7	E4	C4	Meadow	2480	70.4
Lake	8	E4	C4	Meadow	2520	59.8
Lake	9	E4	C4	Meadow	2560	48.2
Lake	10	E4	C4	Meadow	2560	47.2
Lake	11	C5	C4	Meadow	2560	13.1
Lake	12	E5	C4	Meadow	2560	12.5
Lake	13	D5	C4	Meadow	2560	12.1
Bozard	1	E5	C4	Forested	2560	18.7
Bozard	2	E5	C4	Meadow	2560	18.1
Bozard	3	E4	C4	Meadow	2640	13.5
Bozard	4	B4	G1	Forested	2720	4.9
E. Fork Bozard	1	C4	E3	Meadow	2720	8.0
W. Fork Lake	1	C5	C4	Meadow	2560	15.0
W. Fork Lake	2	C5	C4	Meadow	2600	14.3
W. Fork Lake	3	C5	C4	Meadow	2600	11.2
W. Fork Lake	4	E5	E5	Meadow	2680	6.0
W. Fork Lake	5	B4	B4	Forested	2800	5.6

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

$$N = \frac{U_1}{1-(U_2 / U_1)}$$

where:
N = estimated population size;
U_1= 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:

$$se(N) = \sqrt{\frac{M(1-M/N)}{A-\left[(2p)^2(U_2/U_1)\right]}}$$

where:
se(N) = standard error of the population estimate;
M= $U_1 + U_2$;
A= $(M/N)^2$; and
p= $1-\frac{U_2}{U_1}$.

Population estimates when more than two passes were necessary were calculated using the following equation (Armour et al. 1983):

$$N = \frac{M}{1-(1-p)^t}$$

where: N = estimated population size
M = sum of all removals ($U_1 + U_2 + \ldots U_t$)
t = the number of removal occasions
U_i = the number of fish in the ith removal pass
$C = (1)U_1 + (2)U_2 + (3)U_3 + \ldots (t)U_t$
R = (C-M)/M
$p = (a_0)1 + (a_1)R + (a_2)R^2 + (a_3)R^3 + (a_4)R^4$
a_i = Polynomial coefficient from Table 8 (Armour et al. 1983).

The standard error was calculated as:

$$se(N) = \sqrt{\frac{N(N-M)M}{M^2 - \frac{N(N-M)(tp)^2}{(1-p)}}}$$

where: se(N) = standard error of population estimate. The approximate 95% confidence interval on the unknown population size was calculated as follows (Armour et al. 1983):

$$95\%CI = N \pm 2 * \sqrt{\mathrm{var}(N)}$$

The reliability of population estimates was judged by the calculated probability of capture (p). As suggested by Armour (1983), for $p \geq 0.5$, N is probably a good population estimate; for $p \leq 0.5$, results were not used to calculate density values. The population estimates were converted into density values (# fish/100 square meters) for each sample site then extrapolated to the reach in which the samples were collected to estimate the total number of fish in the reach. The confidence intervals were converted in the same manner (Johnson and Bhattacharyya, 2001). Total reach areas were obtained from the digital data layer maintained by the Tribal GIS Program.

We used the program MONITOR (Gibbs, 1995) to estimate the power to detect a positive or negative trend in the existing 6 year time series of fish population data. The MONITOR program uses Monte Carlo simulations to model count surveys over time. The program then generates detection rates produced from route-regression analysis. We ran three types of simulations. In the first simulation, we compared power using the current data to power after adding between one and five additional sites. The addition of five sites would increase the number of population estimate sites, and effort by 30% for Benewah Creek, 40% for Alder Creek, and 50% for Evans and Lake Creeks. We used alpha levels of 0.05, 0.1 and 0.20 in all simulations. The second type of simulation was a comparison of power using the current data when each site was sampled one additional time per year. The current method is to sample once per year. Thus, sampling twice a year would effectively double the number of samplings and effort. The third type of simulation estimated power when the current annual estimates were continued for the next five and ten years.

Age Analysis

Raw scales were used for age determination and calculating growth rates. Salmonid scales were taken from the side of the body just behind the dorsal fin and above the lateral line (Jearld, 1983). Scale samples were sorted by watershed to allow for independent determination of age and growth rate. In the laboratory, several dried scales were mounted between two glass microscope slides and viewed using a Realist, Inc., Vantage 5 microfiche reader. Age was determined by counting the number of annuli (Lux, 1971; Jearld, 1983). A measure of Quality Control was obtained for the scale analysis by having one single individual, who has been trained to identify the circuli patterns for the various fish species, perform all of the scale readings for the stream-captured fish scales (a second individual has read all of the lake-captured scales to date). At such time as the scale reader(s) change, it is planned to have the new reader(s) re-read a statistically significant number of previously read scales so that a comparison can be made.

Simultaneous to age determination, a measurement was made from the center of the focus to the furthest edge of the scale. Along this line, measurements were made to each annulus under a constant magnification. Annual growth was then back calculated using the Lee method as described by Carlander (1981). The formula used:

$$L_i = a + \left(\frac{L_c - a}{S_c} \right) S_i$$

where:

Li = Length of fish (in mm) at each annulus;
a = intercept of the body scale regression line;
Lc = length of fish (in mm) at time of capture;

Sc = distance (in mm) from the focus to the edge of the scale; and
Si = scale measurement to each annulus.

The intercept (a) was obtained from the linear regression of body length versus scale length at time of capture. The proportional method of back-calculation was used for species with small sample sizes due to poor regression results. The following equation was used:

$$L_i = \left(\frac{S_i}{S_c}\right) L_c$$

This formula does not take into account the size of fish at scale formation, as does the Lee method. A linear regression of body length versus age was calculated independently for fish from each subject watershed and the resulting equation was used to determine the age of fish for which scale samples were not taken.

Trout Migration

Migration traps were installed in Lake Creek and Benewah Creek from 1996-2001 to assess migratory life history patterns, length and age frequency distribution, relative abundance and condition factors of adfluvial cutthroat trout. The timing of installation and trapping effeciency has largely been determined by the runoff patterns of the respective watersheds. Typically traps were installed in March (mean date was March 13) and were monitored and maintained into June (mean date was June 10), except during periods of high stream flow. Traps consisted of a weir, runway and a holding box based on a modifed design of the juvenile downstream trap found in Conlin and Tuty (1979). Two traps were installed at each location to capture both fish moving upstream from the lake and fish moving downstream from the upper watershed. Paired traps were placed approximately 10 meters apart.

Traps were checked and cleaned at least once daily during peak spawning periods from April through the mid-May and once daily afterwards until June, when traps were removed. Fish captured in the traps were identified, counted, measured, and weighed. A scale sample was taken to assess the age, growth, and condition of the fish. Catch per unit effort (CPUE), where one unit of effort was defined as one 24-hour period, was calculated to allow for relative comparisons of run size between trap locations and among years.

Mark-Recapture Method

The Coeur d'Alene Tribe performs a limited tagging program in conjunction with monitoring trout migration and stream electroshocking. The intent is to provide information on growth and basic life history information (e.g., migration timing, adult residence time, instance of repeat spawning, etc.) for adfluvial trout. Trout greater than 220 mm length and/or 300 grams weight are marked with a uniquely numbered floy tag. Tag numbers are recorded on a scale sample envelope as well as in a datalogger, along with date/species/length/weight and location information. The recapture data from tagged fish (from both the streams and lake) is then tabulated and graphed.

Habitat Quality

Data on westslope cutthroat trout populations in Reservation tributaries was examined in relation to habitat quality, defined here as the integration of water quality and physical habitat conditions, to validate earlier limiting factor analyses and to refine the existing recommendations for stream restoration that are documented in Lillengreen et al. (1999). Measured trout standing crop from

ten stream reaches on the reservation was correlated to a Habitat Quality Index (HQI) score calculated using the habitat based model developed by Binns and Eiserman (1979). Model inputs included measured data for the following eleven habitat and water quality attributes: stream flow in late summer, annual stream flow variation, maximum summer water temperature, nitrate nitrogen, fish food abundance, fish food diversity, instream cover, eroding streambanks, submerged aquatic vegetation, water velocity, and stream width.

The model inputs for water quality parameters are based on several years of data collected concurrently with population estimates and are thought to be representative of average conditions, however, inputs for the physical habitat parameters, including percent cover, percent eroding banks, substrate, and stream width are based on a single year of data and therefore do not capture annual variability in these measures and in some instances were measured 1-2 years before population estimates were made.

Our application of this model included modifications of maximum summer water temperature criteria to reflect specific tolerances of westslope cutthroat trout consistent with recommendations by Griffith (1993) and Binns and Eiserman (1979) that modifications are needed to provide more accurate evaluations of local habitat conditions consistent with life history requirements of different trout species. The original model was applied to streams that supported multiple salmonid species (including brook, brown, rainbow, and cutthroat trout) and used temperature ranges that were, in some cases, higher than the upper incipient lethal temperature reported for cutthroat trout (Behnke 1979; Behnke and Zarn 1976; Bell 1973). We modified the temperature rating characteristics of the model to provide consistency with the 20-100% suitability index values from Hickman and Raleigh (1982). In addition, we changed the lower rating characteristic for the late summer stream flow attribute to reflect the fact that tributaries on the Reservation support juvenile trout to a much greater extent than resident adults. Therefore, in our model late summer stream flows ≥8% of average annual stream flow provide at least sporadic but limited support for juvenile rearing. Data published by Hickman and Raleigh (1982) indicating 100% suitability for juvenile cutthroat residing in small streams when the average thalweg depth reaches 30 cm, seem to support this assumption. Stream habitat attributes used in the Habitat Quality Index and the characteristics used to rate them are shown in *Table 4*.

As a basis for evaluating reach specific restoration needs and priorities, the tested model was used to predict changes in carrying capacity given several projections of expected improvements in habitat quality and/or water quality resulting from ongoing restoration efforts. These iterations of the model represent a sensitivity analysis of sorts that suggest which model variables exert the greatest influence on fish production during the stream rearing lifestages. The habitat attributes that are thought to be most responsive to restoration techniques during 10-20+ year timeframes, and which have been manipulated during iterations of model predictions, include eroding streambanks, instream cover, fish food abundance and maximum summer water temperature.

Table 4. Stream habitat attributes used in the Habitat Quality Index and the characteristics used to rate them. ADF=average daily flow for the water year; CPF=average daily flow during August and September; SAV=submerged aquatic vegetation, includes algae and moss growing on rocks.

Attribute	**Rating Characteristics**				
	0 (worst)	**1**	**2**	**3**	**4 (best)**
Late summer stream flow	Inadequate to support trout (CPF<10%ADF)	Very limited: potential for support is sporadic (CPF 10-15% ADF)	Limited: CPF may severely limit trout stock every few years (CPF 16-25% ADF)	Moderate: CPF may occasionally limit numbers (CPF 26-55% ADF)	Completely adequate: CPF seldom limiting (CPF>55% ADF)
Annual stream flow variation	Intermittent stream	Extreme fluctuation, but seldom dry; base flow very limited	Moderate fluctuation, but never dry; base flow occupies up to 2/3 of channel	Small fluctuation; base flow stable, occupies most of channel	Little or no fluctuation
Maximum summer stream temperature (°C)	>24	21-24	18-21	16-18	12.6-16
Nitrate nitrogen (mg/l)	<0.01 or >2.0	0.01-0.04 or 0.91-2.0	0.05-0.09 or 0.51-0.9	0.10-0.14 or 0.26-0.50	0.15-0.25
Fish food abundance (#/0.1 m^2)	<25	26-99	100-249	250-500	>500
Fish food diversity (D_s)[a]	<0.80	0.80-1.19	1.20-1.89	1.90-3.99	>4.0
Cover (%)[b]	<10	10-25	26-40	41-55	>55
Eroding banks (%)[c]	75-100	50-74	25-49	10-24	0-9
Substrate	SAV lacking	Little SAV	Occasional patches of SAV	Frequent patches of SAV	Well developed and abundant SAV
Water velocity (m^3/second)	<8 or >122	8-15.4 or 106.6-122	15.5-30.3 or 91.4-106.5	30.4-45.5 or 76.1-91.3	45.6-76
Stream width (m)	<0.6 or >46	0.6-2.0 or 23-46	2.1-3.5 or 15.1-22.9	3.6-5.3 or 6.7-15	5.4-6.6

[a] Diversity Score (Ds) is defined as follows: D_s=antilog$_{10}$D, where D is calculated for each taxon from the formula: $D=P_i\log_{10}P_i$. When P_i is defined as 1/N, and N is the number of organisms, then the formula reduces to $D=\log_{10}N$, as discussed in Watt (1968). D is the mean of all the D values for the sample.
[b] % cover = total amount of cover (m^2)/total area in study section (m^2).
[c] % eroding banks – total length (m) of eroding stream banks in section/total length (m) of study section.

MACROINVERTEBRATES

In 1991, 1994, and 1995, macroinvertebrates were collected at three stations in Lake Creek (Upper, Middle, and Lower) during the spring, summer, and fall of each year. Sample locations correspond to locations #1, #3, and #5 (*Figure 4*). During this time, three Hess samples (area = .10m^2, 250 micron mesh) were collected from riffle habitats at each site. The three samples were collected on straight-line transects, with each sample collected near the left bank, middle channel, and right bank, respectively. In addition, two drift net samples were taken at each site to measure and characterize the drift community in relation to fish food abundance and quality.

Due to changes in study objectives in 1999, field collection methods were changed to more adequately measure biological integrity and to better sample non-riffle habitats found at the additional sampling stations (*Figure 4*). Stations #2 and #4 were added to the existing sample sites to capture a broader range of substrate sizes that would allow for examination of the macroinvertebrate community by substrate type. A rectangular kicknet (0.4826 m wide X 0.3048 m high, 500 micron mesh) was used to collect benthic macroinvertebrates.

Starting at one edge of the stream, the sample collector traveled diagonally upstream, across the thalweg, to the other side of the stream for a set distance of 5 meters. A 5-minute effort level was applied to each sample; therefore, the collector traveled at a rate of one meter per minute. By actively kicking and agitating the stream substrate, dislodged macroinvertebrates were captured in the kicknet, which was held immediately downstream of the collector. This method effectively sampled a bottom area of approximately 2.41m^2. Three samples were collected at each of the five sampling stations and samples were collected in June, August, and October 1999.

Laboratory Methods

Sample Sorting

As soon as samples were brought to the laboratory they were inventoried and examined for leakage or poor seal quality and to ensure that the sample was properly preserved. Samples were then sorted by laboratory technicians. Each sample was emptied into a sorting tray and floated in water. Larger pieces of debris were rinsed, inspected for attached invertebrates and discarded. The remainder of the sample was washed with water to separate any organic matter from inorganic sediments. After agitating the sample in water, the lighter organic material was poured into a 500 micron sieve. The remaining inorganic sediments were inspected under an illuminated 3X magnification lamp to look for any invertebrates too heavy to have been floated off (e.g. mollusks, snails, stone-cased Trichoptera, etc.). Once it was determined there were no more invertebrates in the inorganic fraction of the sample it was discarded.

The organic material, which was retained in the sieve, was then evenly distributed in a Caton subsampler. This is essentially a gridded tray consisting of 30 squares, each square being 6 cm per side (total subsampler dimensions = 30 cm x 25 cm). For this project, all but two of the samples were sorted in their entirety. Two pilot samples, which were processed early in the project, were sub sampled to a fixed count of 500 invertebrates. This was accomplished by randomly selecting a square from the grid, placing the contents of the square into a petri dish and sorting the contents completely under a stereomicroscope (minimum magnification = 6X). If there were less than 500 invertebrates in the first square, another square was randomly selected and sorted. This process was repeated until the target count of 500 invertebrates was reached. If

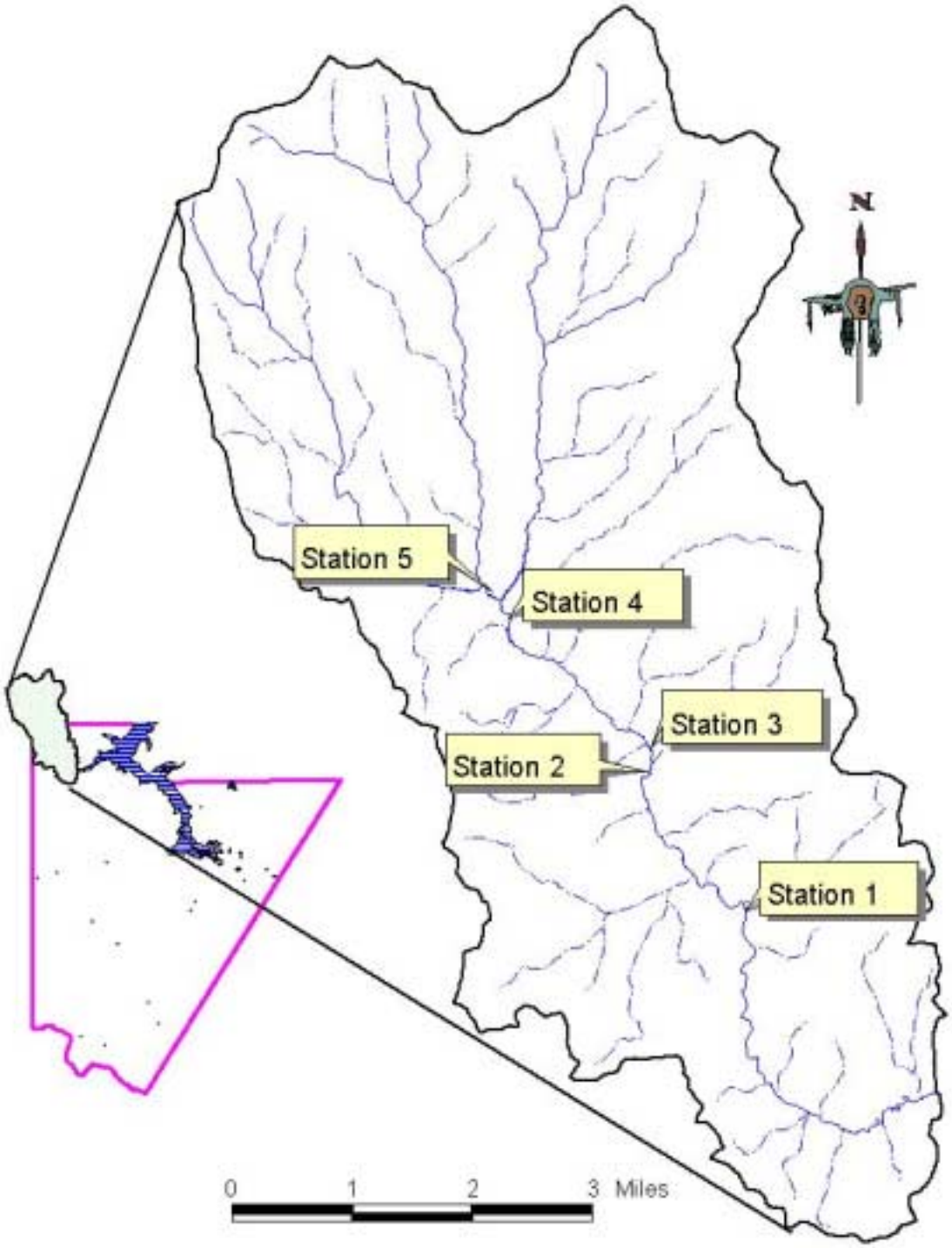


Figure 4. Macroinvertebrate sample stations in the Lake Creek watershed, 1999.

the target count was within reach at the end of a square, another ¼ square was sorted. This method yielded slightly more than 500 invertebrates. The fraction of the sample sorted (# squares sorted/# squares in the tray) was recorded and used later in the analysis to estimate total invertebrate abundance for the entire sample.

The majority of the samples for this project were completely sorted. For these samples, all material was examined under the microscope. The macroinvertebrates from each sample were placed in a single, labeled vial containing 70% ethanol and were stored pending identification by a taxonomist.

Sorting QA/QC

Every sample was checked to ensure that at least 90% efficiency was maintained in the sorting process. After a lab technician sorted the sample and the invertebrates were placed into a vial, the sample material (minus the sorted invertebrates) was redistributed into the gridded sorting tray. The sorted material was evenly distributed and a second technician (the "QC tech") quality checked the sample. The QC tech removed randomly selected squares and resorted them until 20% of the material was checked (six of 30 squares). The QC Tech then calculated an estimated percent efficacy by using the following equations:

Estimating the number of organisms missed:

$$e = (a/b)c$$

where:
e = estimated total number of organisms missed by sorter
a = the number of organisms found in the 20% resort
b = the number of grids resorted (usually 6)
c = the total number of grids in the gridded tray (usually 30)

Estimating the actual total count:

$$c = a + b$$

where:
c = the estimated total number of bugs in the sorted portion of the original sample
a = the number of bugs picked by the first sorter
b = the estimated number of bugs missed (this is the value for "e" in equation #1)

Estimating the percent sorting efficiency:

$$e = (a/b)100$$

where:
e = the estimated percent sorting efficiency
a = number of bugs picked by the first sorter
b = the estimated total number of bugs (the value of "c" in equation #2)

If the estimated percent sorting efficiency was 90% or greater the sample passed the QC check. If the estimate was less than 90%, the sample was completely resorted. When this happened, the sample underwent the QC process again until it passed the 90% efficiency level.

In addition to the sorting quality check, the QC technician performed additional checks. The QC technician briefly looked over the sorted invertebrates to see if there were any reject taxa present in the sorting vial (terrestrial invertebrates, headless organisms, badly damaged specimens, etc.). These were removed and shown to the original technician to help them recognize reject taxa in future work. The QC technician also inspected the labels to ensure that all necessary information had been recorded and all the labels matched. The QC technician's final responsibility was to ensure completion of the feedback loop by discussing the QC results with the original sorter.

Sample Identification:
Morphological characters were examined as the primary method of identifying macroinvertebrates. An extensive library of taxonomic literature, as well as a reference collection of specimens verified by nationally known taxonomists was used to determine the identity of invertebrates for this project. Species limits are often defined by the adult male, which has distinct morphological and genitalia characters. Reliable species level identification of immature stages is often impossible, as larvae of several species within a genus can be physically indistinguishable. Therefore, generic level determinations are common in datasets. Taxonomists often use distributional data in order to put a species name on a specimen; however, this practice was avoided as many historical distributions are now outdated and reliance upon distributional data can ultimately be a considerable source of error. Where possible, identifications were made to the genus/species level, including Chironomidae. This taxonomic effort level corresponded to USEPA RBP Level III biological assessment protocols (USEPA, 2000).

QA/QC of Taxonomic Identifications:
For QA purposes, the project taxonomist established a voucher collection consisting of at least one good specimen (preferably three to five specimens) of each taxon encountered. This collection was reviewed by a second taxonomist and both taxonomists compared and discussed their results.

Data Entry
As each sample was identified the taxonomist entered data into a proprietary dBase macroinvertebrate data entry program. The program has several QC loops built into it, which eliminate most of the common data entry errors (typos, duplicates, omissions, misspellings, etc.). At the end of each sample it was up to the taxonomist to examine his data entry and to make any necessary corrections before moving on to another sample. Human errors could still occur, but this process generally reduced the error frequency.

Data Analysis
A variety of biological metric values were calculated for each sample using the sample taxa list. The metrics included traditional measures of abundance, dominance, taxa richness, diversity, evenness, heterogeneity, community trophic (feeding) structure and others (EPA 1998, EPA 2000). Since the kick sampling method was considered a "semi-quantitative" method, density estimates generated from these samples would have been inaccurate; therefore, total macroinvertebrate abundance in the sample was used to compare invertebrate abundance between sites. A partial list of initial biological metrics that were calculated, along with definitions are presented in *Table 4*.

In order to compare the 1994/1995 dataset with the 1999 dataset, the 1999 data were backed off to family level to match the previous taxonomic effort level. This allowed for direct comparison

of the taxa lists, counts, and biological metrics. However, the change in sampling methods remained a factor that needed to be considered when interpreting the macroinvertebrate data. Of primary concern was the effect that differences in the area of stream bottom sampled would have on the final taxa list and biological metrics. Vinson and Hawkins (1996) stressed the importance of consistent sampling area when comparing richness measures. Although no quantitative correction factor could be applied before comparing the datasets, we assumed the kick sample method, which sampled a greater stream bottom area, would yield greater numbers of invertebrate taxa. Furthermore, abundance estimates were not comparable, due to the different area sampled and to the semi-quantitative nature of the kick sample method vs. the quantitative Hess sample method. However, the change in sampling methods did not likely affect the relative abundance of taxa in a sample; therefore, the dominant species (or family) collected with a Hess sampler would still be the dominant taxa collected with a kick sample.

Another limitation was comparability of community trophic structure (functional feeding groups) at the family level. It was difficult to accurately assign a functional feeding group to an entire family, as there were often several functional groups present within the same family in the same sample (e.g. Chironomidae); therefore, any family level designation was likely to be erroneous. Recognizing the need for accurate classification of the benthic organisms in order to properly assess water and habitat quality, it was decided that functional feeding groups not be compared at the family level.

Table 5. Benthic community metrics calculated for the Coeur d'Alene Tribe macroinvertebrate study.

Biological Metric	Expected Response to Perturbation	Description
Total Macroinvertebrate Abundance	Increase/Decrease	The total number of organisms per square meter of stream bottom.
Percent Dominant Taxa	Increase	Combined proportions of individuals in the three most abundant taxa.
Species Richness	Decrease	Total number of distinct taxa in a macroinvertebrate sample.
EPT Richness	Decrease	The total number of distinct taxa in the orders Ephemeroptera, Plecoptera and Trichoptera.
Percent Filterers	Increase	Proportion of the community that filters water and/or sediment particles to obtain food. Can become dominant under certain conditions.
Percent Gatherers	Increase	Proportion of the community that collects fine organic particles for food. Can dominate in nutrient enriched environments or areas with high sediment levels.
Percent Predators	Unknown	Proportion of the community that eats other live organisms for food. Usually present, but perturbation can either increase or decrease predator proportion.
Percent Scrapers	Decrease	Proportion of the community that scrapes attached periphyton and biofilms from stable substrates such as plant surfaces or large substrate particles for food.
Percent Shredders	Decrease	Proportion of the community that shreds larger pieces of organic debris for food (riparian inputs). Proportion usually related to available stable substrates and food.
Shannon-Weaver H′ (log e)	Decrease	A mathematical expression based on information theory. Incorporates taxa richness and relative abundance into a single index value.
Hilsenhoff Biotic Index	Increase	A measure of average community tolerance to organic pollution. Values range from 0-10. Increases with organic enrichment, stream temperature, and/or sediment.

3.0 RESULTS

LAKE STUDIES

WATER QUALITY

Lake Depths

The recorded depth at each of the monitoring sites was seen to vary from year to year, based assumedly on antecedent precipitation and the operation of Post Falls Dam. The range of recorded depths for each station for the three years of the study are shown in *Table 6*.

Table 6. Coeur d'Alene Tribes' Lake monitoring stations (sites) with associated habitat areas and depths recorded during 1999 - 2001.

LAKE SITES	HABITAT AREA	1999 Depths (m)	2000 Depths (m)	2001 Depths (m)
09 Round Lake	Shallow Water	0.4 - 0.9	0.6 - 1.5	0.9 - 1.8
11 Chatcolet Lake shallow	Shallow Water	0.4 - 0.9	0.6 - 0.9	0.4 - 1.5
01 Rockford Bay	Shallow Bay	12.2 - 13.8	10.4 - 13.6	11.2 - 16.0
02 Windy Bay shallow	Shallow Bay	14.4 - 15.8	14.8- 16.2	14.4 - 15.9
06 Carey Bay	Shallow Bay	11.0 - 13.4	12.4 - 13.4	9.4 - 13.0
03 Windy Bay deep	Deep Open Water	29.7 - 30.7	30.2 - 31.4	26.2 - 31.0
05 Mid Lake Coeur d'Alene	Deep Open Water	18.1 - 18.9	18.2 - 19.4	15.6 - 19.0
07 Conkling Park	Deep Open Water	13.6 - 15.5	14.7 - 15.8	12.0 - 15.9
08 Hidden Lake	Shallow Chain Lakes	7.2 - 8.3	7.9 - 8.5	6.7 - 8.1
10 Chatcolet Lake deep	Shallow Chain Lakes	8.8 - 10.5	10.1 - 10.9	9.4 - 12.0
12 Benewah Lake	Shallow Chain Lakes	3.9 - 4.6	4.6 - 5.1	3.8 - 4.9
04 Coeur d'Alene River	Rivers	9.3 - 12.0	9.9 - 12.	7.8 - 11.4
13 St. Joe River	Rivers	9.3 - 12.1	10.0-11.5	15.0 - 20.4

Secchi Disk Transparency

Secchi disk readings were taken at each of the thirteen stations throughout 1999, 2000 and 2001 and this collected data is shown in Appendix A Table A-1. *Table 7* presents monthly mean Secchi data for the five habitat areas within the sampled portion of Coeur d'Alene Lake for the growing season period March through October. From this it can be seen that water clarity (transparency) increased in all areas between March and August and then began to drop through October. It can be seen in the standard deviations given in *Table 7* that there is a noticeably higher variability in the Secchi readings in the second half of the growing season period. This variability stems from increased differences between sites (within the habitat area groups) as well as increased differences between the sampling dates within a given month for the same site.

Table 7 also shows the similarities and differences in water clarity between the habitat areas. The greatest clarity was seen at the shallow bay sites.

Table 7. Average (+/- SD) of Secchi disk readings (meters) for all months by habitat type in Coeur d'Alene Lake, 1999-2001.

HABITAT AREAS	Mar*	Apr.*	May	Jun.	Jul.	Aug.	Sep.	Oct.**
Shallow Water	***	***	***	***	***	***	***	***
Shallow Bays	2.1 +/- 0.4	2.4 +/- 0.4	3.7 +/- 0.8	4.0 +/- 0.7	6.0 +/- 1.2	8.5 +/- 1.3	7.2 +/- 1.5	6.7 +/- 1.7
Deep Open Water	2.2 +/- 0.4	2.2 +/- 0.4	3.5 +/- 0.7	3.7 +/- 0.7	5.9 +/- 2.1	8.2 +/- 1.9	6.1 +/- 2.0	6.0 +/- 1.9
Shallow Chain Lakes	2.3 +/- 1.1	2.3 +/- 1.1	2.7 +/- 0.9	2.9 +/- 0.5	3.9 +/- 0.7	4.1 +/- 1.0	2.8 + /- 0.5	2.5 +/- 0.4
Rivers	2.1 +/- 0.5	2.5 +/- 0.3	2.8 +/- 0.8	3.6 +/- 1.2	4.0 +/- 1.1	5.1 +/- 2.0	4.2 +/- 1.7	3.8 +/- 2.2

* no data for 2001 ** no data for 2000 *** Secchi Disk on bottom on all dates sampled

Temperature

Vertical temperature profiles were taken at all thirteen stations during the three study years. These profiles were reduced to mean values and surface to bottom ranges for comparison (Appendix A Table A-3). Geomorphologically similar stations showed similarities in the temperature profiles in regard to both timing of stratification and magnitude of the warming during this three-year period. While annual highs and lows were fairly uniform between the three study years, there were some profound differences in the levels and degree of thermal stratification seen.

In February (1999 only) there was little difference between sites or habitat areas with lake water temperatures ranging between 2.4 and 3.3 °C. Between March and June, however, not only did temperatures rise to a range of 7.2 to 20.2 °C but there became established a gradation between the Shallow Bays/Deep Open Water/Shallow Water sites, which were typically lower than the overall mean temperature, and the Shallow Chain Lakes/River sites which were typically above the overall mean. The recorded temperatures during this period in 1999 and 2000 ranged between 4.0 and 6.5 °C the end of March, 5.1 and 12.4 °C the end of April, 7.2 and 20.2 °C the end of May and 6.3 and 18.0 °C the end of June. During this period in 2001 the gradation was between the Shallow Bays/Deep Open Water sites and the Shallow Water/ Shallow Chain Lakes/River sites and collected data ranged between 7.0 and 16.5 °C the end of May and 7.6 and 19.6 °C the end of June, 2001.

During the July through September period in all three years there was a strong difference between the Deep Open water sites and all other sites, with the Deep sites having the lower temperatures. Typically, the Deep Open sites had temperatures between 6.5 and 21.0 °C at the end of July, 7.0 and 22.0 °C the end of August and 9.6 and 18 °C the end of September. The other sites ranged between 10.5 and 22.8 °C the end of July, 9.8 and 23.5 °C the end of August

and 7.0 and 19.2 °C the end of September. The exception to this trend was seen in 1999 when the Shallow Water /Deep Open Water/Shallow Chain Lakes sites had temperatures generally less than the overall mean temperature (10.4 to 15.3 °C) while the Rivers and Shallow Bays sites were greater than the overall mean (13.9 to 15.5 °C).

In October 1999 and 2001 (there was no data for 2000) the Shallow Chain Lakes sites and the Shallow Water sites showed somewhat lower temperatures (8.3 to 11.9 °C) than the Deep Open Water and Shallow Bay sites (7.4 to 12.9°C), with the Rivers sites being somewhat higher in 2001 than in 1999. The only data for November was from 1999 and at this time the Shallow Chain Lakes and Rivers sites showed somewhat lower temperatures (5.7 to 9.8 °C) than the Deep Open Water and Shallow Bays sites (7.8 to 10.0 °C) with no data from the two Shallow Water sites.

Variations in the overall mean temperature for all monitored sites were very similar for the three-year period, as shown in *Figure 5*. The highest overall mean occurred consistently on the early August sampling data and the highest mean values were 19.7 +/- 0.3 °C. For comparison, the optimum temperature requirements for cutthroat and bull trout range between 10° C and 15° C. Additional perspective on the suitability of these waters for cutthroat trout is presented in the Habitat Suitability section, below.

Another measure of temperature consistency or variability in a lake is the development of thermal stratification. As shown in *Table 8* there was a fairly consistent situation during the summers of 1999 and 2000 with all sites except Round Lake and Charcoal Lake Shallow developing stable stratification. However during 2001 only four of the 13 sites developed stratification with the depths of the thermocline being deeper than the previous two years, While the deep, open water sites did stratify, none of the three semi-isolated bay sites or the two riverine sites did.

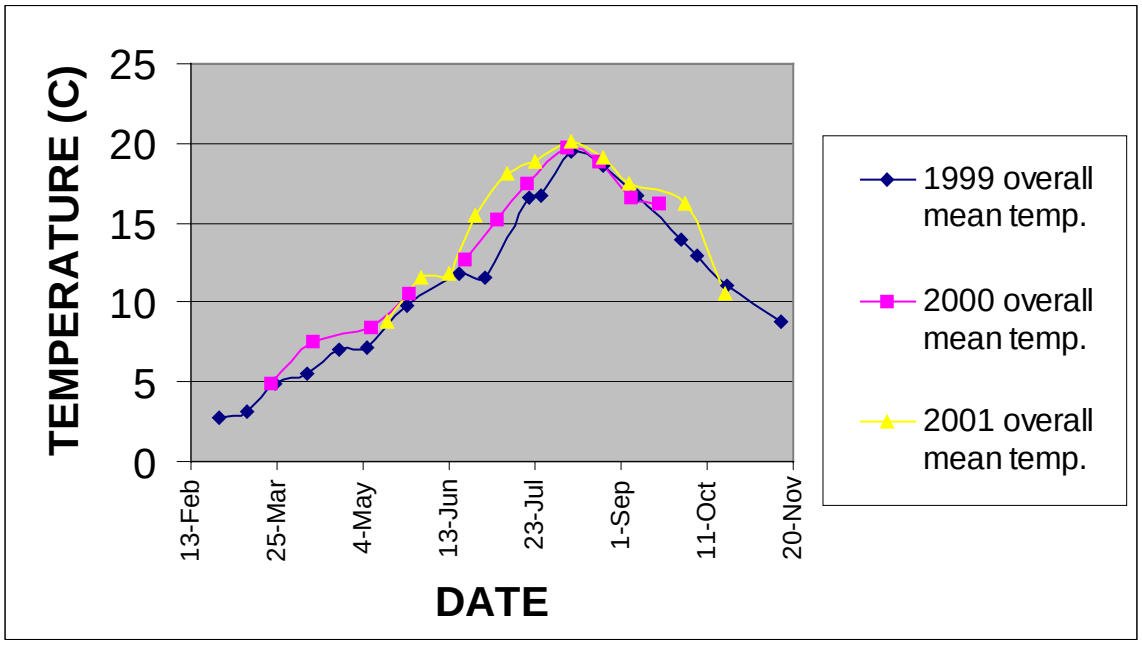


Figure 5. Overall Coeur d'Alene Lake mean temperatures, 1999-2001.

Table 8. Observed thermal stratification at Coeur d'Alene Lake monitoring sites, 1999-2001.

YEAR	DEPTH OF THERMOCLINE	SITES
1999	3 - 5 m	08 Hidden Lake, 12 Benewah Lake*, 13 St. Joe River
	5 - 8 m	04 Coeur d'Alene River, 07 Conkling Park, 10 Chatcolet Deep
	9 - 12 m	01 Rockford Bay, 02 Windy Bay Shallow, 03 Windy Bay Deep, 06 Carey Bay
	12 - 14 m	05 Coeur d'Alene Mid-Lake
	non-stratified	09 Round Lake, 11 Chatcolet Lake Shallow
2000	3 - 5 m	12 Benewah Lake*
	4 - 7 m	06 Carey Bay, 08 Hidden Lake, 10 Chatcolet Lake Deep
	7 - 12 m	02 Windy Bay Shallow, 03 Windy Bay Deep**, 04 Coeur d'Alene River, 05 Coeur d'Alene Mid-Lake, 07 Conkling Park
	9 - 12 m	01 Rockford Bay, 13 St Joe River*
	non-stratified	09 Round Lake, 11 Chatcolet Lake Shallow
2001	6 - 10 m	10 Chatcolet Lake Deep
	12 - 22 m	03 Windy Bay Deep, 05 Coeur d'Alene Mid-Lake, 07 Conkling Park*
	non-stratified	01 Rockford Bay, 02 Windy Bay Shallow, 04 Coeur d'Alene River, 06 Carey Bay, 08 Hidden Lake, 09 Round Lake, 11 Chatcolet Lake

* Benewah Lake thermocline from 3 m to bottom, St Joe River thermocline from 9 m to bottom, Conkling Park thermocline from 13 m to bottom, no hypolimnion at these three sites. ** Windy Bay Deep thermocline from 7 to 16 m

Dissolved Oxygen

Summarized dissolved oxygen (DO) data for the study period are presented in Appendix A, Table A-2. *Figure 6* shows variations in overall mean values (average of all sites and depths within sites for a given date). Most DO readings taken during this period varied with temperature in terms of saturation potential. Levels of DO were somewhat higher during 1999 than during 2000 and 2001 which follows the somewhat lower temperatures during that time (*Figure 6*). In spite of this variation, the typical range of DO values seen, in the surface waters (four to six meter depths at least) was 10 - 12 mg/L during the February through June period. DO in surface waters drops somewhat during July, August and September to a typical range of 9 to 11 mg/L. From the available data it appears that DO levels start to climb again in October, assumably as the water temperature cools in the fall.

Due to the influence of thermal stratification, DO levels in the deeper (hypolimnion) waters can be considerably different than near the water surface. A particular point of reference in this regard is the 6.0 mg/L standard for cutthroat trout. *Table 9* indicates the sites where DO less than 6.0 mg/L were measured. From this, it can be seen that the standard was exceeded (DO values were less than 6.0) primarily at the three Shallow Chain Lakes sites of Hidden Lake, Chatcolet Lake Deep and Benewah Lake and primarily during the period July through September. During this time DO values as low as 0.1 - 0.2 mg/L were measured each season during August. Other sites where DO below 6.0 mg/L were measured more than once included Carey Bay (three instances), Mid Lake Coeur d'Alene (four instances), Conkling Park (nine instances) and the St. Joe river (six instances, mostly in 2001).

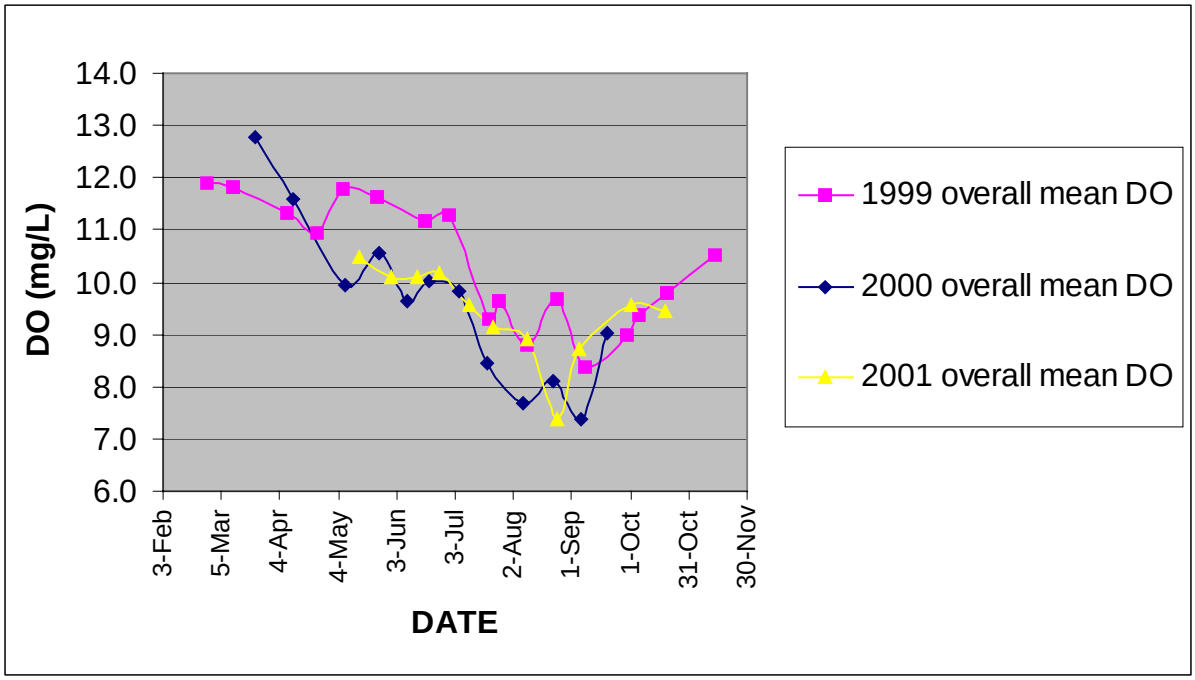


Figure 6. Overall mean dissolved oxygen levels (mglL) for Coeur d'Alene Lake, 1999-2001.

Table 9. Monitoring sites, dates and DO values less than 6.0 mg/l measured in Coeur d'Alene Lake, 1999-2001.

	Date and measured DO		
LAKE SITES	**1999**	**2000**	**2001**
09 Round Lake		9/6 (5.6)	
11 Chatcolet Lake shallow		9/6 (5.3)	
01 Rockford Bay			
02 Windy Bay shallow			
06 Carey Bay		8/7 (5.3), 9/6 (5.3)	10/19 (4.4)
03 Windy Bay deep			10/19 (4.7)
05 Mid Lake Coeur d'Alene		8/22 (5.5)	7/23 (5.6), 8/24 (5.1), 10/1 (4.0)
07 Conkling Park	9/8 (5.8), 9/29 (4.4)	8/7 (4.4), 8/22 (3.2), 9/19 (3.6)	8/9 (5.1), 8/24 (5.6), 9/6 (4.5), 10/19 (4.4)
08 Hidden Lake	7/20 (4.9), 7/26 (3.4), 8/9 (0.2), 8/24 (0.1), 9/8 (0.2)	7/5 (5.2), 7/19 (0.7), 8/7 (0.2), 8/22 (0.1), 9/6 (0.3), 9/19 (0.2)	6/13 (1.0), 6/23 (0.2), 7/10 (0.7), 7/23 (0.5), 8/9 (0.3), 8/24 (0.1), 9/5 (3.7)
10 Chatcolet Lake deep	7/20 (5.4), 7/26 (4.4), 8/9 (2.0), 8/24 (0.2), 9/8 (0.2)	7/5 (5.7), 7/19 (2.5), 8/7 (0.4), 8/22 (0.1), 9/6 (0.3), 9/19 (0.2)	6/25 (4.4), 7/23 (0.2), 8/9 (0.1), 8/24 (0.1), 9/5 (0.1), 10/1 (0.9)
12 Benewah Lake	8/9 (0.4), 8/24 (0.1)	5/8 (4.5), 5/25 (1.2), 7/5 (5.2), 7/19 (0.7), 8/7 (0.2), 8/22 (0.1), 9/6 (0.3), 9/19 (0.4)	7/25 (2.1), 8/24 (3.3)
04 Coeur d'Alene River			
13 St. Joe River		8/7 (4.3)	7/10 (5.6), 7/23 (0.3), 8/9 (0.1), 8/24 (0.1) , 9/5 (0.1)

Temperature-Dissolved Oxygen Curves

To further illustrate the relationship between temperature and DO in the lake, a series of graphs were prepared plotting these parameters together with depth. The number of graphs was limited to one representative site for each of the five habitat areas described above. The use of representative sites is based on the similarity in the temperature profiles of each habitat area's sites shown by Peters et al. (1999). Representative sites were selected based on which site had daily mean temperatures closest to the overall daily mean for all sites in the habitat area. For those habitat areas that only had two sites (Shallow Water and Rivers) the site with the most data for the three-year period was selected. The Shallow Water sites did not stratify during this three-year period so were not included in this analysis.

The temperature-DO curves for Hidden Lake, representing the Shallow Chain Lakes, appear in *Figures 7, 8 and 9* for 1999, 2000 and 2001, respectively. At this site stratification became

apparent during June in 1999 and 2000 but was already present in May 2001. The maximum apparent stratification was seen during August in all three years and this was typically gone by the end of September. DO concentrations were typically within the range of 8 to 12 mg/L in the epilimnion and throughout the water coliumn before and after stratification. During stratification DO values dropped to near zero consistently at depths below six meters.

The 'Windy Bay shallow' monitoring site was chosen for this analysis to represent the Shallow Bays habitat area. This site showed remarkable consistency over the three-year period (see *Figures 10 - 12*). During June of each year a near-linear temperature gradient was seen, from approximately15°C at the surface to 8°C near the bottom while the DO levels were fairly uniform at 10 to 13 mg/L. By late August to early September a strong stratification was set up with a thermocline at the 12 to 15 m depths and no hypolimnion. DO levels at this time, however, only dropped from approximately 10 mg/L to about 7 mg/L. Stratification was gone and turnover had equalized both temperature and DO by the end of September in 1999 and 2000, but not until late October in 2001.

The 'Mid Lake CDA' monitoring site represents the Deep Open Water habitat areas. This site showed some year-to-year similarity prior to stratification (ie May) but many differences thereafter (see *Figures 13 - 15*). As with the Windy Bay site, there was a near-linear temperature gradient between approximately 13°C and 7°C during late May of all three years; while the DO at that time was remained between 9 and 12 mg/L and showed no consistent drop with depth. During the stratification period, however, there were variations in timing of maximum, temperature drop and DO depletion. The apparent maximum stratification occurred late in October of 1999, during late August, 2000 and early October 2001. At the time of the maximum stratification, the surface water temperature at the Mid Lake site was lowest (approximately 12°C) in 1999, highest (approximately 18°C) in 2000 and intermediate (17°C) in 2001. Correspondingly, the temperature drop with depth was least in 1999 (2 to 3 °C), greatest in 2000 (13°C) and intermediate in 2001 (8°C). Conversely, however, the apparent depletion in DO with depth was greatest in 1999 (approximately 9.5 mg/L), least in 2000 (3 mg/L) and intermediate in 2001 (6 mg/L). The period of stratification was only seen clearly in 1999 with the completion of a mid-November sampling; during 2000 and 2001 the lake at this site was still strongly stratified at the time of the last monitoring visit (9/20/00 and 10/19/01).

The 'St. Joe River' site was chosen to represent the Rivers habitat area. This site did not stratify during 1999 or 2000 but did show a strong stratification from late August through the beginning of October 2001 (see *Figures 16 - 18*). The notable factor about this was that the depth of water at the sample site was considerably deeper during 2001, to 20 m, whereas the maximum depth at this site during 1999 and 2000 was12 m. The reason for this difference is believed to be a slight shifting to the side of the river channel where the actual depth was greater. If the depth of the site seen in 1999 and 2000 is used with the 2001 data there is no stratification seen (ie above the 12 m depth).

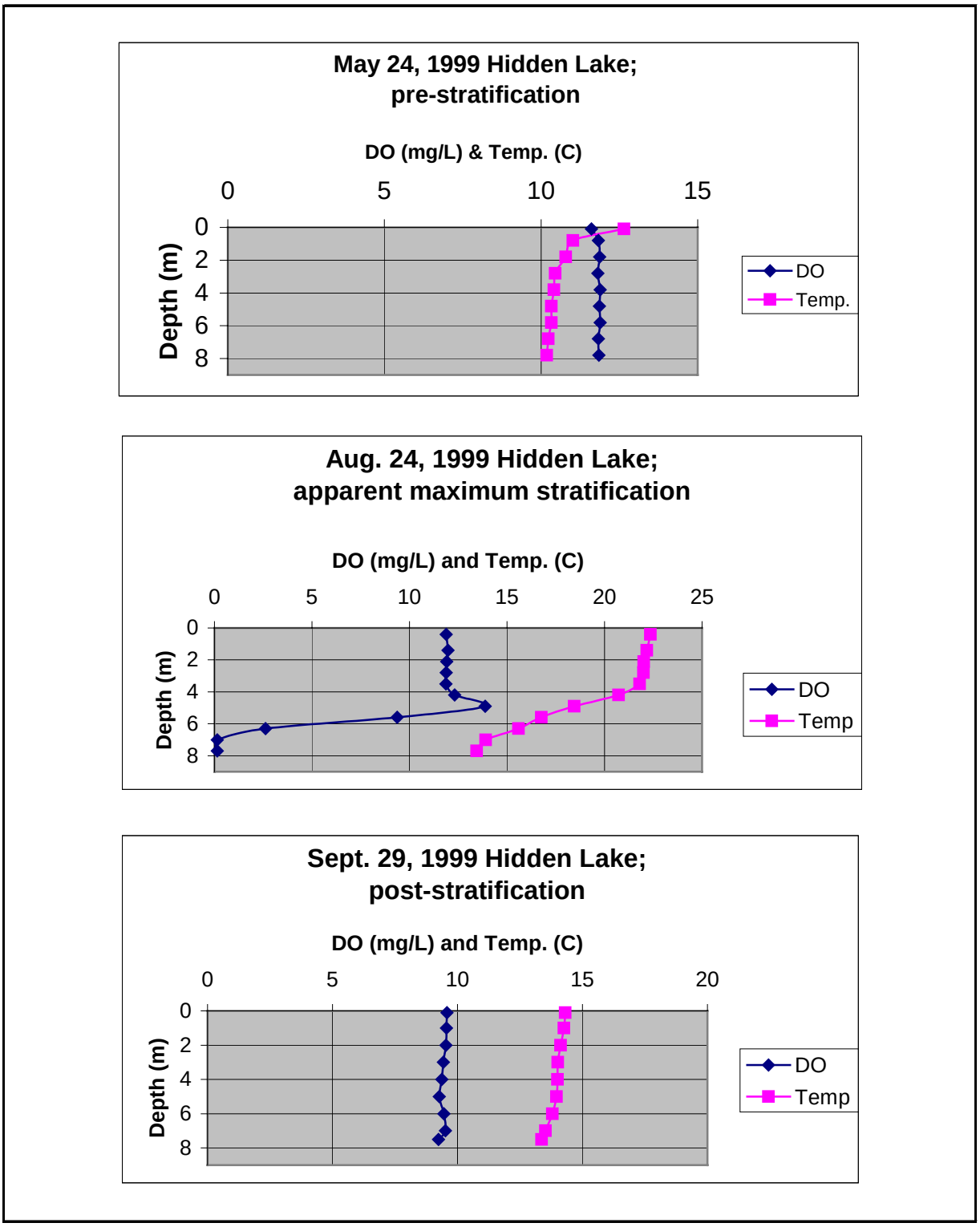


Figure 7. Temperature and Dissolved Oxygen (DO) curves for the 'Hidden Lake' monitoring site 1999; representing the Shallow Chain Lakes habitat area of Coeur d'Alene Lake.

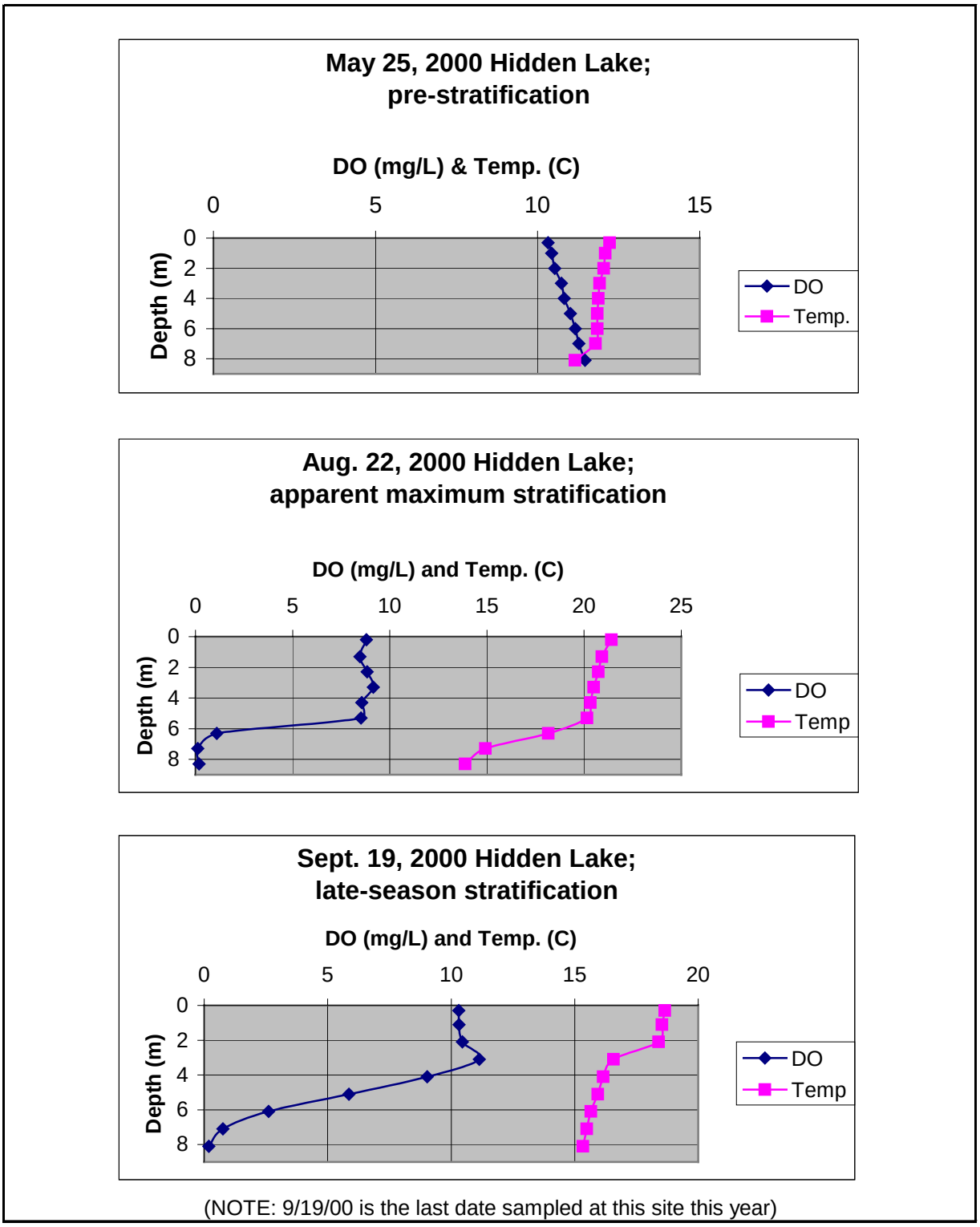


Figure 8. Temperature and Dissolved Oxygen (DO) curves for the 'Hidden Lake' monitoring site 2000; representing the Shallow Chain Lakes habitat area of Coeur d'Alene Lake.

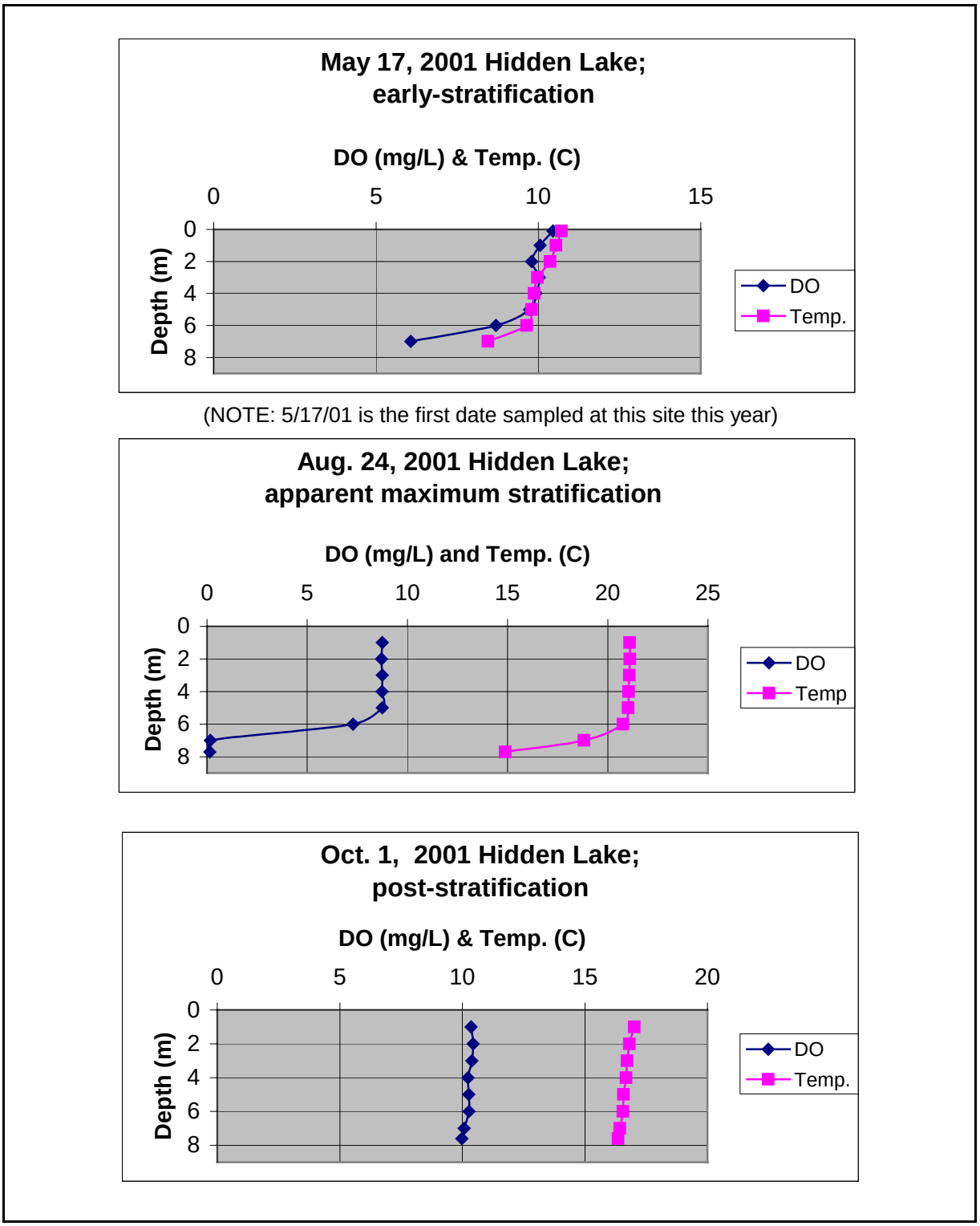


Figure 9. Temperature and Dissolved Oxygen (DO) curves for the 'Hidden Lake' monitoring site 2001; representing the Shallow Chain Lakes habitat area of Coeur d'Alene Lake.

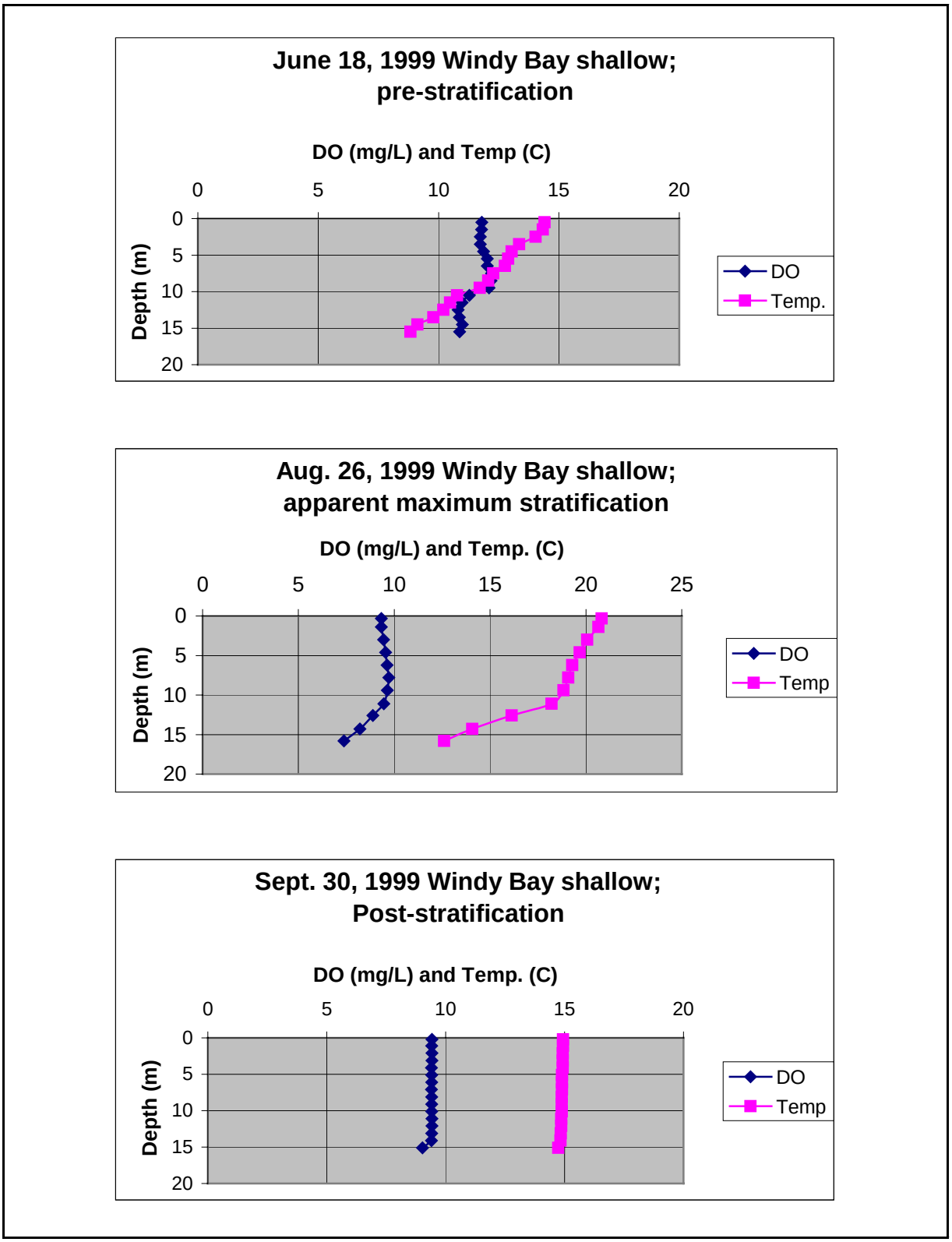


Figure 10. Temperature and Dissolved Oxygen (DO) curves for the 'Windy Bay shallow' lake monitoring site 1999; representing the Shallow Chain Lakes habitat area of Coeur d'Alene Lake.

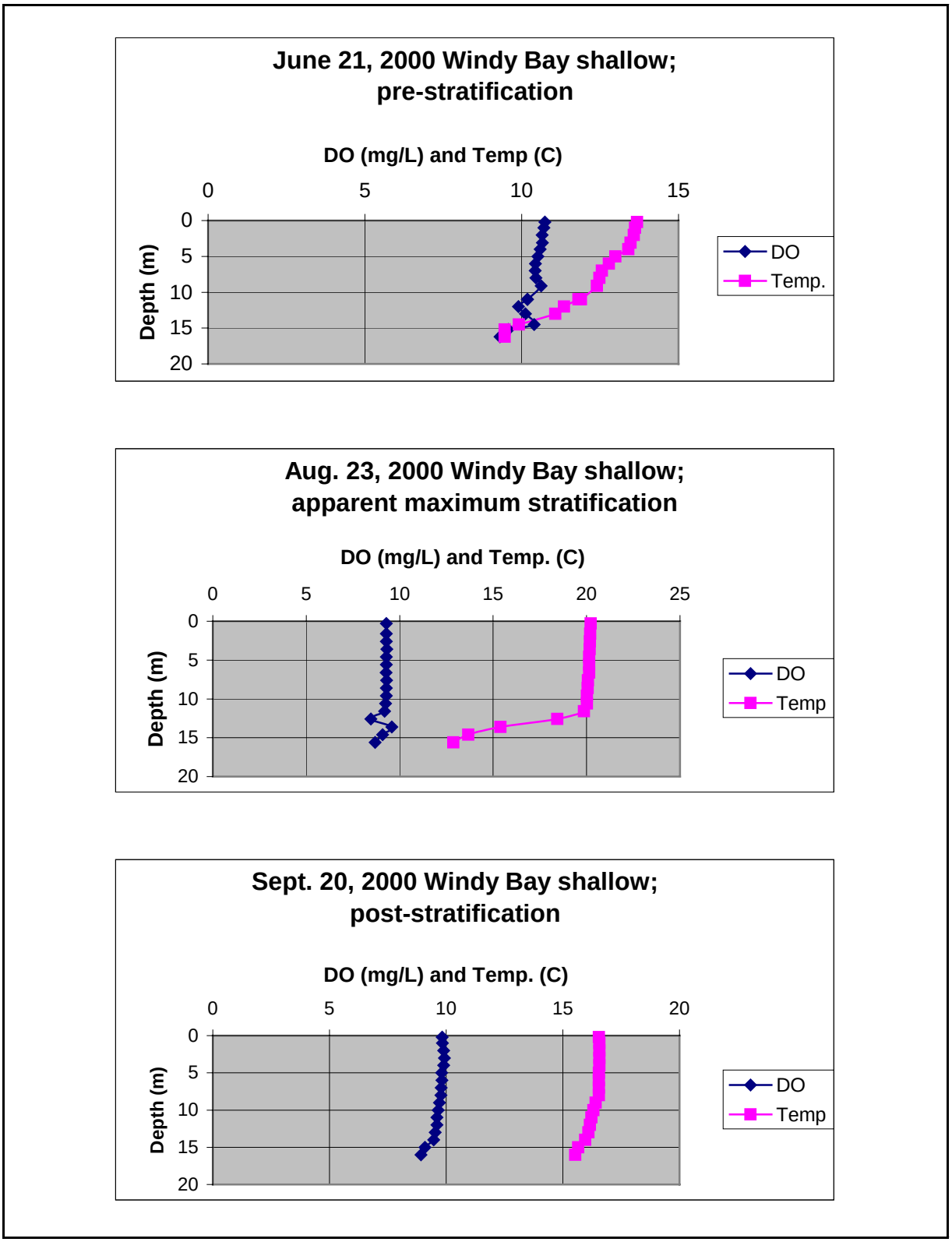


Figure 11. Temperature and Dissolved Oxygen (DO) curves for the 'Windy Bay shallow' lake monitoring site 2000; representing the Shallow Chain Lakes habitat area of Coeur d'Alene Lake.

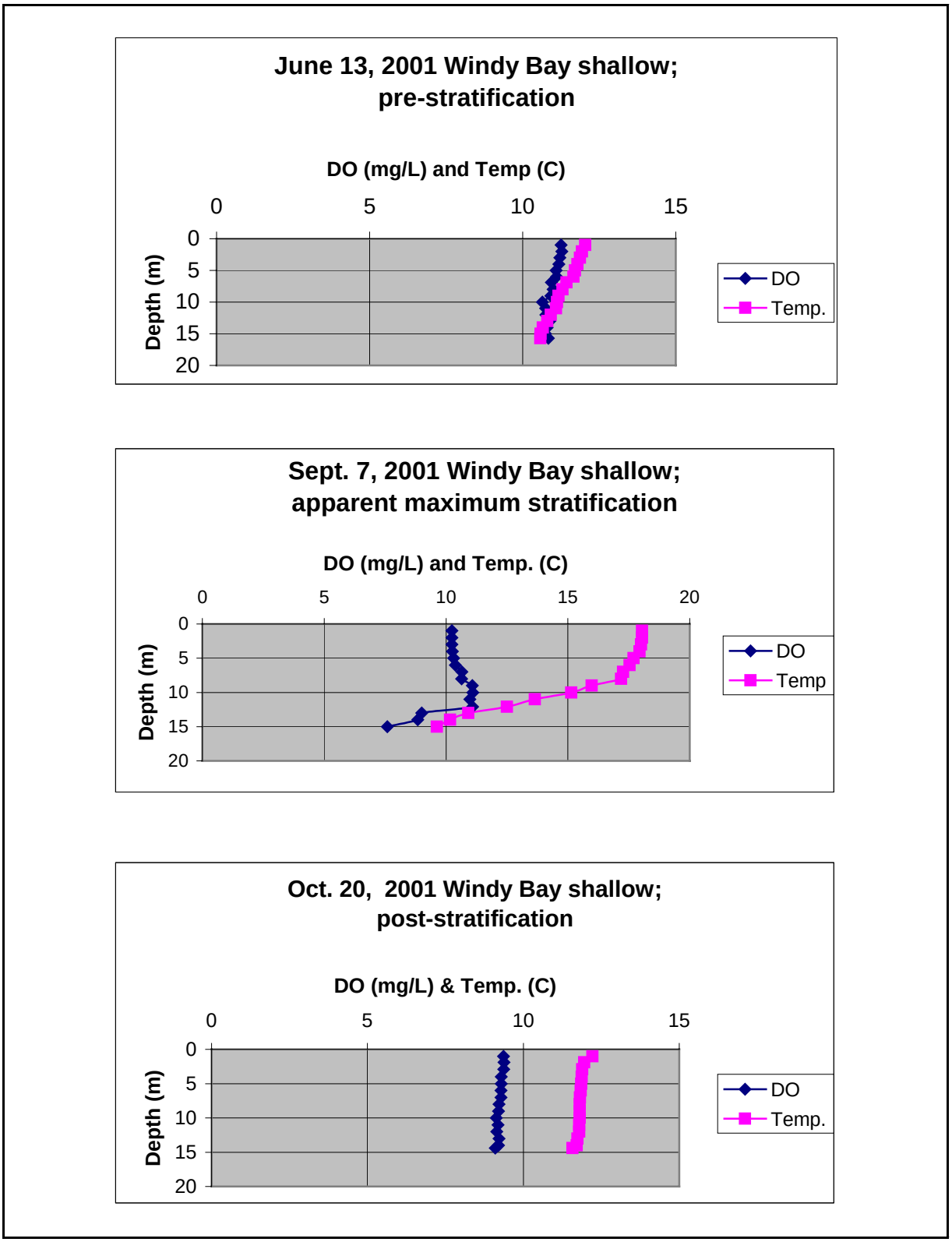


Figure 12. Temperature and Dissolved Oxygen (DO) curves for the 'Windy Bay shallow' lake monitoring site 2001; representing the Shallow Chain Lakes habitat area of Coeur d'Alene Lake.

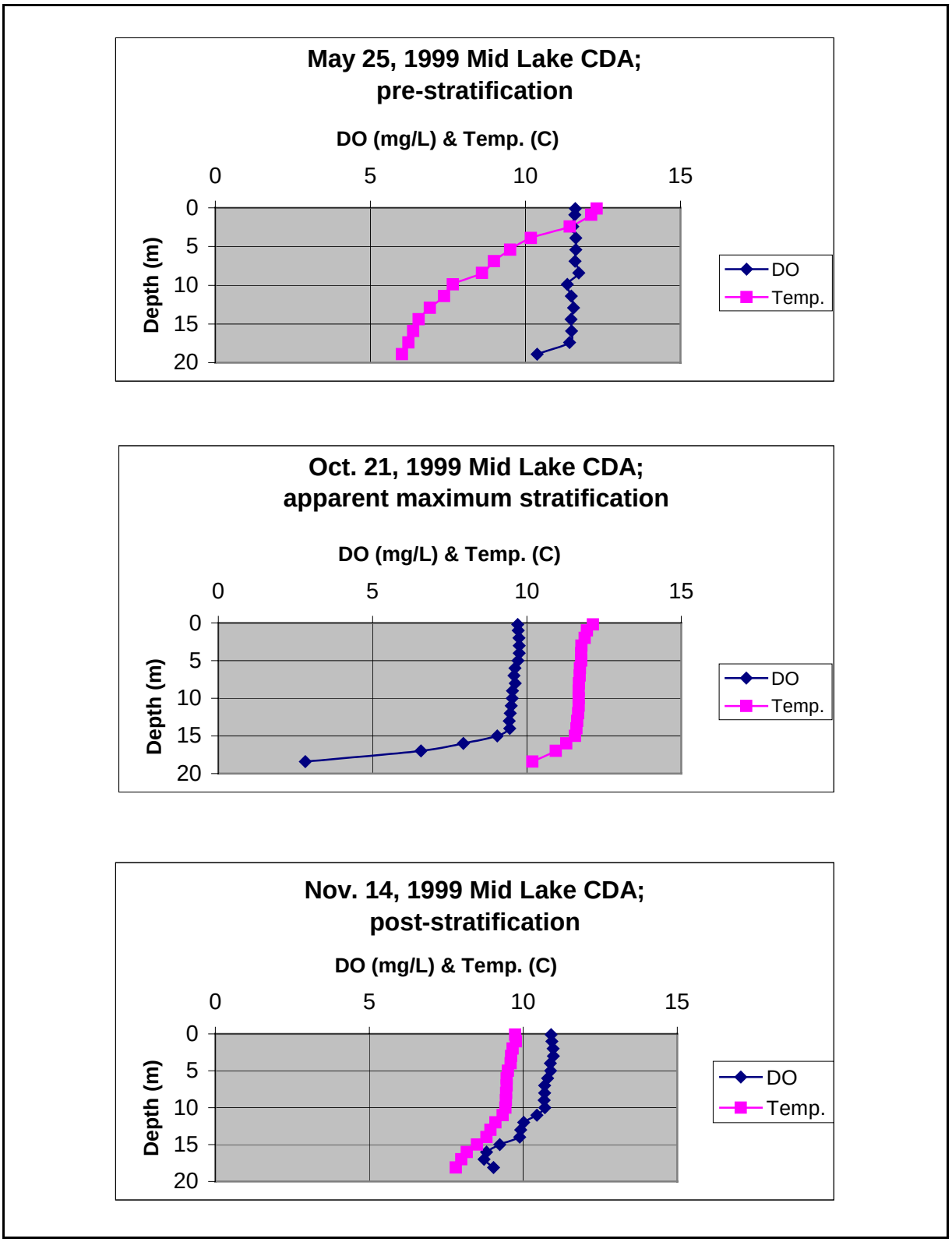


Figure 13. Temperature and Dissolved Oxygen (DO) curves for the 'Mid Lake CDA' lake monitoring site 1999; representing the deep open water habitat area of Coeur d'Alene Lake.

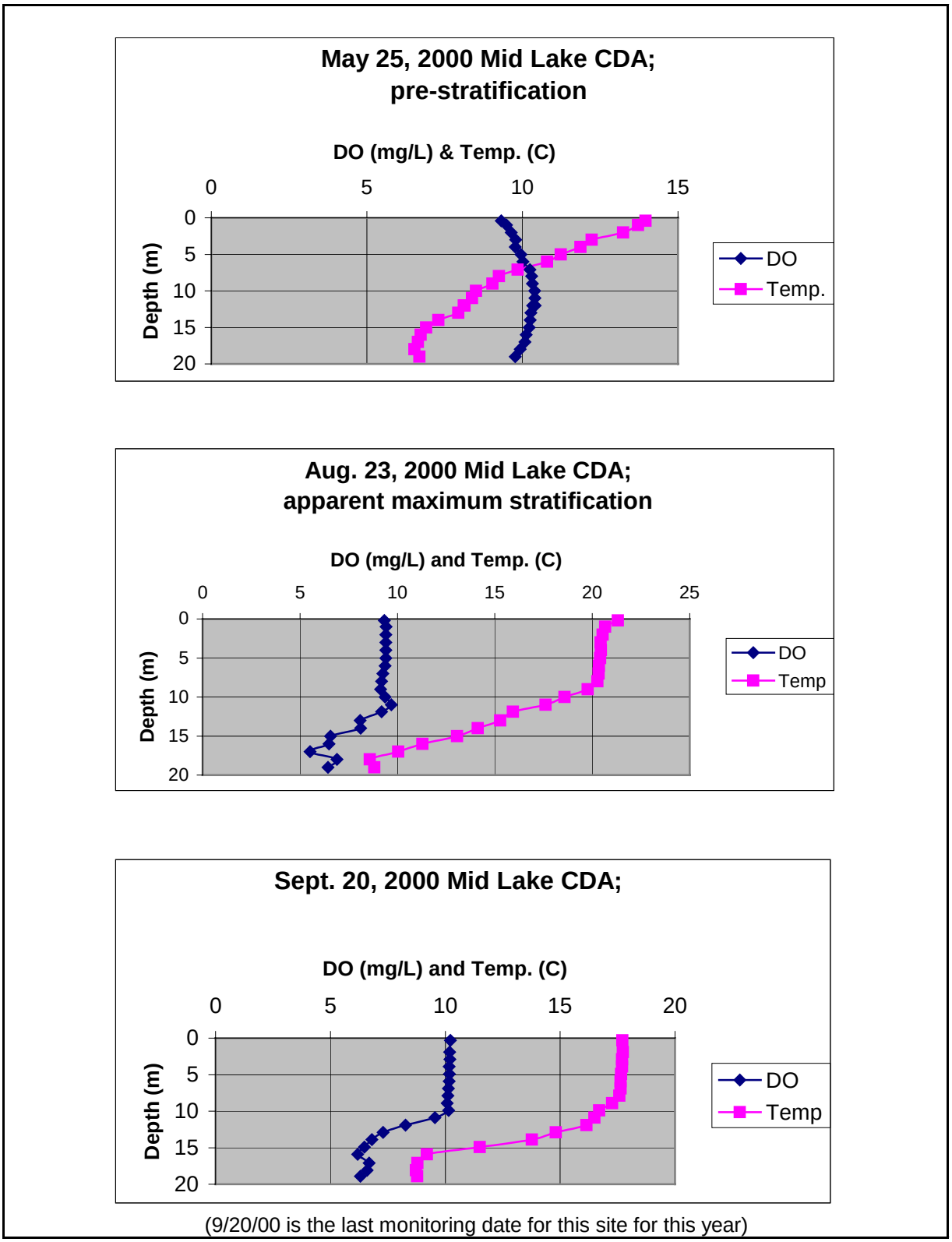
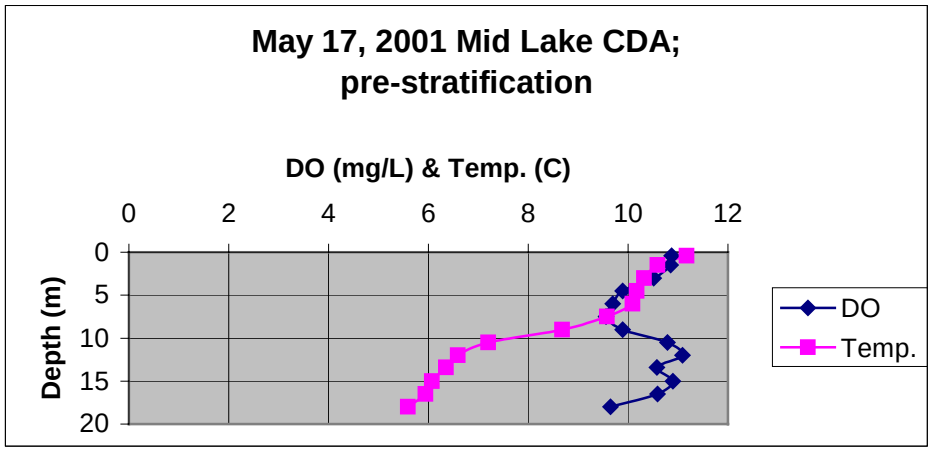
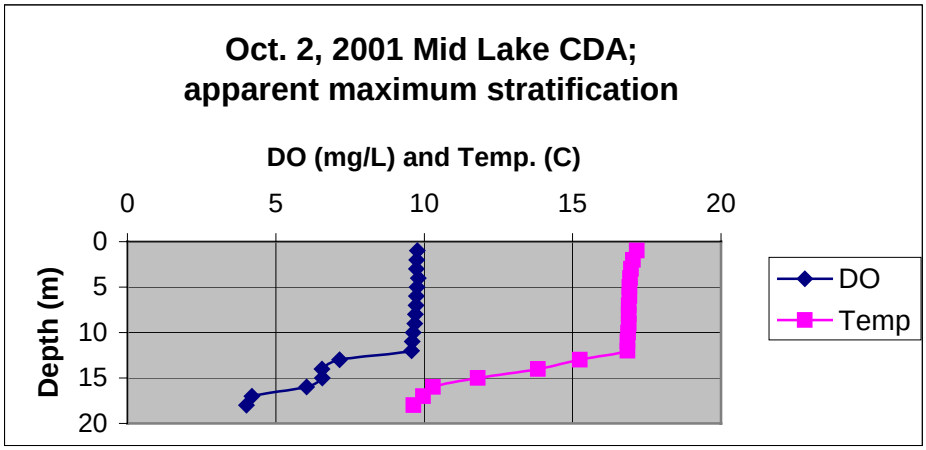
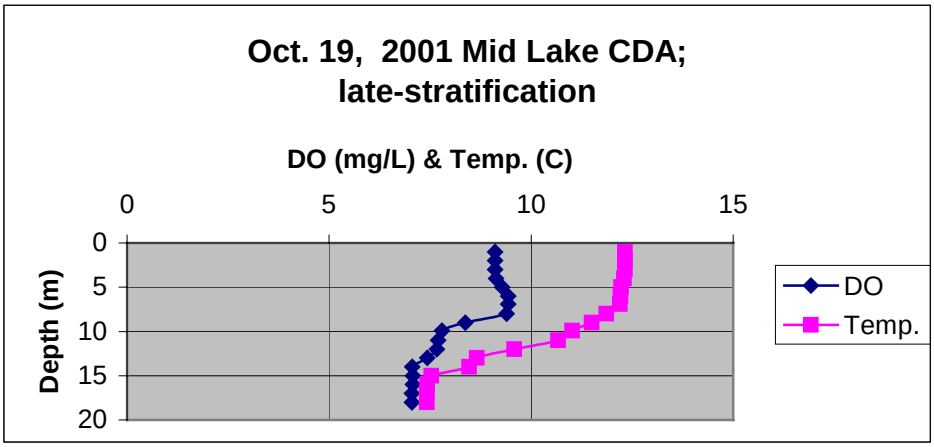


Figure 14. Temperature and Dissolved Oxygen (DO) curves for the 'Mid LakeCDA' lake monitoring site 2000; representing the deep open water habitat area of Coeur d'Alene Lake.



(5/17/01 is the first date monitored at this site for this year)





(10/19/01 is the last date monitored at this site for this year)

Figure 15. Temperature and Dissolved Oxygen (DO) curves for the 'Mid LakeCDA' lake monitoring site 2001; representing the deep open water habitat area of Coeur d'Alene Lake.

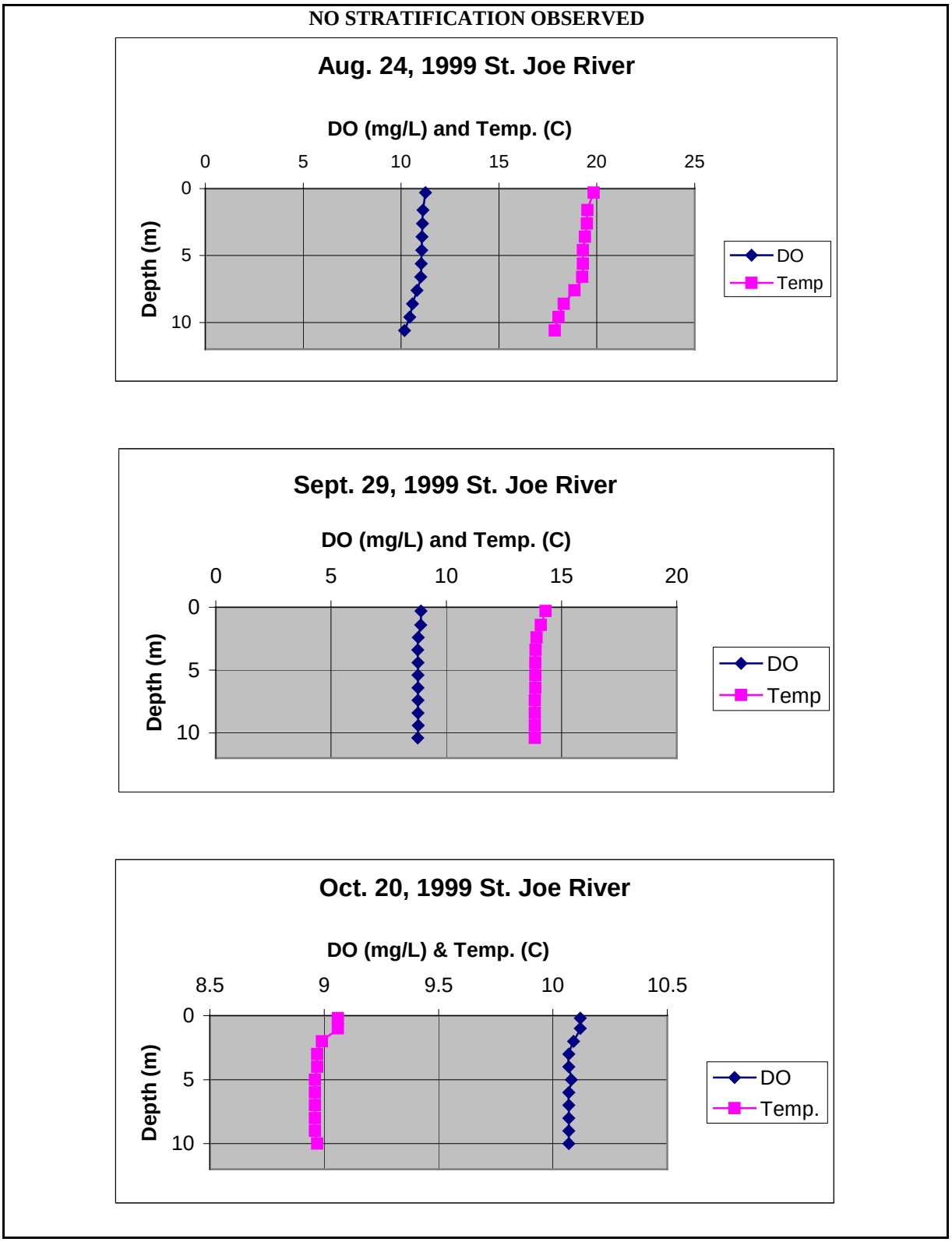


Figure 16. Temperature and Dissolved Oxygen (DO) curves for the 'St. Joe River' lake monitoring site 1999; representing the Rivers habitat area of Coeur d'Alene Lake.

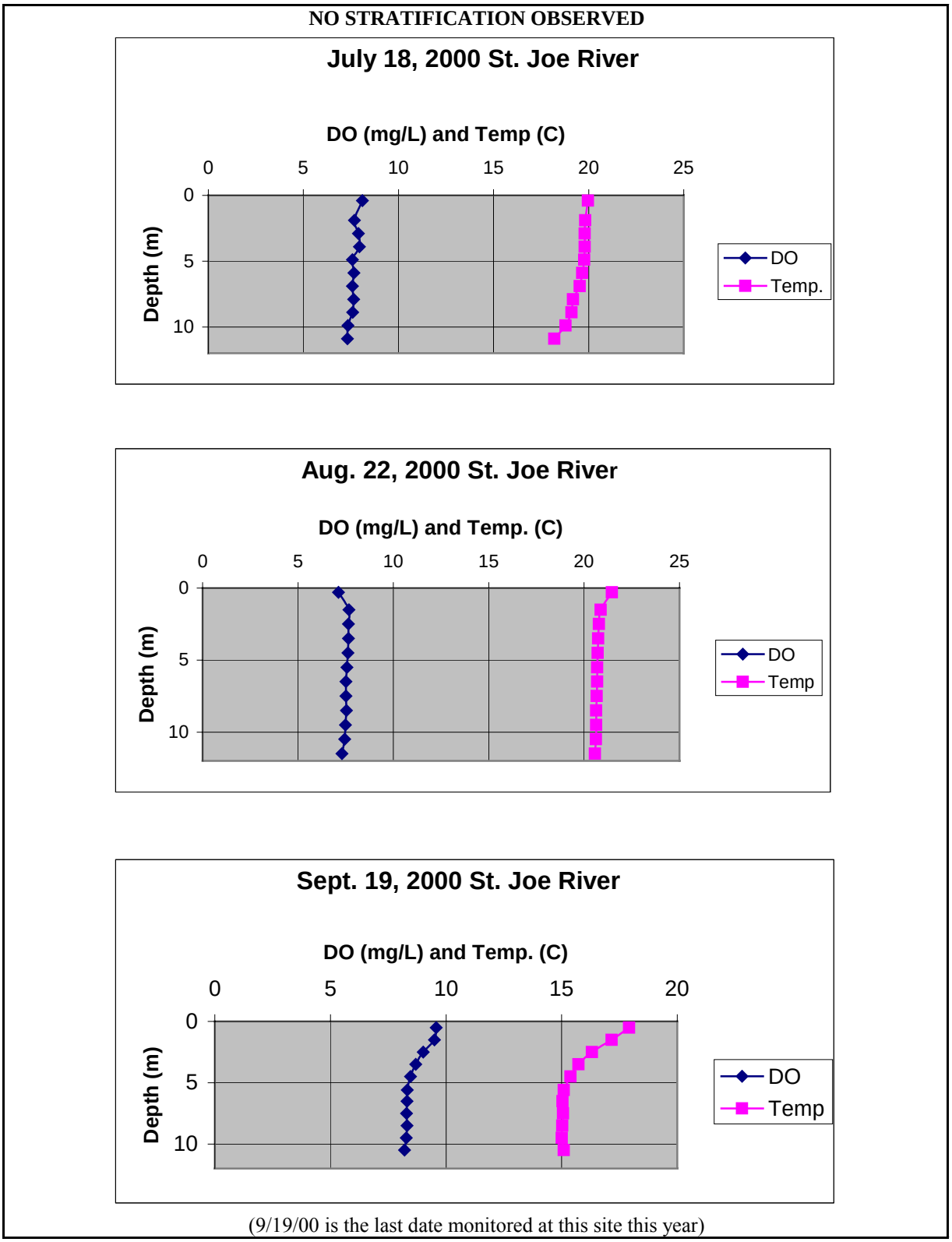


Figure 17. Temperature and Dissolved Oxygen (DO) curves for the 'St. Joe River' lake monitoring site 2000; representing the Rivers habitat area of Coeur d'Alene Lake.

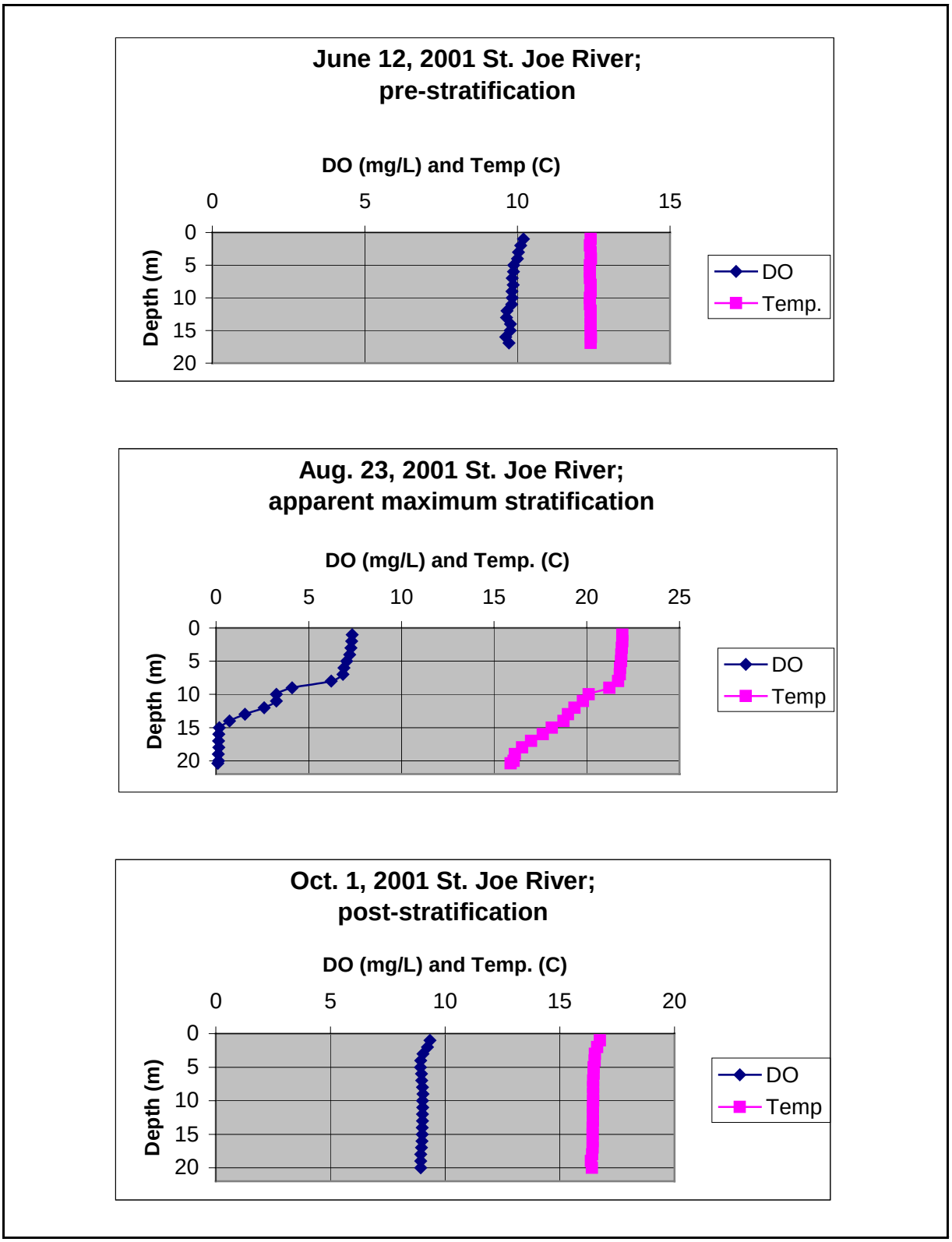


Figure 18. Temperature and Dissolved Oxygen (DO) curves for the 'St. Joe River' lake monitoring site 2001; representing the Rivers habitat area of Coeur d'Alene Lake.

pH

Cutthroat and bull trout have optimum pH limits of 6-8. The pH of Coeur d'Alene Lake does not change very much from season to season or on an annual basis as seen in the summarized data (Appendix A, Table A-4). Typical observed values ranged from 6.6 to 7.8, all within the optimal tolerance limits for cutthroat production. Typically, higher pH values were seen near the lake surface while lower values were seen near the bottom of the monitored sites. The lowest pH seen during this three-year period was 6.1 at the bottom of Benewah Lake in April 2000; the highest pH was 9.4 at the surface of the Chatcolet Lake Shallow site in August 2000. Otherwise the range of pH values seen in 1999 was 6.3 to 9.1 and in 2001 6.3 to 9.2. Thus low pH should not inhibit Cutthroat trout or bull trout growth or survival but high pH may. A simple counting of monitoring sites and dates where pH values of 8.0 or greater were recorded yielded 10 occurrences in 1999, 20 occurrences in 2000 and 25 occurrences in 2001; again most high pH values were recorded near the water surface.

Conductivity

Overall range of lake conductivity values during this reporting period was 10 to 101 µm/cm (Appendix A Table A-5) although the typical range was between 35 and 60 µm/cm which is similar to other surface water systems. Within this range of typical values, the highs were seen during September and October and the lows during May and June. During the first half of 1999 the sites where the highest conductivity levels were measured were Round Lake, Rockford Bay and Windy Bay shallow while the low levels were seen most often at Hidden Lake, Chatcolet Lake and Benewah Lake. After June of 1999 the high conductivity was more often measured in the Coeur d'Alene and St. Joe River stations while the lows were seen at Rockford Bay, Windy Bay shallow and Windy Bay deep. A similar but less pronounced variation was seen in 2000 with the highs shifting from some of the shallow water / shallow bay sites to the river stations after June. The locations where low values were seen showed no apparent consistency, however. In 2001 the shallow bays and Rockford Bay deep showed the high values in May and June but after June highs were seen consistently in the river stations and the shallow water sites (Round Lake and Chatcolet Lake shallow) alike. Low conductivity during late 2001 period was most often measures in the shallow bays samples.

Dissolved Phosphorus

Summarized dissolved ("ortho") phosphorus for "upper" samples (collected at the 1 meter depth) and "lower" (composite sample from below the thermocline) levels for all the lake stations appears in Appendix A (Table A-6). Virtually all results were below the analytical detection limit during this period.

Total Phosphorus

Summarized Total Phosphorus (TP) data for the lake sampling sites appears in Table A-7 in Appendix A. The overall range was from below detection to a single high of 0.171 mg/L. About half of the results were below detection and almost a quarter of the results were above 0.01 mg/L (10 µg/L). It is interesting to note that of the 88 results that were greater than 0.01 mg/L, six were from 1999 samples, 52 were from 2002 samples and 30 were from 2001 samples. TP results greater than 0.01 mg/L were predominant in the shallow chain lakes sites and secondarily in the deep open water sites. Generally speaking, the lowest TP concentrations were seen in the shallow water, the shallow bays and the river sites. While most of the TP greater than 0.01 mg/L

were seen during August and September of the reported years, there were also a series of higher concentrations seen in the 3/22/00 and 5/15/01 samples.

A cursory assessment of the difference between TP levels in the "Upper" and "Lower" sampler was also made. For the dates and sites that had data for both depths, it was found that the "upper" samples had higher TP levels 24% of the time, the "lower" samples had higher TP 26% of the time and the two were the same 50% of the time. Most of the time that "upper" and "lower" results were the same they were both below detection so it cannot be reliably said whether they were actually higher or lower.

Chlorophyll a

Chlorophyll 'a' (CHLa) is an indicator of the primary productivity (algal photosynthesis) taking place in the lake waters. The overall range of CHLa values measured at Tribally monitored lake stations during the reporting period was <0.01 to 16.1 μg/L although the vast majority of analysis results were less than 5 μg/L (see Appendix Table A-8). It is worthy of note that all CHLa results greater than 5 μg/L were found in the shallow chain lakes stations (Hidden Lake, Chatcolet Lake and Benewah Lake) and primarily during the August to October period. 1999 had eight samples that were above 5 μg/L, all but one of which were during this period; 2000 had three samples greater than 5 μg/L, all of which were during this period and 2001 had four samples above 5 μg/L, three of which were during this period.

Chlorophyll 'a' is produced in the lake's epilimnion where energy from the sun is available. As algae mature and scenece they will sink down through the hypolimnion, although the CHLa is rapidly degraded. As a result it is expected that CHLa levels will be greater in the epilimnion than hypolimnion ('Upper' sample results versus 'Lower' sample results in Table A-8). While this is generally seen to be true in the data, there are numerous sample sets ('upper' and 'lower') that did not support this. In fact, out of a total of 22 sample dates during the three year period, 11 had calculated simple means of the lake-wide results that were higher in the 'upper' samples than in the 'lower' samples.

HABITAT SUITABILITY

Overview

A wide range of water quality analyses has been performed by the Tribe to assess the suitability of the Coeur d'Alene Lake habitats for fish (primarily salmonids). The key parameters that could have direct or indirect effects on that suitability are listed in *Table 10* for the two predominant lake habitat areas -- shallow bays and deep, open water. The measured values presented in *Table 10* are the low to high range for each parameter, seen during the 1999 - 2001 period, and are from typical bay and open water sites; ie. Carey Bay and the Mid Lake sites, respectively. Also presented in *Table 10* are reference criteria for optimum health of salmonid fishes.

This analysis leads to the conclusion that most pertinent parameters in Coeur d'Alene Lake are well within the range of healthy, supportive habitat. Included in this list are pH, Conductivity, Total Suspended solids (TSS), Turbidity, Chloride, Fluoride, Nitrate, Nitrite, Sulfate and most metals. The parameters that did not appear to meet the salmonid criteria were DO, Temperature, Aluminum, Selenium and Zinc. Of these, Selenium was consistently below the analytical detection limit (0.08 mg/L) which is, unfortunately, above the reference criteria (0.01 mg/L). It is possible that Selenium is below this criteria. The results for Zinc are also open to question due

to the fact that there are three different criteria listed. Thus if the ADFG (Alaska Department of Fish and Game, 1987) criteria is considered (0.005 mg/L) all measured results exceed the criteria. However, if the Larsen criteria is considered (0.05 mg/L, Piper, 1982) most results would be below the criteria. Aluminum is the one metal that does appear to exceed the stated criteria (0.01 mg/L; ADFG, 1987) although, again, the lower detection limit (0.02 mg/L) is above the criteria. Further research would be required to determine if these metals are actually causing any health stress in Coeur d'Alene Lake.

The two non-supportive parameters, DO and Temperature, do exceed the criteria some of the time (or at some depths) and could cause acute, adverse health effects or habitat avoidance. The fact that these physical parameters are of key importance is well established for salmonids, and for Cutthroat trout in particular. As a result, data for these parameters has been subjected to further analysis in the form of the Habitat Suitability Index (HSI) presented by Hickman & Raleigh (1982).

Habitat Suitability Index

Calculated Cutthroat Trout Habitat Suitability Index parameters and corresponding SI values are shown in Appendix B for maximum temperature, maximum pH and minimum dissolved oxygen for each lake monitoring site and each early May and early August period for 1999 - 2001. The early August period was further divided into apparent stratified layers, when stratification was present.

Table 11 presents summary HSI values calculated using the formula presented by Hickman & Raleigh (1982). From this Table is can be seen that habitat suitability was very good (greater than 0.60) at all sites during the early spring period of each year examined. However, habitat suitability was very poor (less than 0.25) at the Shallow Water sites (Round Lake and Chatcolet Lake Shallow) as well as in the epilimnion of all other sites. This condition is due to high water temperature; any measurement greater than 21 °C produces a Suitability Index value of less than 0.25 and any measurement greater than 22 °C produces a SI of 0.0. A total of 29 early August epilimnion SI values out of 36 were 0.0 due to high temperatures.

Table 10. Range of water quality test results for typical bay and deep-water areas compared to suggested water quality criteria for optimum health of salmonid fishes. Concentrations are in mg/L, Conductivity in ms/cm, pH in pH units, Temperature in degrees Ce

	Optimum Criteria			Measured Values*	
Source	Wedemeyer, 1977 from Piper, 1982	Larsen, H.N. from Piper,1982	ADFG, 1987	Carey Bay	Mid-Lake CDA
Parameters					
pH	---	6.5-8.0	6.5-8.0	6.4 - 8.3	6.2 - 8.1
Conductivity	---	---	---	30.6 - 60.6	28.0 - 61.2
D.O.	---	>5.0	>7.0	4.7 - 12.8	2.76 - 12.8
Temperature	---	---	0-15 C	2.7 - 22.9	2.5 - 23.2
TSS	<80	---	<80.0	<2.0 - 17.5	<2.0 - 7.6
Turbidity	---	<2,000	---	0.31 - 17.4	0.27 - 16.7
Chloride	---	---	<4.0	0.258 - 1.32	0.261 - 1.36
Fluoride	---	---	---	<0.02 - 0.281	<0.020 - 0.261
Nitrate	---	<3.0	<1.0	<0.005 - 0.210	<0.005 - 0.253
Nitrite	<0.06	---	<0.1	All <0.01	All <0.010
Sulfate	---	---	<50.0	0.96 - 5.22	1.10 - 5.41
Aluminum	---	---	<0.01	No data	<0.020 - 0.657
Arsenic	---	---	<0.05	No data	All <0.04
Barium	---	---	<5.0	No data	0.007 - 0.020
Cadmium	<0.0004	---	<0.0005	No data	All <0.005
Chromium	---	---	<0.03	No data	All <0.007
Copper	<0.006	---	<0.006	No data	<0.004 - 0.015
Iron	---	<0.15	<0.1	No data	0.006 - 0.589
Lead	<0.03	---	<0.02	No data	<0.001 - 0.005
Magnesium	---	needed	<15.0	No data	1.04 - 2.00
Manganese	---	<0.01	<0.01	No data	0.001 - 0.976
Mercury	<0.002	---	<0.0002	No data	No data
Nickel	---	---	<0.01	No data	All <0.010
Potassium	---	---	<5.0	No data	0.360 - 1.27
Selenium	---	---	<0.01	No data	All <0.08
Silver	---	---	<0.003	No data	All <0.005
Sodium	---	---	<75.0	No data	1.01 - 2.03
Zinc	<0.03	<0.050	<0.005	No data	0.006-0.093

*overall range from 1999-2001

Table 11. Calculated Habitat Suitability Index (HSI) values for lucustrine Cutthroat Trout at Coeur d'Alene Lake monitoring sites during stratified and unstratified conditions, 1999-2001.

	1999			2000			2001		
LAKE SITES	DEPTHS	May **HSI**	Aug. **HSI**	DEPTHS	May **HSI**	Aug. **HSI**	DEPTHS	May **HSI**	Aug. **HSI**
09 Round Lake	0 - bot.	**0.93**	**0.00**	0 - bot.	**0.97**	**0.00**	0 - bot.	**0.98**	**0.00**
11 Chatcolet Lake shallow	0 - bot.	**0.91**	**0.00**	0 - bot.	**0.95**	**0.00**	0 - bot.	**0.98**	**0.00**
01 Rockford Bay	0 - 9 m	**0.97**	**0.00**	0 - 9 m	**0.99**	**0.00**	0 - bot.	**0.96**	**0.34**
	9 - 12 m		**0.79**	9 - 12 m		**0.84**			
	12 - bot.		**1.00**	12 - bot.		**1.00**			
02 Windy Bay shallow	0 - 9 m	**0.94**	**0.00**	0 - 7 m	**0.98**	**0.00**	0 - bot.	**0.94**	**0.45**
	9 - 12 m		**0.89**	7 - 10 m		**0.46**			
	12 - bot.		**0.97**	10 - bot.		**0.91**			
06 Carey Bay	0 - 9 m	**0.98**	**0.46**	0 - 4 m	**1.00**	**0.00**	0 - bot.	**1.00**	**0.00**
	9 - 12 m		**0.99**	4 - 7 m		**0.46**			
	12 - bot.		**1.00**	7 - bot.		**0.56**			
03 Windy Bay deep	0 - 9 m	**0.95**	**0.00**	0 - 7 m	**0.99**	**0.00**	0 - 12 m	**0.94**	**0.37**
	9 - 12 m		**0.97**	7 - 16 m		**0.62**	12 - 22 m		**0.75**
	12 - bot.		**1.00**	16 - bot.		**0.97**	22 - bot.		**0.97**
05 Mid Lake Coeur d'Alene	0 - 12 m	**0.98**	**0.00**	0 - 7 m	**0.99**	**0.00**	0 - 12 m	**1.00**	**0.00**
	12 - 14 m		**0.99**	7 - 12 m		**0.87**	12 - 15 m		**1.00**
	14 - bot.		**0.99**	12 - bot.		**0.98**	15 - bot.		**0.99**
07 Conkling Park	0 - 5 m	**0.97**	**0.37**	0 - 7 m	**0.99**	**0.00**	0 - 13 m	**0.99**	**0.00**
	5 - 7 m		**0.82**	7 - 12 m		**0.82**	13 - bot.		**0.91**
	7 - bot.		**0.28**	12 - bot.		**0.74**			
08 Hidden Lake	0 - 3 m	**0.98**	**0.00**	0 - 4 m	**0.98**	**0.00**	0 - bot.	**0.99**	**0.00**
	3 - 6 m		**0.82**	4 - 7 m		**0.23**			
	6 - bot.		**0.00**	7 - bot.		**0.00**			
10 Chatcolet Lake deep	0 - 5 m	**0.95**	**0.00**	0 - 4 m	**0.99**	**0.00**	0 - 6 m	**0.99**	**0.00**
	5 - 8 m		**0.00**	4 -8 m		**0.79**	6 - 10 m		**0.00**
	8 - bot.		**0.00**	8 - bot.		**1.00**	10 - bot.		**0.00**
12 Benewah Lake	0 - 3 m	**1.00**	**0.00**	0 - 3.5 m	**1.00**	**0.00**	0 - bot.	**0.97**	**0.00**
	3 - bot.		**0.00**	3.5 - bot.		**0.00**			
04 Coeur d'Alene River	0 - 6 m	**0.93**	**0.00**	0 - 7 m	**0.99**	**0.00**	0 - bot.	**1.00**	**0.00**
	6 - 9 m		**0.81**	7 - 10 m		**0.70**			
	9 - bot.		**1.00**	10 - bot.		**0.97**			
13 St. Joe River	0 - 3 m	**0.90**	**0.00**	0 - 10 m	**0.93**	**0.00**	0 - bot.	**0.98**	**0.00**
	3 - 5 m		**0.45**	10 - bot.		**0.00**			
	5 - bot.		**0.46**						

Table 11 also indicates that HSI was very poor in the metalimnion and hypolimnion of the three Shallow Chain Lakes sites (Hidden Lake, Chatcolet Lake Deep and Benewah Lake) and in the St. Joe River. These conditions were caused by low dissolved oxygen. In waters that are less than or equal to 15 °C a DO less than 7.0 will produce a SI of 0.0 and in waters that are greater than 15 °C a DO less than 9.0 does the same. As indicated above, the three Shallow Chain Lakes sites had numerous days each summer period with DO levels well below 7.0 mg/L.

The metalimnion and hypolimnion of the stratified deeper water areas, both Deep Open Water sites and the Shallow Bays sites, showed high HSI values for Cutthroat trout. It should be noted that pH was not a significant parameter in this HIS analysis; in all but three isolated instances pH was in the range providing very good Suitability Index values.

LAKE FISHERIES

Fish Population Sampling

There are 21 identified species of fish present in Coeur d'Alene Lake. These species and the Species Codes used in the following discussion appear in *Table 12*.

Table 12. Fish species found in Coeur d'Alene Lake and Species codes.

Species	**Species Code**
Brown / Black Bullhead	BBH
Black Crappie	BC
Bull Trout	BLT
Channel Catfish	CCF
Chinook Salmon	CHN
Cutthroat Trout	CTT
Kokanee	KOK
Largemouth Bass	LMB
Large Scale / Long Nose Sucker	LSS
Mountain White Fish	MWF
Northern Pike	PIK
Pumpkin Seed Sunfish	PSS
Rainbow Trout	RBT
Sculpin	SCP
Smallmouth Bass	SMB
Northern pikeminnow	SQW
Tench	TCH
Yellow Perch	YP
Red Sided Shinner	RSS

For the years 1994-96 the CDA Fisheries Program contracted with the Spokane Tribe for the use of a research vessel to be used for fish collection. In 1997 the Program purchased their own research vessel. The fish capture effectiveness of the new vessel shows in the years 1997-01. In

1999, due to the high numbers of fish being caught and fish stress concerns, the sampling time was reduced by half. This reduction in sampling effort shows in years 1999-01. *Figure 19* provides a comparison of the three years of fish collection and the relative total numbers captured by each sampling method.

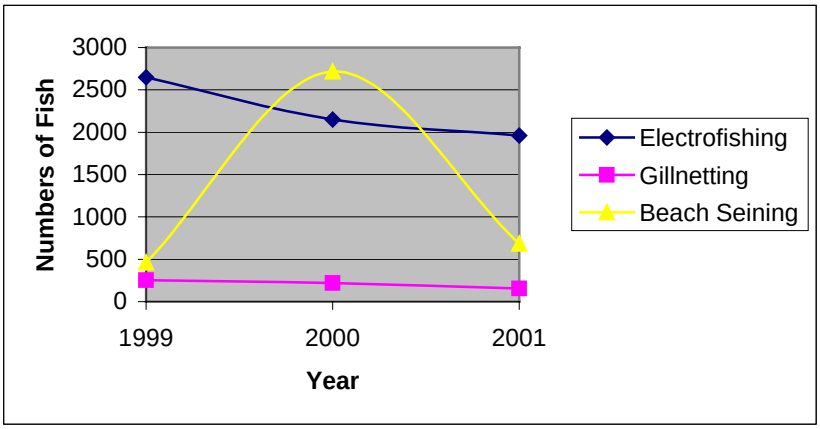


Figure 19. Total numbers of lake fish collected in 1999, 2000 and 2001 by the Coeur d'Alene Tribe using electrofishing, gillnetting and beach seining.

In 1999, a total of 2,649 fish were sampled using electroshocking methods (see *Table 13*). No bull trout were sampled by this method. While no one species occupied more than 20% of the year's catch, four predominant species each occupied approximately 15% of the electroshocked sample: Pumpkin Seed Sunfish (487 individuals), Large Scale Sucker (438), Black Bullhead (412) and Yellow Perch (397). A total of 254 fish were sampled with the gill nets, including one bull trout which was collected near Spokane Point (Transect 8; see *Figure 3*). The bull trout had a length of 591 mm and weighed 1,871 g; it was sampled 0.6 m from the bottom in a 0.06 m mesh vertical net. It was a five-year-old fish that was tagged and released back into Coeur d'Alene Lake. During the month of September the Coeur d'Alene Fisheries Program implemented beach seining on Coeur d'Alene Lake. This year Yellow Perch accounted for 35% of the gill net catch (90 individuals), Large Scale Suckers for 25% (64) and Squawfish for 24% (60). A total of 461 fish were sampled by beach seining, including 262 Pumpkin Seed Sunfish (57% of the catch) and 93 Bullhead (20%). There were no bull trout sampled by this method.

In 2000, a total of 2,148 fish were sampled using electroshocking methods (see *Table 14*). Of this total catch, 21% (441 individuals) were Yellow Perch, 16% (351) were Black Crappie and 15% (313) were Bullhead. A a total of 220 fish were sampled with the gill nets, including 33% (72) Yellow Perch, 29% (64) Squawfish and 24% (52) Suckers. Beach seining resulted in 2,716 fish sampled. There were no bull trout sampled in 2000 using any of the three fish sampling methods.

Fish sampling in 2001 collected 1,970 fish by electrofishing, 155 fish by gill netting and 682 fish by beach seining (*Table 15*). Electrofishing netted 21% (417 individuals) Yellow Perch and 21% (409) Bullhead; gill netting captured 35% (54) Squawfish and 27% (42) Large Scale Suckers. Beach seining collected 37% (254) Black Crappie and 21% (146) Perch. No Bull Trout were collected by any method during 2001.

Table 13. Relative abundance of fishes captured in Coeur d'Alene Lake using electroshocking, gillnetting and beach seining methods, 1999.

Species	Electroshocking (n=2649)	Species	Gillnetting (n=254)	Species	Beach Seining (n=461)
PSS	18.38% (487)	YP	35.43% (90)	PSS	56.83% (262)
LSS	16.53% (438)	LSS	25.20%(64)	BBH	20.17% (93)
BBH	15.55% (412)	SQW	23.62% (60)	LMB	14.09% (65)
YP	14.99% (397)	KOK	3.54% (9)	BC	5.20% (24)
LMB	12.84% (340)	PIK	3.15% (8)	YP	3.37% (14)
BC	11.82% (314)	CHN	2.36% (6)	LSS	0.43% (2)
SQW	4.76% (126)	BC	1.57% (4)	SQW	0.21% (1)
TCH	3.47% (92)	BBH	1.57% (4)		
PIK	0.60% (16)	CTT	1.57% (4)		
CTT	0.38% (10)	TCH	1.57% (4)		
CHN	0.23% (6)	BLT	0.39% (1)		
SMB	0.23% (6)				
MWF	0.11% (3)				
KOK	0.04% (1)				
SCP	0.04% (1)				

Table 14. Relative abundance of fishes captured in Coeur d'Alene Lake using electroshocking, gillnetting and beach seining methods, 2000.

Species	Electroshocking (n=2148)	Species	Gillnetting (n=220)	Species	Beach Seining (n=2716)
YP	20.53% (441)	YP	32.73% (72)	YP	36.89% (1002)
BC	16.34% (351)	SQW	29.09% (64)	BC	34.43% (935)
BBH	14.57% (313)	LSS	23.64% (52)	PSS	13.73% (373)
LSS	13.27% (285)	BBH	7.73% (17)	BBH	5.6% (152)
LMB	11.79% (253)	BC	2.27% (5)	LMB	2.39% (65)
PSS	8.43% (181)	PIK	2.27% (5)	CTT	2.25% (61)
SQW	6.38% (137)	KOK	1.36% (3)	SQW	2.21% (60)
TCH	4.33% (93)	TCH	0.45% (1)	KOK	0.85% (23)
CTT	2.14% (46)	CHN	0.45% (1)	LSS	0.70% (19)
SMB	1.35% (29)			SMB	0.48% (13)
CHN	0.37% (8)			TCH	0.29% (8)
PIK	0.37% (8)			CHN	0.074% (2)
SCP	0.093% (2)			PIK	0.074% (2)
KOK	0.047% (1)			SCP	0.037% (1)

Table 15. Relative abundance of fishes captured in Coeur d'Alene Lake using electroshocking, gillnetting and beach seining methods, 2001.

Species	Electroshocking (n=1970)	Species	Gillnetting (n=155)	Species	Beach Seining (n=682)
YP	21.17% (417)	SQW	34.84% (54)	BC	37.24% (254)
BBH	20.76% (409)	LSS	27.10% (42)	YP	21.41% (146)
LSS	15.53% (306)	YP	12.90% (20)	CHN	15.98% (109)
BC	14.48% (284)	TCH	8.39% (13)	LMB	10.18% (67)
LMB	10.46% (206)	BC	7.74% (12)	CTT	4.40% (30)
PSS	5.48% (108)	PIK	4.52% (7)	BBH	3.52% (24)
SMB	5.74% 113)	CTT	1.33% (2)	PSS	3.37% (23)
SQW	3.47% (68)	KOK	0.67% (2)	SQW	1.61% (11)
TCH	1.83% (36)	CHN	0.645% (1)	KOK	1.47% (10)
CTT	0.91% (18)	BBH	0.645% (1)	LSS	0.587% (4)
CHN	0.102% (2)	SMB	0.645% (1)	TCH	0.440% (3)
PIK	0.102% (2)			SMB	0.147% (1)
MWF	0.059% (1)				

Catch per Unit Effort

During the 1999 sampling season, total electrofishing "shock" time was 11.15 hours, in 2000 this was 16.17 hours and in 2001, 9.98 hours. In comparison, total gill netting time (referred to as "soak time") in 1999 was 327 hours, 464 hours in 2000 and 357 hours in 2001. Beach seining in 1999 was performed for 1.33 hours (referred to as total set time), with 28.31 hours in 2000 and 16.32 hours in 2001. (Note that the beach seining set times were based on an estimate of 20 minutes (0.333 hours) per set since actual set times were not recorded.) These total shock, soak or set times were used to generate the catch-per-unit-effort (CPUE) values shown in *Table 16*. All CPUE values are reported as number of individuals of a species per hour of effort.

Following the relative abundance discussion, above, the four predominant species electroshocked in 1999 represent CPUE's of 43.68 for Pumpkinseed Sunfish, 39.28 for Large Scale Sucker, 36.95 for Black Bullhead and 35.61 for Yellow Perch. By comparison the top three species gill netted had CPUE's of 0.25 for Yellow Perch, 0.18 for Sucker and 0.17 for Squawfish. The top three captured by beach seining had CPUE's of 196.70 for Sunfish, 69.82 for Crappie and 48.80 for Largemouth Bass. CPUE's for the Cutthroat Trout collected in 1999 were 0.90 for electroshocking and 0.01 for gill netting. There were no Cutthroat caught by beach seineing in 1999.

The predominant fish species electroshocked in 2000 yielded the following CPUE's: 27.28 for Perch, 21.71 for Black Crappie and 19.36 for Bullhead. Gill netting during the same period yielded 0.16 for Perch, 0.14 for Squawfish and 0.11 for Sucker. Beach seining results were similar to the electrofishing with 35.40 foor Perch, 33.03 for Crappie and 13.18 for Sunfish. The CPUE for electrofished and beach seined Cutthroat in 2000 were the highest of the three-year period, 2.85 and 2.16, respectively. No Cutthroat were collected by gill netting that year.

Table 16. Calculated Catch per unit effort (CPUE) for Coeur d'Alene Tribe lake fish population sampling using electrofishing, gill netting and beach seining, 1999-2001.

ELECTROFISHING:

1999 (Total shock time = 11.15 hours)			**2000** (Total shock time = 16.17 hours)			**2001** (Total shock time = 9.98 hours)		
Species	(n=2,649)	Fish/Hour	Species	(n=2,148)	Fish/Hour	Species	(n=1,970)	Fish/Hour
PSS	487	43.68	YP	441	27.28	YP	417	41.77
LSS	438	39.28	BC	351	21.71	BBH	409	40.97
BBH	412	36.95	BBH	313	19.36	LSS	306	30.65
YP	397	35.61	LSS	285	17.63	BC	284	28.45
LMB	340	30.49	LMB	253	15.65	LMB	206	20.63
BC	314	28.16	PSS	181	11.20	SMB	113	11.32
SQW	126	11.30	SQW	137	8.47	PSS	108	10.82
TCH	92	8.25	TCH	93	5.75	SQW	68	6.81
PIK	16	1.43	CTT	46	2.85	TCH	36	3.61
CTT	10	0.90	SMB	29	1.79	CTT	18	1.80
CHN	6	0.54	CHN	8	0.49	CHN	2	0.20
SMB	6	0.54	PIK	8	0.49	PIK	2	0.20
MWF	3	0.27	SCP	2	0.12	MWF	1	0.10
KOK	1	0.09	KOK	1	0.06			
SCP	1	0.09						

GILL NETTING:

1999 (Total soak time = 327 hours)			**2000** (Total soak time = 464 hours)			**2001** (Total soak time = 357 hours)		
Species	n=254	Fish/Hour	Species	(n=220)	Fish/Hour	Species	(n=155)	Fish/Hour
YP	90	0.275	YP	72	0.155	SQW	54	0.151
LSS	64	0.196	SQW	64	0.138	LSS	42	0.118
SQW	60	0.183	LSS	52	0.112	YP	20	0.056
KOK	9	0.028	BBH	17	0.037	TCH	13	0.036
PIK	8	0.024	PIK	5	0.011	BC	12	0.034
CHN	6	0.018	BC	5	0.011	PIK	7	0.020
BBH	4	0.012	KOK	3	0.006	CTT	2	0.006
BC	4	0.012	TCH	1	0.002	KOK	2	0.006
CTT	4	0.012	CHN	1	0.002	BBH	1	0.003
TCH	4	0.012				CHN	1	0.003
BLT	1	0.003				SMB	1	0.003

BEACH SEINING

1999 (Total set time = 1.33 hours)			**2000** (Total set time = 28.31 hours)			**2001** (Total set time = 16.32 hours)		
Species	(n = 461)	Fish/Hour	Species	(n = 2,716)	Fish/Hour	Species	(n = 682)	Fish/Hour
PSS	262	196.70	YP	1002	35.40	BC	254	15.57
BC	93	69.82	BC	935	33.03	YP	146	8.95
LMB	65	48.80	PSS	373	13.18	CHN	109	6.68
BBH	24	18.02	BBH	152	5.37	LMB	67	4.11
YP	14	10.51	LMB	65	2.30	CTT	30	1.84
LSS	2	1.50	CTT	61	2.16	BBH	24	1.47
SQW	1	0.75	SQW	60	2.12	PSS	23	1.41
			KOK	23	0.81	SQW	11	0.67
			LSS	19	0.67	KOK	10	0.61
			SMB	13	0.46	LSS	4	0.25
			TCH	8	0.28	TCH	3	0.18
			CHN	2	0.07	SMB	1	0.06
			PIK	2	0.07			
			SCP	1	0.04			

In 2001 the predominant electroshocked species and their respective CPUE's were Perch, 41.77; Bullhead 40.97 and Sucker, 30.45. These CPUE's are very similar to the values for the top three species collected by electroshocking in 1999, although the species are not the same. The CPUE's for the top three species were noticeably lower in 2000. The 2001 gill netting CPUE results were 0.15 for Squawfish, 0.12 for Sucker and 0.06 for Perch. Beach seining CPUE's for 2001 were 15.57 for Crappie, 8.95 for Perch and 6.68 for Chinook Salmon (which are infrequently caught by any method). Cutthroat Trout CPUE's in 2001 were 1.80 for electroshocking, 0.006 for gill netting and 1.84 for Cutthroat Trout.

In addition to the CPUE analysis, beach seining data were also used to calculate actual density of collected fish species, since the area seined was consistent and was based on the length of the net (200 feet). The deployed net was typically a semicircle with both ends of the net on the shore, with the resultant area being 6,366 square feet. Thus the total area seined was determined by the number of sets multiplied by the assumed area of a set.

In 1999 the most numerous species captured in the beach seine were Pumpkinseed Sunfish (262 individuals), Black Crappie (93) and Largemouth Bass (48.80). These numbers correspond to densities of 11.07, 3.93 and 2.75 fish per 100 m^2, respectively. These were the highest densities seen during this three-year period. The predominant species captured in 2000 and their respective numbers and densities were Perch (1,002 count, 1.99 density per 100 m^2) , Crappie (935 count, 1.86 density) and Sunfish (373 count, 0.74 density). In 2001 the three most numerous species captured in the beach seines were Black Crappie (254), Yellow Perch (146) and Chinook Salmon (109). These numbers relate to densities of 0.88, 0.50 and 0.38, respectively.

Table 17. Calculated fish density for Coeur d'Alene Tribe lake fish population sampling using beach seining, 1999-2001.

BEACH SEINING

1999			**2000**			**2001**		
(Number of sets = 4)			**(Number of sets = 85)**			**(Number of sets = 49)**		
Species	**Number**	**Density***	**Species**	**Number**	**Density***	**Species**	**Number**	**Density***
PSS	262	11.07	YP	1002	1.99	BC	254	0.88
BC	93	3.93	BC	935	1.86	YP	146	0.50
LMB	65	2.75	PSS	373	0.74	CHN	109	0.38
BBH	24	1.01	BBH	152	0.30	LMB	67	0.23
YP	14	0.59	LMB	65	0.13	CTT	30	0.10
LSS	2	0.08	CTT	61	0.12	BBH	24	0.08
SQW	1	0.04	SQW	60	0.12	PSS	23	0.08
Total =	461		KOK	23	0.05	SQW	11	0.04
			LSS	19	0.04	KOK	10	0.03
			SMB	13	0.03	LSS	4	0.01
			TCH	8	0.02	TCH	3	0.01
* Density in (#/100 sq. meters)			CHN	2	0.00	SMB	1	0.00
			PIK	2	0.00	Total =	682	
			SCP	1	0.00			
			Total =	2,716				

Cutthroat Trout Age Analysis

A large number of fish scale samples were collected during the 1999-2001 period and scale reading to determine fish ages had not been completed at the time of this writing. Only cutthroat trout scales from 1999 have been read to date. The results of this limited analysis are shown in *Figures 20 and 21;* the Cutthroat age-length and age-weight regressions. While based on a small number of scales (11 total fish; three age 4+, four age 5+, two age 6+ and one each age 7+ and 8+), it can be seen from these graphs, that the age-length relationship is very good ($R^2 = 0.976$)

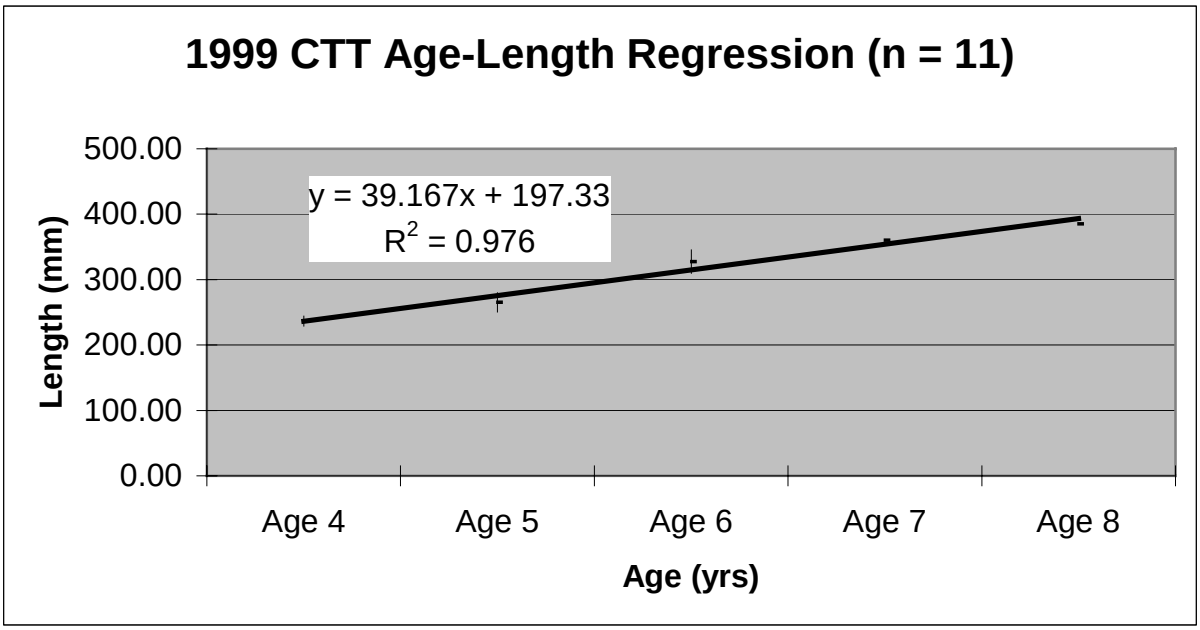


Figure 20. Age-Length analysis of Coeur d'Alene Tribe captured lake Cutthroat Trout for 1999.

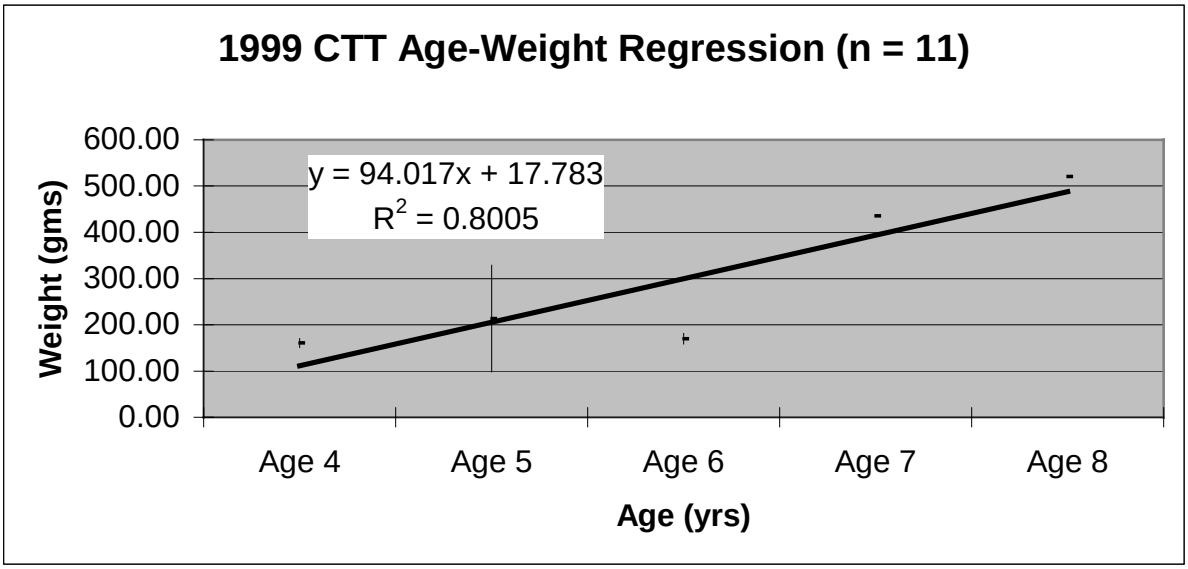


Figure 21. Age-Weight analysis of Coeur d'Alene Tribe captured lake Cutthroat Trout for 1999.

while the age-weight relationship is somewhat less linear (R^2 = 0.801). These results are consistent with results from 1998 while in 1997 the age-weight regression was actually higher than the age-length, R^2 = 0.928 and 0.913, respectively.

Lake Mark-Recapture Study Results, 1994 - 2001

Since 1994 the Coeur d'Alene Tribe's Fisheries Program has conducted a limited mark-recapture study. This study relies heavily on the effectiveness of the fish sampling program and on angler's participation. To date 889 fish have been captured and tagged and there have been 53 recaptures between the Fisheries Program and anglers. Anglers have harvested 47 tagged fish.

Eleven out of the 21 species of fish found in Coeur d'Alene Lake have been tagged. It is likely that the tag return results are biased because not all anglers report their catch, tags can be removed by anglers and they can fall out. During the 1999 and 2001 field season all game fish that were 300 mm or more in length and 300 g or more in weight received a floy tag. Through the mark-recapture study we are finding that northern pike have a tendency to migrate from the original sampling site and largemouth bass are very territorial, rarely moving from the site where they were tagged. Apparent exceptions occur when anglers transport fish large distances in boat holding tanks and release them far from the original catch area. *Table 18* provides a summary of the total fish that were captured and tagged during the years 1994 through 2001.

Table 18. Total Coeur d'Alene fish captured and tagged by the Coeur d'Alene Tribe, 1994 - 2001.

	Fish Species Code													
Year	**LMB**	**SMB**	**PIK**	**CTT**	**BLT**	**KOK**	**RBT**	**SQW**	**CHN**	**CCF**	**MWF**	**BC**	**YP**	**Totals**
1994	44+**1**	0	2	8	0	0	0	1	1	8	0	2	0	**67**
1995	36	0	1	9	0	1	0	0	0	0	1	1	0	**49**
1996	18	0	2	1+**1**	0	0	0	0	0	**1**	0	0	1	**24**
1997	169	0	21	20+**1**	0	0	1	0	0	4+**4**	0	0	0	**220**
1998	256	1	33+**4**	3	0	0	0	0	0	4	0	1	0	**302**
1999	73	0	14	10+**1**	**1**	0	0	0	1	0	0	0	0	**100**
2000	58	1	5	1	0	0	1	1	0	0	1	0	1	**69**
2001	55	1	0	1	0	0	0	0	0	0	0	0	1	**58**
Totals	**710**	**3**	**82**	**56**	**1**	**1**	**2**	**2**	**2**	**21**	**2**	**4**	**3**	**889**

Tagged fish captured by electroshocking = 875

Tagged fish captured by gillnetting = 14 **(bold)**

Table 19 presents a summary of fish tagged and returned by species. Tag returns were predominantly from largemouth bass (38 returns) and northern pike (10 returns).

Table 19. Number of tagged and recaptured fish in Coeur d'Alene Lake, 1994 - 2001

	TAGGED FISH BY SPECIES		TAG RETURNS BY SPECIES
Species Code	**Electroshocking**	**Gill Netting**	**Fisheries Program**
LMB	709	1	38
SMB	3	0	0
PIK	78	4	10
CTT	53	3	4
BLT	0	1	0
KOK	1	0	0
RBT	2	0	0
SQW	2	0	0
CHN	2	0	0
CCF	16	5	0
MWF	2	0	0
BC	4	0	0
YP	3	0	1
Totals	**875**	**14**	**53**

Table 20 presents a summary of the largemouth bass tag returns including the date the fish were first tagged, the date they were recaptured and the estimated distance between capture and recapture locations.

Of particular interest in the tag-recapture study is the distance that fish move during their life in Coeur d'Alene Lake. *Figure 22* shows the times and distances between capture and recapture locations for the largemouth bass shown in *Table 20*. From this graph it can be seen that most largemouth bass migrate less than a mile (1.6 km) from their original capture location, even within times approaching 40 months. This graph also shows the "outliers", those fish that appeared to have moved over one mile and up to 15 miles (24.1 km). These are believed to be excessive movements and are suspected to be made in live wells of fishing boats, for example.

Table 20. Largemouth Bass tag return summary, 1995 - 2001.

Species	Date Tagged	Tag Number	Date Caught	Distance	Time	Area	Comments
LMB	6/14/1995	500958	7/19/1995	.5 miles	1 month	T3 to T3	
LMB	8/22/1996	500983	6/7/1999	.6 miles	34 months	T4 to T4	caught/released 9/96
LMB	8/22/1996	500983	9/16/1996	.5 miles	<1 month	T1 to T1	
LMB	9/10/1997	500847	7/6/1998	.6 miles	10 months	T4 to T4	
LMB	10/7/1997	500706	9/1/1998	<0.5 miles	11 months	T1 toT1	released
LMB	10/8/1997	500713	8/1/2000	<.5 miles	34 months	T3 to T3	released
LMB	10/8/1997	500722	10/26/1997	1.6 miles	<1 month	T10 to T10	
LMB	10/8/1997	500718	5/3/1998	13 miles	7 months	T10 to *	*up the Joe river
LMB	10/13/1997	500737	8/29/2000	<.5 miles	35 months	T10 to T10	released
LMB	4/16/1998	500859	7/8/1998	.5 miles	2 months	T13 to T13	
LMB	4/21/1998	500865	6/28/2001	<.5 miles	38 months	T1 to T1	released
LMB	5/18/1998	500893	7/10/1998	<.5 miles	2 months	T1 to T1	
LMB	6/17/1998	501178	8/24/1998	<.5 miles	2 months	T1 to T1	
LMB	6/17/1998	501176	7/3/1998	.7 miles	<1 month	T1 to *	*up Plummer creek
LMB	6/18/1998	501190	7/8/1998	.9 miles	<1 month	T1 to T1	
LMB	7/13/1998	501196	10/24/2000	6.5 miles	27 months	T7 toT3	
LMB	9/14/1998	500707	6/12/2002	unknown	2 months	T5 to ?	
LMB	9/16/1998	500627	7/8/2002	1.1 miles	10 months	T10 to T3	
LMB	9/16/1998	500641	8/27/2000	14 miles	23 months	T10 to *	*up the Joe river
LMB	10/5/1998	500673	6/30/2001	<.5 miles	32 months	T3 to T3	
LMB	10/7/1998	501070	5/30/1999	0.5 miles	10 months	T8 to T8	
LMB	10/16/1998	500687	11/31/00	3.5 miles	25 months	T10 to T3	released
LMB	10/16/1998	500629	8/1/2000	3.0 miles	22 months	T10 toT3	released
LMB	8/4/1999	501251	6/11/2001	14.5 miles	22 months	T11 to *	*Kidd Island bay
LMB	8/4/1999	501089	9/5/1999	<.5 miles	1 month	T3 to T3	
LMB	8/4/1999	501271	10/13/1999	4.3 miles	2 months	T11 to T8	
LMB	8/5/1999	501270	5/27/2001	<.5 miles	21 months	T1 to T12	
LMB	8/20/1999	500837	8/23/1999	<.5 miles	<1 month	T3 to T3	
LMB	10/11/1999	501298	8/28/2000	<.5 miles	10 months	T1 to T1	
LMB	4/3/2000	501203	8/15/2001	1.8 miles	16 months	T6 to T4	
LMB	6/13/2000	501027	7/1/2002	<.5 miles	24 months	T1 to T1	
LMB	8/2/2000	501218	7/9/2001	<.5 miles	13 months	T3 to T3	
LMB	10/3/2000	500547	5/27/2001	1.2 miles	5 months	T1 to T12	
LMB	10/30/2000	501241	8/22/2001	unknown	10 months	T8 to ?	
LMB	6/19/2001	400545	7/8/2001	<.5 miles	<1 month	T3 to T3	
LMB	8/13/2001	400525	6/22/2002	2.0 miles	10 months	T3 to T1	
LMB	8/31/2001	400003	10/10/2001	2.1 miles	2 months	T1 toT3	
LMB	10/3/2001	500540	9/9/2001	<.5 miles	12 months	T3 to T3	
Total of 38	Largemouth Bass tags returned						

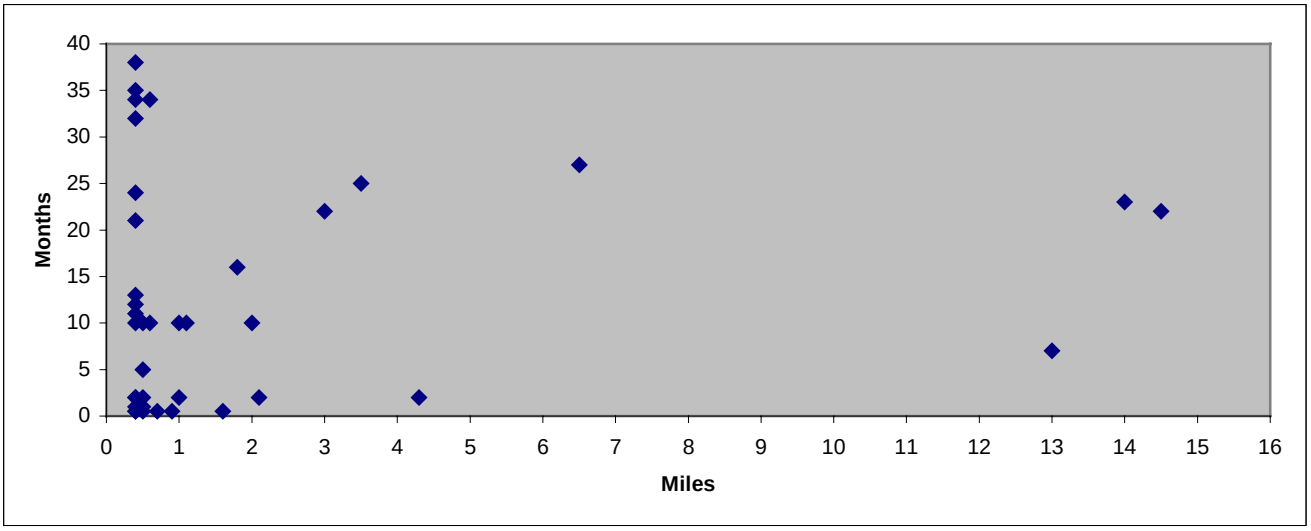


Figure 22. Time and distance of Largemouth Bass migration between initial capture/tagging and recapture in Coeur d'Alene Lake, 1995 - 2001.

Table 21 presents a summary of northern pike tag returns for 1996 through 2001. The CDA Fisheries Program received the first northern pike tag return in 1998. Since 1998 a total of ten northern pike tags have been retuned, all by anglers. The average time from tagged to capture and distance traveled for the ten fish is 12.7 months and 2.64 miles (4.2 km).

Figure 23 shows the times and distances between capture and recapture locations for the largemouth bass shown in *Table 19*. Unlike the largemouth bass graph, it can be seen that pike are more likely to travel several miles even in relatively short times.

Table 21. Summary of Northern Pike tag returns in Coeur d'Alene Lake, 1996 - 2001.

Species	Date Tagged	Tag Number	Date Caught	Distance	Time	Area	Comments
PIK	8/22/1996	500981	3/23/1998	2.4 miles	19 months	T12 to T5	
PIK	9/23/1997	500533	3/13/1998	8 miles	6 months	T1 to T9	
PIK	10/7/1997	500709	11/1/1998	<.5 miles	2 months	T1 to T1	
PIK	4/24/1998	500152	7/1/1998	.5 miles	38 months	T13 to T13	
PIK	6/18/1998	501189	10/17/1998	1.2 miles	4 months	T1 to T2	
PIK	10/5/1998	500670	10/24/1999	4.5 miles	12 months	T12 to T3	
PIK	10/6/1998	501061	7/10/1999	2.5 miles	9 months	T7 to T8	
PIK	10/16/1998	500695	3/19/1999	3.5 miles	5 months	T4 to T1	
PIK	8/2/1999	501084	* 3/?/01	<.5 miles	19 months	T13 to T13	*exact date unknown
PIK	9/16/1999	500645	10/22/1999	3.0 miles	13 months	T10 to T10	In the Joe River sys.
Total of 10	Northern Pike tags returned						

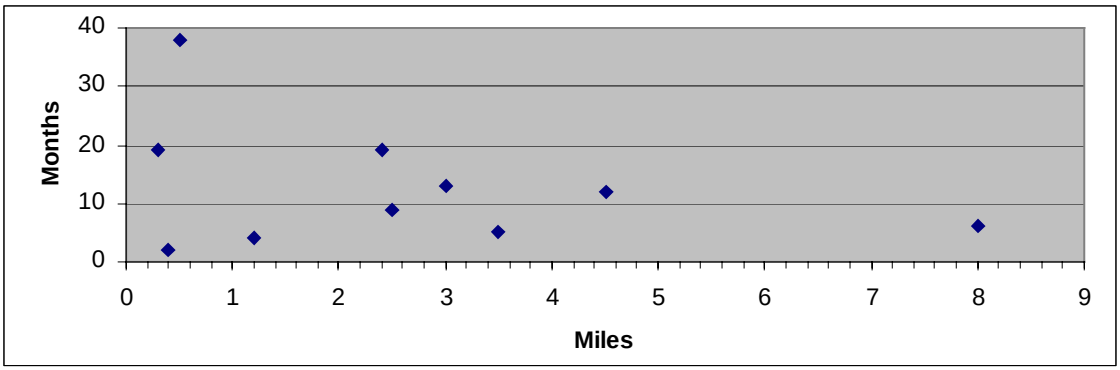


Figure 23. Time and distance of northern pike migration between initial capture/tagging and recapture in Coeur d'Alene Lake, 1995 - 2001.

Table 22 presents a summary of the tagging and return data collected for the cutthroat trout recaptures. These fish were all first tagged in streams (either migrant trapping or electroshocking) and all but one were recaptured in the lake. The cutthroat appeared likely to migrate long distances, up to 17 miles (27.4 km) in this case. As indicated, all of the recaptured fish included a stream in their migration.

Table 22. Summary of cutthroat trout tag returns in Coeur d'Alene Lake, 1996 - 2001.

Species	Date Tagged	Tag Number	Date Caught	Distance	Time	Area	Comments
CTT	5/2/1998	500049	6/9/98	5 km*	1 month	Lk Cr. to T13	*4.8 km Str. Migration
CTT	7/13/1998	200296	9/7/98	<.0.8 km	1 month	R2 Evans Cr.	Fish did not leave str.
CTT	5/14/2001	500190	5/?/02	39 km*	12 months	Lk Cr. To**A.P.	*4.8 km Str. Migration
							**Arrow Point
CTT	5/15/2001	500194	6/22/2002	27 km*	13 months	Lk Cr. to T4	*4.8 km. Str. Migration
Total of 4	**Cutthroat Trout tags returned**						

STREAM STUDIES

WATER QUALITY

Streamflow

There were 15 streams or stream segments monitored for water quality parameters and discharge during the 1999 - 2001 period. Summarized instantaneous flow measurements for all sites with data are given in Table A-9 in Appendix A. The highest recorded discharge in 1999 was 440.55 cfs at the Benewah Creek 3-mile site on 3/26/99. In 2000 the highest flow was 664.73 cfs at the Lower Lake Creek site on 4/13/00. In 2001 the highest flow was only 94.69 cfs which was measured at the Lower Lake Creek site on 3/28/01

The average of instantaneous flows measured for this study, along with annual low "base flows" are presented in *Table 23*. From this it can be seen that discharge decreased from 1999 through

2001, at least at the Alder Creek sites and the Benewah Creek sites. Average discharge and high flow in the Lake Creek sites increased from 1999 to 2000 but was substantially lower in 2001.

Table 23. Average discharge and base flows for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001. All flows in cubic feet per second (cfs).

	1999			2000			2001		
STREAM SITES	Average Flow*	Base Flow**	High Flow***	Average Flow*	Base Flow**	High Flow***	Average Flow*	Base Flow**	High Flow***
Alder Cr.	36.48	1.49	132.66	24.97	4.11	43.56	8.34	0.36	30.46
N. Fork Alder Cr	18.73	nd	18.73	10.21	1.43	16.99	2.95	0.11	11.53
Upper Benewah	7.74	0.72	28.39	5.38	0.45	10.50	2.52	0.20	10.14
Three Mile Benewah	77.59	3.47	440.55	42.81	6.44	67.59	1.32	0.04	5.62
Nine Mile Benewah Cr.	nd	nd	nd	37.68	3.46	60.47	11.16	0.72	31.85
W. Fork Benewah Cr.	5.26	0.34	19.28	4.56	1.16	8.10	9.98	0.25	33.9
Schoolhouse Cr.	5.47	0.01	18.62	3.92	0.33	9.62	1.34	0.00	5.88
Whitetail Cr.	4.91	0.26	16.65	1.63	0.16	4.57	1.28	0.00	3.15
Windfall Cr.	6.37	0.01	24.06	3.51	0.49	9.01	2.08	0.00	6.71
Evans Cr	26.16	7.31	37.26	28.22	5.86	50.52	6.42	1.20	16.60
Upper Evans Cr.	19.04	7.94	34.50	nd	nd		4.84	1.03	11.69
E. Fork Evans Cr.	2.00	1.11	4.202	6.44	0.50	13.71	nd	nd	
Upper Lake Cr.	41.51	3.50	119.91	50.01	7.14	156.99	7.18	0.06	28.89
Lower Lake Cr.	nd	nd	nd	174.22	6.60	664.73	51.86	9.03	94.69
Bozard Cr.	11.31	0.14	22.98	10.33	4.76	15.91	4.12	0.10	15.11

* Average of all available data for year. ** Lowest flow recorded during August - September period. *** Highest recorded flow for year

Temperature

Stream temperature data are summarized in Table A-10 in Appendix A. Overall, stream water temperatures were below 5° C until mid-April in 1999, through March in 2000 and through April in 2001. As summer progressed the stream waters warmed to the 15° C level in late-June or July and maintained this level, typically until mid-August. The only monitored streams that did not exceed a temperature of 15° C at all during the three years were Upper Evans Creek, East Fork of Evans Creek and Bozard Creek. The stream sites with the greatest number of exceedences of this 15° C level over this three-year period were Benewah Creek (3-mile and 9-mile) and the W. Fork Benewah Creek.

Dissolved Oxygen

Stream dissolved oxygen data for the reporting period are compiled into Table A-11 in Appendix A. The apparent range of DO levels in these streams in 1999 was 5.52 mg/L (Schoolhouse Creek on 9/21/99) to 15.59 mg/L (Upper Benewah Creek on 9/21/99). In 2000 the range was 5.88 mg/L (Whitetail Creek on 8/9/00) to 13.79 mg/L (Nine Mile Benewah Creek on 4/3/00).

The range in 2001 was 5.51 mg/L (Schoolhouse Creek on 9/13/01 to 14.53 mg/L (Nine Mile Benewah Creek on 3/28/01). From this it would appear that DO levels were fairly consistent from year to year. No DO levels less than 5.0 mg/L were seen in these streams during this reporting period.

pH

The measured pH values for the Reservation streams were typically circumneutral with few exceptions noted (see summarized data in Table A-12 in Appendix A). The range of values in 1999 was 6.49 (Bozard Creek on 3/10/99) to 7.81 (Alder Creek on 7/13/99). In 2000 the range was 6.18 (Bozard Creek on 4/18/00) to 7.93 (N. Fork Alder Creek on 7/14/00). In 2001 the range was 6.60 (Bozard Creek on 4/18/01) to 8.67 (Alder Creek on 9/13/01). From this it can be seen that pH values generally tended to be slightly lower in the spring and increase through the summer months, although this trend was not seen in all sites.

Dissolved Phosphorus

The majority of the water samples collected for dissolved ("ortho") phosphorus analyses had levels near or below the analytical detection limit, as shown in Table A-13 in Appendix A. However, because of differences in the reported detection limit (<0.02 mg/L in 1999, <0.006 in 2000 and <0.01 in 2001) no other conclusions can be drawn.

Total Phosphorus

Unlike the dissolved phosphorus, total phosphorus was below detection in only a small proportion of the samples, as shown in Table A-14 in Appendix A. In 1999 most of the analysis results from the sampled Alder, Evans and Lake Creek sites were below detection (note, again there was a change in the detection limit between these years). Most measurable results from these sites were seen late in the monitoring season. At the Benewah Creek sites, however, most samples did yield measurable results throughout the monitoring period except at Upper Benewah and the W. Fork of Benewah. The high TP value seen this year in Alder Creek was 0.026 mg/L (on 5/12/99), the high value in Bozard Creek was 0.029 mg/L (on 9/21/99) and the high value in Upper Evans was 0.031 mg/L (on 9/21/99). The highest value in the Benewah Creek system was 0.037 mg/L in Whitetail Creek on 7/12/99.

During 2000 there was a somewhat higher proportion of measurable results and also a more noticeable spread in the time that the high values occurred. In fact, most of the high values were found during the April - May period. The highest value in the Alder Creek sites was 0.035 mg/L (on 5/15/00). The highest TP value in any of the Benewah Creek sites was 0.263 mg/L in Whitetail Creek on 4/13/00 (although the W.Fork, Schoolhouse and Windfall Creek sites also showed values near 0.2 mg/L on this date. The highest value in the Evans Creek sites was 0.135 mg/L, again on 4/13/00. The highest value in the Lake Creek sites was 0.046 mg/L on 4/3/00.

2001 showed few results that were below detection and an even earlier shift in the time of the highest TP values. The highest value in the Alder Creek sites was 0.032 mg/L on 3/28/01. The highest value in the Benewah Creek sites was 0.132 mg/L, again at Whitetail Creek. The highest TP in the Evans Creek was 0.211 mg/L on 3/28/01, and the highest in the Lake Creek watershed was 0.135, also on 3/28/01.

Habitat Suitability

The Habitat Suitability Index values for Cutthroat Trout in all monitored Reservation streams was calculated following Hickman & Raleigh (1982). This involved the use of data on annual maximum temperature, annual minimum dissolved oxygen, annual maximum (or minimum) pH and base flow. The stream data used for the calculations and the resulting parameter-specific Suitability Index values are shown in Table B-2 in Appendix B. The overall calculated HSI for each stream for each year (including previously calculated results for 1997 - 98 from Peters et al., 1999) are shown in *Table 24*.

For the most part, the chemical characteristics (DO and pH) of the water in the monitored streams provided high Suitability Indexes. All monitored sites had DO SI values greater than 0.4 (indicating good or very good suitability) and pH SI values were 1.0 with only one exception (Alder Creek in 2001 had a SI of 0.72).

The temperature and base flow, however, both tended to lower the calculated HSI. During the three years of this report, the Alder Creek, Windfall Creek and Lower Lake Creek sites consistently had temperature SI values at or just above zero. The 3-mile and 9-mile Benewah sites also had temperature SI values of zero during two out of the three years. As far as base flow goes, both of the Alder Creek sites, all of the Benewah Creek sites and all of the Lake Creek sites had SI values less than 0.4, including zero values in 2001 for the Schoolhouse, Windfall and Whitetail Creeks sites. Only the Evans Creek sites had base flow SI values greater than 0.4 (the only exception being W. Fork of Evans in 2000 which hasd a SI of 0.15).

The combined HSI results shown in *Table 24* point to the best water quality being in Evans Creek (based on the average of available results being greater than 0.60). The averaged results from 1997-98 were generally in agreement with the 1999 - 2001 results with two notable exceptions: the HSI for 1997-98 was 0.62 compared to a high of 0.33 and two zeros during 1999-2001 and the zero for Upper Benewah in 1997-98 appears out of synch with the 0.47 - 0.63 calculated for 1999-2001. Generally, however, high stream temperatures and low base flows are indicated as being the most restrictive water quality factors for cutthroat trout.

Table 24. Summary of calculated Habitat Suitability Index (HIS) values for cutthroat trout in Coeur d'Alene Reservation streams. (From Hickman & Raleigh, 1982; using formula (V_1 x V_3 x V_{13} x V_{14})$^{1/4}$).

STREAM HSI CALCULATIONS

	1997-98	1999	2000	2001	Overall Mean
STREAM SITES					
Alder Cr.	**0.62**	**0.00**	**0.00**	**0.33**	0.24
N. Fork Alder Cr	**nd**	**nd**	**0.66**	**0.45**	0.56
Upper Benewah	**0.00**	**0.54**	**0.47**	**0.63**	0.41
Three Mile Benewah	**0.00**	**0.00**	**0.00**	**0.38**	0.10
Nine Mile Benewah	**nd**	**nd**	**0.00**	**0.00**	0.00
W. Fork Benewah	**0.69**	**0.38**	**0.82**	**0.37**	0.57
Schoolhouse Cr.	**0.45**	**0.45**	**0.57**	**0.00**	0.37
Whitetail Cr.	**nd**	**0.55**	**0.54**	**0.00**	0.36
Windfall Cr.	**0.00**	**0.35**	**0.00**	**0.00**	0.09
Evans Cr	**0.85**	**0.88**	**0.75**	**0.74**	0.81
Upper Evans Cr.	**nd**	**0.95**	**nd**	**0.81**	0.88
E. Fork Evans Cr.	**nd**	**1.00**	**0.57**	**nd**	0.79
Upper Lake Cr.	**0.65**	**nd**	**0.73**	**0.31**	0.56
Lower Lake Cr.	**0.00**	**0.00**	**0.00**	**0.00**	0.00
Bozard Cr.	**nd**	**0.29**	**0.88**	**0.42**	0.53

STREAM FISHERIES

Population Estimates

A total of 6,092 resident salmonids, including 4,159 cutthroat trout and 1,933 brook trout were collected between 1996 and 2001 in the four target watersheds (*Tables 25 and 26*). The population estimates calculated from these sample efforts (*Figures 24 - 27*) reveal the consistent higher density of westslope cutthroat trout in tributary reaches compared to mainstem reaches in Benewah, Evans and Lake creeks. In contrast, westslope cutthroat trout density was higher in mainstem Alder Creek compared to the tributary North Fork Alder Creek (*Figure 30*). When mainstem and tributary densities were combined, Lake Creek and Evans Creek had the highest densities (#/100m^2) of westslope cutthroat trout, 19 times greater than Alder Creek. When comparing mainstem reaches Evans Creek had the highest density (6.3±1.1) of westslope cutthroat trout, followed by Lake Creek (1.9±1.3). Benewah Creek had the lowest mainstem density (0.8±0.5). Lake Creek and Evans Creek had the highest density of westslope cutthroat trout from tributary reaches (26.3±17.6) and (21.4±21.6) respectively. Alder Creek had the lowest tributary density (0.8±0.5). No significant trends in density were identified in the four systems and year-to-year variation is high for most estimates.

Brook trout and westslope cutthroat trout were sampled in the same reaches in Alder Creek and Benewah Creek (*Figures 28 and 29*). However, Alder Creek is dominated by non-native brook

trout having high densities in both mainstem (7.7±4.6) and tributary (15.9±10.6) reaches from the period of 1996-2001. The density of brook trout is much higher than for westslope cutthroat trout in Alder Creek (*Figure 30*). In contrast, cutthroat trout density is much higher than brook trout density in Benewah Creek (*Figure 31*).

Table 25. Characteristics of westslope cutthroat trout sampled by electrofishing in streams on the Coeur d'Alene Reservation, 1996-2001.

Year	N	Length (mm)		Weight (g)	
		Mean (SD)	Range	Mean (SD)	Range
1996	770	117 (44)	30-245	23 (23)	1-180
1997	1096	121 (50)	40-300	28 (38)	1-300
1998	472	141 (49)	50-322	36 (47)	1-317
1999	591	127 (47)	25-310	27 (32)	1-251
2000	507	134 (77)	47-420	35 (58)	1-310
2001	723	123 (47)	40-312	25 (31)	1-315

Table 26. Characteristics of eastern brook trout sampled by electrofishing in streams on the Coeur d'Alene Reservation, 1996-2001.

Year	N	Length (mm)		Weight (g)	
		Mean (SD)	Range	Mean (SD)	Range
1996	236	149 (61)	28-290	53 (52)	2-246
1997	482	114 (62)	14-380	32 (60)	1-318
1998	269	147 (41)	55-337	40 (52)	1-420
1999	340	140 (45)	24-262	37 (37)	1-244
2000	197	147 (48)	49-280	43 (44)	1-233
2001	409	112 (46)	32-255	19 (24)	1-150

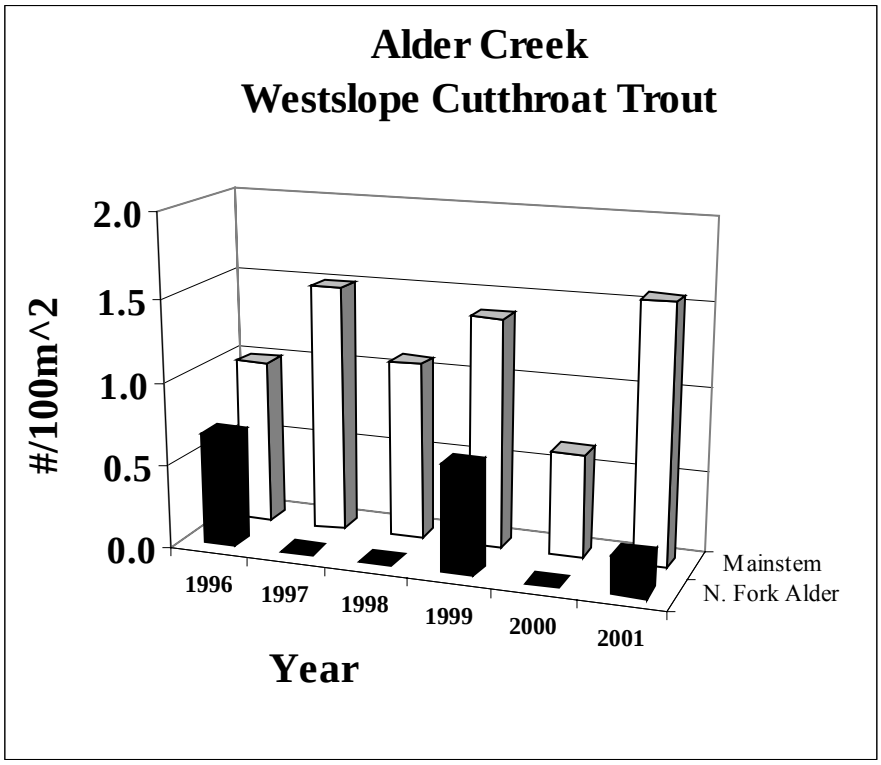


Figure 24. Mean westslope cutthroat trout density from reaches in the mainstem and tributaries of Alder Creek.

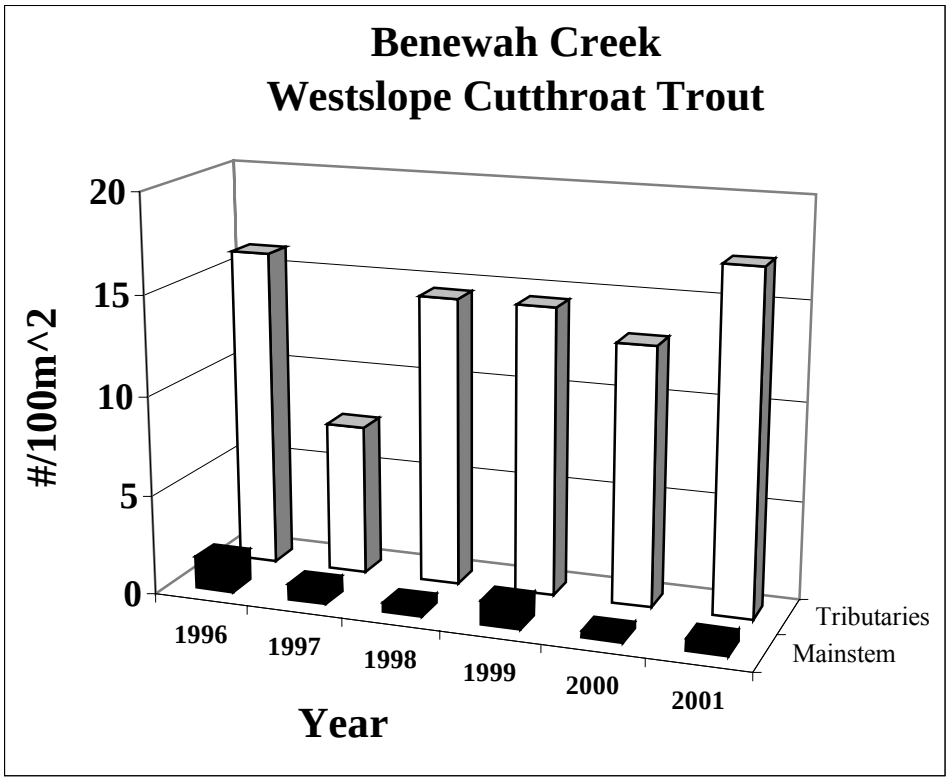


Figure 25. Mean westslope cutthroat trout density from reaches in the mainstem and tributaries of Benewah Creek.

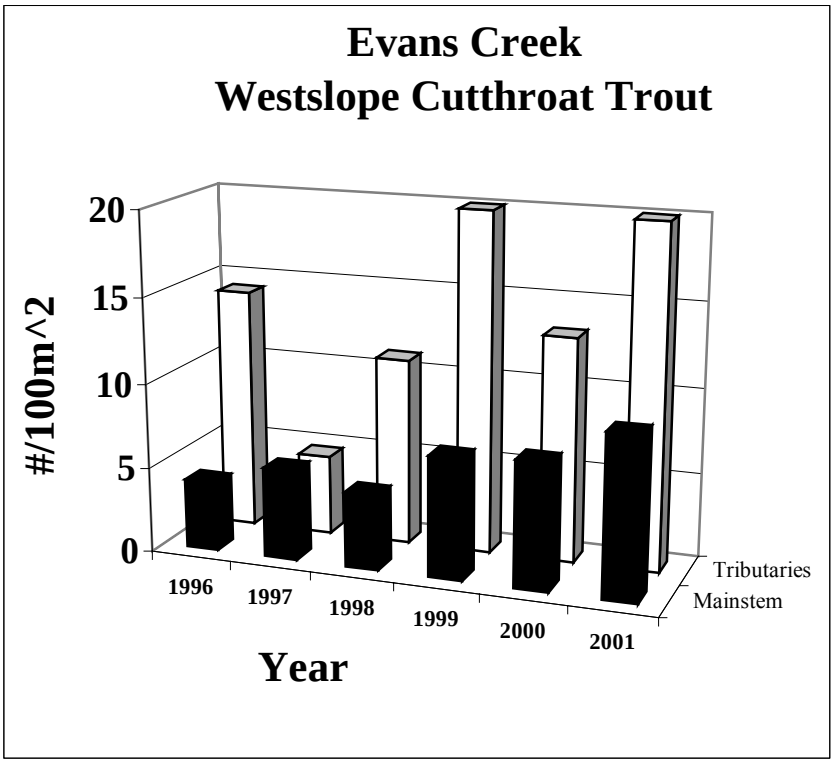


Figure 26. Mean westslope cutthroat trout density from reaches in the mainstem and tributaries of Evans Creek.

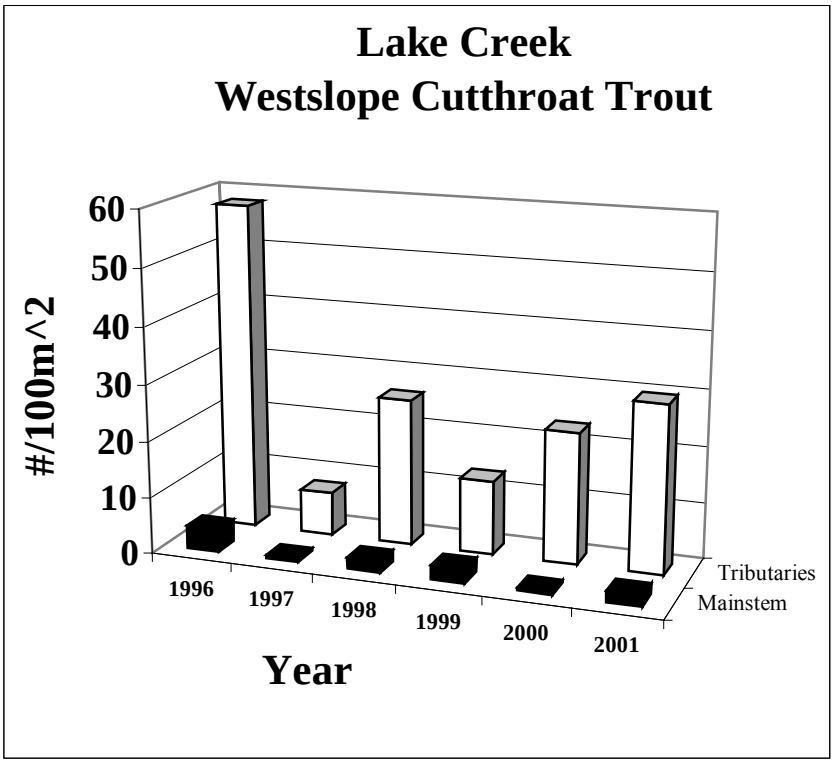


Figure 27. Mean westslope cutthroat trout density from reaches in the mainstem and tributaries of Lake Creek.

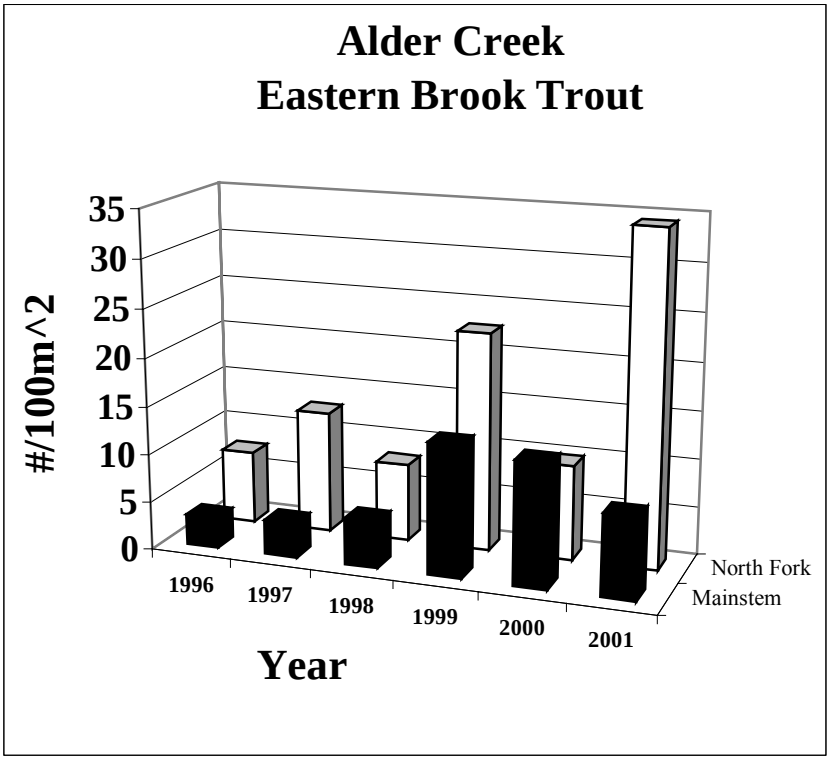


Figure 28. Mean eastern brook trout density from reaches in the mainstem and tributaries of Alder Creek.

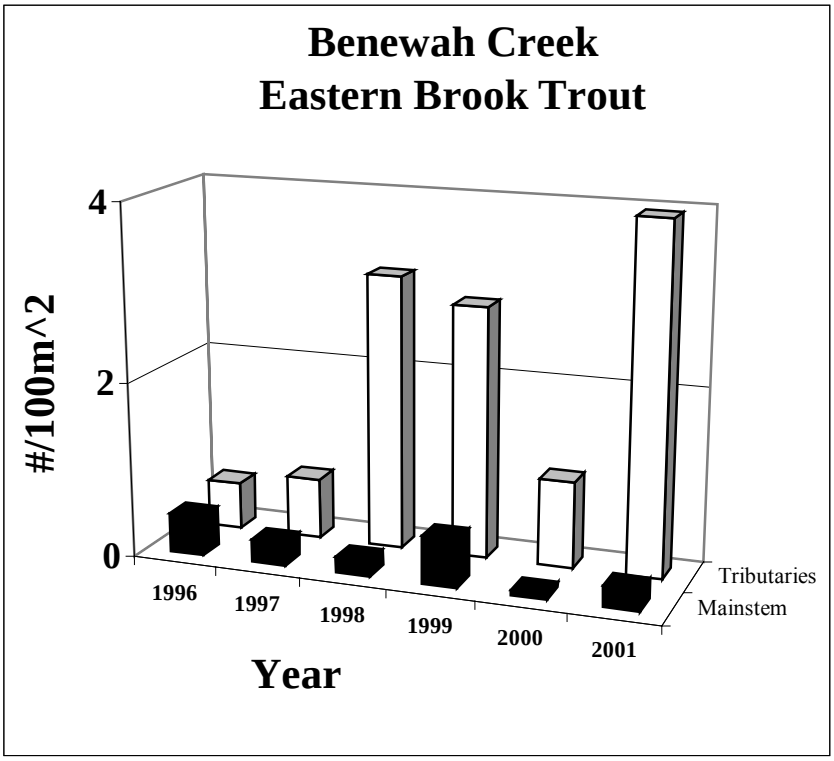


Figure 29. Mean eastern brook trout density from reaches in the mainstem and tributaries of Benewah Creek.

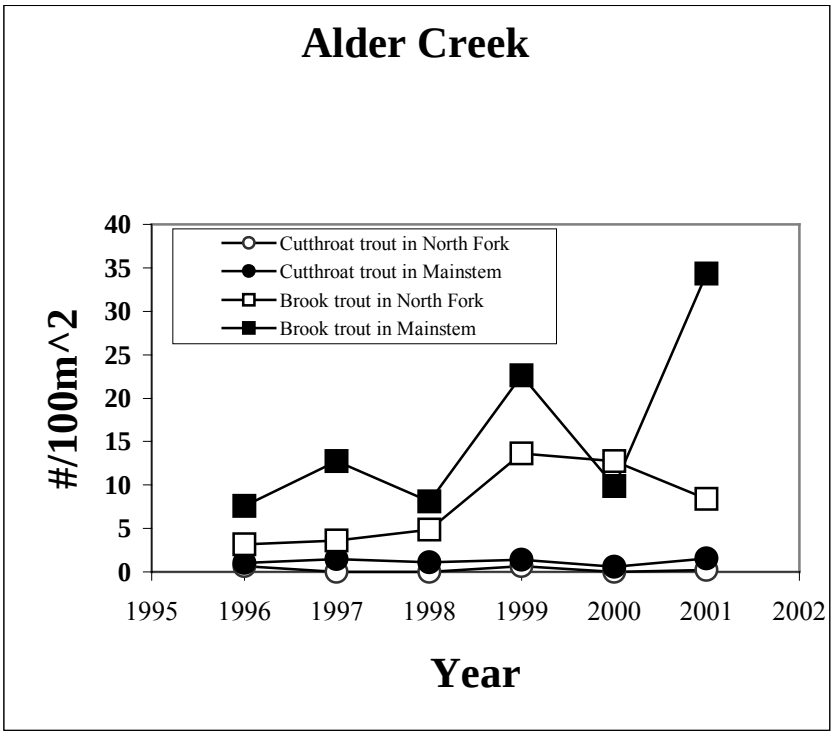


Figure 30 Comparison of eastern brook trout and westslope cutthroat trout density in Alder Creek.

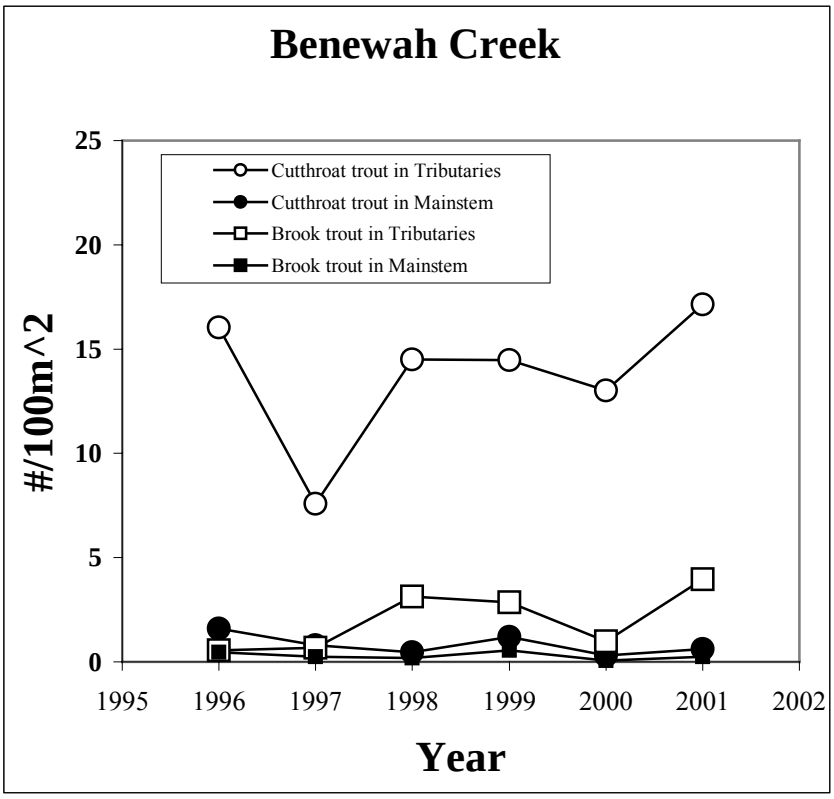


Figure 31. Comparison of eastern brook trout and westslope cutthroat trout density in Benewah Creek.

Stream population data for the 1996 - 2001 period have been compiled to show the ratio of total reach area to area sampled, population estimates (N), 95% confidence intervals, and fish density (Appendix C). Calculated total N for cutthroat trout ranged from a low of 301 in Alder Creek in 2000 to a high of 8,367 in Evans Creek in 2001. Calculated total N for eastern brook trout ranged from a low of 352 in Benewah Creek in 2000 to a high of 7,154 in Alder Creek in 1999.

Total fish population estimates (±95% confidence intervals) for the 6 year time series of data are summarize by watershed in *Figures 32-37*. Linear regressions of total estimated population by year have been calculated to show general trends in watershed populations over time. The population trends are generally not well described by linear regressions due to the high between-year variability in the data. The best fit for cutthroat trout was seen in the Evans Creek data (r^2=0.47). The best fit in this regression analysis was for brook trout in Alder Creek (r^2=0.78). Regression trends indicated generally increasing numbers of trout in all watersheds and populations except for cutthroat in Alder Creek. Brook trout numbers in the Alder Creek watershed increased significantly (P=0.01) during the 6-year time series. High between-year variability masked significant differences in the other watersheds.

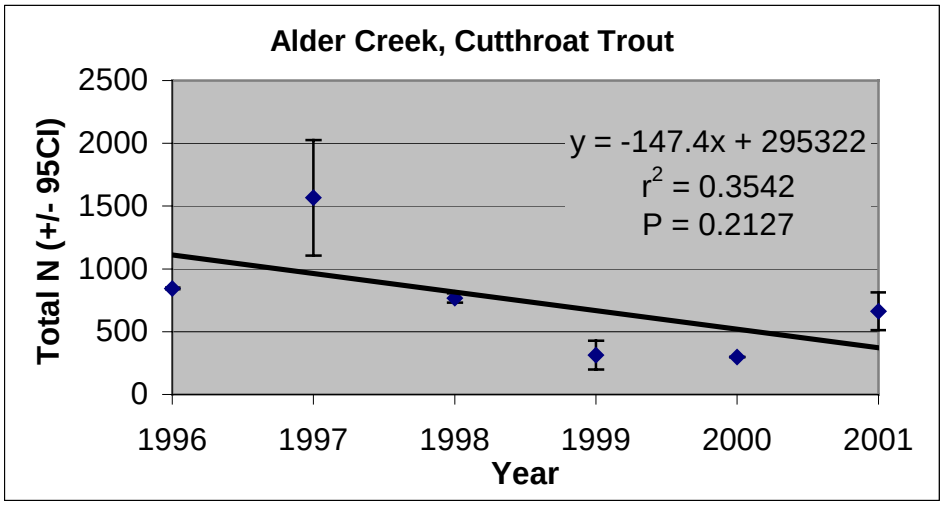


Figure 32. Total estimated cutthroat trout numbers in the Alder Creek watershed, 1999 - 2001. Error bars indicate 95% confidence intervals.

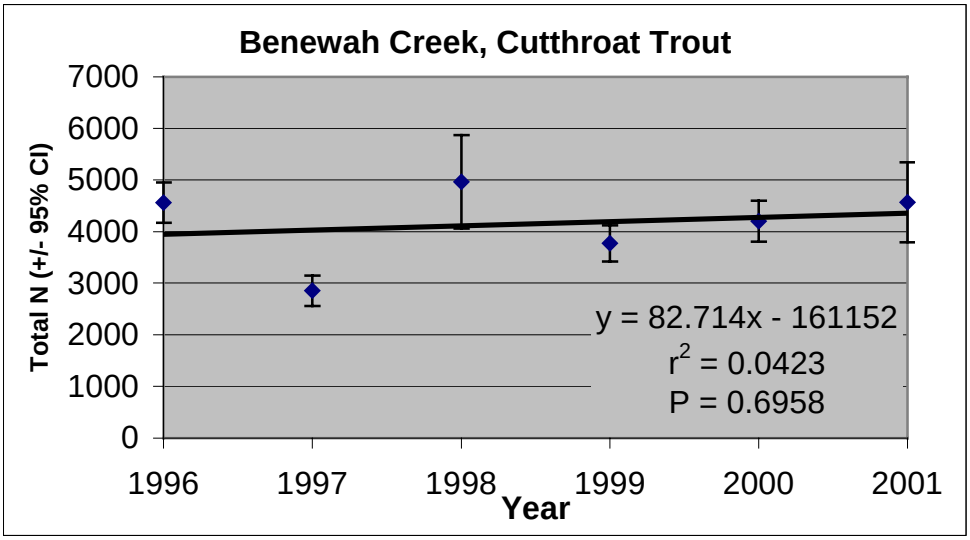


Figure 33. Total estimated cutthroat trout numbers in the Benewah Creek watershed, 1999 - 2001. Error bars indicate 95% confidence intervals.

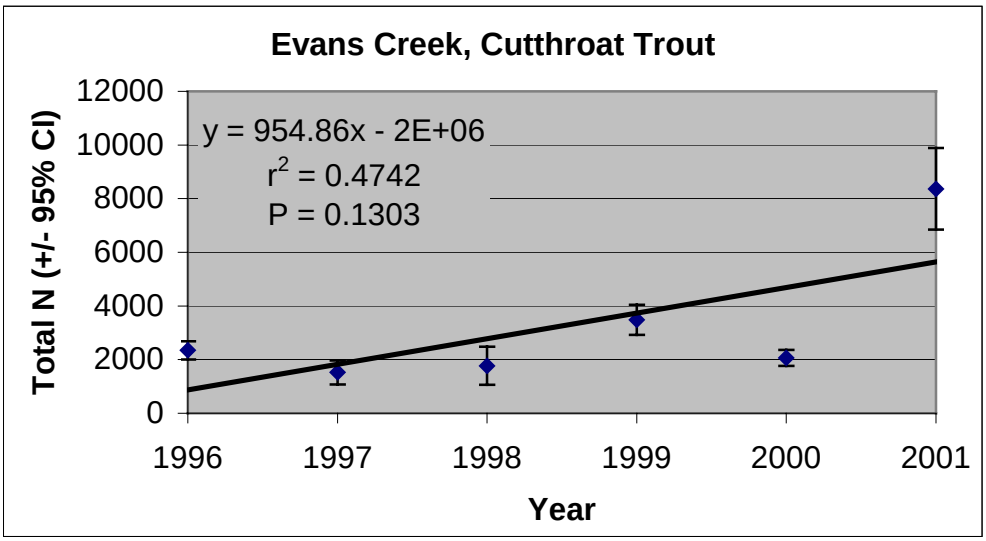


Figure 34. Total estimated cutthroat trout numbers in the Evans Creek watershed, 1999 - 2001. Error bars indicate 95% confidence intervals.

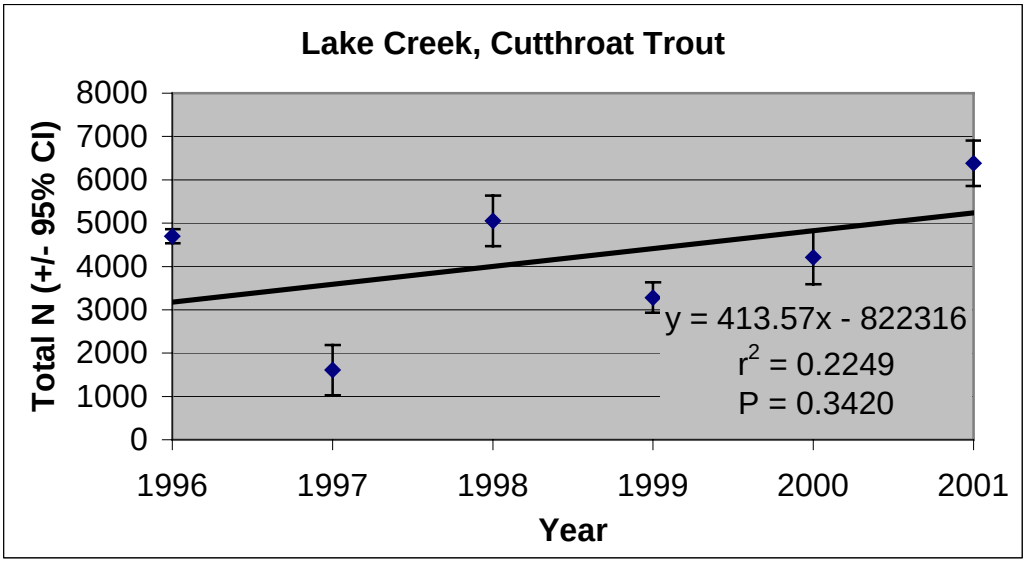


Figure 35. Total estimated cutthroat trout numbers in the Lake Creek watershed, 1999 - 2001. Error bars indicate 95% confidence intervals.

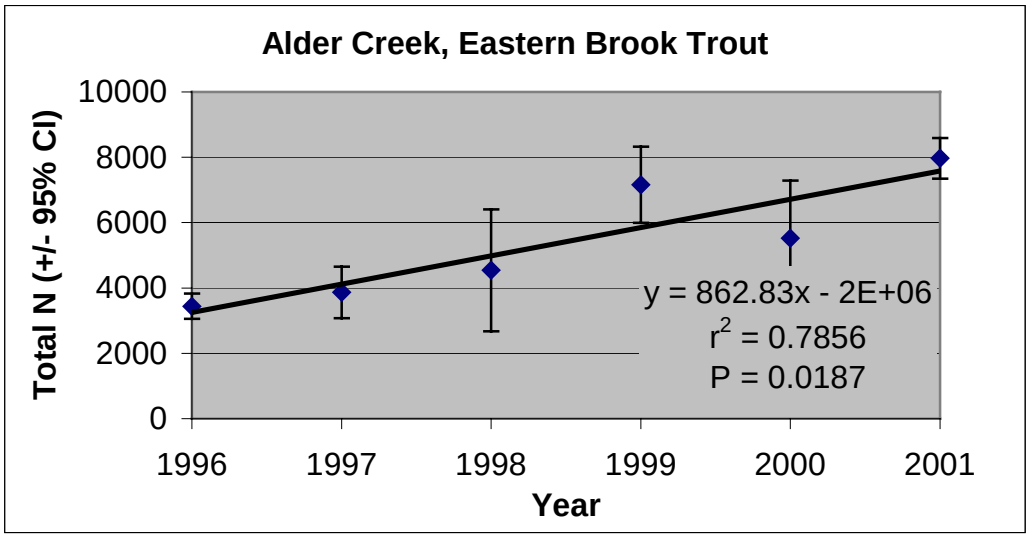


Figure 36. Total estimated brook trout numbers in the Alder Creek watershed, 1999 - 2001. Error bars indicate 95% confidence intervals.

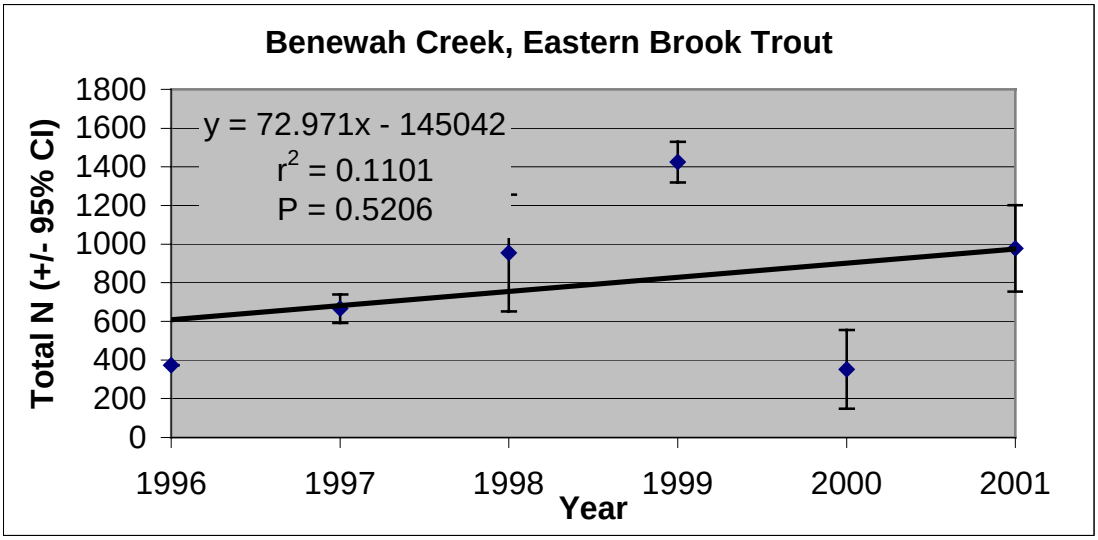


Figure 37. Total estimated brook trout numbers in the Benewah Creek watershed, 1999 - 2001. Error bars indicate 95% confidence intervals.

Cutthroat and Brook Trout Growth and Condition

Figure 38 presents growth of the 1995 cutthroat trout cohort from Alder, Benewah, Lake and Evans creeks. Cutthroat trout in Alder were longer at age one than cutthroat from the other creeks. However, Alder creek cutthroat growth slowed and was lower than the other creeks from age 2 through age 5. Benewah Creek cutthroat exhibited the highest growth rate, followed closely by Evans and Lake Creek. *Figure 39* compares growth of Westslope cutthroat trout with non-native brook trout in the Alder Creek system. Cutthroat trout length in Alder Creek was higher at the start and growth remained consistent throughout the next four years. Brook trout length was lower, and growth rate didn't change among brook trout and cutthroat trout.

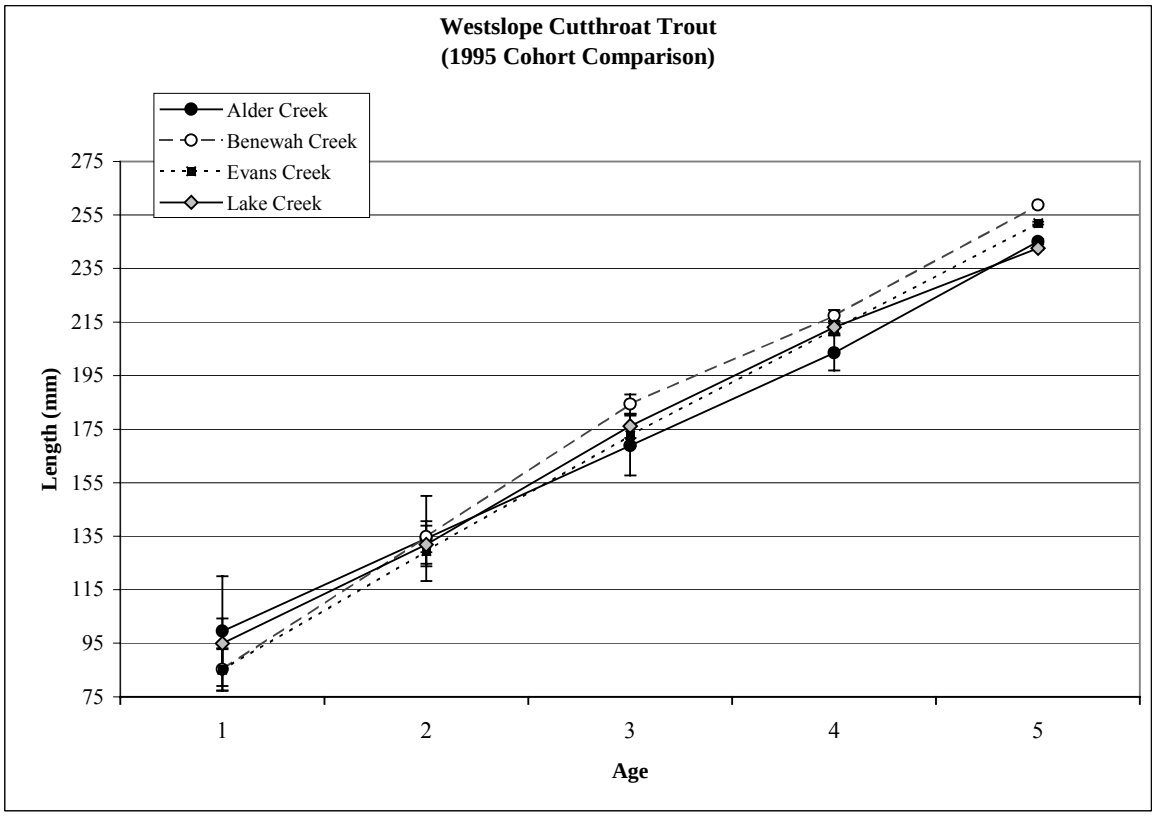


Figure 38. Comparison of length at age of westslope cutthroat trout from the 1995 cohort from four streams on CDA reservation. Length was back-calculated from scale analysis of known scale annuli length at age and age to length relationships (error bars are ± 95% confidence intervals).

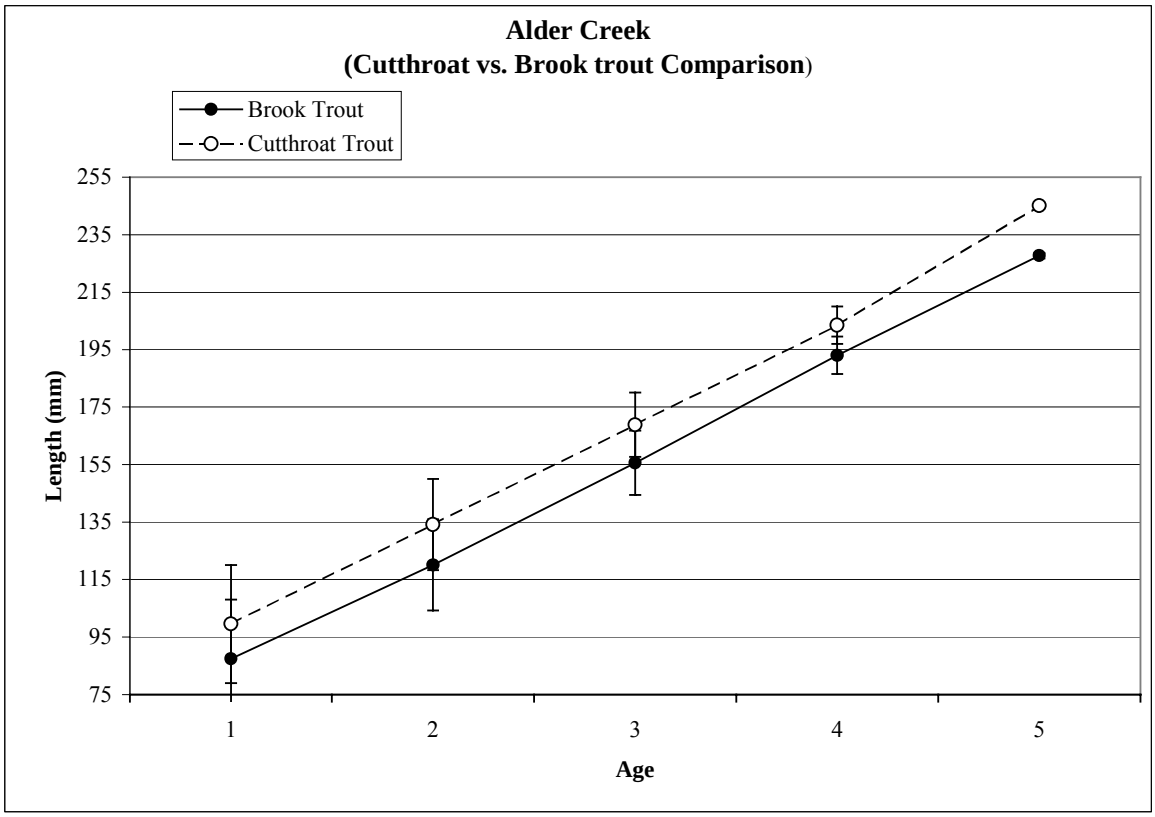


Figure 39. Comparison of length at age of westslope cutthroat trout and Brook trout from the 1995 cohort from Alder Creek on the CDA reservation. Length was back-calculated from scale analysis of known scale annuli length at age and age to length relationships (error bars are ± 95% confidence intervals).

Figures 40 - 43 present the comparison of mean weight, length and condition factor for cutthroat trout from Alder Creek and Benewah Creek. The range of condition factors was narrower than for brook trout. Variation between years was moderate but not statistically significant. *Table 27* provides results comparing mean weight, length and condition factor of various ages of westslope cutthroat trout. The only significant difference was weight between age 4 cutthroat.

Figures 44 - 48 compare condition factor of brook trout for the same three creeks. Mean condition factor fluctuated between 0.8 and 1.2 for ages 1-5, and between years. Variability was consistent between years. Mean weight and condition factor were not significantly different for brook trout ages 1-5 from Alder and Benewah Creeks (*Table 28*). The only significant difference was length between age 4 fish.

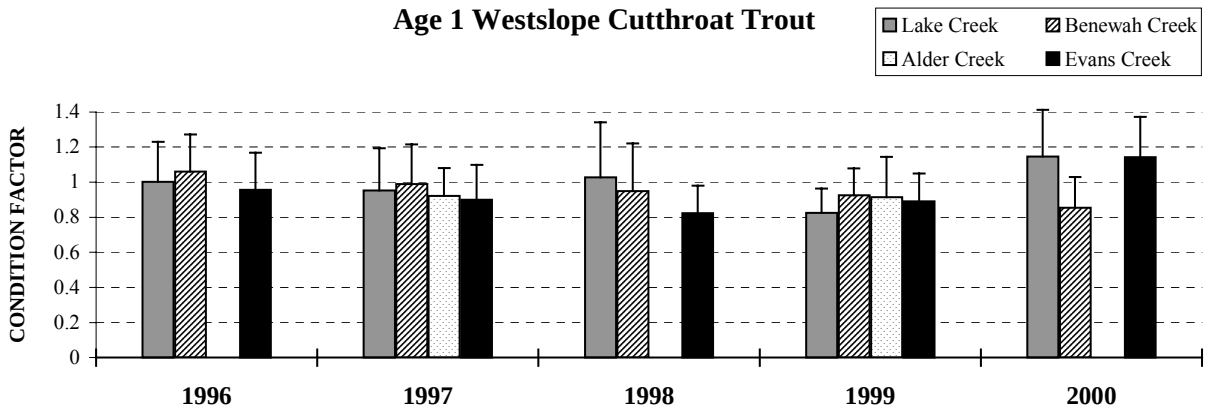


Figure 40. Condition factor of age 1 westslope cutthroat trout collected during summer population estimates (mean +/-s.d.).

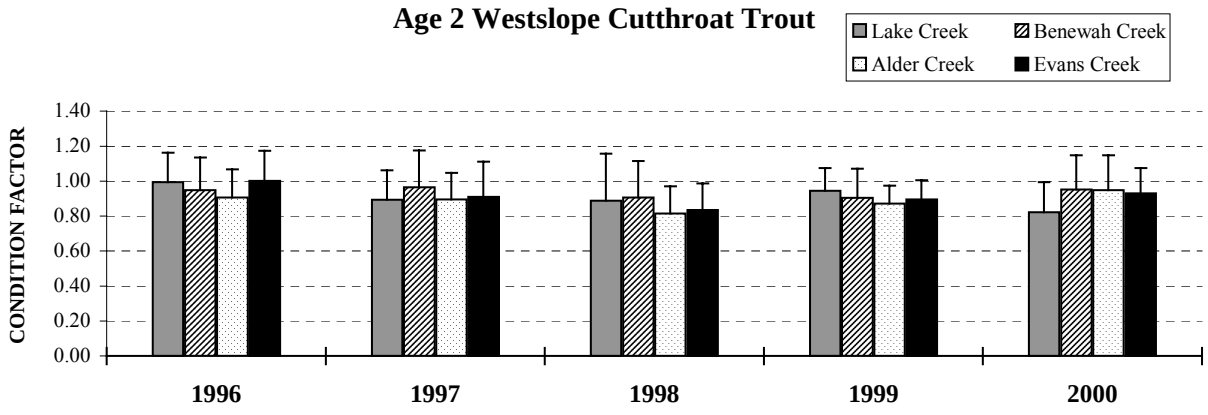


Figure 41. Condition factor of age 2 westslope cutthroat trout collected during summer population estimates (mean ±s.d.).

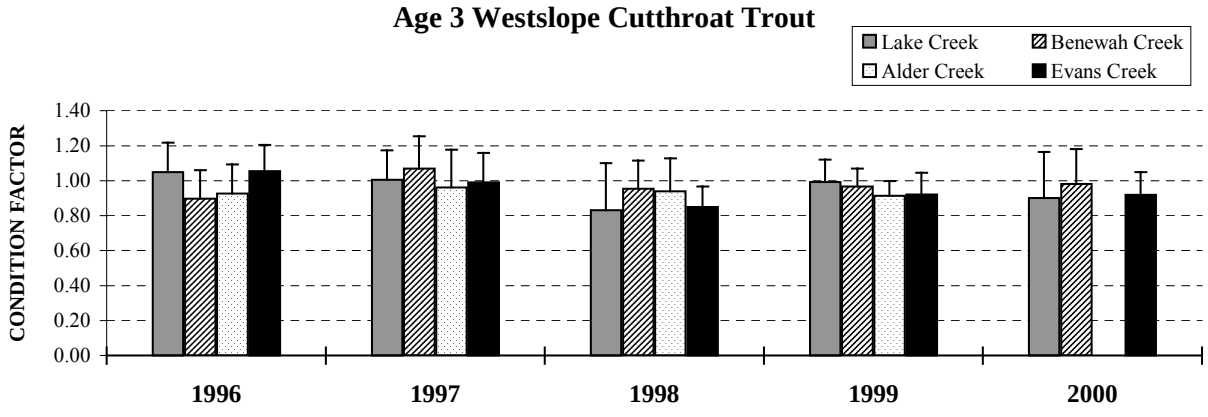


Figure 42. Condition factor of age 3 westslope cutthroat trout collected during summer population estimates (mean ±s.d.).

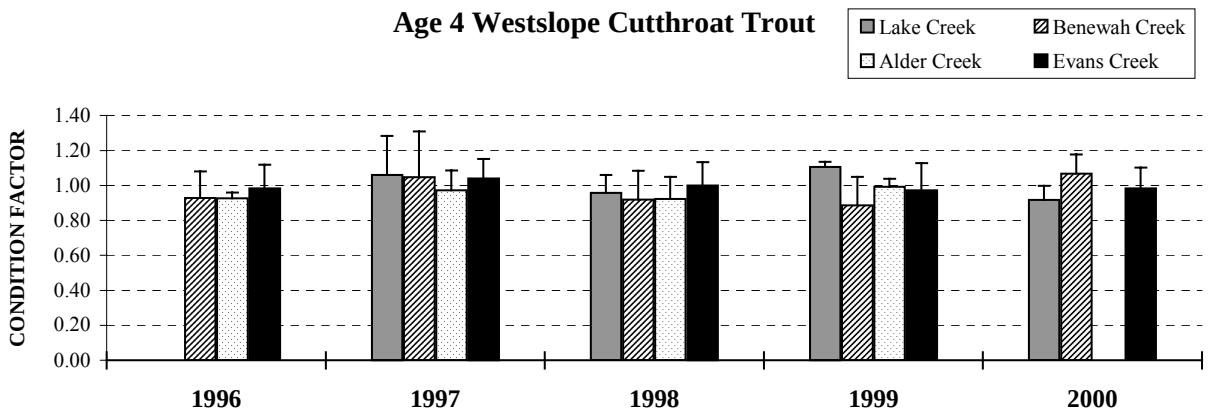


Figure 43. Condition factor of age 4 westslope cutthroat trout collected during summer population estimates (mean ± s.d.).

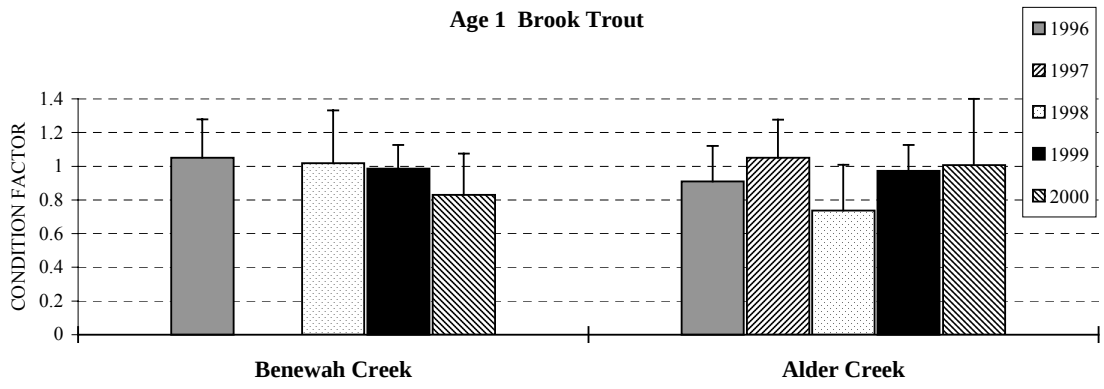


Figure 44. Condition factor of age 1 brook trout collected during summer population estimates (mean ± s.d.).

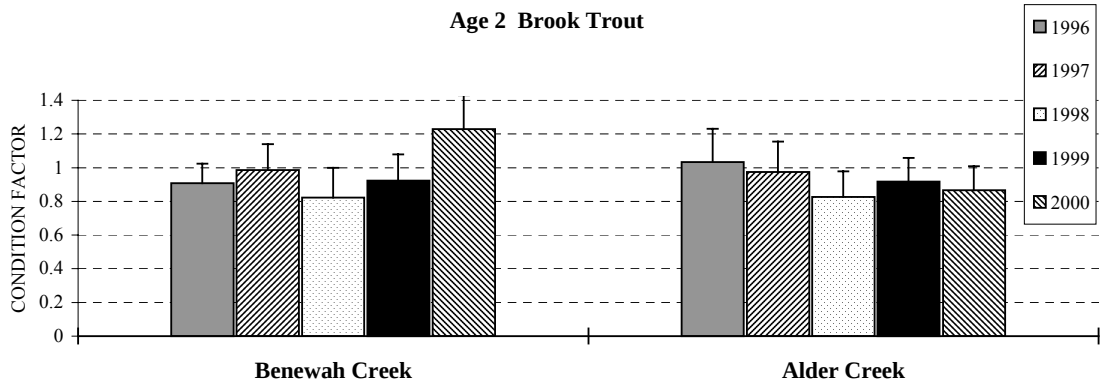


Figure 45. Condition factor of age 2 brook trout collected during summer population estimates (mean ± s.d.).

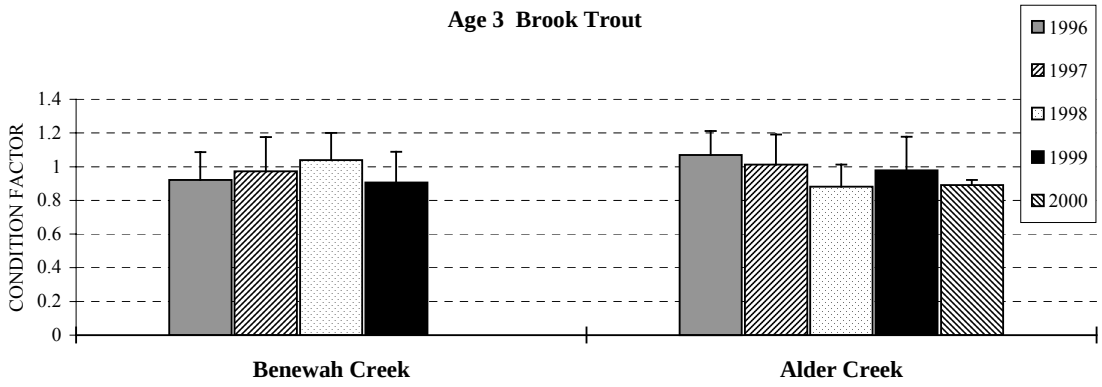


Figure 46. Condition factor of age 3 brook trout collected during summer population estimates (mean ± s.d.).

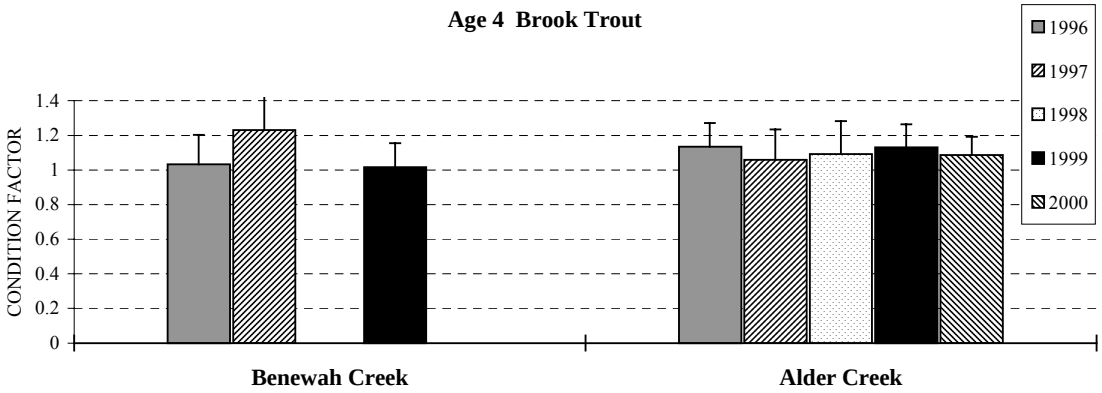


Figure 47. Condition factor of age 4 brook trout collected during summer population estimates (mean ± s.d.).

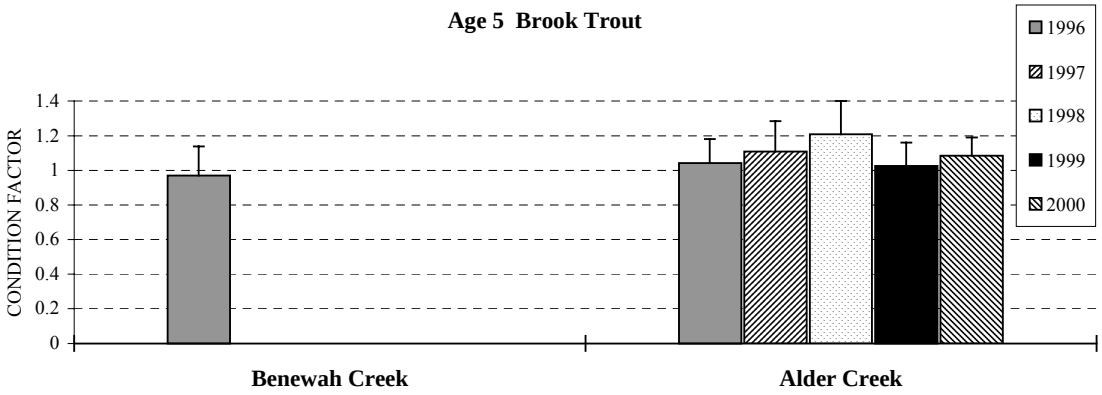


Figure 48. Condition factor of age 5 brook trout collected during summer population estimates (mean ± s.d.).

Table 27. Kruskal-Wallis test of mean length, weight and condition factor of westslope cutthroat trout collected during summer population estimates in Benewah, Alder, Lake and Evans Creeks for the years 1996-2000. Bold type is significant at a =0.05. H_o: length, weight and condition factor of westslope cutthroat trout are equal from Benewah, Alder, Lake and Evans Creeks.

Variable	Age	H	P-value
Length	1	2.97	0.40
	2	2.67	0.45
	3	2.78	0.43
	4	6.45	0.09
	5	2.53	0.47
Weight	1	2.19	0.54
	2	2.14	0.55
	3	1.64	0.65
	4	7.65	**0.05**
	5	3.29	0.35
Condition Factor	1	1.97	0.58
	2	3.43	0.33
	3	0.81	0.85
	4	1.78	0.62
	5	4.91	0.18

Table 28 Mann-Whitney test of mean length, weight and condition factor of brook trout collected during summer population estimates in Benewah and Alder Creeks for the years 1996-2000. Bold type is significant at a =0.05. H_o: length, weight and condition factor of brook trout are equal from Benewah and Alder Creeks.

Variable	Age	U	Z	P-value
Length	1	14	-0.98	0.33
	2	15	-0.52	0.60
	3	14	-0.98	0.33
	4	14	-1.94	**0.05**
	5	4	-0.88	0.38
Weight	1	12	-0.49	0.62
	2	16	-0.73	0.47
	3	16	-1.47	0.14
	4	13	-1.64	0.10
	5	3	-0.29	0.77
Condition Factor	1	12	-0.49	0.62
	2	14	-0.31	0.75
	3	10	0.00	1.00
	4	10	-0.75	0.46
	5	5	-1.46	0.14

Population Trends

Power Analysis

At the current level of sampling effort, all streams, except Lake Creek have at least an 80% probability to detect a 10% increase in the cutthroat trout population at an alpha level of 0.20 (*Figures 49-52*). Benewah Creek (16 sites) and Evans Creek (10 sites) have the highest power to detect trends in westslope cutthroat trout population. Lake Creek has the lowest power of the four streams, only having 77% power to detect a 10% increase in the cutthroat trout population at

an alpha level of 0.20 (*Figure 52*). Lake Creek exhibited the highest increase in power to detect positive trends when five additional sites were added (*Figure 52*). Alder Creek and Lake Creek had the highest increase in power to detect negative trends (*Figures 49 and 52*). Power did not increase as dramatically for Evans and Benewah Creeks (*Figures 50 and 51*) when five additional sites were added. One aspect to note in this analysis is that currently, adequate power (at least .80) only exists for detecting coarse population change, i.e. 8-10%. In all four populations, adding five sample sites did not increase the resolution to detect more subtle changes, i.e. 0-3%.

When accounting for all sites, the addition of an extra sample per year in each reach does not increase power as effectively as did the addition of five extra sites (*Figures 53-56*). Given the fact that it also doubles the effort makes this method less appealing. Even so, Lake Creek would benefit most from the sampling each site twice per year (*Figure 56*).

Figure 57 presents the power when all current population estimate sites are combined. This gives an estimate of the overall power to detect trends on a basin-wide scale. The increased sample size increases power by detecting moderate trends (6% and 7%) with 80% and even 90% probability at an alpha level of 0.2. At this level there is a > 90% probability of detecting a +10% change at an alpha level of 0.05 (a 5% probability of committing a type II error). Thus, the current data enables detection of coarse trends at a high power on a basin-wide scale.

Figures 58-61 present power to detect trends in cutthroat trout populations if the streams are sampled annually for the next five and ten years. This would produce at least an 11 year time series of annual population estimates. Simulating power to detect changes in westslope cutthroat trout populations in the next five or ten years is important because this time frame coincides with the period when ongoing habitat restoration projects are likely to begin providing more habitat for rearing and spawning. These additional five and ten year simulations reveal the dramatic effect that sampling consistently over time has toward increasing the power to detect changes in populations. For example, in Benewah Creek an additional five years of population estimate sampling reveals an 80% probability of detecting a +4%, or a –4% change at an alpha level of 0.05 (*Figure 59*). An additional 10 years of sampling on Benewah Creek allows a 90% probability of detecting a +3% or –7% at an alpha level of 0.05 (*Figure 59*). For Lake Creek, an additional five years of population estimate sampling allows an 80% probability of detecting a +8% change at an alpha level of 0.05. (*Figure 61*), a dramatic increase in power compared to the power estimates for Lake Creek in *Figure 52*. Alder and Evans Creeks (*Figures 58 and 60*) exhibit the same significant increases in power at lower alpha levels as Benewah and Lake Creeks.

Figure 62 shows the power to detect changes in brook trout density in Alder Creek if the current sites are sampled twice per year. The addition of the extra annual sampling period improves power, allowing for over 90% probability to detect a 10% increase in the brook trout population at an alpha level of 0.05, as compared to the 75% probability to detect a 10% increase in the brook trout population at the same alpha level with the current sampling frequency of once per year. The power drops significantly when trying to detect a 4% increase or decrease (*Figure 62*). Adding additional five sites to the current number of sites in Alder Creek produces similar results as sampling twice per year (*Figure 63*). The greatest increase in power comes from addition of 5 and 10 years of population estimates (*Figure 64*). Adding an additional 10 years will allow for a 90% probability to detect a 3% increase or decrease in the brook trout abundance

at an alpha level of 0.10, or a 10% probability of committing a type II error (not detecting a change when one actually occurred).

The power to detect changes in brook trout abundance in Benewah Creek is much lower than in Alder Creek (*Figures 65-67*). The current sampling effort can only detect coarse-scale changes in brook trout abundance. Power did not increase as dramatic when an additional annual sampling period was added (*Figure 65*), or when 5 additional sites were added (*Figure 66*). At best addition of 5 sites or sampling current sites twice annually only allows an 80% probability to detect a positive 10% change in brook trout abundance (*Figure 66*). However, as with Alder Creek, if Benewah Creek is sampled for the next 10 years, the ability to detect fine-scale changes increases dramatically (*Figure 67*)

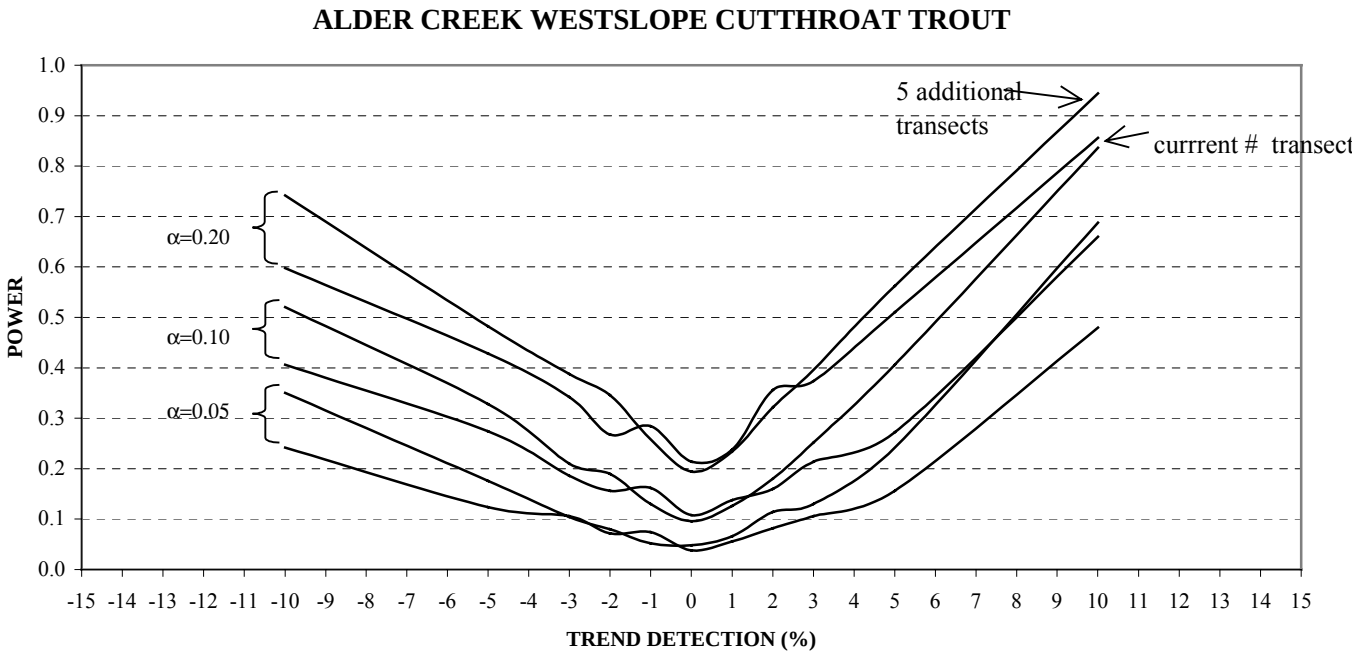


Figure 49. Power analysis of westslope cutthroat trout population estimates from Alder Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 12 sites, and what the power to detect would be if additional sites were sampled. Three levels of significance were simulated, α=0.05, 0.10 and 0.20. The program used for the Monte Carlo simulations was the MONITOR program (Gibbs, 1995).

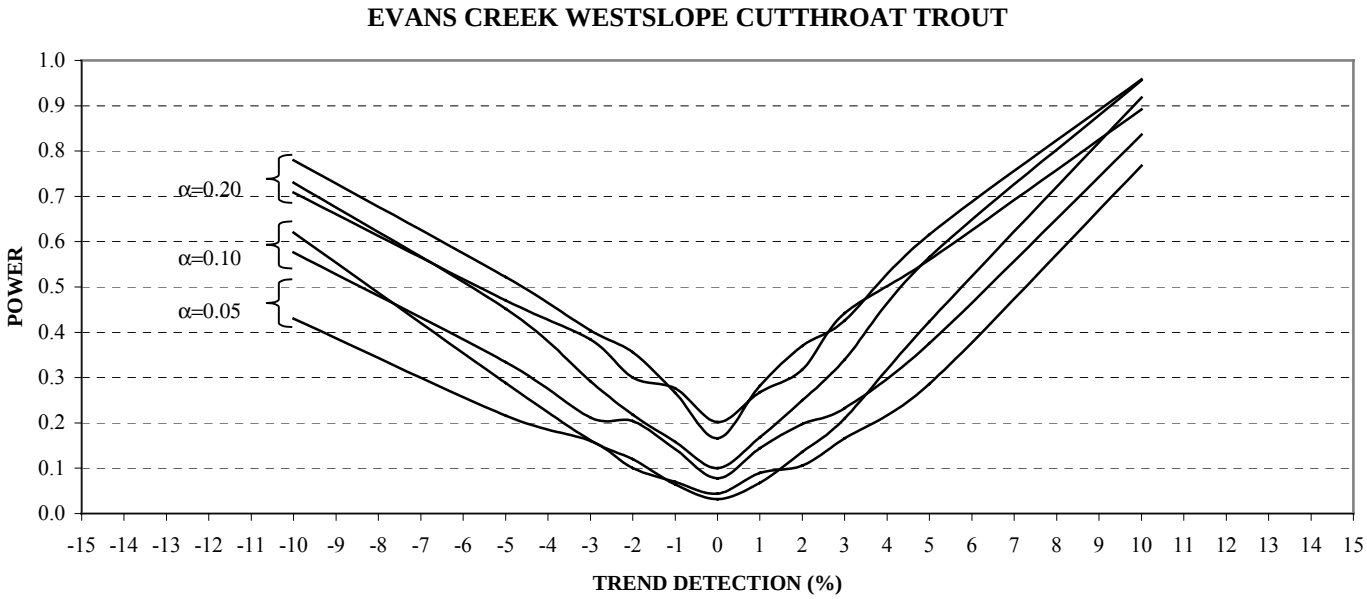


Figure 50. Power analysis of westslope cutthroat trout population estimates from Evans Creek, CDA Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 10 sites, and what the power to detect would be if additional sites were sampled. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

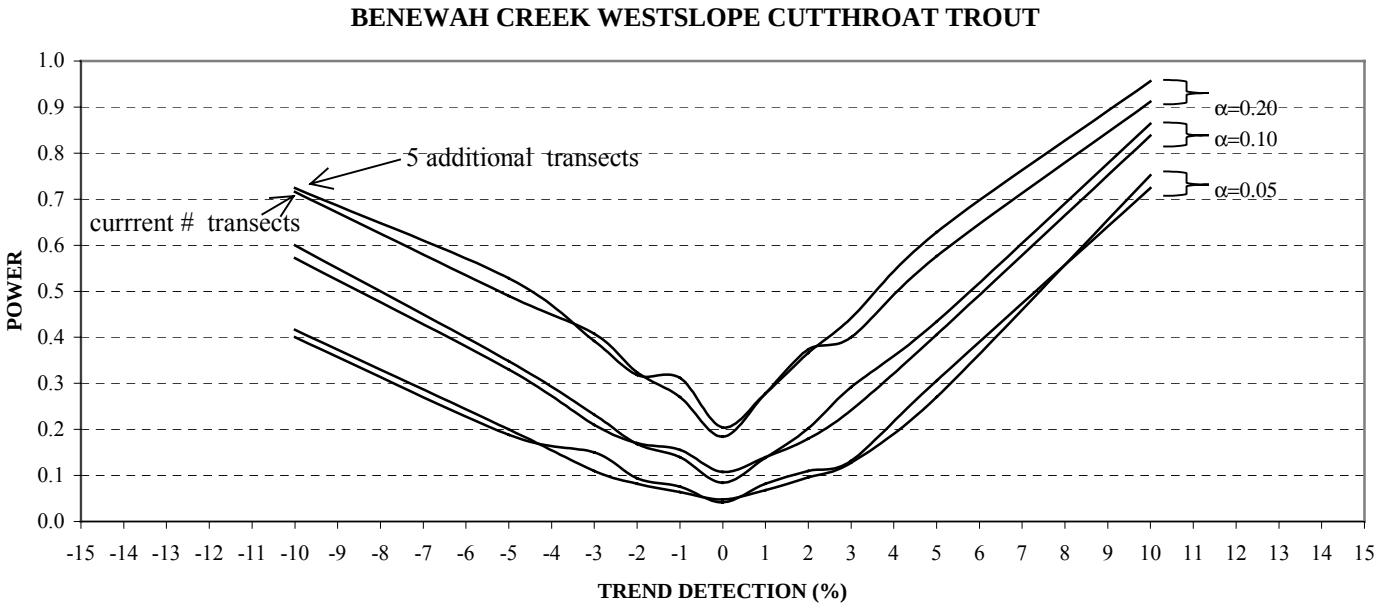


Figure 51. Power analysis of westslope cutthroat trout population estimates from Benewah Creek, CDA Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 16 sites, and what the power to detect would be if additional sites were sampled. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

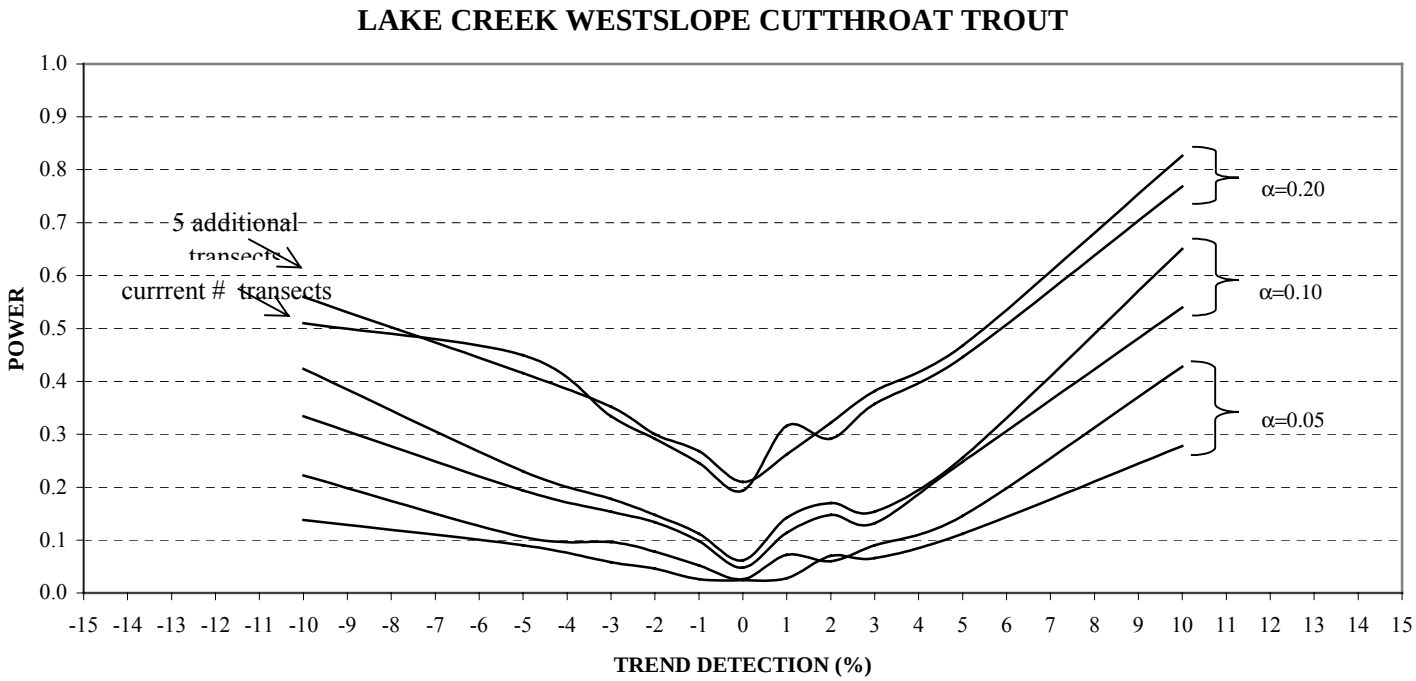


Figure 52. Power analysis of westslope cutthroat trout population estimates from Lake Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 10 sites, and what the power to detect would be if additional sites were sampled. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

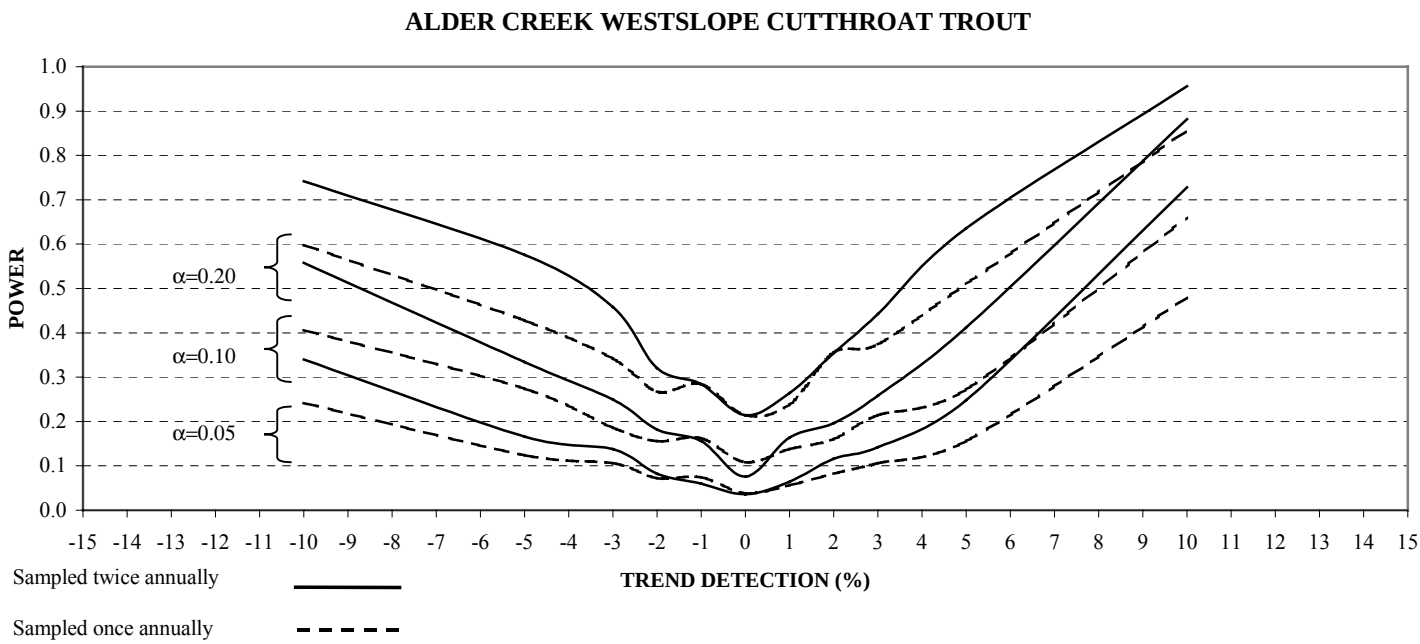


Figure 53. Power analysis of westslope cutthroat trout population estimates from Alder Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 12 sites, and what the power to detect would be if sites were sampled twice per year. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

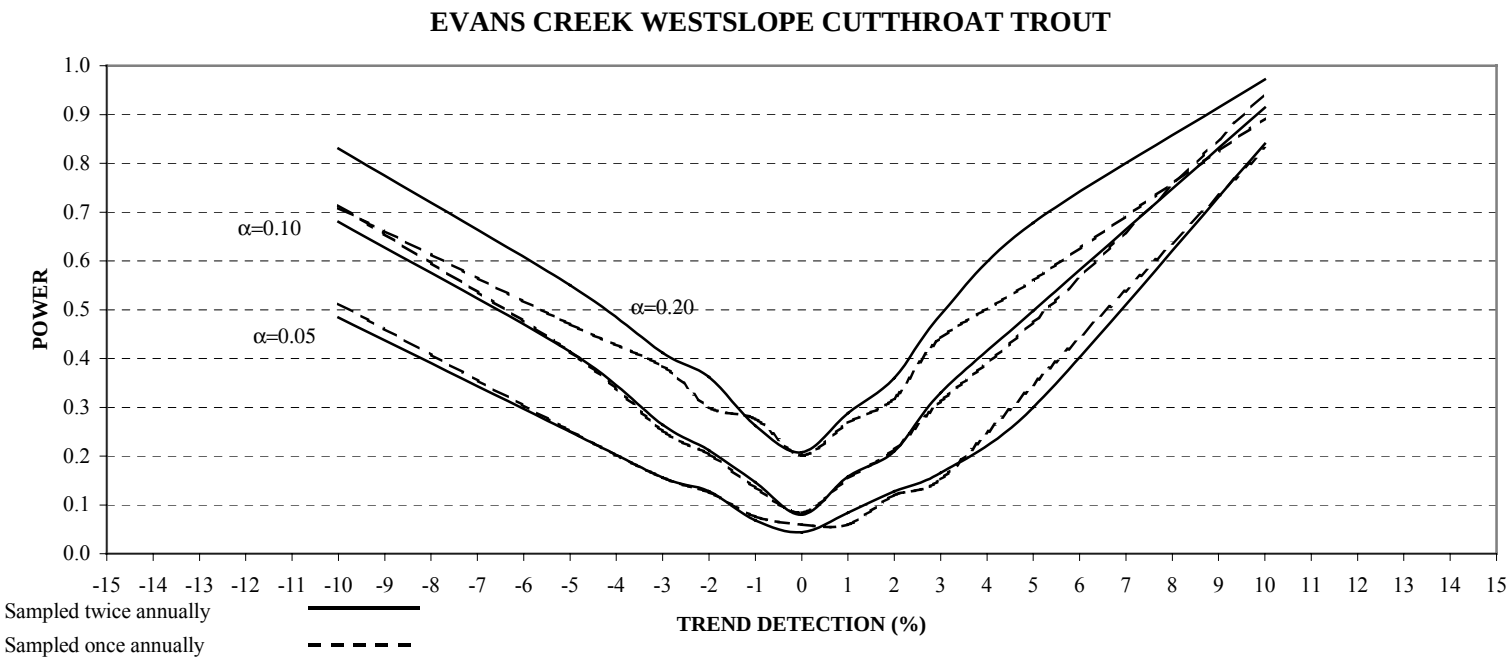


Figure 54. Power analysis of westslope cutthroat trout population estimates from Evans Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 10 sites, and what the power to detect would be if sites were sampled twice per year. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

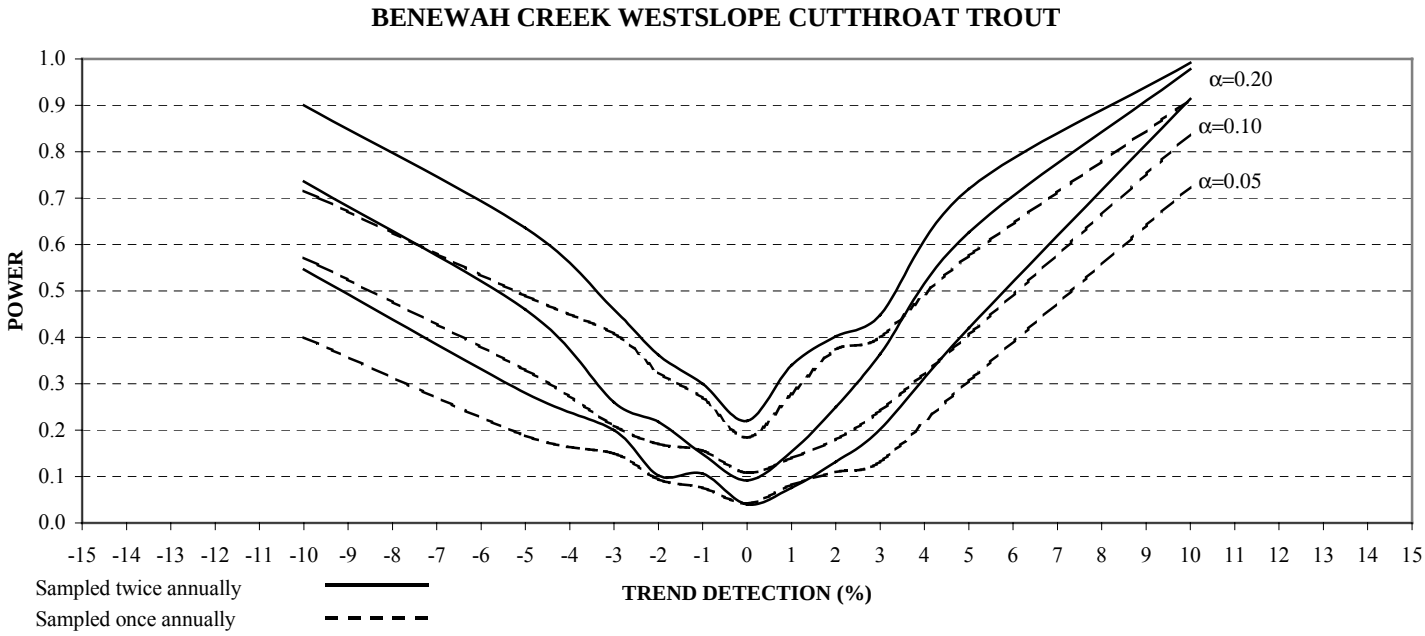


Figure 55. Power analysis of westslope cutthroat trout population estimates from Benewah Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 16 sites, and what the power to detect would be if sites were sampled twice per year. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

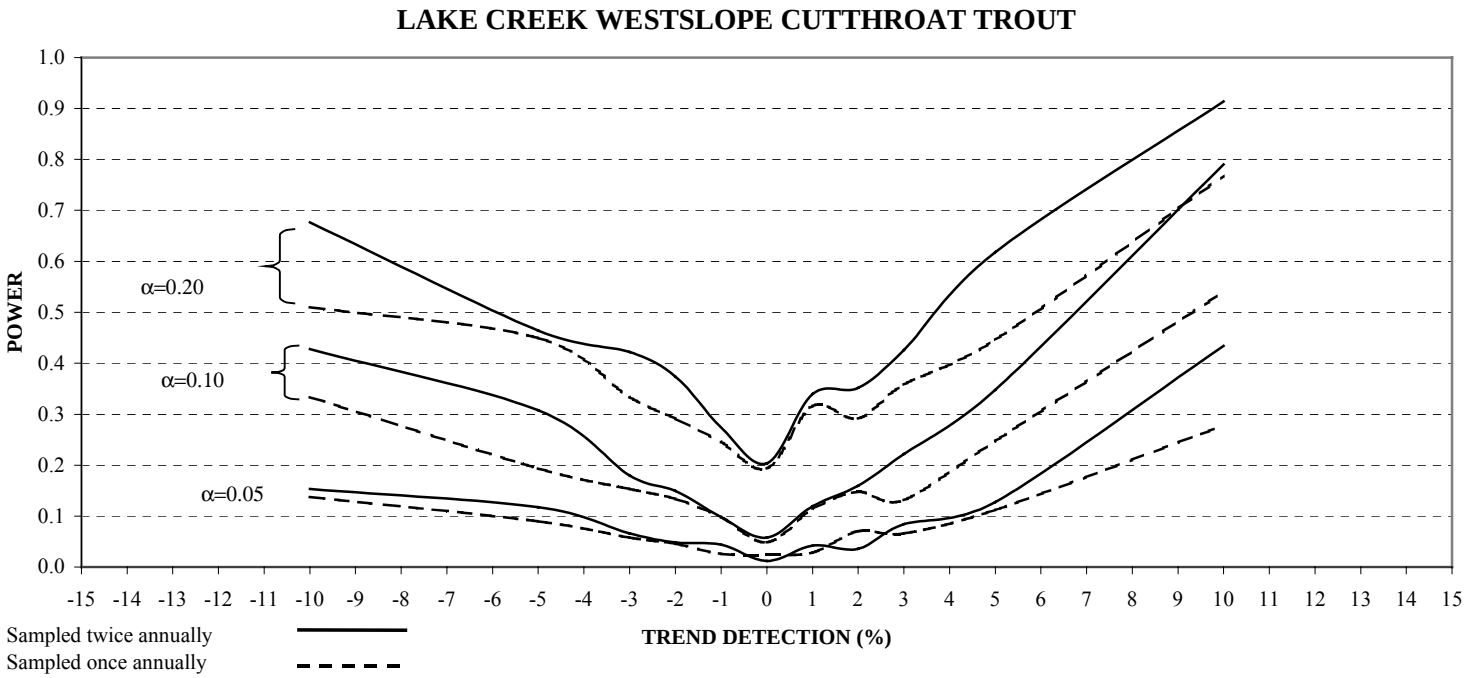


Figure 56. Power analysis of westslope cutthroat trout population estimates from Lake Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 10 sites, and what the power to detect would be if sites were sampled twice per year. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

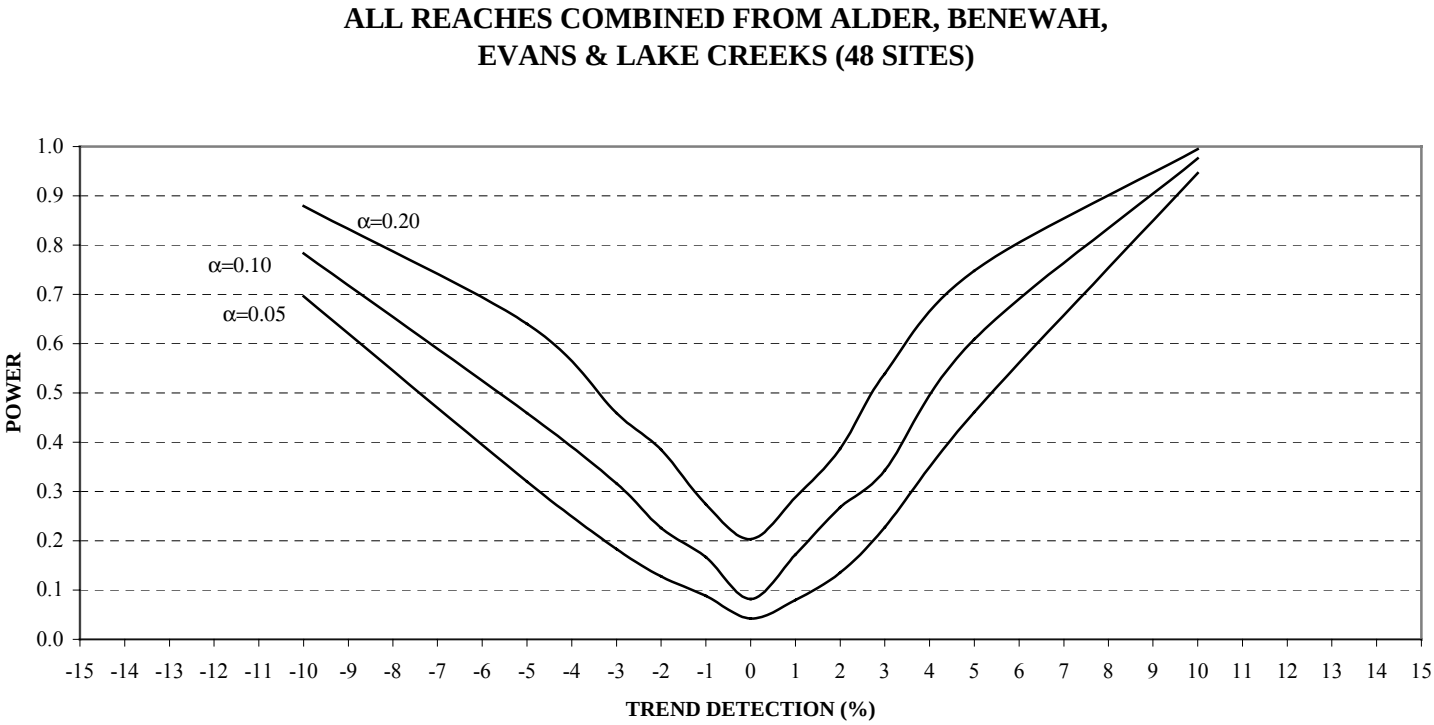


Figure 57. Power analysis of westslope cutthroat trout population estimates from 48 sample reaches, combined from Alder, Benewah, Evans and Lake Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

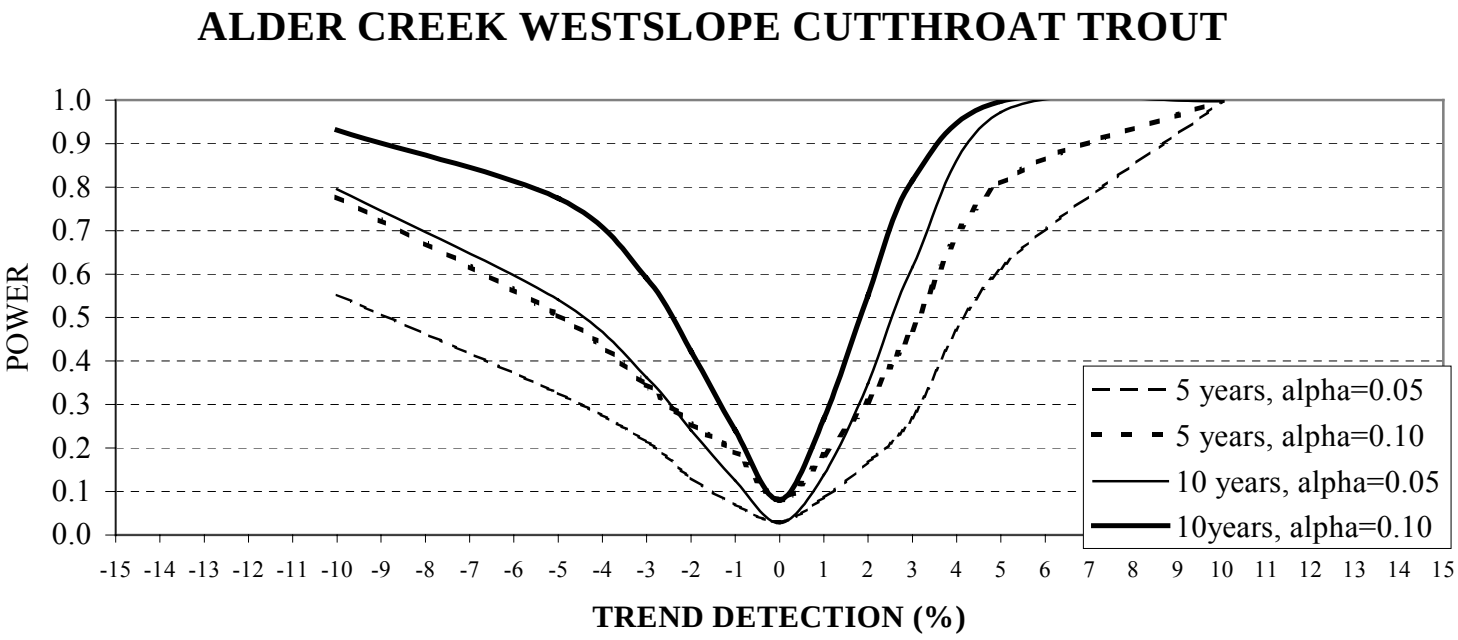


Figure 58. Power analysis of westslope cutthroat trout population estimates from Alder Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 12 sites if they were sampled annually for the next 5 and 10 years. Two levels of significance were simulated, α=0.05, 0.10.

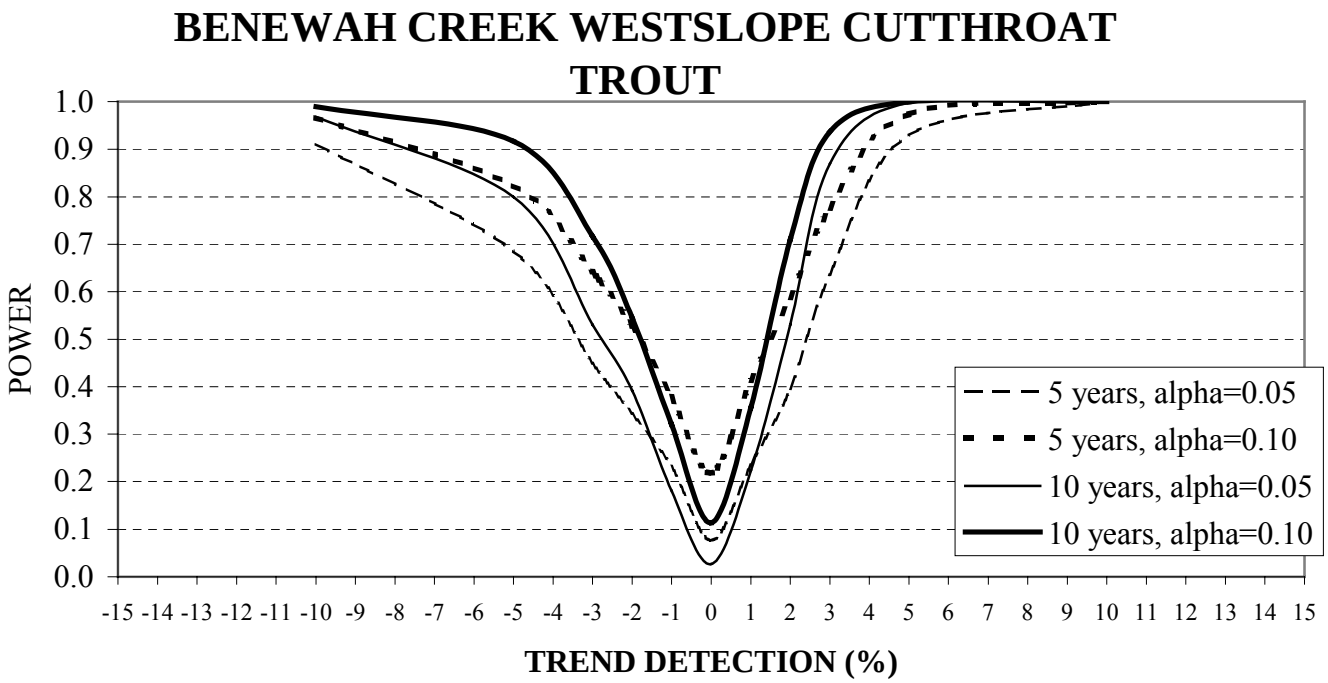


Figure 59. Power analysis of westslope cutthroat trout population estimates from Benewah Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 16 sites if they were sampled annually for the next 5 and 10 years. Two levels of significance were simulated, α=0.05, 0.10.

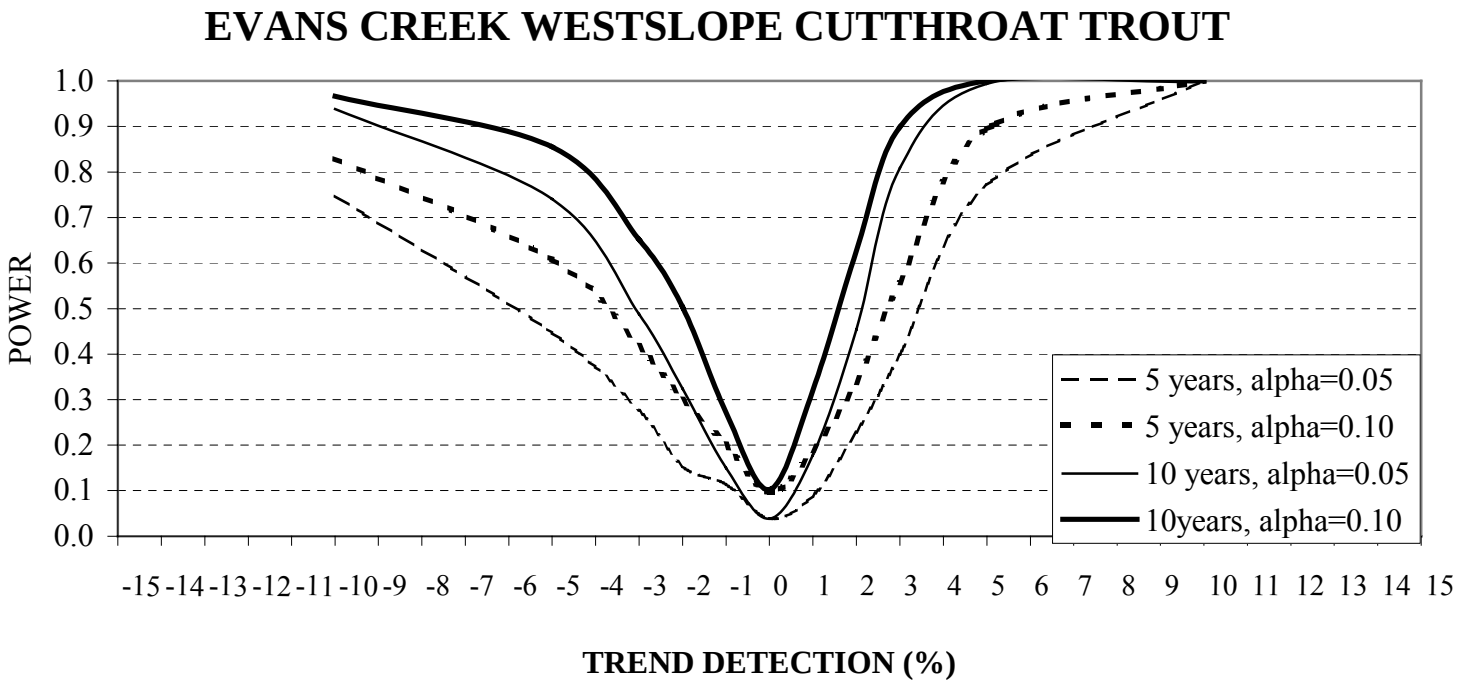


Figure 60. Power analysis of westslope cutthroat trout population estimates from Evans Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 10 sites if they were sampled annually for the next 5 and 10 years. Two levels of significance were simulated, α=0.05, 0.10.

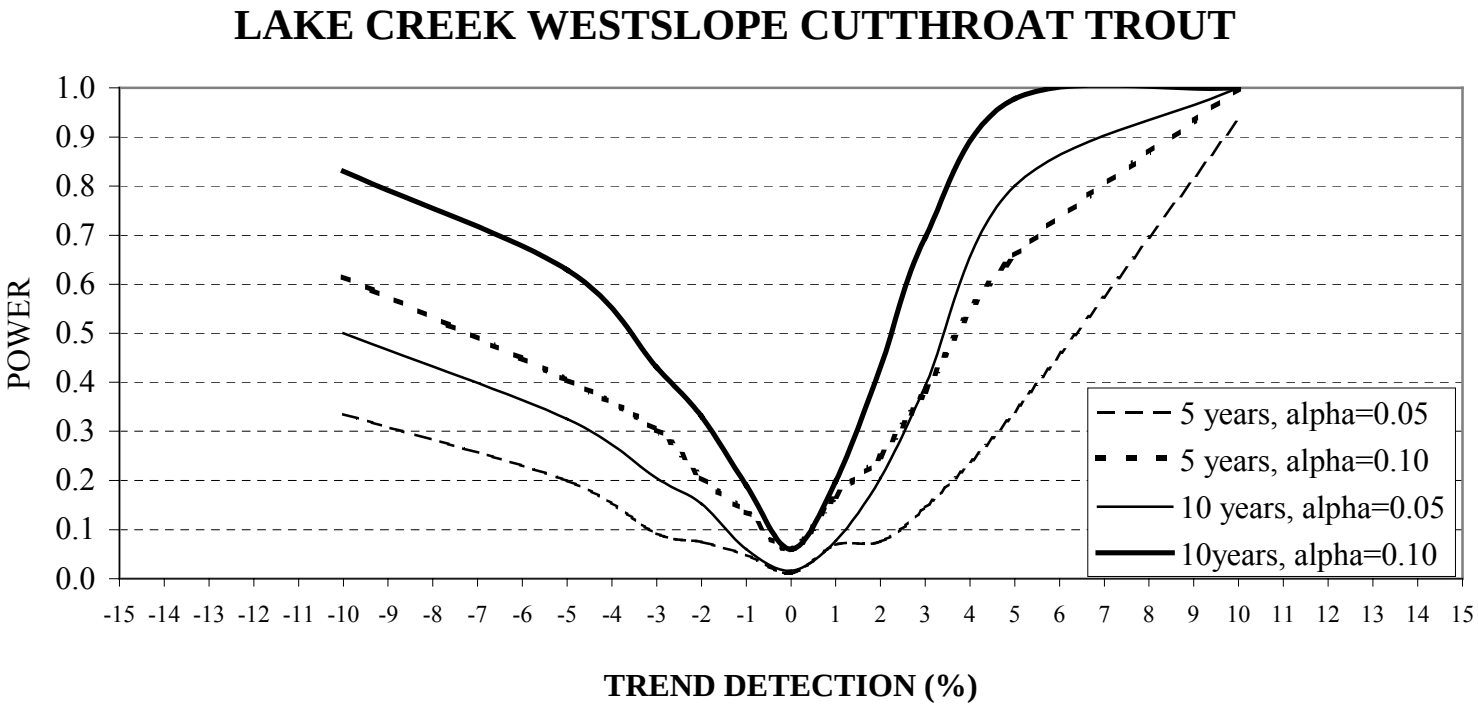


Figure 61. Power analysis of westslope cutthroat trout population estimates from Lake Creek, CDA Tribe Reservation. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 10 sites if they were sampled annually for the next 5 and 10 years. Two levels of significance were simulated, α=0.05, 0.10.

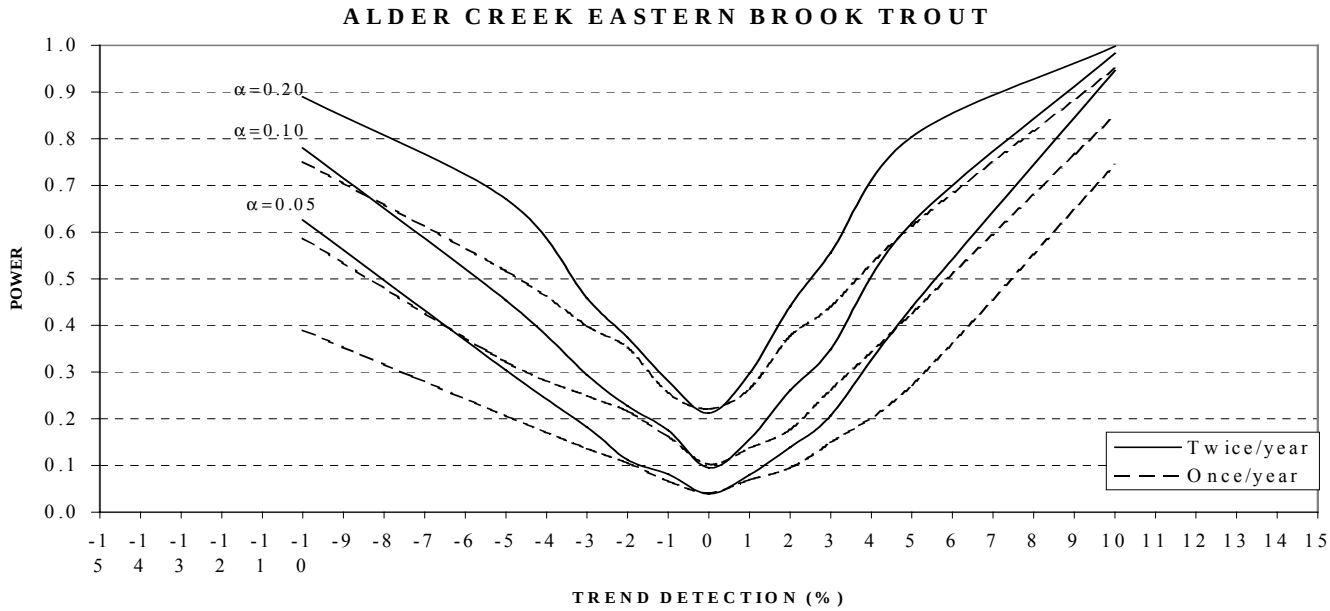


Figure 62. Power analysis of brook trout population estimates from Alder Creek. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 12 sites if they were sampled twice annually. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

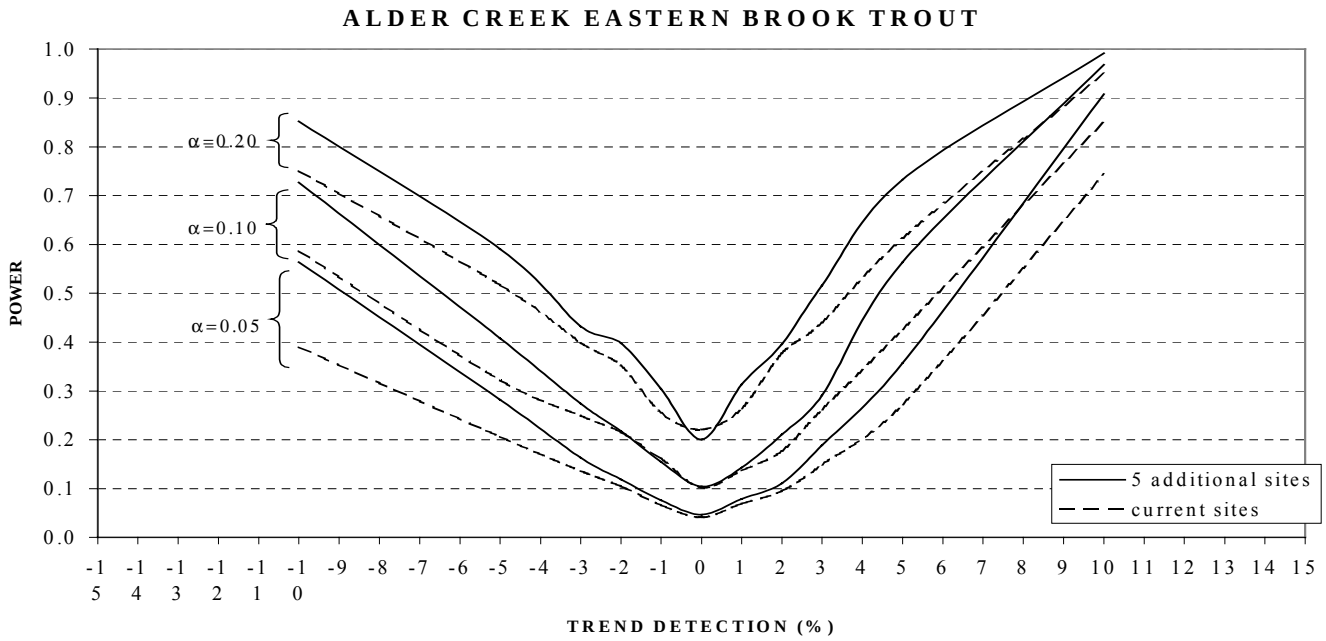


Figure 63. Power analysis of brook trout population estimates from Alder Creek. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 12 sites if 5 additional sites were added. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

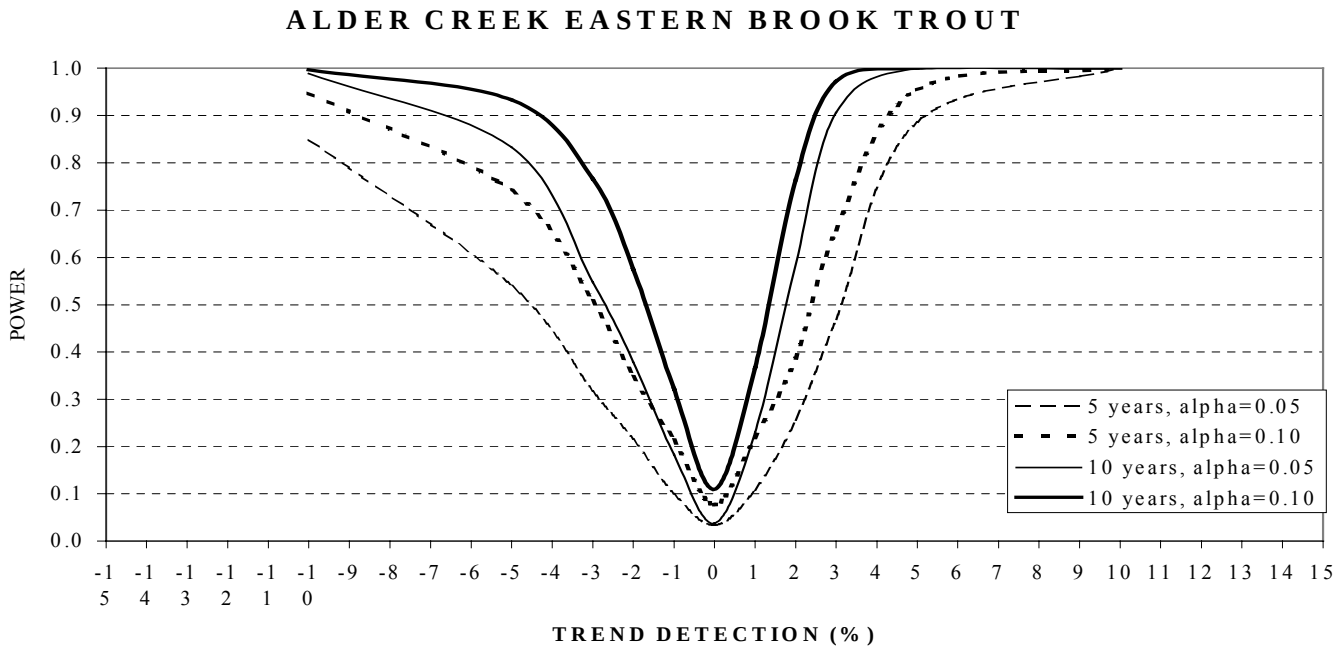


Figure 64. Power analysis of brook trout population estimates from Alder Creek. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 12 sites if they were sampled annually for the next 5 and 10 years. Two levels of significance were simulated, α=0.05, 0.10.

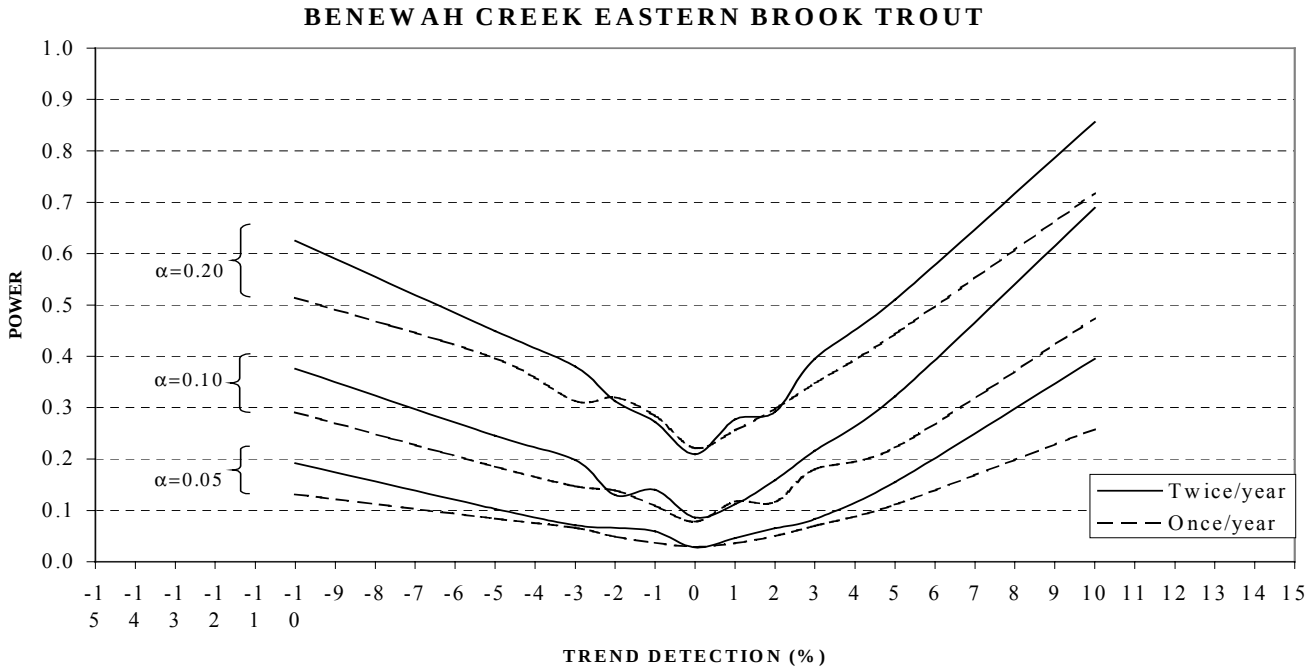


Figure 65. Power analysis of brook trout population estimates from Benewah Creek. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 11 sites if they were sampled twice annually. Three levels of significance were simulated, α=0.05, 0.10 and 0.20. The program used for the Monte Carlo simulations was the MONITOR program (Gibbs, 1995).

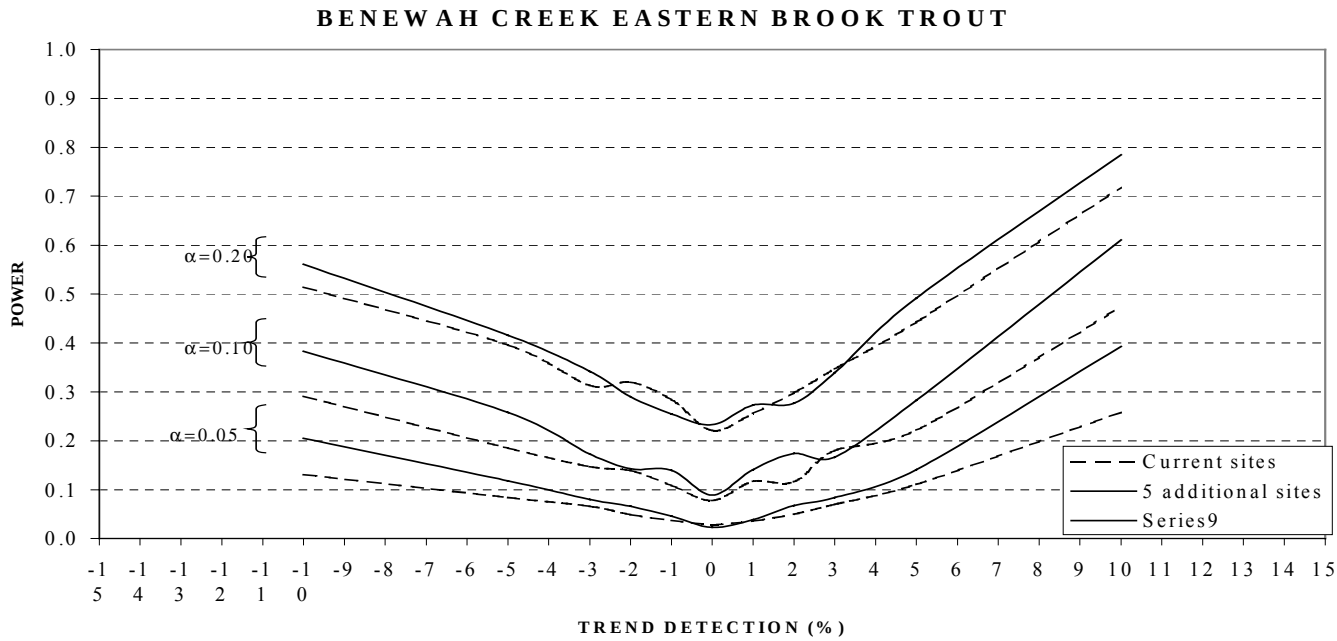


Figure 66. Power analysis of brook trout population estimates from Benewah Creek. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 11 sites if 5 additional sites were added. Three levels of significance were simulated, α=0.05, 0.10 and 0.20.

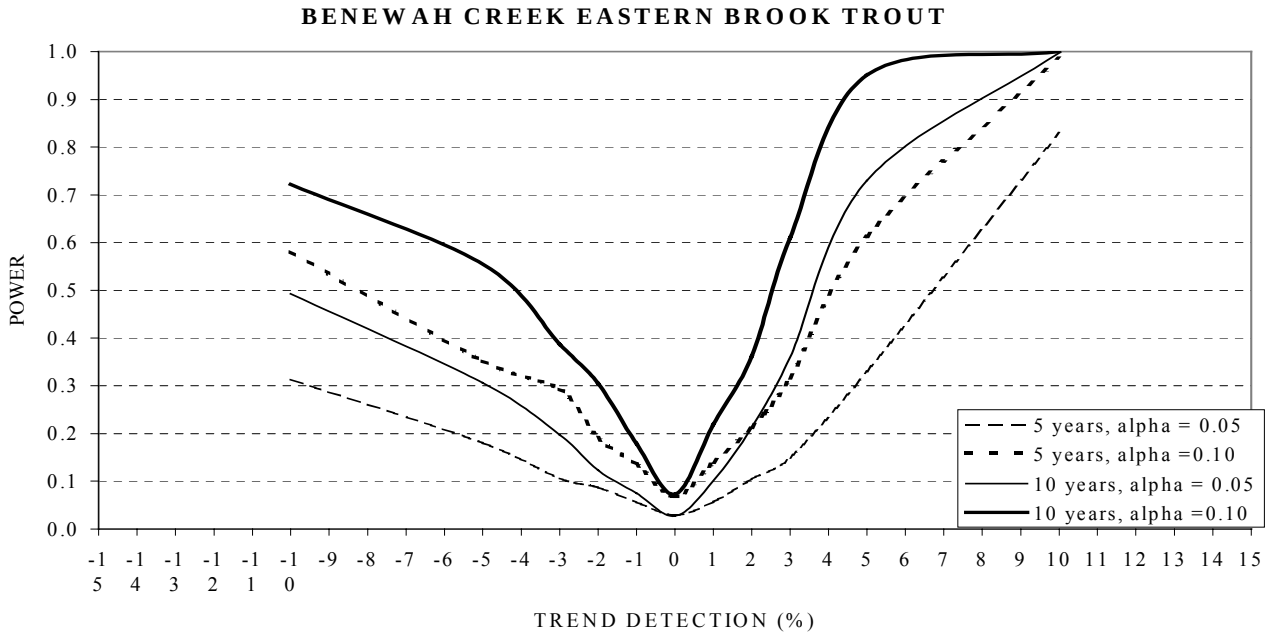


Figure 67. Power analysis of brook trout population estimates from Benewah Creek. Power analysis was done to estimate power to detect a positive or negative % change in the population from the current 11 sites if they were sampled annually for the next 5 and 10 years. Two levels of significance were simulated, α=0.05, 0.10.

Trout Migration

Table 29 presents a summary of the fish collected and recaptured in migration traps for the years 1996 through 2001. The number of fish captured is highly variable from year to year and this variability is thought to be as much a reflection of capture efficiency as it is of differences in year class strength. Total number of salmonids captured ranged from a high in 1998 of 1813 fish to a low in 1999 of 223 fish. The recapture percentage for adult fish has been very low, ranging from 0-17.6 percent of tagged adults. The recapture percentage is not well correlated to run size but is correlated to discharge, with capture efficiency being greatest during sustained periods of relatively consistent, low runoff. Adult fish (Age 4+) have comprised 11.1% (sd.=6.1%) of the total run size on average.

Table 29. Summary of fish tag and recapture data from Coeur d'Alene Reservation streams, 1996 - 2001. All fish, unless otherwise noted are westslope cutthroat trout.

Year	Total # captured	Total # tagged	Total # Recaptured	% Recaptured	BLT Recaptured	EBT Recaptured
1996	920	34	6	17.6	0	0
1997	299	14	0	0	0	0
1998	1813	128	11	8.6	0	4
1999	223	41	2	4.9	1	0
2000	771	133	3	2.3	0	9
2001	533	82	1	1.2	0	1
Totals =	**4559**	**432**	**23**	**5.3**	**1**	**14**

The age composition of outmigrating westslope cutthroat trout from Benewah and Lake creeks indicates that age 2 and 3 cutthroat dominate, while age 1 and 4 migrants comprise only 3-7% of the total (*Figure 69*). The large error bars associated with age 2 and 3 fish are due to age 3 dominating in 1998, when the age 3 outmigrants comprised >70%. However, in 1996, 1997 and 1999, age 2 outmigrants dominated comprising 70-80%.

Comparison of the mean length, weight and condition factor between outmigrating age 2, 3 and 4 westslope cutthroat trout indicate that there were no significant differences in length, weight and condition factor between the cutthroat trout outmigrants from Benewah and Lake Creeks (*Figure 68 and Table 30*). The mean condition factor of the outmigrants (March-April) is lower than for cutthroat trout sampled during population estimates in September.

The mean length and weight of pre-spawn adult westslope by age is similar for Benewah and Lake creeks. In both watersheds, this group is dominated by large cutthroat trout age 6 and older. Comparison of Benewah and Lake Creek cutthroat trout with adfluvial westslope cutthroat trout from Flathead Lake indicates that the length at age is similar between these systems. The largest fish trapped was 465 mm and was 10 years old (*Table 31*).

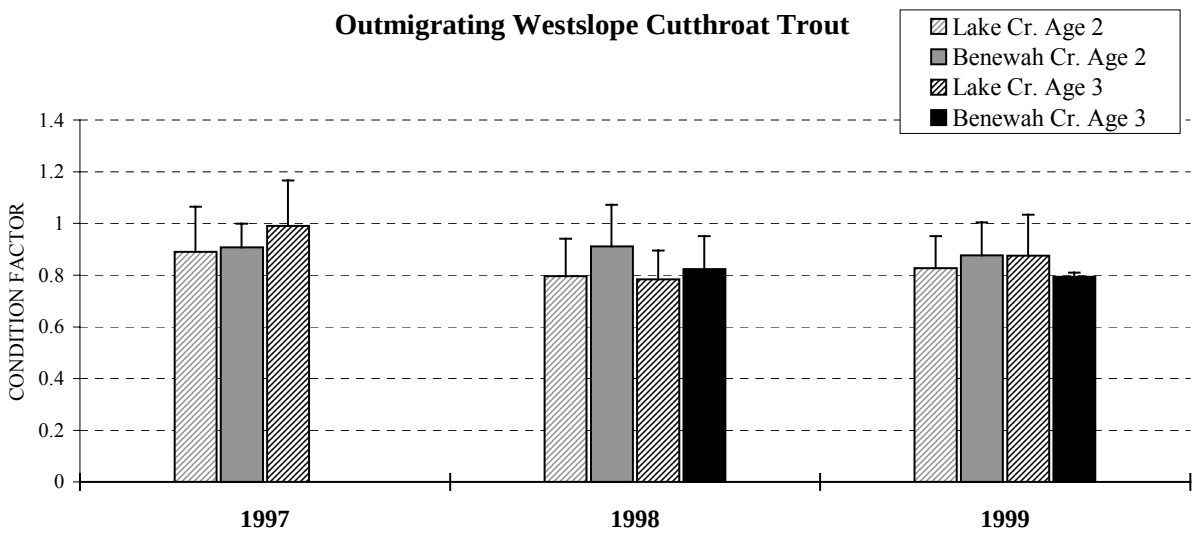


Figure 68. Condition factor of age 2 and 3 westslope cutthroat trout collected in outmigration traps in Lake and Benewah Creeks (mean ± s.d.).

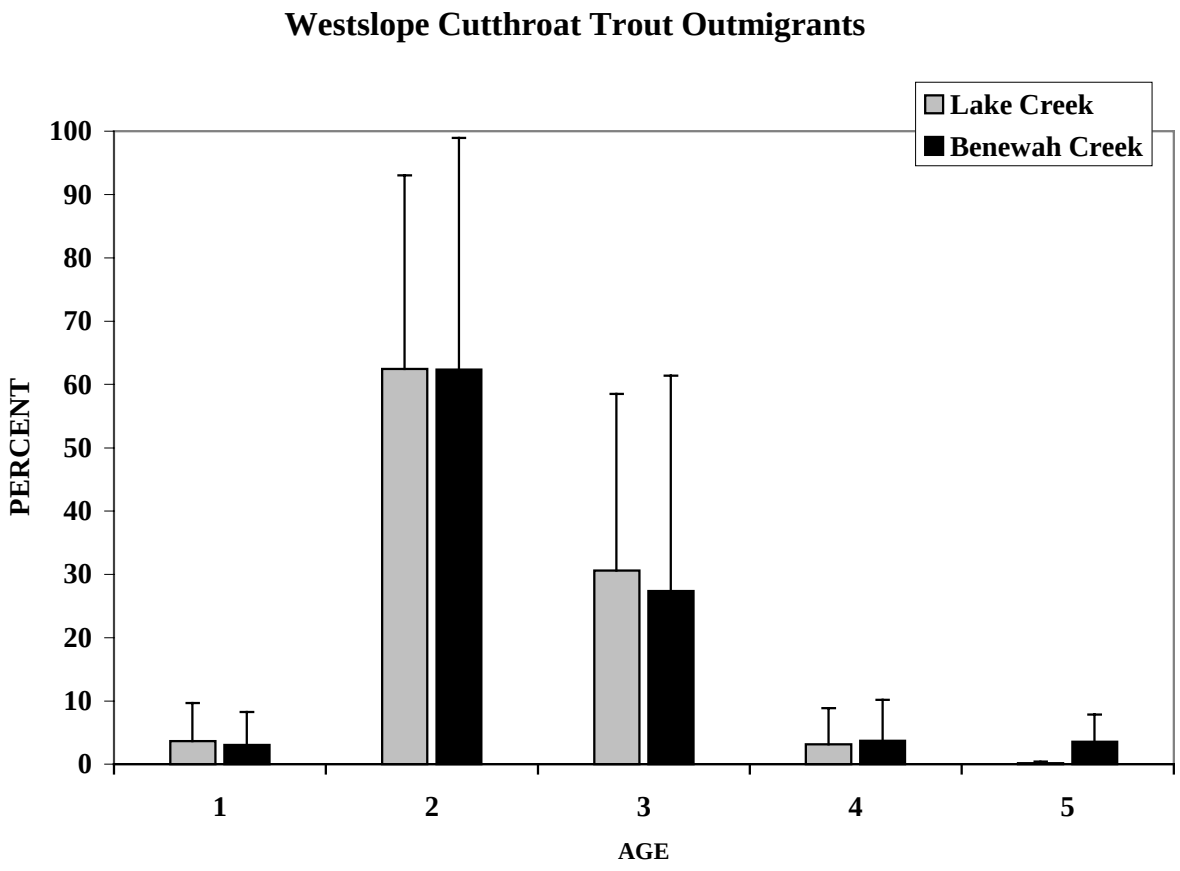


Figure 69. Age composition of westslope cutthroat trout collected from outmigrant traps in Lake and Benewah Creeks from 1996-1999. (mean ± s.e.).

Table 30. Mann-Whitney test of mean length, weight and condition factor of westslope cutthroat trout collected in out-migrant traps in Benewah and Lake Creeks for the years 1996-2000. Bold type is significant at a =0.05. H_o: length, weight and condition factor of westslope cutthroat trout are equal from Benewah and Lake Creeks.

Variable	Age	U	Z	P-value
Length	2	7	-0.35	0.72
	3	6	-0.93	0.36
	4	1	0.00	1.00
Weight	2	6	0.00	1.00
	3	6	-0.93	0.36
	4	2	-1.23	0.22
Condition Factor	2	11	-1.77	0.08
	3	6	-0.93	0.36
	4	2	-1.23	0.22

Table 31. Comparison of length and weight data from lacustrine-adfluvial Westslope cutthroat trout sampled from migrant traps in Lake and Benewah Creeks (1996-1999) and Flathead Lake, Montana (1962-1980).

System	Age	n	Length (mm)	Weight (g)
Lake Creek CDA	6	6	335.0 ± 13.5	343.8 ± 51.7
	7	8	349.1 ± 9.4	363.4 ± 42.2
	8	2	387.0	492.5
	10	1	456.0	698.0
Benewah Creek CDA	6	7	330.0 ± 14.1	279.1 ± 41.4
	7	9	358.1 ± 7.4	399.3 ± 28.9
	8	1	420.0	654.0
Flathead Lake[1] Montana (1962-1980) n = 318	6		330	
	7		364	
	8		413	

[1] Leathe and Graham (1981)

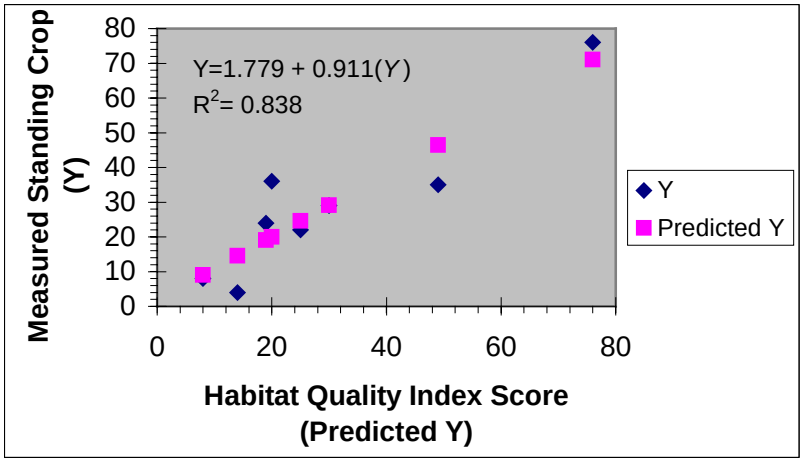
Habitat Quality

When HQI scores ($\hat{Y}$) were plotted against a three-year mean of measured trout standing crop (Y), the scatter of data points was best fitted by the linear equation $Y = 1.779 + 0.911(\hat{Y})$ (*Figure 70*). The model explained 83% of the variation in trout standing crop for 8 stream reaches that were tested in the Lake, Alder, Benewah and Evans creek watersheds. A high correlation coefficient (R = 0.915) suggested a strong relationship between HQI score and trout standing crop (*Table 32*).

For two tributaries (Evans Creek and SE Benewah Creek), there was considerable deviation between measured and predicted values. In Evans Creek, a history of human intervention probably explains the difference between these values. Evans Creek served as a source of brood stock for state sponsored stocking programs, and adfluvial adults were captured and removed throughout the 1970's and early 1980's (personal communication, IDFG). We believe this resulted in complete failure of multiple year classes, and compensatory survival (a result of decreased competition and increased growth in response to favorable conditions) has not yet

resulted in reseeding of available habitats. Reasons for the discrepancy between measured and predicted values in SE Benewah are unknown but may be a result of underseeded habitat or the effects of competitive interactions between cutthroat and brook trout, which comprise up to 38% of the salmonid biomass.

Figure 70. Relationship between HQI score and trout standing crop (kg/hectare) at 8 tributaries evaluated with HQI Model II.



Manipulation of the model attributes that are thought to be most responsive to restoration activities, including instream cover, streambank erosion, and maximum summer water temperature, resulted in increases in both standing crop (kg/hectare) and the number of juvenile fish. Improving the instream cover and eroding streambank attributes by a 5% increment in all tributaries that did not receive the highest attribute rating predicted a 3.7% increase in biomass compared with current values. This potential for response is thought to be achievable in a 10-year post-restoration time frame as reflected in *Tables 32 and 33*. Improving the instream cover and eroding streambank attributes by an additional 5% increment and decreasing maximum summer water temperature by 1°C in all tributaries that exceed 17°C, resulted in a 25% increase in biomass and 34.7% increase in the number of juveniles compared with 1998 values. This potential response is reflected in the 20-year post-restoration scenarios shown in *Tables 32 and 33*. The 20+-year post-restoration prediction constitutes a 117.1% increase in the total number of juveniles compared with 1998 values (*Table 34*). This prediction was arrived at by improving the instream cover and eroding streambank attributes by an additional 5% increment in all tributaries that did not receive the highest attribute rating. In addition, maximum summer water temperature was decreased by 1°C in all tributaries that exceeded 16.8°C.

Table 32. Carrying capacity predictions for juvenile cutthroat trout in tributaries on the Coeur d'Alene Reservation under post-restoration scenarios representing 10-20+ year recovery time frames.

	Standing Crop (kg/hectare)				Number of Juveniles			
Tributary	**1998**	**10 year**	**20 year**	**20+ year**	**1998**	**10 year**	**20 year**	**20+ year**
Lake Creek (Lower)	8	9	24	27	1,036	1,165	3,108	3,496
Lake Creek (Upper)	49	49	68	108	7,322	7,322	10,161	16,138
Evans Creek	122	122	158	250	18,129	18,129	23,478	37,149
N.F. Alder Creek	30	33	45	83	1,132	1,245	1,698	3,333
Alder Creek	25	28	37	37	4,211	4,716	6,232	9,510
Benewah Creek (mainstem)	14	14	14	39	4,577	4,577	4,577	13,313
S.E. Fork Benewah	95	100	130	130	2,401	2,527	3,285	3,655
West Fork Benewah	76	80	80	80	1,200	1,263	1,263	964
Whitetail Creek	19	19	25	43	461	461	607	863
Windfall Creek	20	22	30	51	828	910	1,241	1,229
Totals	458	476	611	848	41,295	42,316	55,650	89,650

Table 33. Habitat Quality Index attribute measurement data, ratings and calculations for stream reaches in select tributaries on the Coeur d'Alene Reservation.

Habitat Quality Index attribute measurement data, ratings and calculations for tributaries of the Coeur d'Alene Reservation, based on current conditions (1998).

Attribute	Model symbol	Lake Creek below Elder Rd		Lake Creek upper		Evans Creek		N.F. Alder Creek		Alder Creek		Benewah Creek below 9mile		S.E. Benewah		W.F. Benewah		Whitetail		Windfall	
		Data	Rating	Data	Rating	Data	Rating	Data	Rating	Data	Rating	Data	Rating	Data	Rating	Data	Rating	Data	Rating	Data	Rating
Late summer stream flow	X1	CPF=6%ADF	0	CPF=10%ADF	1	CPF=16%ADF	2	CPF=6%ADF	1	CPF=6%ADF	1	CPF=10% ADF	1	CPF=10%ADF	1	CPF=9%ADF	1	CPF=4%ADF	0	CPF=7%ADF	0
Annual stream flow variation	X2		2		2		3		2		2		2		2		1		1		1
Maximum summer water temperature (°C)	X3	22.6	1	18.0	3	17.1	3	20.1	2	21.4	2	23.1	1	16.8	4	16.2	4	18.6	3	24.3	3
Nitrate nitrogen (mg/l)	X4	0.10	3	0.05	2	0.10	3	0.05	2	0.05	2	0.12	3	0.06	2	0.30	3	0.05	2	0.05	2
Fish food abundance (number/0.1 m2)	X5	534	4	129	2	535	4	530	4	437	3	499	3	594	4	594	4	594	4	594	4
Fish food diversity	X6	2.41	3	2.41	3	2.35	3	2.29	3	2.29	3	2.25	3	2.25	3	2.25	3	2.25	3	2.25	3
Cover (%)	X7	40	2	35	2	57	4	48	3	25	1	28	2	51	3	54	3	30	2	40	2
Eroding banks (%)	X8	22	3	7	4	8	4	25	2	40	2	45	2	8	4	7	4	9	4	15	3
Substrate	X9		3		3		2		3		3		3		3		3		3		3
Water velocity	X10		2		2		2		2		2		2		2		2		2		2
Stream width (m)	X11	3.6	3	1.5	1	3.6	3	3.7	3	3.6	3	5.0	3	2.7	2	1.6	1	2.0	1	2.1	2
Calculation of trout standing crop																					
X1 + 1			1		2		3		2		2		2		2		2		1		1
X2 + 1			3		3		4		3		3		3		3		2		2		2
X3 + 1			2		4		4		3		3		2		5		5		4		4
P + 1			1296		192		3456		864		216		648		1152		864		384		576
F + 1			18		36		36		24		24		18		48		72		36		36
S + 1			18		8		48		18		6		12		24		12		8		12
Model I - Predicted standing crop (kg/hectare)			10		33		194		34		22		17		79		37		10		11
Model II - Predicted standing crop (kg/hectare)			**8**		**49**		**122**		**30**		**25**		**14**		**95**		**76**		**19**		**20**
Measured standing crop (kg/hectare)																					
1996			5		21		18		34		26		8		25		37		51		23
1997			7		46		24		20		14		2		19		94		13		33
1998			11		36		14		34		26		1		33		98		9		51
Mean			**8**		**35**		**18**		**29**		**22**		**4**		**26**		**76**		**24**		**36**

Table 34. Habitat Quality Index attribute measurement data, ratings, and predictions of trout standing crop based on expected improvements in habitat quality during 10-20+ year post-restoration time frames.

Habitat Quality Index attribute measurement data, ratings and predictions based on expected improvements in habitat quality during 10-year post-restoration time frames.

Attribute	Model symbol	Lake Creek below Elder Rd. Data	Rating	Lake Creek upper Data	Rating	Evans Creek Data	Rating	N.F.Alder Creek Data	Rating	Alder Creek Data	Rating	Benewah Creek below 9mile Data	Rating	S.E. Benewah Data	Rating	W.F. Benewah Data	Rating	Whitetail Data	Rating	Windfall Data	Rating
Late summer stream flow	X1	CPF=6%ADF	0	CPF=10%ADF	1	CPF=16%ADF	2	CPF=8%ADF	1	CPF=8%ADF	1	CPF=10% ADF	1	CPF=10%ADF	1	CPF=9%ADF	1	CPF=4%ADF	0	CPF=7%ADF	0
Annual stream flow variation	X2		2		2		3		2		2		2		2		1		1		1
Maximum summer water temperature (°C)	X3	22.6	1	18.0	3	17.1	3	20.1	2	21.4	2	23.1	1	16.8	4	16.2	4	18.6	3	18.6	3
Nitrate nitrogen (mg/l)	X4	0.10	3	0.05	2	0.10	3	0.05	2	0.05	2	0.12	3	0.06	2	0.30	3	0.05	2	0.05	2
Fish food abundance (number/0.1 m2)	X5	534	4	129	2	535	4	530	4	437	3	499	3	594	4	594	4	594	4	594	4
Fish food diversity	X6	2.41	3	2.41	3	2.35	3	2.29	3	2.29	3	2.25	3	2.25	3	2.25	3	2.25	3	2.25	3
Cover (%)	X7	45	3	40	2	57	4	53	3	30	2	33	2	56	4	59	4	35	2	45	3
Eroding banks (%)	X8	17	3	7	4	8	4	20	3	35	2	40	2	8	4	7	4	9	4	10	3
Substrate	X9		3		3		2		3		3		3		3		3		3		3
Water velocity	X10		2		2		2		2		2		2		2		2		2		2
Stream width (m)	X11	3.6	3	1.5	1	3.6	3	3.7	3	3.6	3	5.0	3	2.7	2	1.6	1	2.0	1	2.1	2
Model II - Predicted standing crop (kg/hectare)			**9**		**49**		**122**		**33**		**28**		**14**		**100**		**80**		**19**		**22**

Habitat Quality Index attribute measurement data, ratings and predictions based on expected improvements in habitat quality during 20-year post-restoration time frames.

Attribute	Model symbol	Lake Creek below Elder Rd. Data	Rating	Lake Creek upper Data	Rating	Evans Creek Data	Rating	N.F.Alder Creek Data	Rating	Alder Creek Data	Rating	Benewah Creek below 9mile Data	Rating	S.E. Benewah Data	Rating	W.F. Benewah Data	Rating	Whitetail Data	Rating	Windfall Data	Rating
Late summer stream flow	X1	CPF=6%ADF	0	CPF=10%ADF	1	CPF=16%ADF	2	CPF=8%ADF	1	CPF=8%ADF	1	CPF=10% ADF	1	CPF=10%ADF	1	CPF=9%ADF	1	CPF=4%ADF	0	CPF=7%ADF	0
Annual stream flow variation	X2		2		2		3		2		2		2		2		1		1		1
Maximum summer water temperature (°C)	X3	21.5	2	17.0	3	17.1	3	19.1	2	20.4	2	22.1	1	16.8	4	16.2	4	17.6	3	17.6	3
Nitrate nitrogen (mg/l)	X4	0.10	3	0.10	3	0.10	3	0.10	3	0.10	3	0.12	3	0.10	3	0.30	3	0.10	3	0.10	3
Fish food abundance (number/0.1 m2)	X5	534	4	250	3	535	4	530	4	437	3	499	3	594	4	594	4	594	4	594	4
Fish food diversity	X6	2.41	3	2.41	3	2.35	3	2.29	3	2.29	3	2.25	3	2.25	3	2.25	3	2.25	3	2.25	3
Cover (%)	X7	50	3	45	3	57	4	58	4	35	2	38	2	56	4	59	4	40	2	50	3
Eroding banks (%)	X8	12	3	7	4	8	4	15	3	30	2	35	2	8	4	7	4	9	4	9	4
Substrate	X9		3		3		3		3		3		3		3		3		3		3
Water velocity	X10		2		2		2		2		2		2		2		2		2		2
Stream width (m)	X11	3.6	3	1.5	1	3.6	3	3.7	3	3.6	3	5.0	3	2.7	2	1.6	1	2.0	1	2.1	2
Model II - Predicted standing crop (kg/hectare)			**24**		**68**		**158**		**45**		**37**		**14**		**130**		**80**		**25**		**30**

Table 34. cont.

Habitat Quality Index attribute measurement data, ratings and predictions based on expected improvements in habitat quality during 20+-year post-restoration time frames.

		Lake Creek		***Lake Creek***		***Evans Creek***		***N.F.Alder Creek***		***Alder Creek***		***Benewah Creek***		***S.E. Benewah***		***W.F. Benewah***		***Whitetail***		***Windfall***	
	Model	***below Elder Rd.***		***upper***								***below 9mile***									
Attribute	***symbol***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***	***Data***	***Rating***
Late summer stream flow	X1	CPF=6%ADF	0	CPF=10%ADF	1	CPF=16%ADF	2	CPF=8%ADF	1	CPF=8%ADF	1	CPF=10% ADF	1	CPF=10%ADF	1	CPF=9%ADF	1	CPF=4%ADF	0	CPF=7%ADF	0
Annual stream flow variation	X2		2		2		3		2		2		2		2		1		1		1
Maximum summer water temperature (°C)	X3	20.5	2	16.0	4	16.1	4	18.1	3	19.4	2	21.1	2	16.8	4	16.2	4	16.6	4	16.6	4
Nitrate nitrogen (mg/l)	X4	0.10	3	0.10	3	0.10	3	0.10	3	0.10	3	0.12	3	0.10	3	0.30	3	0.10	3	0.10	3
Fish food abundance (number/0.1 m2)	X5	534	4	500	4	535	4	530	4	500	4	525	4	594	4	594	4	594	4	594	4
Fish food diversity	X6	2.41	3	2.41	3	2.35	3	2.29	3	2.29	3	2.25	3	2.25	3	2.25	3	2.25	3	2.25	3
Cover (%)	X7	55	4	50	3	57	4	58	4	40	2	43	3	56	4	59	4	45	3	55	4
Eroding banks (%)	X8	9	4	7	4	8	4	10	3	25	2	30	2	8	4	7	4	9	4	9	4
Substrate	X9		3		3		3		3		3		3		3		3		3		3
Water velocity	X10		2		2		2		2		2		2		2		2		2		2
Stream width (m)	X11	3.6	3	1.5	1	3.6	3	3.7	3	3.6	3	5.0	3	2.7	2	1.6	1	2.0	1	2.1	2
Model II - Predicted standing crop (kg/hectare)			**27**		**108**		**250**		**83**		**37**		**39**		**130**		**80**		**43**		**51**

MACROINVERTEBRATES

Forty-five macroinvertebrate samples were collected in Lake Creek in 1999. In total, 170 macroinvertebrate taxa were collected in these samples, including 27 mayflies (Ephemeroptera), two dragonflies (Odonata), 14 stoneflies (Plecoptera), one true bug (Hemiptera), 13 beetles (Coleoptera), one alderfly (Megaloptera), 28 caddisflies (Trichoptera), 17 true flies (Diptera), 55 midges (Diptera: Chironomidae), and 12 non-insect taxa (clams, crayfish, leeches, etc.) Appendix D contains complete taxa lists for all sampled stations.

Total macroinvertebrate abundance in each sample ranged from 40 at Station 3 (June) to 4,640 at Station 1 (October) (*Figure 71*). Macroinvertebrate abundance was highest in August at all sites. In general the abundance increased from June to August and then decreased again by October. Station 1 had the highest abundance in June and October, while Station 3 had the highest abundance in August. Overall, macroinvertebrate abundance appeared higher at lower sampling stations (Stations 1 and 2) than upper stations (Stations 4 and 5) during October Figure 50 Percent contribution of the dominant 3 taxa ranged from 27 percent at Station 4 (August) to 81 at Station 1 (June). Total taxa richness ranged from 16 at Station 3 (June) to 59 at Station 3 (August) and EPT richness ranged from 5 at Station 5 (October) to 25 at Station 1 (June). The Hilsenhoff Biotic Index (HBI) ranged from 2.28 at Station 1 (October) to 6.56 at Station 2 (August) Appendix D contains a complete list of metrics for all sampled stations.

<u>Community Trophic Structure</u>

Macroinvertebrate community trophic structure in Lake Creek varied between sampling stations and sampling seasons (*Figure 72*). The control site (Station 5) was highly dominated by collector-gatherers in August, but more balanced in June and October. The high proportion of this group indicates that deposited fine particulate organic matter (FPOM) was a significant food source. The next most abundant groups were predators in June and October and shredders in August (*Figure 72A*). Given that Station 5 was a low-gradient site dominated by fine substrate, the macroinvertebrate community trophic structure was reflective of those conditions.

Station 4, also a low-gradient site, was dominated by collector-gatherers and collector-filterers during all sampling seasons, but during August and October shredders and predators became more abundant (*Figure 72B).* Again, the high proportion of gatherers indicated that suspended and deposited FPOM was a readily available food source. Later in the year, however, the increase in shredders indicated terrestrial vegetation (leaves, etc.) became an available food source. Predators were able to better exploit macroinvertebrate food resources later in the year. Although the community was not well balanced in June or August, it came into a healthy balance by October.

In June, Station 3 was highly dominated by collecting organisms, which indicated FPOM was the dominant food source. Scrapers were the next most abundant group, which indicated that attached diatoms and other algae were a secondary food source. By October, however, the community had shifted into balance with predators, scrapers and shredders comprising greater than half of the community (*Figure 72C*)

Station 2 was highly dominated by collecting organisms during all sampling seasons, which indicated FPOM was the dominant food source. Predators were the next abundant group,

followed by shredders and scrapers. As with Stations 3,4, and 5, the community was better balanced in October (*Figure 72D).*

Station 1 had low proportions of collecting organism, which indicated that FPOM was not a primary food source at the site. In fact the high abundance of scrapers indicated that attached periphyton was of primary importance in June. Shredders dominated the community in August and October, indicated that riparian sources of coarse particulate organic matter (CPOM) was the primary food source (*Figure 72E*).

Community Similarity Between Stations

Two measures of community similarity were calculated to determine the degree of similarity between sampling stations during the three sampling seasons in 1999. First was the Jaccard's similarity index (Jaccard, 1908), which was based on presence-absence data and was unaffected by relative abundance of specific taxa with each sample, and essentially reported the percentage of species shared in common by two samples (Washington 1984). Second, the percent similarity index (Whittaker, 1952), which took into account the relative abundance of each species, was calculated. In general, similarities of 50 percent or greater indicate highly similar macroinvertebrate communities (Bode et al., 1990).

The Jaccard and percent similarity values are presented in *Figures 73 and 74*, respectively. Generally, the degree of similarity for both indices decreased in a downstream direction. As expected, percent similarity dropped off more sharply in a downstream direction than did Jaccard's; this was due to the influence of relative abundance on percent similarity (*Figure 73).* The degree of similarity between sites tended to be highest in August for both indices. Complete similarity matrices for Jaccard's and percent similarity are presented in Appendix C.

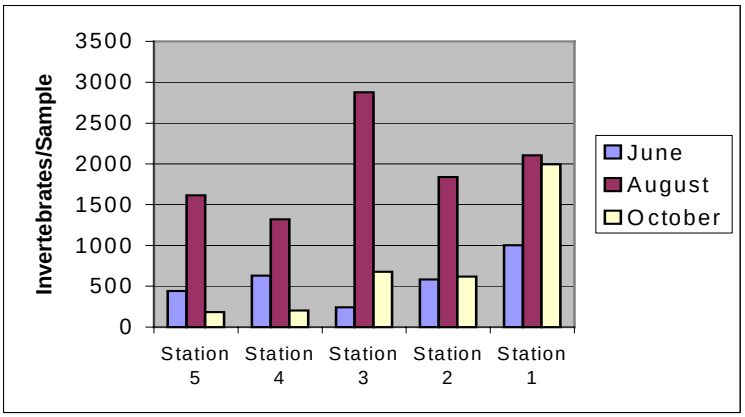
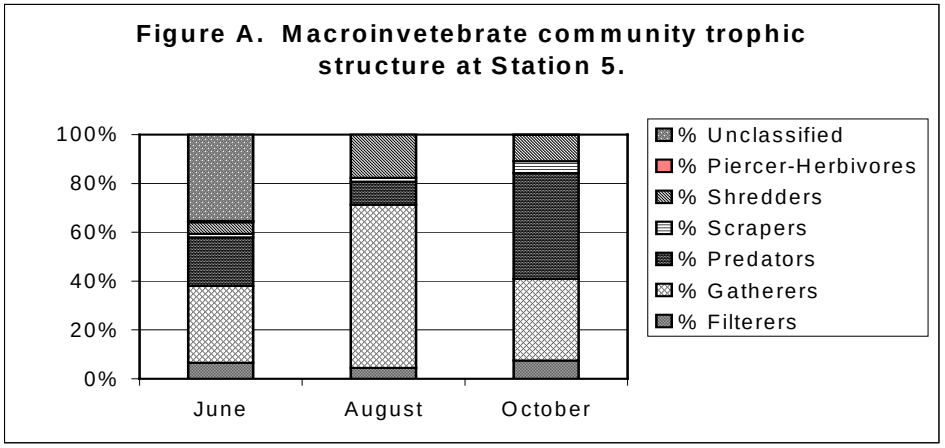
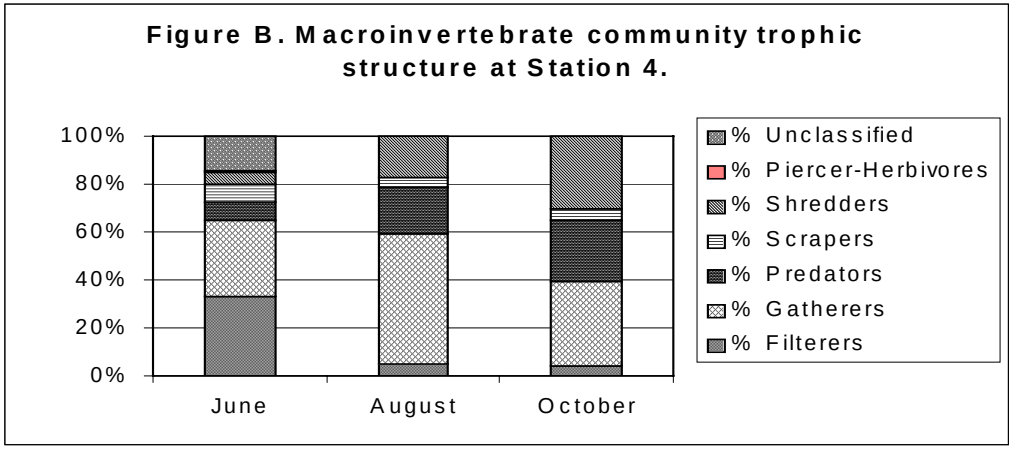
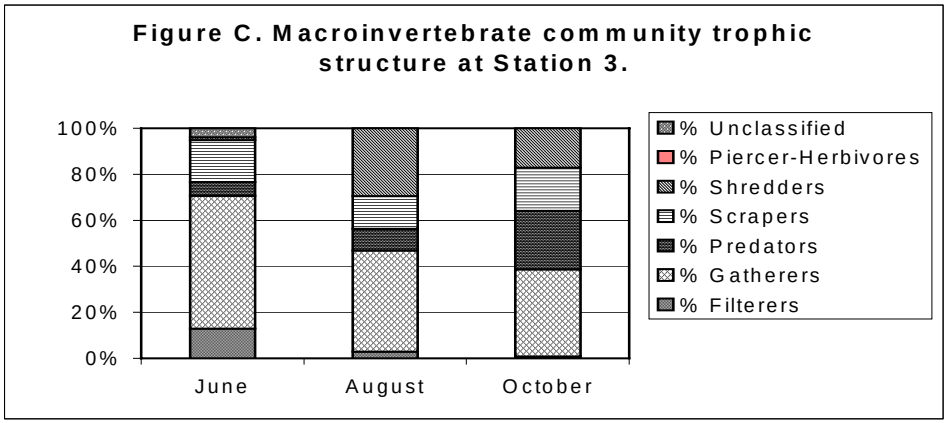
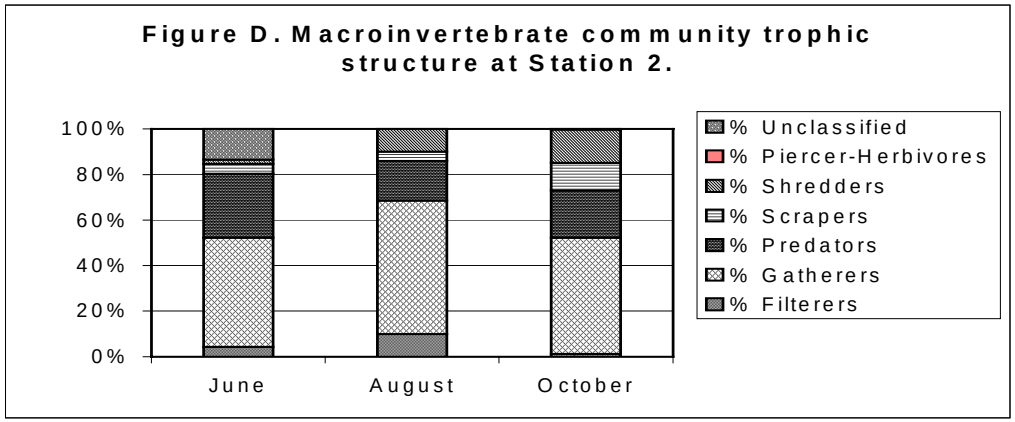


Figure 71. Macroinvertebrate abundance in Lake Creek, 1999.









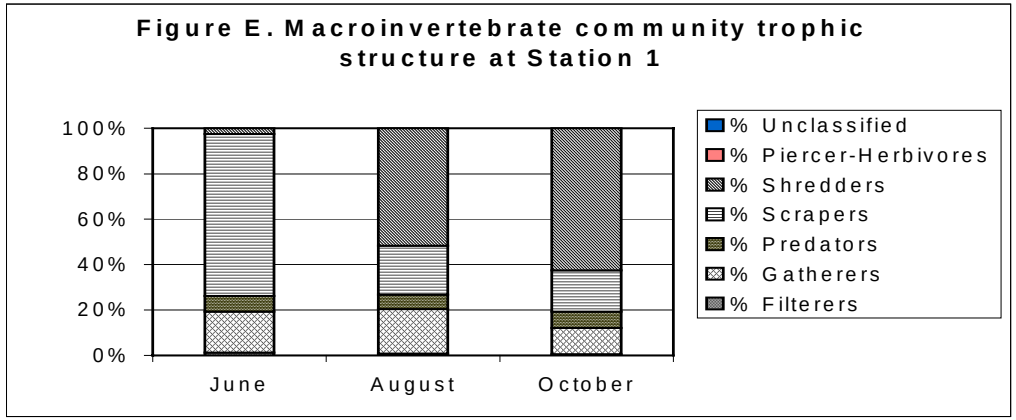


Figure 72. Macroinvertebrate community trophic structure at 5 stations in Lake Creek, 1999.

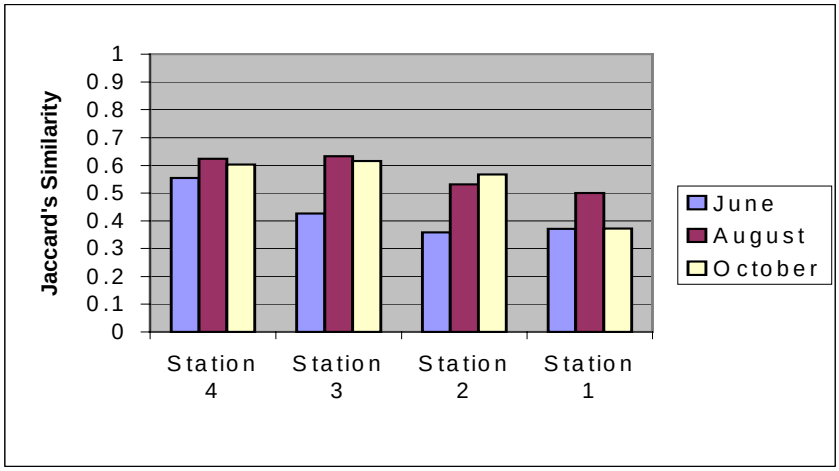


Figure 73. Jaccard's similarity between control (station 5) and test sites.

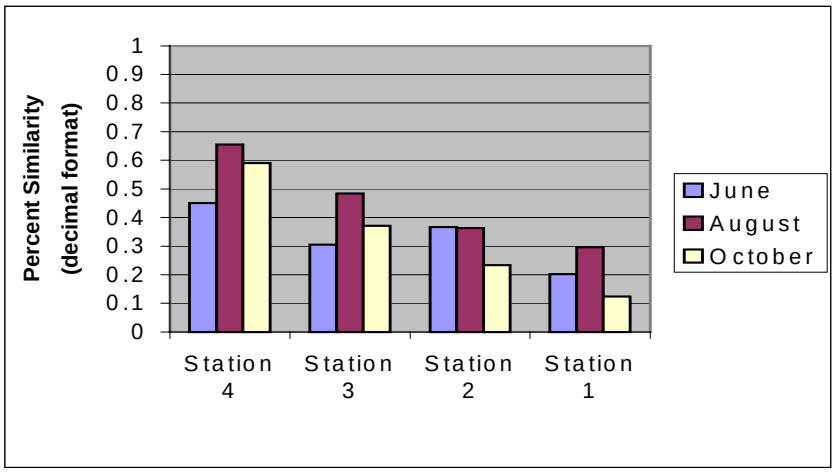


Figure 74. Percent similarity between control (station 5) and test sites.

4.0 DISCUSSION

LAKE STUDIES

In previous reports (Peters et. al. 1998, 1999 and Vitale et. al. *in press*) the Tribe looked at water quality conditions in Coeur d'Alene Lake. These reports determined that temperature, dissolved oxygen and sedimentation in the nearshore areas potentially exhibit some suppressive effects on the cutthroat trout population in Coeur d'Alene Lake. To what extent these suppressive effects limit the population we currently do not know.

In the three years that this report covers, little or no change was noted. It still appears that the magnitude of effects from temperature and DO are dependent on the seasonal weather pattern (Vitale et. al. *in press*). Basically, the hotter the air temperature the warmer the surface water of the lake will be. Sedimentation is dependent on the amount and duration of the run-off. In Peters et. al. (1998) sedimentation and it potential effects on habitat quality were discussed. Plummer Creek and it associated effects on Chatcolet Lake were the primary areas looked at. However, it is noted that similar conditions exist in almost every bay along the western side of Coeur d'Alene Lake. No data at this time is presented herein, however the investigators observed these conditions on many occasions and subsequently verified them with aerial photographs.

It is our opinion, based on personal observations and visual evidence from aerial photograph, that conditions exist at the mouths of the creeks on the western side of Coeur d'Alene Lake that are more conducive to the production of warm water fish species than westslope cutthroat trout. These conditions are he physical aspects of large shallow deltas (greater than 500 meters across) with almost 100% coverage of aquatic macrophytes created in the last 60-70 years primarily from agricultural runoff. Water quality analysis results, particularly for nutrients and chlorophyll *a*, did not appear noticeably different when compared to previously reported values (Peters et. al. 1998) and those reported by Woods and Beckwith (1995) for other lake areas.

In correlating measured water quality parameters with optimum fish health criteria published from 3 different sources it appears that only a few of the measured parameters warrent further discussion here. Of the heavy metals tested for in the water column, only two (aluminum and zinc) warranted more investigation. Three other metals (Copper, Iron and Manganese) exceeded recommended levels for optimum fish health on an acute basis and only for a limited duration of time. These three metals had highest concentrations associated with high TSS (ie. sediment particles) and concentrations dropped when TSS dropped. Since no testing has been completed on these three metals, acute toxic response has yet to be determined. However, in our judgement at this time it is suspected that these three have little affect on the overall population of cutthroat trout in the lake.

Of the two metals of concern, aluminum, appears to be found in natural background concentrations. When compared to concentrations of aluminum found in nearby wells, the concentration in the lake appears to be about the same (Peters et. al. 1999). The other metal of concern, zinc, appears to be the result of mining activities upstream in the silver valley. This industrialization has most likely accelerated the release into the environment. The US Fish and Wildlife Service, Coeur d'Alene Tribe and ID Department of Fish and Game are currently

working together to complete a fish tissue analysis for these metals as well as other toxicants associated with mining activities in the upper basin. Results from this research are still pending.

Two physical habitat parameters, DO and Temperature, do exceed the criteria some of the time (or at some depths) and could cause acute, adverse health effects or habitat avoidance. As this is found to be quite common in lacustrine environments, several published reports on their linkages to fish survival have been published. Hickman and Raleigh (1982) published a series of reports linking habitat features to fish survivability for a wide range of species at different life stages in a wide variety of habitats. In particular, they published a report (1982) detailing the cutthroat life cycle over several of its life stages. Hickman and Raleigh singled out three physical habitat parameters as being most important for cutthroat survivability in a lacustrine environment. As you will see in the following discussion they are the same parameters that violated the optimum criteria for salmonid fish heath described by Piper et. al. (1982) and others.

Calculated Habitat Suitability Indices (Hickman and Raleigh 1982) for cutthroat trout during 1999 - 2001 were similar to previously reported results. It appears that the upper 10 meters of the water column, during July, August and the first two weeks of September is generally considered unsuitable (from results reported in this report and Peters et. al. (1998) and Vitale et. al. *in press*). The HSI values ranged between 0 and 0.6 with an average of about 0.4 (with 0.6 - 1.0 representing very good conditions) for the years 1999-2001. There appears to be on average a 92 % reduction of available habitat from 0-10 meters during this time frame. However, the rest of the year conditions appear to be very good with high HSI values (averaging around 0.9). Looking at depths below 10 meters there appears to be a significant amount of available habitat for cutthroat trout (average of about 0.6). Furthermore, areas with depths greater than 12 meters had almost 100 % of optimum below that depth. Given these results it does not appear that water quality conditions are limiting populations currently. These conditions could have a suppressive effect in that there is some reduction in available habitat in the summer. The Tribe is currently waiting for a bathymetric map of Coeur d'Alene Lake to be completed (currently underway through a non-BPA funded project) such that these reductions in available habitat can be quantified. At this time the data does not support that kind of analysis.

Given these results, the Tribe is able to hypothesize with very little risk (given current cutthroat population levels in the lake) that habitat availability is not limiting. We feel this is true because, it appears that cutthroat are found in both shoreline and pelagic waters. Relative abundance estimates average 0.69% (with a range of (0.17-0.91) for the years 1994-2001 for the shoreline and an average of 1.15 % (with a range 0.91-1.51) for the for the same period for the pelagic areas. Along side of the cutthroat trout in the pelagic areas are kokanee salmon that presumably could be feeding on some of the same foodstuffs. It would be appropriate to complete a diet analysis of both cutthroat and kokanee to make this determination. However, this information is not available so best professional judgement must be relied upon. If kokanee and cutthroat were occupying similar habitats at least during the summer months then they would presumably be in competition for at least space and maybe food as well. This is where it appears that habitat is not limiting for cutthroat because kokanee populations can fluctuate by over 500,000 per year (Jim Fredericks, IDFG, personal communication). Thus, if cutthroat trout populations were ranging in that 500,000 +/- no competition for habitat would exist. We do feel that at some higher population level habitat availability would be limiting particularly in the areas inundated by the

construction of Post Falls Dam. The details were previously reported (Peters et. al. 1998) with similar conditions still exist today.

Fishery relative abundance estimates are commonly used to determine stock status or abundance relative to the other species found in the lake. If the average relative abundance or catch per unit effort for individuals or the whole population within a given area is consistent from year-to-year or over the course of 7 years it could be assumed that dramatic changes in the population within the area sampled did not occur. An examination of relative abundance estimates from 1994-2001 (1994-1997 in Peters et. al. 1998 and Vitale et. al *in press* for 1998 and this report for 1999-2001) shows little change in the relative stock status of the species of key concern to the Tribe (cutthroat, large-mouth bass, northern pike and chinook salmon). This would indicate at least for the southern end of the lake that fish populations of concern to the Tribe have stabilized at or about their current densities.

One new addition however, (smallmouth bass) will soon be making their mark on other predator populations in the lake. Under most conditions smallmouth bass and largemouth bass habitat seldom overlap (Scott and Crossman, 1973) even though the two species are often found in the same lake. In Coeur d'Alene Lake the introduction of smallmouth bass will most likely dislocate or eliminate largemouth bass from sub-optimal habitat and force them into a much smaller niche. This will effectively limit production of largemouth bass in the future. It has yet to be seen if smallmouth bass seek out and prey upon cutthroat trout.

Preliminary results from a recently completed but unpublished report (JUB to the CD'A Tribe, 2002) show that northern pike may be selecting cutthroat trout as a food item with higher regularity than other fishes. Additionally, we find that northern pike tend to migrate farther than do other predators. It could be hypothesized that northern pike are migrating to prime foraging sites on a seasonal basis while other predators are not. This information helps us in that if we were to ask the question, "If we were to have to manage predators in the lake to optimize cutthroat availability then what species would we look to manage for first"? Based on the information gained from our mark-recapture and diet analysis studies we could say that northern pike are most likely the key predator on cutthroat trout in the lake. Additionally, we feel that this species (northern pike) would also be the easiest to manage because of their susceptibility to our capture methods.

Avista Utilities recently (April 2003) had an independent review of two predation studies completed on Coeur d'Alene Lake. The Tribe feels that this review supports our previously reported conclusions on predation in Coeur d'Alene Lake. The following is an excerpt from that review:

"These data are not robust for northern pike and chinook, but are adequate to reach conclusions for determining the course of additional investigations to be conducted for the Spokane River HED relicensing effort.

…northern pike are clearly substantial predators of cutthroat trout in Coeur d'Alene Lake. The pike are consuming a wide range of sizes of cutthroat, implying that they probably eat cutthroat throughout the year rather than just young fish shortly after they first enter the lake habitat. The presence of cutthroat trout as a major prey item in these ambush predators is an indication that

cutthroat tend to be present in moderately shallow shoreline areas of Coeur d'Alene Lake. Only a single pike was collected from the pelagic zone in the Tribe's study.

Chinook salmon are also a substantial predator of cutthroat trout. However, the available data indicate they prey only on those smaller cutthroat that have recently entered the lake habitat.

The data provide a clear indication the largemouth bass, smallmouth bass, and northern pikeminnow are not substantial predators of cutthroat trout in Coeur d'Alene Lake. The sample sizes examined for these species are sufficiently large to support a firm conclusion.

At this time the Tribe feels that we have completed our baseline study on fisheries stock status, water quality and nutrient cycling. The Tribe would like to continue the mark-recapture study. Tags are still out in the lake and we would like to maintain the benefits from those recoveries in helping us determine population estimates as well as the public outreach aspect of the study. Continuation of this work helps the Tribe demonstrate to the general public that we are a fully vested partner with the state and the federal government in the fish management arena.

In the future we feel that Lake Studies projects will be focused on specific issues, problems and or limiting factors. The types of work will include a sampling program stratified by time, area, and habitat type using a combination of net and electrofishing methods. Predator-prey analysis will also be conducted in areas where significant temporal distribution of cutthroat and fish predators overlap (such as tributary mouths during migration periods).

Predation evaluations are already in progress (BPA Project #1990-044-02) to estimate the seasonal and annual relative importance of cutthroat trout in the predator species diet and estimate the annual and seasonal selectivity of predator fish prior to supplementation.

This work on predation will continue to be a need for the Tribe. If any management actions are taken to lessen the effects of predation on cutthroat trout then most certainly more information of this type will be needed to support the management decisions.

STREAM STUDIES

Two life history strategies of westslope cutthroat trout are expressed in the Coeur d'Alene Lake catchment. Westslope cutthroat trout in Benewah and Lake Creeks exhibit resident and lacustrine-adfluvial life histories. The adfluvial component outmigrates to Coeur d'Alene Lake primarily at ages 2 and 3 and return to spawn in natal streams starting at age 5 or 6. Lacustrine-adfluvial cutthroat trout exhibit strong site fidelity, returning to natal stream sections to spawn repeatedly (Northcote 1997). Westslope cutthroat trout in Alder and Evans exhibit only resident life histories, rearing in the stream and migrating upstream to suitable spawning habitat. Historically there was a adfluvial life history component in Evans Creek that migrated to Coeur d'Alene Lake via the Coeur d'Alene River to rear, then return to spawn. The size of lacustrine-adfluvial westslope cutthroat trout from Lake and Benewah Creek were comparable with cutthroat from Flathead Lake. Adfluvial westslope cutthroat trout in Flathead lake share similar life history to Benewah and lake Creek. Flathead lake adfluvial cutthroat trout also reared in streams for 2, 3 and 4 years prior to migration to Flathead Lake (Leathe and Graham, 1981).

Population Trends

The population estimate results provide evidence of the degraded nature of the mainstem reaches on target watersheds. Population estimates were done in August in all four systems when the temperature in mainstem reaches was at the annual maximum. Elevated water temperatures combined with lower quality habitat in the mainstem reaches are likely the most important factors that explain why brook trout and westslope cutthroat trout select the tributaries instead of the mainstem reaches.

The regressions performed on the total estimated number of trout by watershed indicate stable or increasing population trends in all watersheds for both cutthroat and brook trout, except for cutthroat trout in the Alder Creek watershed. In Alder Creek, cutthroat appear to be declining slightly but the trend is not significant (P=0.21). Nevertheless, this is an important observation in light of the trend for brook trout numbers. The increase in brook trout numbers in the Alder Creek watershed was significant (P=0.01) and total numbers appear to have increased by nearly 2-fold during the 6 year sample period. None of these trends can be attributed directly to restoration or enhancement actions at this time as the response to improved habitat or water quality is thought to take place over longer time frames (perhaps several generations). This could be a response to fishing regulations, which closed fishing in the target tributaries in 1993. Fishing remained closed in Benewah and Lake Creeks throughout this reporting period. The importance of this data series cannot be overstated as it will continue to serve as a basis for making pre- and post- restoration comparisons of population structure.

The power analysis conducted on the westslope cutthroat trout population estimates revealed the current ability to detect a coarse-scale change (10%) in cutthroat trout population at the individual basin scale for Alder, Benewah, Lake and Evans Creeks. Continuing the annual population estimates for an additional 5 to 10 years for cutthroat trout will increase the detection power significantly, allowing for detection of changes in population as low as 3% with only a 10% probability of making a type II error. The power to detect changes in the brook trout population in Alder Creek is as high as detecting cutthroat trout changes in the other systems.

When comparing the benefits of increasing sample size or frequency with effort and cost, little benefit would be realized from changing the current stream sampling protocols. Additional population estimate sites will likely not be needed because of the substantial increase in power to detect population changes when annual population estimate are made over the next five to ten years. Furthermore, it is unlikely that any increase in westslope cutthroat trout population will be realized until at least several generations have benefited from the restoration projects. Since it takes an adfluvial westslope cutthroat trout 5-8 years to reproduce, we will have sampled populations of westslope cutthroat trout annually at least that many years, dramatically increasing the power to detect changes in the population.

The comparison of westslope cutthroat trout length, weight and condition factor between streams revealed that the growth did not differ between streams. Non-native brook trout length, weight and condition factor did not significantly differ between Benewah and Alder Creeks. The lack of differences in growth and condition factor might be due in part to the four systems being similar in physical characteristics. The four systems are at similar elevations, and have similar basin relief and headwater tributaries in the basins run through similar geologic strata. There are significant differences in basin size, however, that can affect productivity. The Benewah Creek catchment is the largest at 35,017 acres followed by Lake Creek (23,074 acres), Alder (17,525

acres) and Evans at 8,484 acres. It is more likely that differences are not apparent due to the affects of habitat degradation and/or competition on growth. The data that is summarized in this report all represent pre-enhancement conditions and several years of post-enhancement data may be needed before differences become apparent.

The systems have varying degrees of habitat loss and an aggressive habitat restoration program is underway. Continued implementation of restoration projects will ultimately provide the basis for testing hypotheses about growth of juvenile trout. The growth and condition factor data is a good baseline to help measure the response of the cutthroat and brook trout to habitat improvements, especially for the planned treatment/control experiments. This stands to reason since presumably poor habitat and/or water quality conditions result in suppressed growth and improvements in habitat will result in increased growth during stream residence. Continued monitoring of growth for juvenile migrants will allow for comparisons of pre- and post-restoration data series. The comparisons of growth and condition should be made both for fish sampled during the summer stream population estimates and for known adfluvial fish captured during spring migration.

The Effects Of Habitat Quality On Fish

Application of the Habitat Quality Index (HQI) model to Reservation streams using measured data produced some noteworthy results. The model output explained 83% of the variation in trout standing crop for 8 stream reaches that were tested in the Lake, Alder, Benewah, and Evans creek watersheds. A high correlation coefficient (R = 0.915) suggested a strong relationship between HQI score and trout standing crop.

This HQI model was initially developed to predict trout standing crop in Wyoming streams where it explained 96% of the variation in trout biomass for the 36 streams from which it was developed (Binns and Eiserman 1979) and 87% of the variation for 16 additional streams (Conder and Annear 1987). Our use of this model produced results that are comparable to those of Binns and Eiserman and are apparently more successful than other correlative models based on the HQI that have been assembled for areas ranging from Colorado to Ontario (*Table 34*). Part of this success may be attributed to the use of the three-year mean of measured trout standing crop (1996-98; pre-enhancement) as a basis for comparing model outputs. This has the effect of reducing the inter-annual variability that is inherent in most resident fish populations. Given the results of model predictions and in consideration of mitigating factors, we believe the HQI Model II is a reasonable predictor of cutthroat trout standing crop for Reservation streams and can be used as an indicator of juvenile carrying capacity as well as for evaluating restoration/enhancement needs and priorities for stream reaches for which there is adequate data on select habitat and water quality attributes.

Table 35. Results of models predicting trout biomass in streams based on measures of habitat quality (after Griffith 1993).

Study	Location	Trout Species	Biomass range (kg/hectare)	Significant variables	r^2
Wesche et al. (1987)	Southeast Wyoming	Brown	2-211	Overhead bank cover	0.31
Scarnecchia and Bergersen (1987)	Northern Colorado	Brook, cutthroat, rainbow, brown	39-282	Width and depth, width, alkalinity	0.82

(1987)		rainbow, brown			
Bowlby and Roff (1986)	Southern Ontario	Brook, brown, rainbow	0.5-150	Suspended microcommunity, biomass, mean maximum temp., benthic biomass, pool area, piscivore presence	0.62
This report	Coeur d'Alene Reservation, Northern Idaho	Brook, cutthroat	8-122	Stream flow, maximum temp., benthic biomass, %cover, %eroding banks, substrate	0.83

These model predictions generally support our understanding of the limiting factors for cutthroat trout production in the target tributaries that have been reported previously and in some instances provide better resolution on limiting factors at finer spatial scales (Lillengreen et al. 1999; Peters et al. 1999).

As suggested by the HQI and HSI model outputs described in this report, maximum summer water temperature is the most significant factor in limiting salmonid distribution and abundance in these small, low elevation watersheds. These limitiations are expressed primarily in the mainstem reaches of Alder, Benewah and Lake creeks. The maximum summer water temperature in the mainstem of Alder Creek is 1-2 degrees lower than in the mainstem reaches of both Benewah and Lake creeks and this explains the distribution and relatively higher standing crops of trout (2-5 times greater) in that watershed. The fact that brook trout dominate in these same reaches in the Alder Creek watershed is thought to be primarily a result of competitive exclusion.

The HQI modeling exercise effectively demonstrates that even small incremental decreases (1-2 °C) in maximum summer water temperature in these reaches have the potential to substantially increase production by up to 3-4 times over current levels. This supports the notion of effective riparian buffer management as the most critical restoration/enhancement strategy for these reaches. In most areas, buffer widths will need to be greatly increased and diversified to include a significant conifer component in order to play a role in temperature regulation in the future. This will be most easily accomplished on lands purchased exclusively for management of fish and wildlife resources and on lands where private landowners are amenable to sustainable management of forest products. Ideally, these restored and more functional riparian buffers would eventually be linked into continuous corridors in these watersheds. In the short term, however, focusing enhancement/restoration efforts on lands immediately downstream from the reaches currently supporting the highest levels of production seems to be the best strategy. This is consistent with the current management direction suggested in the Fisheries Program Management Plan (Lillengreen 1999). Another strategy that warrents continued research and evaluation is the use of water releases from large sediment basins or constructed wetlands as a means of creating local refugia from elevated temperatures. The working hypothesis for this strategy is that contribution of cool surface water and/or contribution of stored water to the ground water table translates into hyporhic upwelling that can serve as an attractant to both fish and aquatic insects during critical time frames. This is a primary strategy in Lake Creek where forest lands have been converted for agricultural uses on a large scale.

The model ratings for late summer stream flow would suggest that this is also a significant limiting factor for all the stream reaches that were tested. This is generally not supported, however, by the observed densities of fish in the smallest tributaries. Past reports have documented that these densities are notably higher than the average density (9.2/100 square meters) reported for seven other westslope cutthroat trout populations in Idaho and Montana (Shepard et al. 1984b, Ireland 1993). While increases in base flow would undoubtedly translate into more available habitat, modification of stream flow doesn't readily translate into a feasible management strategy.

Enhancement of instream cover components and streambank stabilization is a more feasible management strategy that has been shown to result in small increases in production potential with relatively quick response times. This is most apparent in the small 2nd order tributaries where spawning is focused and where rearing densities are the highest. In these areas, the presence of deep pools with adequate cover components provided primarily by accumulations of large wood play an important role in food production, as well as summer and winter rearing. Implementing projects that rely on a combination of bioengineered stream bank protection and addition of large woody debris is a justifiable means of reaching Tribal production goals even on relatively small scales (200-300 meter reaches) and is consistent with the current management direction recommended in the Fisheries Program Management Plan (Lillengreen 1999). These strategies are also integral to restoring some mainstem reaches in the target watersheds because even a slight degree of channel incision leads to a predictable sequence of adjustments that result in accelerated bank erosion that can make it difficult to recover riparian plant communities (Rosgen 1996).

Interpretations of these model results are made with caution, and applications for management are not intented for stream reaches where corroborating data is not available. This type of conservative approach is supported by several critical reviews of models that predict standing crops of fish from habitat variables (Griffith 1993; Fausch et al. 1988). Griffith (1993) indicated that other attempts to apply the HQI to populations of salmonids in streams outside of Wyoming have generally not been successful. Fausch et al. (1988) also caution that the none of the 99 models they reviewed, including the HQI, were developed through manipulative experiments. The application of this model to Reservation streams in the manner described, therefore, involves an inductive leap that may be beyond the defined population of streams to which inferences are valid. Ultimately, the evaluation of fisheries response to habitat enhancement will best be addressed not by application of the HQI model but by the more rigorous experimental designs identified in the Tribe's Draft RM&E Plan (2002).

Is Competition Limiting Westslope Cutthroat?

Aside from habitat degradation, non-native brook trout in natal streams and non-native piscivorous predators in Lake Coeur d'Alene are two potentially significant factors affecting westslope cutthroat trout populations in the Coeur d'Alene Lake catchment. The brook trout population is significantly larger than the cutthroat trout population in Alder Creek and there is a general trend of increasing abundance in the Benewah Creek watershed between 1996 and 2001. The pattern of distribution in Alder Creek indicates that cutthroat trout are not utilizing the optimal habitat found in tributaries, yet brook trout are found in these same habitats at densities that typically exceed 15 fish/100sq. meters. In Benewah Creek, estimates of the total number of brook trout have ranged from 262 to 1417, with the highest numbers recorded in 1999 and 2001,

respectively. Much of this increase is a result of increasing densities in two key tributaries including the SE Fork and West Fork.

There is weak evidence that suggests brook trout may be more effective in utilizing mainstem reaches in these watersheds. Densities of brook trout in Benewah Creek have consistently exceeded those for cutthroat in at least one mainstem reach located immediately below the two principle spawning tributaries in the watershed. The relatively wider range of temperature preferences for brook trout as suggested by probability-of-use curves may account for this difference in utilization (Bovee 1978; Raleigh 1982). In several instances brook trout have been observed spawning in mainstem reaches in Benewah Creek and Alder Creek. The success of mainstem spawning is likely to be very low due to relatively frequent freshets that result in mobilization of gravels, however, these observations suggest that a great deal more potential spawning habitat is available to brook trout than for cutthroat trout as a result of differences in the timing of spawning.

There is weak evidence that a negative interaction with brook trout is reducing growth of westslope cutthroat trout because cutthroat trout growth in Alder Creek is slightly lower than for Lake, Benewah and Evans creeks, respectively. Griffith (1972) demonstrated that cutthroat trout fry emerge from the gravel later in the year than brook trout and, thus, age-0 cutthroat trout acquire a statistically significant length disadvantage that may continue throughout their lifetime. Such a size discrepancy may enhance resource partitioning, but in times of habitat shortage cutthroat trout may be at a disadvantage if they cannot hold territories against larger competitors. Byorth and Magee (1998), on the other hand, found little evidence that non-native brook trout negatively affected habitat use and growth of native Arctic Grayling in the Big Hole River, Montana. We suggest that interactions between brook trout and cutthroat is resulting in a fluctuating coexistence in Benewah Creek as the environment alternately favors one species over the other. Over time, however, maintenance of this balance is uncertain and the mere presence of brook trout in the watershed poses some risk to recovery efforts.

Some key uncertainties exist regarding the potential impact brook trout might have on cutthroat trout in Alder and Benewah Creeks. First, what mechanism(s) keep brook trout at low densities in Benewah creek compared to the high density in Alder Creek where the brook trout outnumber westslope cutthroat trout significantly? Although the date of introduction is unknown it is likely, given the close proximity of the watersheds, that brook trout have been in the two watersheds for about the same amount of time. The key difference may be the presence of the adfluvial stock in Benewah Creek and their reliance on tributary habitats for a relatively shorter portion of their lifecycle compared with resident stocks. Secondly, is a competitive interaction occurring in Alder Creek between brook trout and westslope cutthroat trout, forcing cutthroats to use the marginal mainstem habitat and reducing their growth? Third, will brook trout benefit from habitat improvements and continue to be a competitive factor potentially suppressing westslope cutthroat trout populations in Alder Creek and Benewah Creek. Fourth, is it feasible to reduce brook trout density by removing them from the affected reaches in the Alder and Benewah creek watersheds?

An experimental removal program for brook trout is probably warranted given the trends apparent in this data. Logically, removal efforts should be focused in Benewah Creek, where there is greater opportunity for success due to fairly limited distribution and abundance of brook

trout. In addition, increasing emphasis should be placed on monitoring cutthroat/brook trout response in areas that have already been targeted for enhancement/restoration measures.

MACROINVERTEBRATES

Biological Trends

Most of the taxa encountered in this study were temperate eurytherms that could tolerate elevated summer temperatures. Cold stenothermic taxa, which require cold summer temperatures (10-13 degrees Celsius) to survive, were limited to Capniidae and Leuctridae (stoneflies), *Prosimulium sp*. (blackflies), and *Heleniella sp*. (a midge). Based on the species found in 1999, it was likely that summer temperatures in 1998 and 1999 were high enough to eliminate most cold stenotherms from the macroinvertebrate communities in Lake Creek. Drift from the upper watershed would account for the limited presence of these species in the spring samples.

Percent contribution of the three most dominant taxon has been shown to be a reliable indicator of stress in macroinvertebrate communities, where higher dominance accurately reflected higher disturbance in the watershed (Fore et al. 1996). In Lake Creek, the highest dominance was found at Station 1 (the lowest site in the watershed), where dominance ranged from 64.9 percent in August to 69.4 percent in October. Dominance values less than 40 percent are typically expected from healthy, montane streams (Wisseman 2000). Stations 2-4 had dominance values ranging from 40-56 percent, while Station 5 ranged from 37 percent (October) to 52 percent (August). There did not appear to be significant differences in dominance between Stations 2-5 (*Figure 55*). However the longitudinal trend was consistent with improved water quality in an upstream direction.

Total taxa richness was generally similar at all sites and did not show any significant trends within the watershed (*Figure 56*). However, EPT richness, which was a count of the relatively intolerant species of mayflies, stoneflies, and caddisflies exhibited seasonal and longitudinal trends. With the exception of Station 2, EPT richness declined at all sites between June, August, and October. Furthermore, EPT richness was consistently highest at Station 1 (Figure 57). This was likely due to the fact that Station 1 was dominated by clean cobble substrate, while the upstream stations tended to have higher levels of fine sediment.

Community diversity, as measured by the Shannon-Weiner H' was lowest at Station 1 during all sampling seasons. There were no longitudinal trends in diversity apparent in the watershed; furthermore, there did not appear to be a consistent shift in diversity between sampling seasons (*Figure 58*).

The Hilsenhoff Biotic Index (HBI), which measured community tolerance to organic enrichment, was variable between sites and between sampling seasons. Station 1 had the lowest HBI scores in August (2.99) and October (2.49). These scores indicated the macroinvertebrate community was intolerant to organic enrichment. Station 2 had HBI scores of 5.72 and 5.67 in August and October, respectively, indicating severe organic enrichment at the site. The HBI at Station 2 dropped to a moderate 3.99 in October. Stations 3 and 4 HBI values indicated moderate enrichment during all sampling seasons. Station 5 had moderate HBI scores in June and August, but the score indicated severe organic enrichment in October. Longitudinal trends in HBI were not apparent during June and August, but during October there was a definite trend toward lower HBI scores in a downstream direction (*Figure 59*).

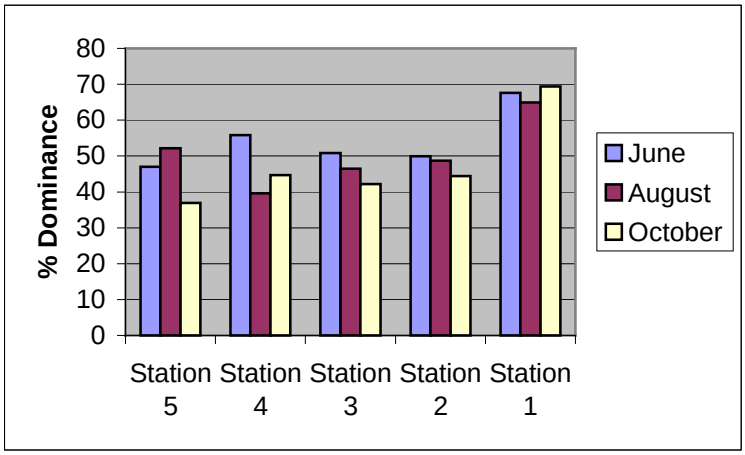


Figure 75. Percent contribution of three dominant macroinvertebrate taxon in Lake Creek 1999.

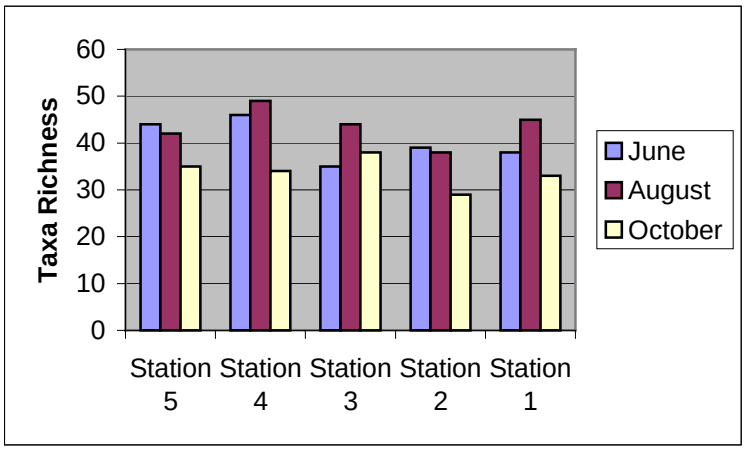


Figure 76. Taxa richness in Lake Creek, 1999.

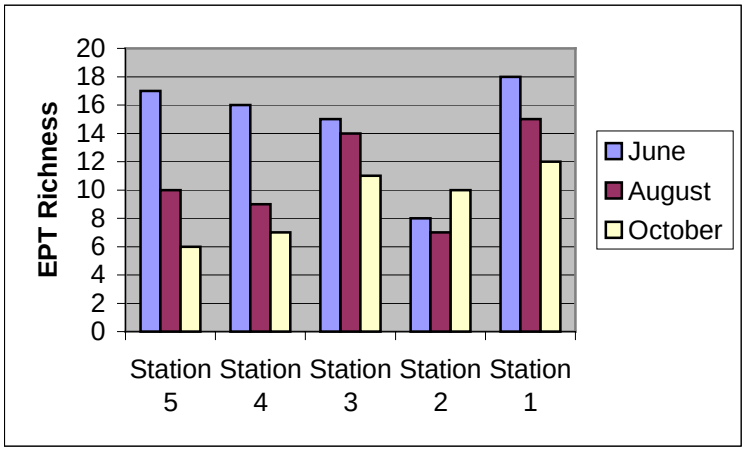


Figure 77. EPT richness in Lake Creek, 1999.

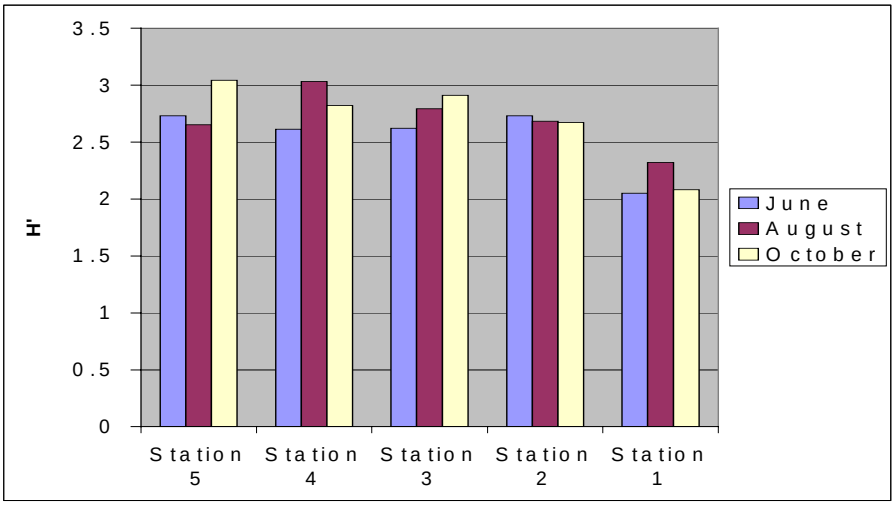


Figure 78. Shannon-Weiner diversity in Lake Creek, 1999.

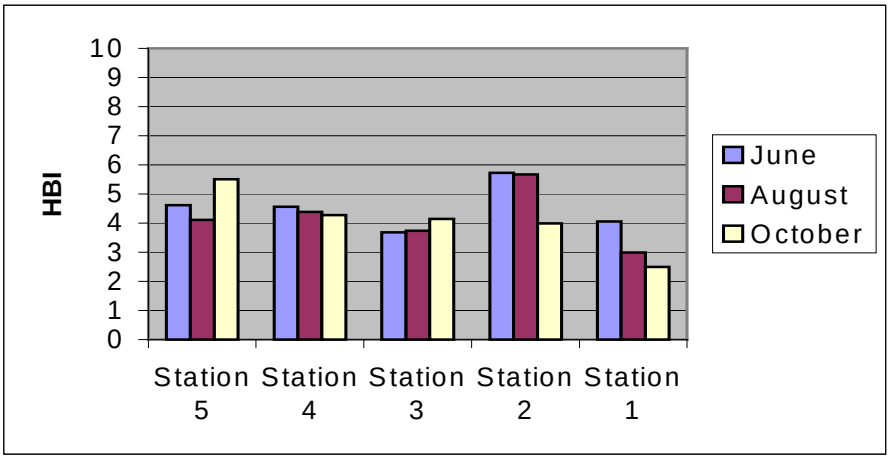


Figure 79. Hilsenhoff biotic index scores for 5 stations in Lake Creek, 1999.

1999 Data vs. 1994/1995 Data – Comparisons at the Family Level

Family level taxa lists, community metrics, and similarity matrices are presented in Appendix C, respectively. Percent contribution of the dominant three taxa at Station 5 did not show distinct trends between years. The fall sampling season was the most variable and in 1994 there was a trend toward increasing dominance between sampling seasons. Based on these data, there did not appear to be significant changes in the macroinvertebrate community over time at Station 5. Dominance at Station 3 tended to be slightly lower in the spring and summer of 1999 than in previous years. The fall sampling season at Station 3 yielded the most consistent dominance values. These data suggested the possibility of increased habitat and/or improved water quality at Station 3 during the spring and summer sampling seasons. At Station 1 percent dominance exhibited a decrease between sampling seasons in 1995, but no other consistent trend was evident.

Total taxa richness values for Stations 5, 3, and 1 are presented in Figures 60A-C, respectively. At Station 5 taxa richness was consistently highest in 1999, with significant increases noted in the spring and summer sampling events. There did not appear to be a distinct seasonal trend in taxa richness at this site during any of the sampling years. At Station 3 taxa richness during the spring and summer was highest in 1999, but during the fall it was highest in 1995. As seen at Station 5, there did not appear to be a distinct seasonal trend in taxa richness. At Station 1 taxa richness was consistently highest in 1999, although differences were not significant. Again, no seasonal trend in taxa richness was evident. When looking at longitudinal trends in the watershed, it was noted that family level taxa richness at Station 5 was higher than the downstream stations during all years. This indicated the upstream site had a more diverse community than downstream stations, lending support to its proper consideration as a control site within the watershed.

Family level EPT richness at Station 5 was highest in the spring and summer of 1999, but during the fall it was highest in 1995. The effect of sampling season on EPT richness was generally variable at this site except in 1999 when it increased steadily throughout the year. The same patterns were observed at Station 3. At Station 1, however, EPT richness was consistently highest in 1999, although not substantially so. No seasonal trends were evident at this site during any year. EPT richness did not exhibit longitudinal trends in the watershed, but it tended to be highest at Station 1. The likely reason for this was the high amount of stable cobble substrate, which was a preferred habitat for EPT organisms.

Values for community diversity, as measured by Shannon-Weiner H', are presented in Figure 61A-C. The metric did not exhibit any trends between sampling years at Station 5; however, the spring sampling season yielded highly variable results between years. This was probably because macroinvertebrate communities were responding to natural, springtime hydrological disturbances. The change in sampling methods did not appear to artificially increase community diversity, as diversity in 1999 was similar to other years. Since most changes in land management activities occurred downstream of Station 5, it was not surprising to see relatively consistent values for diversity between sampling years. At Station 3, however, diversity was highest in 1999 during all sampling seasons. This could have been due to improvements in water or habitat quality at the site. Diversity at Station 1 was variable between seasons and between sampling years. The spring sampling season yielded the most variable diversity results, probably

because macroinvertebrate communities were responding to springtime hydrological disturbances.

The HBI at Station 5 ranged between 4.03 and 6.05, indicating the macroinvertebrate community at this site was moderately tolerant to organic enrichment and/or fine sediment. There was no trend between years, but in 1999 the HBI score increased throughout the year (*Figure 62A)*. At Station 3 the HBI scores were significantly lower in the spring and summer of 1999. During the fall HBI scores were similar during all years at Station 3 Figure 61B. At Station 1 HBI scores were significantly lower in 1999 during all seasons and indicated the community was intolerant to organic enrichment. In addition, HBI scores tended to decrease throughout the year in 1995 and 1999 (*Figure 61C*). The lower 1999 scores may indicate a positive macroinvertebrate community response to better land management practices in the watershed.

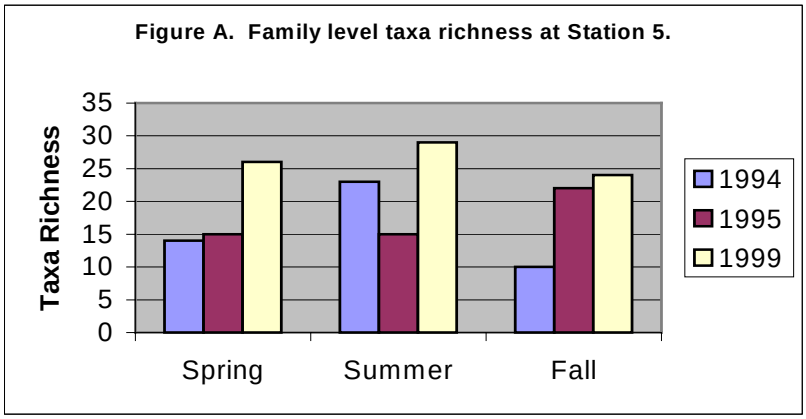
Community Similarity Between Stations

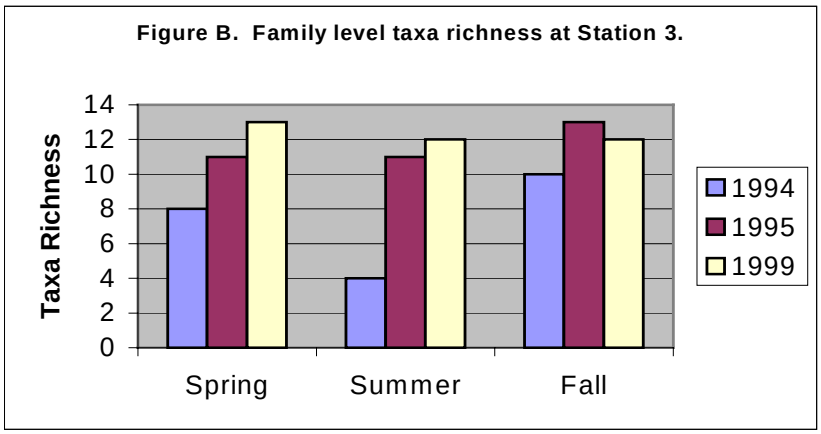
The Jaccard's similarity index showed no spatial or temporal trend during the spring sampling events when compared to Station 5. However, the index generally improved between Site 5 and the downstream stations over time during the summer and fall sampling seasons. These data indicated that over time Station 3 and Station 1 tended to share more species in common with the control site (Station 5). The percent similarity index did not show clear trends over time, as shifts in relative abundance of taxa (to which this index was sensitive) were too variable.

Recommendations

Future monitoring activities for macroinvertebrates in the target watershed should include genus-species level identifications in order to detect ecologically important species (such as cold stenotherm taxa). In addition, new bioassessment tools, including a temperature tolerance metric and a sediment tolerance metric, will be available to specifically assess the effects of sediment and temperature on the macroinvertebrate communities over time.

In addition, multiple season sampling might not be necessary in streams that flow year round. Most monitoring programs in permanent streams sample once per year, typically during the summer or fall during baseflow conditions. This would allow more sites to be monitored annually, given a fixed budget.





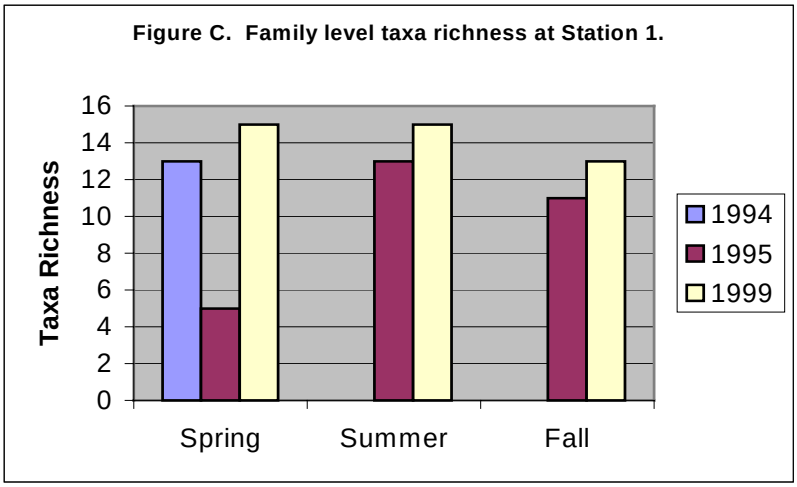
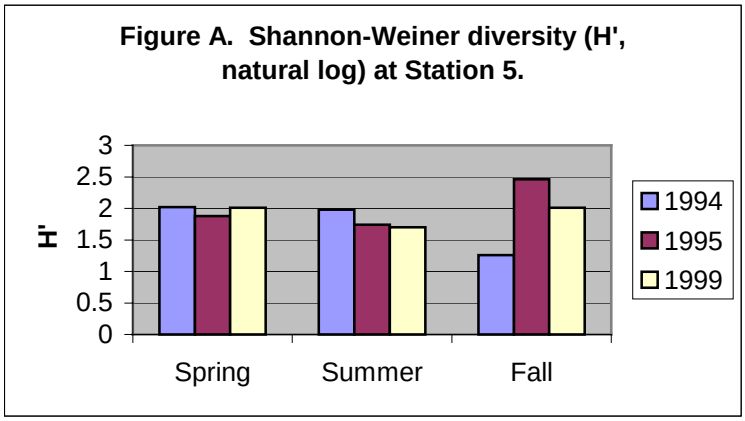
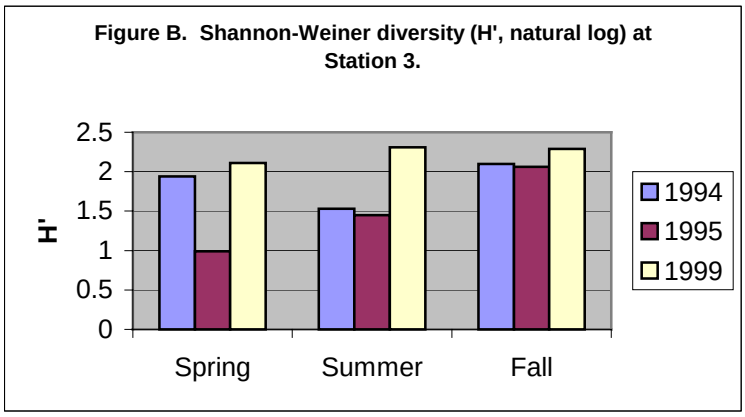


Figure 80. Family level taxa richness at three stations in Lake Creek, 1999.





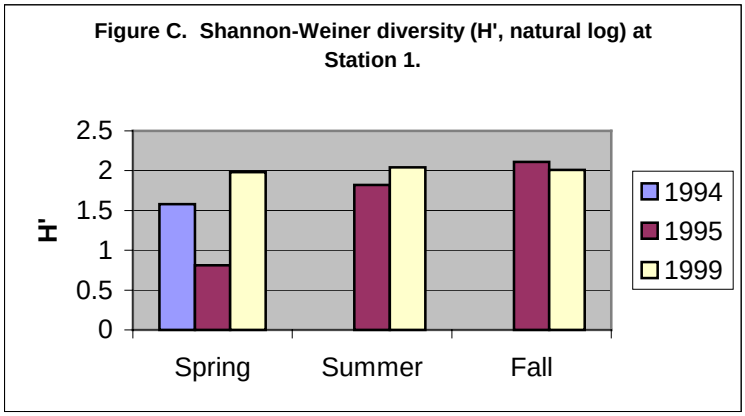
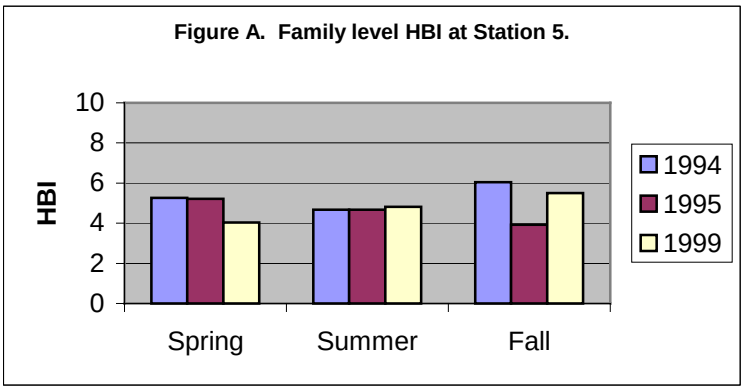
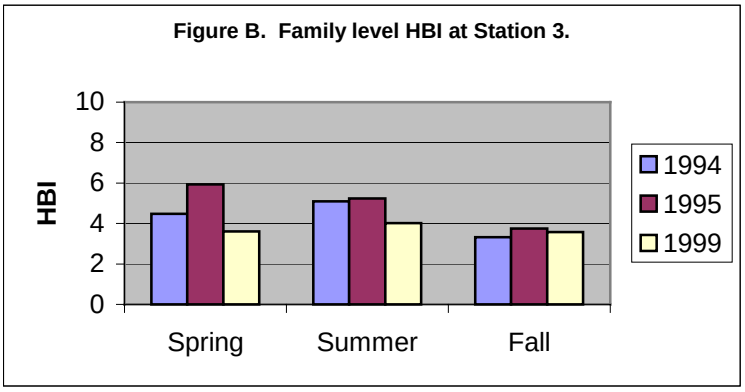


Figure 81. Shannon-Weiner diversity (H_l natural log) at three stations in Lake Creek.





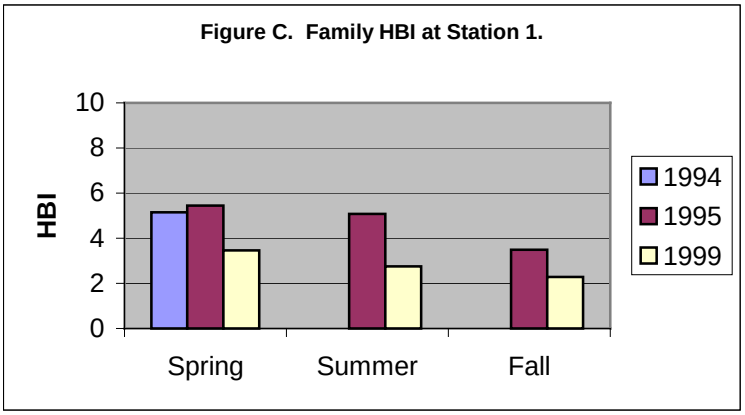


Figure 82. Family level HBI at 3 stations in Lake Creek.

5.0 REVIEW OF ANNUAL SCOPES OF WORK, 1995-2001

RESTORATION AND ENHANCEMENT

PROJECT SUMMARIES

Thirty-six individual restoration/enhancement treatments have been implemented at 25 project sites between 1995 and 2001. Long-term agreements have been signed with 12 landowners in three watersheds, providing protection and enhancement for more than 850 acres of upland and riparian habitat and 4 miles of stream channel. More than 50,000 trees and shrubs have been planted over a five year period to enhance water retention and riparian function. Eight acres of constructed wetlands have reduced non-point source pollution from 630 acres of farm land and instream habitat improvements have elicited positive responses from fishes at several sites. Cost shares for implementation, monitoring and evaluation activities currently occur with seven partnership agencies.

All restoration activities for 1995-2001 are summarized in chronological order in *Table 35* and the locations of treatment sites is cross-referenced by "Project ID" in *Figures 77-79.* A brief explanation of the project ID is warranted here. The project ID is an alphanumeric code that corresponds to the location of individual treatments in relation to the river-mile of the drainage network for the watersheds of interest. The first digit of the code signifies the watershed that the treatment is located in, using the first letter in the watershed name (e.g., L=Lake Creek, B=Benewah Creek, etc.). The series of numbers that follow correspond to the river-mile location (in miles and 10^{ths}) at the lower end of treatment sites. River mile is tabulated in an upstream direction from mouth to headwaters and treatments that are located in tributary systems have river mile designations separated by a forward slash (/). For example, the downstream end of project L_5.2/0.2 is located in the Lake Creek watershed 0.2 miles up on a tributary that has its confluence with the mainstem 5.2 miles from the mouth. This nomenclature clearly indicates the spatial relationship of treatments to the mainstem and tributary aquatic habitats having significance to the target species. Furthermore, it readily conveys information about the relationship of multiple treatments by indicating the distance to common points in the drainage network.

A more detailed site characterization and summary of activities for individual treatments follows. In several locations, multiple treatments were implemented to meet the objectives for larger sites. These treatments are described together so that the interrelationship of activities is more apparent. Tables 36-38 show these restoration/enhancement activities in relation to the recent scopes of work (1999-2001) that were contracted with the Bonneville Power Administration.

Table 36. Chronological summary of restoration/enhancement activities by location, 1995-2001.

Projects			Activity By Year						
Project ID	**Location**	**Treatments**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
B_8.5	RM 8.5-8.9	Riparian fencing; Instream structure; Streambank stabilization; Riparian planting; 670m	Agreement 6/95; design, permitting, construction of fence and weir completed	Photo points established; pre-treatment surveys, cross-sections established; instream structures installed; planted 1,400 trees and shrubs	Minor repair work completed; cross-sections surveys; design and construction of revetment completed; planted 2,750 trees and shrubs	Landowner assumed O&M for fence; riparian function assessment completed	Riparian function assessment completed	Out-planted 400 from Tribal nursery	
B_8.1	RM 8.1-8.5	Riparian fencing; Riparian planting; bank stabilization; 560m		Agreement 7/96; fence construction completed; pre-treatment survey; planted 2,000 trees and shrubs; permitting and construction completed 9/96	Landowner assumed O&M for fence; re-planted 250 trees and shrubs	Riparian function assessment completed	Riparian function assessment completed		
E_1.3	RM 1.3-1.4 Anderson	Streambank stabilization, 225m		Design, permitting and construction completed; planted 1,000 willows	M&E; water quality monitoring	water quality monitoring	water quality monitoring	water quality monitoring	water quality monitoring
E_1.6	RM 1.6-1.9 East Side Hwy Dist.	Streambank stabilization, 100m; Road improvement 670m		Cost-share agreement 8/96; Design, permitting, consultation with USCOE, construction completed 10/96					
L_6.0	RM 6.0-6.3	Riparian planting, 560m		Agreement 5/96; pre-treatment survey; planted 1,400 trees and shrubs	Planted 1,000 trees and shrubs		Riparian function assessment completed		Planted 1,200

Projects			Activity By Year						
Project ID	**Location**	**Treatments**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
B_8.2	RM 8.2	Channel modification, 50m		Agreement 7/96	Pre-treatment survey; design, permitting, construction completed	M&E	Landowner cost-share for planting	Planted additional trees	
L_5.2/0.2	T48N, R5W, S20, NE ¼	Water storage, 39 hectares			Agreement 8/97; design and construction completed	Landowner planted 600 trees and shrubs as cost-share;	Water quality monitoring; NRCS constructed gully plugs as cost-share	Water quality monitoring	Water quality monitoring; water release
L_5.4/0.1	T48N, R5W, S17, SE ¼	Water storage, 7.3 hectares			Agreement 8/97; design and construction completed	Landowner planted 100 plants as cost-share	NRCS constructed gully plugs as cost-share		
B_8.5/0.0	T45N, R3W, S7	Slope stabilization, 45 hectares				Pre-treatment survey; planted 1,250	Planted 1,800	Planted 1,500	Planted 1,350
B_8.1/0.0	T45N, R3W, S8, SW ¼ x	Slope stabilization, 1.8 hectares				Agreement 7/96; planted 1,250	M&E	Re-planted 950, installed rodent protection	
L_8.8	RM 8.8-9.1	Riparian planting, 435m				Agreement 5/98; pre-treatment survey; design, contractor hired, site prep; planted 900	M&E; replanted 250; tree tubes installed		Planted 300
L_8.5	RM 8.5-8.8	Riparian planting, 480m				Agreement 4/98; pre-treatment survey; design, contractor hired, site prep; planted 900	M&E; replanted 250; tree tubes installed		
L_6.7/0.2/0.0	T48N, R5W, S17, NW ¼	Water storage, 51 hectares				Agreement 8/98; design and construction completed	Water quality monitoring	Water quality monitoring; water release	Water quality monitoring; water release
L_7.3/0.2	T48N, R5W, S12, SW ¼	Slope stabilization, 8 hectares				Agreement 5/96; Planted 1,200	Planted 2,450; M&E		Planted 800

Projects			Activity By Year						
Project ID	**Location**	**Treatments**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
E_0.1	RM 0.1-0.5	Riparian planting, 560m					Cost-share agreement 1/99; design; site prep; planted 1,650	Site prep; planted 1,500	M&E; planted 1,050
L_8.2 L_8.2/0.0 L_8.2/0.0/0.0	RM 8.2-8.5 T48N, R6W, S12, NW ¼	Instream structure (550m); Riparian planting (1175m); Slope stabilization (0.8 hectares)		Population monitoring	Population monitoring	Gravel analysis, habitat survey, population monitoring	Agreement 4/99; pre-treatment survey; Design, permitting, construction completed; planted 2,890 trees in riparian, 2,000 trees in upland; post-treatment M&E	M&E; Planted 1,350, installed tree tubes; Survival est.	M&E; planted 1,050 trees in riparian, 850 trees in upland; installed tree tubes
B_6.5	RM 6.5-6.9	Channel construction (695m); Riparian planting; Riparian fencing		Population monitoring upstream and downstream	Population monitoring upstream and downstream	Population monitoring upstream and downstream	Population monitoring upstream and downstream	Contract for design work; pre-treatment survey; Landowner agreement 7/00; permitting completed, phase I construction completed; planted 1,675 trees and shrubs	Phase II construction completed; hydroseeded; Planted 1,500 grass/sedge plugs and 1,950 trees and shrubs; completed fence construction; M&E
B_8.5/0.2	T45N, R3W, S8 SW ¼	Slope stabilization, 4 hectares						Pre-treatment assessment; planted 1,050	
L_7.3 L_7.6/0.0	RM 7.3-7.6	Riparian planting, 868 m		Population monitoring	Population monitoring	Habitat survey, population monitoring	Population monitoring	Planted 1,520	Planted 1,650
L_8.7/0.1	T48N, R6W, S1, SW ¼	Water storage, 19.8 hectares						Agreement 8/00; design and construction completed	Planted 1300

Projects			Activity By Year						
Project ID	**Location**	**Treatments**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
L_5.9/0.4	T48N, R5W, S17, SW ¼	Gully repair (1,000m); Gully repair (115 hectares)						Cost-share agreement signed; design and construction of grade control structures completed	Landowner agreement signed 7/01; design and construction of sediment basin completed
L_6.5/0.1	T48N, R5W, S17, NW ¼	Water storage, 16 hectares							Agreement 8/01; design and construction completed
L_5.9/0.4/0.0	T48N, R5W, S17, SW ¼	Slope stabilization, 4.9 hectares							Site prep; planted 1,200, installed tree tubes

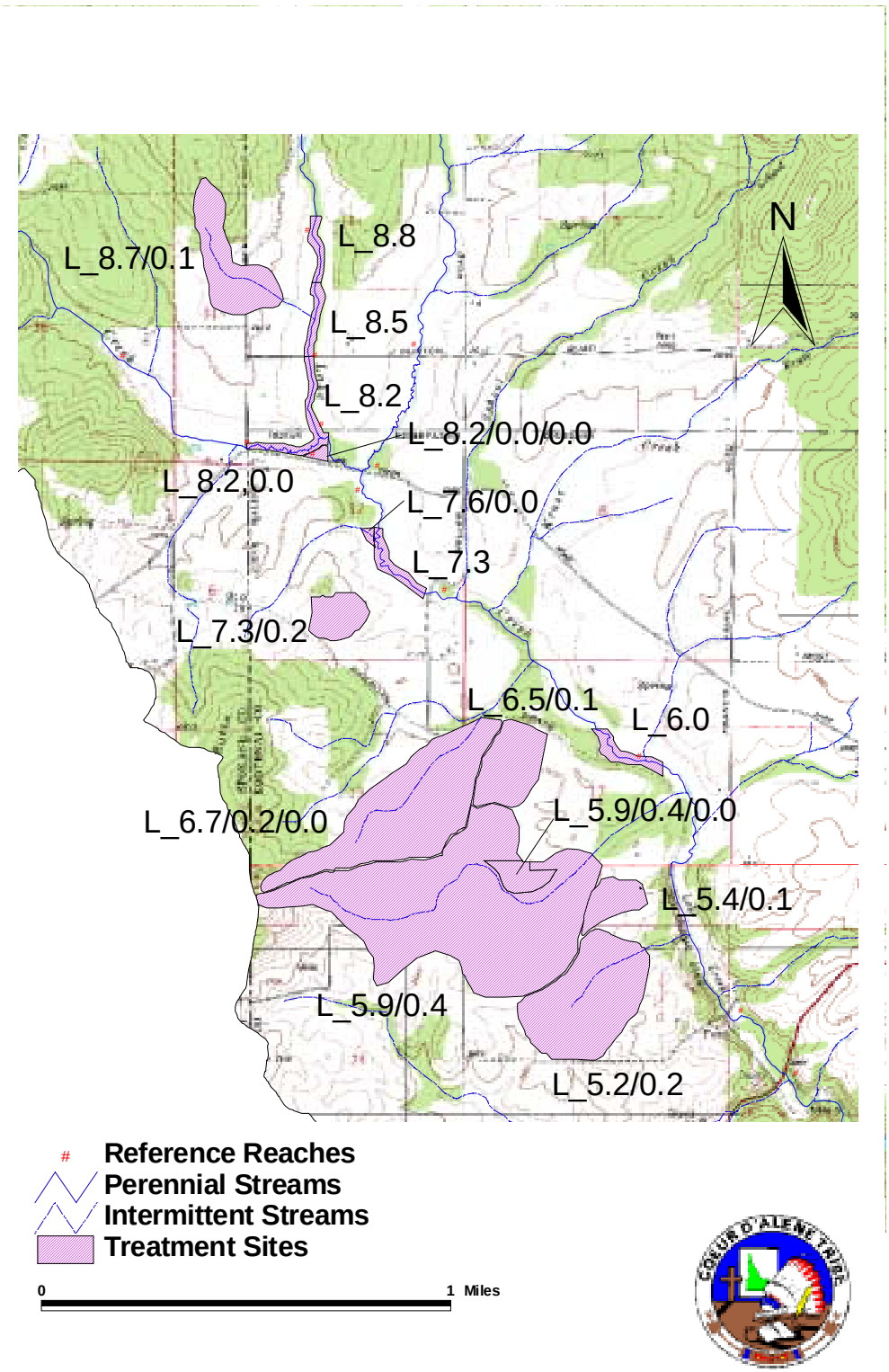


Figure 83. Location of restoration/enhancement project sites in the Lake Creek watershed.

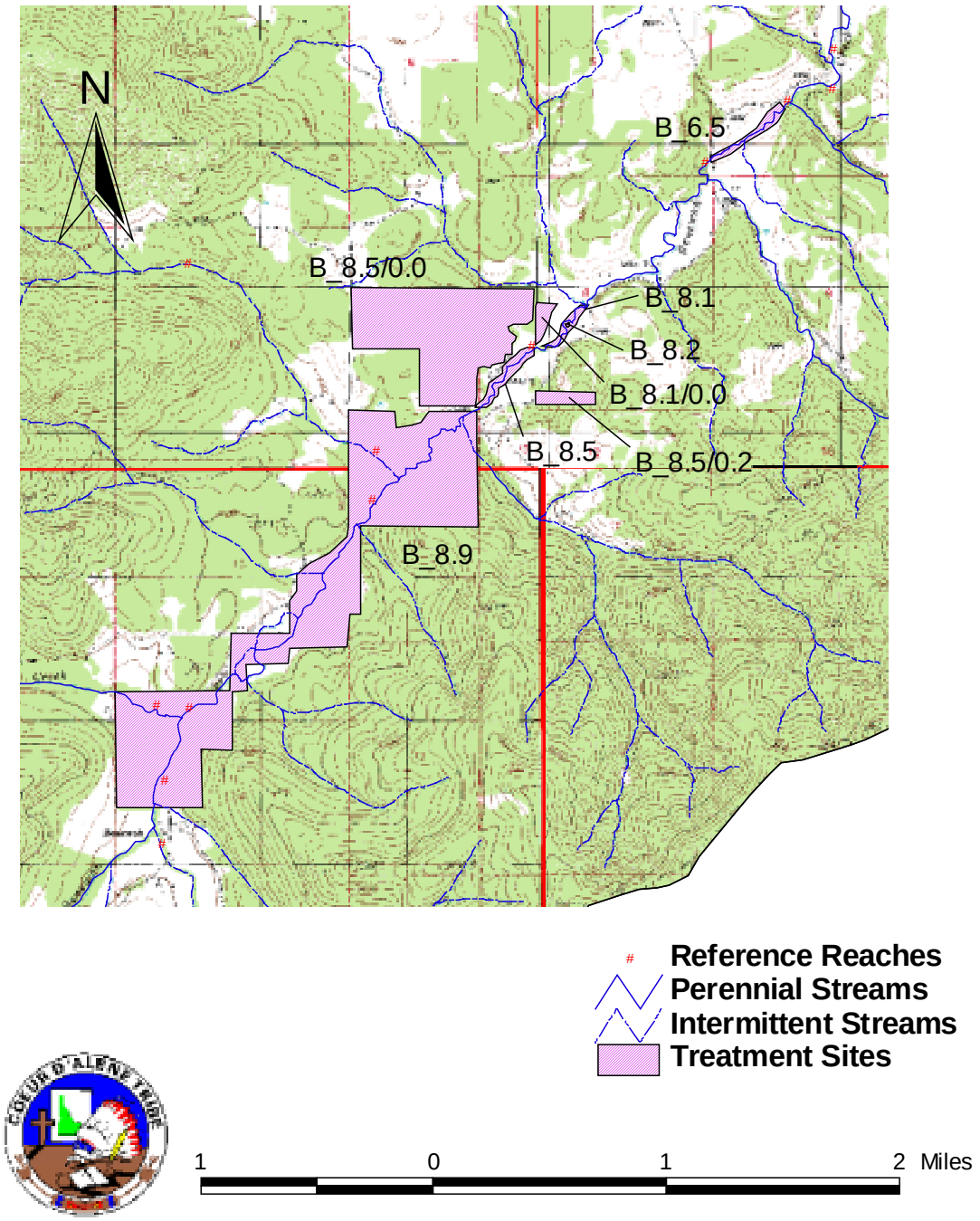


Figure 84. Location of restoration/enhancement sites in the Benewah Creek watershed.

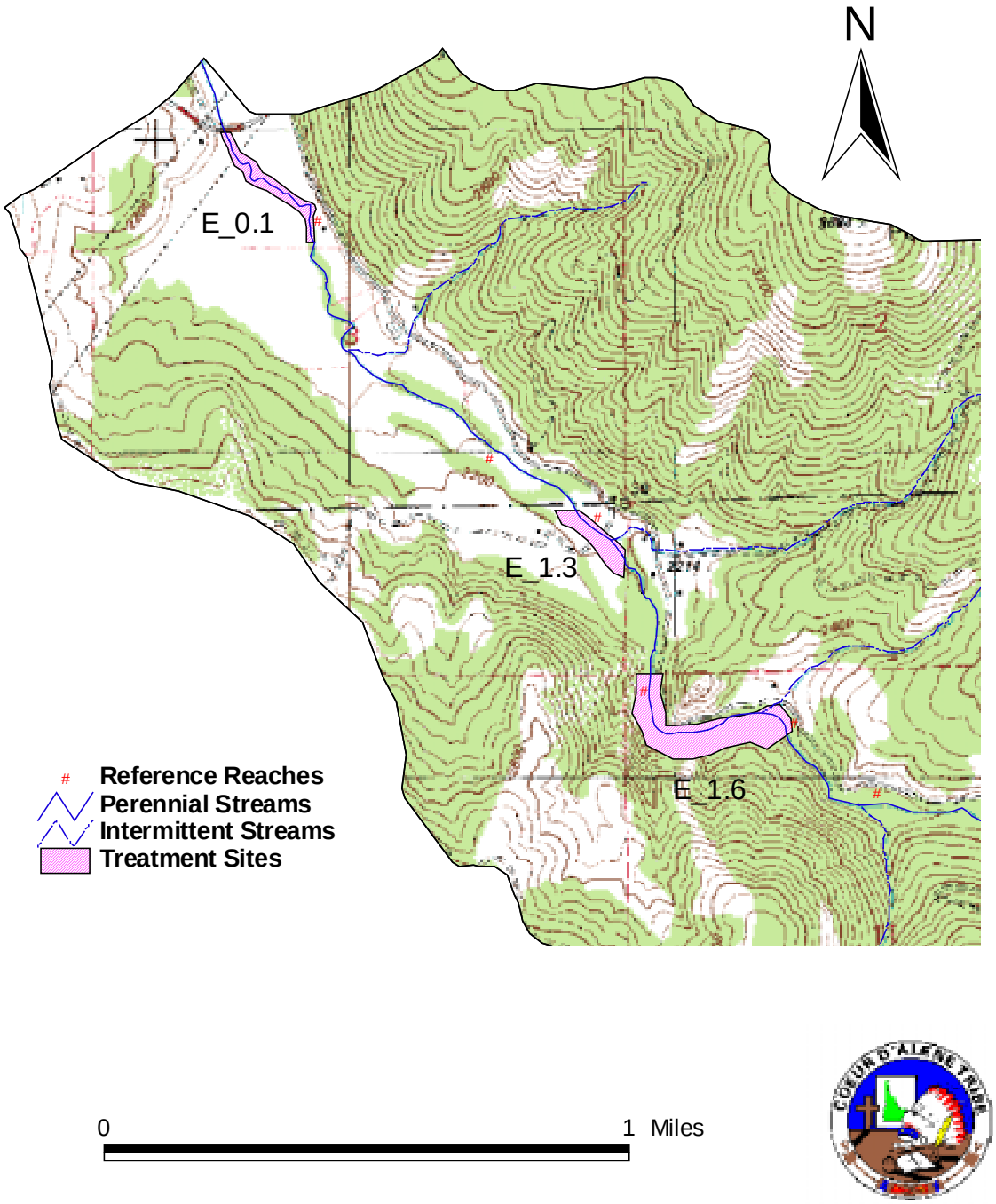


Figure 85. Location of restoration/enhancement sites in the Evans Creek watershed

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BPA PROJECT SUMMARY

PROJECT ID: B_8.5

PROJECT CATEGORY/TREATMENT: Riparian/Grazing Management; Instream/Streambank Stabilization; Instream/Instream Structure; Riparian/Riparian Planting

PROJECT LOCATION:

Watershed: Benewah | Legal: T45N, R3W, S8, SW ¼

Sub Basin (River Mile): RM 8.5-8.9

SITE CHARACTERISTICS:

Slope/Valley gradient: 1% | Valley Type: B2 | Elevations: 2680

Proximity to water: Riparian | Channel type: C4

Other: Project treats 10 acres of riparian/floodplain habitat and 2,198 linear feet of stream

PROBLEM DESCRIPTION: This property was the first to be enrolled with the Tribe under this enhancement project in 1995. A history of anthropogenic disturbances that altered channel form and riparian function and resulted in very unstable conditions made this property a good target for enhancement. A splash dam and flume, operated from 1915-1930, temporarily altered the hydrology and hydraulic forces in the channel. Clearing of land to develop streamside pastures (1930's) followed by a long history of intensive grazing (1930-1980's) reduced the density and diversity of deep-rooted plant species. Following flooding in 1990, a large channel avulsion rerouted the main flow of the stream into an area with little riparian vegetation, beginning an evolutionary process that exposed unconsolidated, highly erodible bank materials and initiated further head cutting. During the 5 years following the flood, channel adjustments have decreased channel length, locally increased the gradient, and the channel has become slightly incised for more than 1,000 feet. The historic channel and floodplain were abandoned as head cutting in the new channel lowered the base elevation of the stream.

The combined effects of recent channel incision and uncontrolled grazing have severely compromised the ability of the riparian community to function in reducing streambank erosion. Woody debris volumes are relatively low (10.2 in^3/ft^2) and because most of the 94 pieces of large wood identified in pre-treatment surveys are smaller pieces (mean length=9.8", dia=5.4") they are unstable and contribute little to channel forming processes. Canopy density over the stream channel is only 14%, well under the target for this reach, and overhanging vegetation (mean=1.9ft.) provides little near bank cover.

The reach is located immediately downstream from a spawning tributary and historic use included both summer and over winter rearing for cutthroat trout.

DESCRIPTION OF TREATMENT: Several treatments were initiated in this reach between 1995 and 1997 to improve the condition of the riparian community and to stabilize the stream channel and banks. A landowner contract was signed 7/95 to establish terms and conditions for maintaining improvements.

Beginning in 1995, approximately 4,400 feet of new fence was constructed to create a 10-acre riparian pasture that will be managed to protect stream channel/floodplain habitats and future riparian plantings. The completed fence consisted of 4-strand barbed wire with 6x6 treated posts and cross beams. One rocked access point was constructed in the middle of the fenced area. Cattle will be excluded from the riparian pasture for an indefinite period to allow for recovery and establishment of riparian plantings. The landowner assumed O&M responsibilities following the initial installation.

A single rock vortex weir was constructed in 1995 at the upstream end of the channel avulsion to serve as a grade control structure to prevent upward migration of the headcut and to decrease near-bank sheer stress and increase the energy in the center of the channel. Secondary objectives were to create deeper pool habitat to provide holding cover for trout using the reach during rearing periods. Streambanks immediately downstream from the weir were sloped to further reduce near-bank sheer stresses. In addition, the connections to the historic channel and one other side channel were reestablished to ensure that some amount of stream flow would continue to maintain the mature vegetation established at the elevation of the historic floodplain. Four permanent cross-sections were established near the weir to monitor channel changes.

In 1996, a series of lunker structures were installed in a continuous series along the current-bearing bends of four large radius meanders. The structure is a modification of the bank cover and current deflector described by Hunt (1993), and is designed specifically to increase the combination of pool and overhead cover habitat for trout. The structures consist of a prefabricated, sandwich-like, wooden platform that rests directly on the stream bottom. Each platform was anchored in place with rebar and covered with rock and dirt, then finished with a mix of grass seed.

Riparian plantings were initiated in 1997 with the principle goal of reestablishing a vigorous, multi-storied canopy that would restore many of the lost riparian functions. A pre-treatment survey completed in 1996 documented canopy density, extent of overhanging vegetation and biomass and volumes of woody debris, both in the channel and in floodprone areas. A total of 2,750 trees and shrubs were planted in 1997. Species included ponderosa pine, white pine, Douglas fir, Sitka alder, water birch, scouler willow and black cottonwood. Materials consisted of plugs and containerized stock grown from local seed sources. Riparian function surveys were repeated again in 1998 and 1999 following the initial plantings. An additional 400 trees (2-2) were out-planted on the site from the Tribal nursery in 2000.

Following the initial riparian plantings in 1997, additional bank stabilization treatments were implemented within the new channel avulsion in an attempt to establish vegetation and slow bank erosion processes. While the natural tendency for a stream having experienced channel incision is to balance its slope with that of its valley and rebuild a new floodplain through a process of lateral meander extension, the goal of this treatment was to provide temporary stabilization until such time that the stream could be reintroduced to the historic channel, where well established vegetation offers much higher resistance to erosion.

A series of streambank revetments were built using woody material collected near the treatment sites. Live posts of cottonwood, willow, and alder were augured into the base of eroding streambanks to serve as anchor points for the structures. Successive layers of brush and pole sized material were then lashed to the anchor points to form a semi-rigid framework. The revetment is designed to help stabilize and rebuild streambanks by trapping fine sediment and by decreasing near-bank velocity. The live posts used as anchors will take root over time and increase stream channel shading in the near term. Similar projects have been successfully implemented in the Palouse River drainage near Pullman, Washington. Six cross sections were measured at the time of installation to monitor changes in width/depth ratio and streambank stability.

PROJECT TIMELINE: Fence construction was completed 9/95. Stabilization measures and instream enhancements were completed in 1996 and 1997. Riparian plantings were completed in 1997 and 2000. Additional project design for reactivating the historic channel is anticipated in future years when plantings have matured.

PROJECT GOALS & OBJECTIVES: Goals include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote bank stabilization; 4) increase riparian species diversity and cover; and 5) increase holding cover for trout. Riparian fencing helps to supports these goals by providing a means for excluding cattle from streamside habitats while plantings recover and mature and allow for long-term management of grazing pressure such that riparian functions are restored to the fullest extent possible.

RELATIONSHIP TO SCOPE OF WORK: Initial treatments satisfied the Program commitments in the FY1995 Scope of Work and Budget Request (Contract # 90BP10544). Subsequent treatments fulfilled portions of the Program commitments for Objective 4, task 1 in the FY1996 Scope of Work and for Objective 3, task 3.2 in the FY1997 Scope of Work.

BPA PROJECT SUMMARY

PROJECT ID: B_8.1

PROJECT CATEGORY/TREATMENT: Riparian/Fencing; Riparian/Planting; Instream/Streambank stabilization

PROJECT LOCATION:

Watershed: Benewah	Legal: T45N, R3W, S8, SW ¼
Sub Basin (River Mile): RM 8.1 - 8.5	

SITE CHARACTERISTICS:

Slope/Valley gradient: 1%	Valley Type: B2	Elevations: 2680
Proximity to water: floodplain	Channel type: C4	
Other: Project treats approximately 1,300 linear feet of stream channel and associated floodplain		

PROBLEM DESCRIPTION: The site encompasses approximately 1,300 feet of stream channel and the adjacent floodplain. Channel gradient is less than 1 percent, average bankfull width is 18 feet, and average bankfull depth is 3.0 feet. The reach has a Pfankuch channel stability rating of fair. The site serves as potential summer and winter rearing habitat for cutthroat trout, but limited cover opportunities (instream wood volume=5.17 in^3/ft^2; mean vegetative overhang=1.0ft) decrease both the quality and quantity of usable area.

The riparian area in the upper 500 feet of the project site is well vegetated with mature alder, but vegetation is sparse along the lower portion of the floodplain. The vegetation community lacks the diversity of less disturbed areas and the lack of a conifer component limits the ability of the site to moderate stream temperatures and provide large woody debris to the channel. Stream canopy density (23%) is well below the target values for the reach.

The valley on the west side of the stream is currently under cultivation and some encroachment on the floodplain has occurred. These areas are characterized by actively eroding streambanks. Future land use plans, including limited livestock grazing, threaten the integrity of the existing riparian buffer.

DESCRIPTION OF TREATMENT: The proposed action calls for integration of several treatments, including: 1) fencing; 2) riparian planting; and 3) minor bank stabilization and reconnection of side channel habitat. The entire west side of the stream will be fenced to exclude cattle from the riparian area. The fence line will roughly follow the edge of the cultivated field, while providing a 15-20 foot buffer to accommodate any future channel migration. Two 32-foot cattle gates will be installed to provide access to the fenced exclosure. Existing fence lines that cross the creek at the upper and lower ends of the project area will be removed and replaced with movable cattle gates. Planting will occur on the upper banks for the lower portion of the site. Plantings will consist of cottonwood, aspen, willows, serviceberry, and native grasses, sedges, and rushes. Bank stabilization will be accomplished by using large rock to reinforce the toe of unstable banks. These areas occur primarily on the west side of the creek where the channel has encroached into a cultivated field, and along a 50-foot section of creek adjacent to a historic barn where a steep cutbank exists. Minor amounts of bank sloping may be needed in addition to placement of rock. In these areas, banks will be sloped to enhance floodplain features and increase the floodprone width. Erosion control mating impregnated with seed will be anchored on the cutbank near the barn to speed the recovery of vegetation.

A riparian function assessment was completed prior to beginning restoration work at the site. The assessment evaluated woody debris volumes, canopy density and overhanging cover. Fence construction was completed 7/96. Permitting and bank stabilization was completed by 9/96. A total of 2,000 trees and shrubs were planted in 1996 and an additional 250 trees were planted in 1997 to restock the site following the first growing season.

Subsequent functional assessments were completed in 1998 and 1999. Canopy density increased significantly (t=0.1) as did overhanging cover (t=0.05) following the initial planting and cessation of grazing.

PROJECT TIMELINE: A pre-treatment survey was completed in 1996. All treatments were completed by 1997. Monitoring is ongoing with riparian function assessments scheduled at 3-year intervals.

PROJECT GOALS & OBJECTIVES: Goals for this project include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote bank stabilization; 4) increase riparian species diversity and cover; and 5) enhance stream buffer capacity.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills the Program commitments for implementation Objective 4, task 1 under the FY 1996 Scope of Work and Budget Request and partially fulfills the commitments for implementation Objective 3, task 3.2 under the FY 1997 Scope of Work (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: E_1.3

PROJECT CATEGORY/TREATMENT: Instream/Streambank Stabilization

PROJECT LOCATION:

Watershed: Evans | Legal: 47N, R2W, S3, SE¼

Sub Basin (River Mile): RM 1.3 – 1.4

SITE CHARACTERISTICS:

Slope/Valley gradient: 3% | Valley Type: E3 | Elevations: 2200

Proximity to water: Instream | Channel type: C3

Other: Project treats 225 meters of stream channel

PROBLEM DESCRIPTION: Portions of the floodplain on this site were cleared and developed as pastures in the past. Loss of woody vegetation on the streambanks significantly reduced the roughness coefficient along 225 meters of stream channel and increased their susceptibility to erosive forces. Much of these banks have a very high erosion hazard potential due not only to the lack of surface protection and root density but to over steepened banks. Recent lateral migration of the channel into these areas has resulted in very high width/depth ratios for much of this reach.

DESCRIPTION OF TREATMENT: This project consisted of implementing streambank stabilization treatments to improve riparian habitat. Large angular rock (45-60 cu. yds.; >24" in two dimensions) was hauled from local pits to the project site and used to construct three barbs to stabilize the outside bends where strong downwelling and upwelling currents generate high stress in the near-bank region. The barbs were designed to reduce bank erosion by reducing nearbank slope, velocity, stream power and sheer stress. Additional rock was placed to reinforce the toe of the remaining unstable bank areas not treated by the barbs. Streambanks were sloped to reduce the bank angle in conjunction with placement of the rock. Then 1,000 live willow cuttings were installed in dense layers and sandwiched between soil courses and the base rock in each of the resloped areas.

PROJECT TIMELINE: Designs were finalized 7/96. Permits were received by 8/96 and construction was completed 10/96.

PROJECT GOALS & OBJECTIVES: Reduce velocity gradient, boundary stress and stream power in the near-bank region of the treatments. Provide a stable environment to encourage growth of woody vegetation.

RELATIONSHIP TO SCOPE OF WORK: This project satisfies the contractual obligations for Objective 4, task 3 in the FY1996 Scope of Work.

BPA PROJECT SUMMARY

PROJECT ID: L_6.0

PROJECT CATEGORY/TREATMENT: Riparian/Planting

PROJECT LOCATION:

Watershed: Lake	Legal: T48N, R5W, S17, NE ¼
Sub Basin (River Mile): RM 6.0-6.3	

SITE CHARACTERISTICS:

Slope/Valley gradient: 1%	Valley Type: C4	Elevations: 2520
Proximity to water: floodplain	Channel type: E4	
Other: Project treats 1,778 linear feet of stream channel and associated floodplain.		

PROBLEM DESCRIPTION: This stream reach is located in a portion of the watershed that historically provided important summer rearing habitat for westslope cutthroat. Much of the forest on the north side of the creek was cleared and converted to agricultural uses in the past. The site has been fallow for at least 20 years but very little woody vegetation has regenerated.

Current riparian function is somewhat degraded as evidenced by low stream canopy closure (mean=28%) and little overhanging vegetation (mean=2.7ft.). Although LWD (pieces >4in dbh) volumes were relatively high at this site (20.78 in^3/ft^2) compared with other project sites, the wood is mostly comprised of small pieces (mean dia=6.7", mean length=9.2') that generally do not function to shape channel morphology or maintain habitat diversity. Also, the existing riparian community offers little potential for providing recruitable large wood in the future.

DESCRIPTION OF TREATMENT: Riparian function will be enhanced by planting native trees and shrubs in the near bank region and adjacent floodprone areas. Plantings consisted of Douglas fir, western white pine, ponderosa pine, cottonwood, quaking aspen, serviceberry, willow and blue elderberry. Plant materials consisted of small tublings and containerized plants. A total of 1,400 trees and shrubs were planted in 1996. Follow-up plantings were completed in 1997 and 2001 with 1,000 and 1,200 plants installed, respectively.

PROJECT TIMELINE: A pretreatment survey was completed in the spring of 1996 to evaluate riparian canopy density, vegetative cover and woody debris volume. The first 1,400 plants were installed following the initial survey. Additional plantings were done in spring 1997 and 2001 to fill the remaining prepared sites and to replace plants that didn't survive during the initial planting effort. A post treatment survey was completed in 1999.

PROJECT GOALS & OBJECTIVES: Goals for this project include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote bank stabilization; 4) increase riparian species diversity and cover; and 5) enhance stream buffer capacity. Provide for significant increases in canopy density and overhanging vegetation over the term of the landowner contract. Target canopy closure is 92%.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills a portion of the Program commitments for implementation Objective 4, task 1 under the FY 1996 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: B_8.2

PROJECT CATEGORY/TREATMENT: Instream/Channel Modification

PROJECT LOCATION:

Watershed: Benewah | Legal: T45N, R3W, S8, SW ¼

Sub Basin (River Mile): RM 8.2

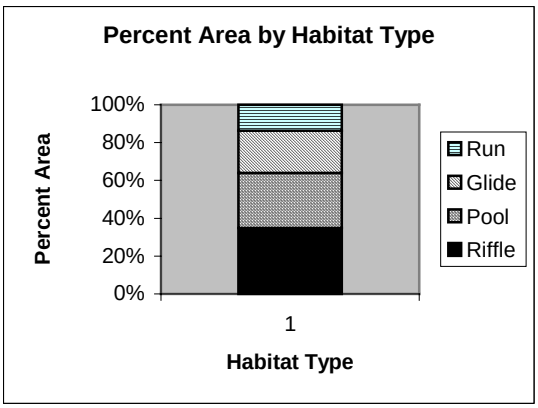
SITE CHARACTERISTICS:

Slope/Valley gradient: 1% | Valley Type: B2 | Elevations: 2680

Proximity to water: floodplain | Channel type: C4

Other: Project creates approximately 2500 sq. ft. of side channel rearing habitat

PROBLEM DESCRIPTION: The target reach serves as potential summer and winter rearing habitat for cutthroat trout, however, poorly developed pool habitat and lack of cover decreases both the quality and quantity of usable area on the site. Although pool habitats comprise an acceptable percentage of the total area (figure 1), pool quality in general is very low. Pool frequency in the surveyed reach equated to 25-pools/stream mile and is below target pool frequencies (47-56 pools/mile) for streams of similar gradient, substrate size, and wetted width (USFS 1995). Mean residual pool depth was 1.95 ft and was also less than target values for streams of similar size (Hickman and Raleigh 1982). Existing volumes of woody debris (5.17 in^3/ft^2) and poor riparian condition (mean vegetative overhang=1.0ft) also limit cover opportunities for trout.



DESCRIPTION OF TREATMENT: The treatment for this site involved creating side channel rearing habitat that is accessible to fish during all flow levels. A single, deep pool (mean depth=8 ft) measuring approximately 32ft. x 78ft. was excavated on a low river terrace adjacent to the main channel. Similar channel features develop naturally in river systems either along abandoned meander scars or in swales between scroll bars. Access to the habitat is maintained at all flows through a series of step pools that were constructed at the outlet of the pool. Inflow is also maintained at all times through a gravity flow system consisting of several perforated pipes (4"dia) that were buried between the upstream edge of the pond and the main channel. Similar types of riverine ponds have been shown to provide important winter refuge and habitat capacity during migratory periods (Peterson 1985; Cederholm and Scarlett 1982).

The landowner provided approximately $5,000 in cost-share by purchasing and planting large trees around the perimeter of the pond in 1999 and 2000.

Other treatments completed on the site in 1996 attempt to address some of the problems associated with riparian condition.

PROJECT TIMELINE: Pre-treatment surveys were completed in 1996. Design and permitting was completed 7/97 and construction of the pond was completed in 8/97.

PROJECT GOALS & OBJECTIVES: Increase summer and winter rearing area for cutthroat trout on the site.

RELATIONSHIP TO SCOPE OF WORK: This project partially fulfills the Program commitments for implementation Objective 4, task 4.1 under the FY 1997 Scope of Work (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_5.2/0.2

PROJECT CATEGORY/TREATMENT: Riparian/Water Storage

PROJECT LOCATION:

Watershed: Lake	Legal: T48N, R5W, S20, NE ¼
Sub Basin (River Mile): pond drains to RM 5.2	

SITE CHARACTERISTICS:

Slope/Valley gradient: 12%	Valley Type: C2	Elevation: 2520
Proximity to water: Riparian	Channel type: Intermittent	
Other: Project treats storm water runoff from approximately 97 acres of farm ground.		

PROBLEM DESCRIPTION: The subject property is located at the lower end of a 97-acre, unnamed sub-watershed flowing to Lake Creek. Landuse is intensive agriculture with a rotation that alternates between annual cropping and continuous sod cover. Soils consist of Taney silt loam with slopes ranging from 3-25%. The soil has a slow infiltration rate when thoroughly wet, runoff is rapid, and the hazard of erosion is high. Sheet and rill erosion under an annual cropping scenario generates 15.1 tons/acre/year of sediment with an estimated 10% delivery to Lake Creek (SCS 1990; CDA Tribe 1998). Gully erosion is also a problem.

DESCRIPTION OF TREATMENT: A large pond was constructed to act as a stilling basin for storm water runoff from 97 acres of farm ground and to allow for storage and subsequent release of clean, cold water. A 317' long embankment impounds water along the natural contours of the site. The resulting pool has a surface area of 2.5 acres and a holding capacity of approximately 13 acre-feet.

The project was completed under a cost-share agreement between the landowner, Tribe and NRCS. The landowner planted 600 trees, shrubs and emergent aquatic plants in 1998. The cost-share also funded construction of 4 gully plugs in 1999 that will further reduce sediment generation from this sub-watershed and extend the effective life of the pond.

PROJECT TIMELINE: Construction was completed 10/97. Dam was seeded and mulched 10/97 and the landowner completed plantings around the pond as portion of a cost-share agreement in 1997 and 1998. Water quality monitoring has been ongoing since 1999 and water was released 2001.

PROJECT GOALS & OBJECTIVES: Reduce sediment transport from 97 acres of ground for the life of the project. Store and release up to 7 acre-feet of water annually to recharge ground water and supplement base flow in Lake Creek.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills the Program commitments for Objective 5, task 5.2 under the FY 1997 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_5.4/0.1

PROJECT CATEGORY/TREATMENT: Riparian/Water Storage

PROJECT LOCATION:

Watershed: Lake	Legal: T48N, R5W, S17, SE ¼
Sub Basin (River Mile): pond drains to RM 5.4	

SITE CHARACTERISTICS:

Slope/Valley gradient: 10%	Valley Type: C2	Elevation: 2560
Proximity to water: Riparian	Channel type: Intermittent	
Other: Project treats storm water runoff from approximately 18 acres of farm ground.		

PROBLEM DESCRIPTION: The subject property is located at the lower end of an 18-acre, unnamed sub-watershed flowing to Lake Creek. Landuse is intensive agriculture with a rotation that alternates between annual cropping and continuous sod cover. Soils consist of Taney silt loam with slopes ranging from 3-25%. The soil has a slow infiltration rate when thoroughly wet, runoff is rapid, and the hazard of erosion is high. Sheet and rill erosion under an annual cropping scenario generates 15.1 tons/acre/year of sediment with an estimated 10% delivery to Lake Creek (SCS 1990; CDA Tribe 1998). Gully erosion is also a problem.

DESCRIPTION OF TREATMENT: A large pond was constructed to act as a stilling basin for storm water runoff from 18 acres of farm ground and to allow for storage and subsequent release of clean, cold water. A 275' long embankment impounds water along the natural contours of the site. The resulting pool has a surface area of 1.0 acres and a holding capacity of approximately 7 acre-feet.

The project was completed under a cost-share agreement between the landowner, Tribe and NRCS. The cost-share funded construction of 2 gully plugs in 1999 that will further reduce sediment generation from this sub-watershed and extend the effective life of the pond. Also, the landowner planted 100 trees, shrubs and emergent aquatic plants in 1998.

PROJECT TIMELINE: Construction was completed 10/97. Dam was seeded and mulched 10/97 and additional planting was completed in spring 1998. No water has been released as of 2001.

PROJECT GOALS & OBJECTIVES: Reduce sediment transport from 18 acres of ground for the life of the project. Store and release up to 6 acre-feet of water annually to recharge ground water and supplement base flow in Lake Creek.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills the Program commitments for Objective 5, task 5.2 under the FY 1997 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: B_8.5/0.0

PROJECT CATEGORY/TREATMENT: Upland/Slope Stabilization

PROJECT LOCATION:

Watershed: Benewah	Legal: T45N, R3W, S7, S½ and S8, SW¼
Sub Basin (River Mile): Hillslope drain to RM 8.5	

SITE CHARACTERISTICS:

Slope/Valley gradient: 3-20%	Valley Type: C3	Elevations: 2760-2820
Proximity to water: upland	Channel type: Intermittent	
Other: Project treats 45 hectares of upland forest		

PROBLEM DESCRIPTION: The project site consists of 45 hectares of upland forest/scrub-shrub habitat types that drain to the mainstem of Benewah Creek at river mile 8.5. The property has a frequent fire regime history, with the most recent burn (1978) replacing much of the older trees. Much of the stand is less than 30 years old and very little natural regeneration has occurred, leaving hillslopes susceptible to rill and gully erosion. Fifteen percent of the total area is rated as a high erosion hazard potential due to a combination of slope gradient, vegetation coverage, and proximity to intermittent and perennial stream channels. Delivery rate is also high because of the proximity to mainstem Benewah Creek.

DESCRIPTION OF TREATMENT: This project involved planting conifers in 45 hectares of under stocked upland habitat. Plantings will help fill in areas that have been burned and have not shown appreciable natural regeneration and will be interspersed with older plantings to achieve a stocking rate of 400 trees/acre in selected areas. A total of 1,250 trees were planted in 1998, 1,800 were planted in 1999, 1,500 were planted in 2000 and 1,350 were planted in 2001. Species included ponderosa pine, western white pine, western larch and lodgepole pine.

The landowner provided cost-shares by preparing the planting sites and providing labor to plant the trees. These activities were conducted as an addendum to an existing landowner contract.

PROJECT TIMELINE: Plantings took place over a 4-year period and all planned activities for this project have been completed.

PROJECT GOALS & OBJECTIVES: Restore upland scrub-shrub habitats to a forested condition in the most erosive parts of the project area. Achieve 70% survival during the first year following planting and maintain a stocking rate of 400 trees/acre in the target areas.

RELATIONSHIP TO SCOPE OF WORK: This project satisfies a portion of the contractual obligations for Objective 1, task 1.1 in the 1998 and 1999 Scopes of Work; Objective 4, task 4.2 in the 2000 Scope of Work; and Implementation Objective 1, task 1c in the 2001 Scope of Work.

BPA PROJECT SUMMARY

PROJECT ID: B_8.1/0.0

PROJECT CATEGORY/TREATMENT: Upland/Slope Stabilization

PROJECT LOCATION:

Watershed: Benewah	Legal: T45N, R3W, S8, SW¼
Sub Basin (River Mile): Hillslope drain to RM 8.1	

SITE CHARACTERISTICS:

Slope/Valley gradient: 20%	Valley Type: C3	Elevations: 2740
Proximity to water: upland	Channel type: Intermittent	
Other: Project treats 1.8 hectares of upland		

PROBLEM DESCRIPTION: The project site consists of 1.8 hectares of upland that drain to the mainstem of Benewah Creek at river mile 8.1. The forest was cleared from this area in the late 1940's and has had a history of intensive grazing and cropping up until 1993. The area is rated as a high erosion hazard potential due to a combination of silt loam soils, slope gradient, vegetation coverage and proximity to perennial stream channels. Delivery rate is also high because of the proximity to mainstem Benewah Creek.

DESCRIPTION OF TREATMENT: The current landowner has an interest in converting this area back to a native forest community. This project involved planting conifers in 1.8 hectares of under stocked upland habitat. Trees will be planted to achieve a stocking rate of 400 trees/acre. Species included ponderosa pine, western white pine, and Douglas fir. A total of 1,250 trees (2-1) were out planted from the Tribal nursery in 1998. Monitoring completed in 1999 indicated low survival (40%) with mortality attributed primarily to rodent damage. An additional 950 trees were planted in 2000 and tree tubes were installed that same year.

These activities were conducted as an addendum to an existing landowner contract.

PROJECT TIMELINE: Plantings took place over a 3-year period and all planned activities for this project have been completed.

PROJECT GOALS & OBJECTIVES: Restore prior converted forest habitat back to a native forest community. Reduce sheet and rill erosion and increase water retention. Achieve 70% survival during the first year following planting and maintain a stocking rate of 200 trees/acre.

RELATIONSHIP TO SCOPE OF WORK: This project satisfies a portion of the contractual obligations for Objective 1, task 1.1 in the 1998 and Objective 4, task 4.2 in the 2000 Scope of Work.

BPA PROJECT SUMMARY

PROJECT ID: L_8.8

PROJECT CATEGORY/TREATMENT: Riparian/Planting

PROJECT LOCATION:

Watershed: Lake | Legal: T48N, R6W, S1, SW ¼

Sub Basin (River Mile): RM 8.8-9.1

SITE CHARACTERISTICS:

Slope/Valley gradient: <1% | Valley Type: C4 | Elevations: 2560

Proximity to water: floodplain | Channel type: E5

Other: Project treats 1,427 linear feet of stream channel and associated floodplain.

PROBLEM DESCRIPTION: Reed canarygrass has become well established within the riparian areas of this site to the exclusion of virtually all other species. Although reed canarygrass is providing good stabilization of the streambanks, it is severely inhibiting establishment and/or regeneration of native, woody plant species that provide a more complete suite of riparian functions. The project site is located in an area where significant thermal loading can occur during base flow conditions and the canarygrass community lacks the ability to adequately shade the stream channel. Average canopy density as measured during the pre-treatment survey was 41%, however most of this is provided by herbaceous vegetation and doesn't adequately address temperature issues. Additionally, no measurable in-channel or recruitable woody materials currently exist at the site. Revegetation with native, woody plant species is necessary to aide in reestablishing proper riparian function.

DESCRIPTION OF TREATMENT: A power auger attached to an excavator was used to prepare the planting site by removing reed canary grass stems and rhizomes in 3'diameter plots on 10' centers throughout the site. Removal of rhizomes in this manner was done to reduce competition with planted species and slow recolonization of the site by reed canary grass. A combination of bareroot and containerized stock was shovel planted in the scalped areas. Species included western white pine, mountain alder, thinleaf alder, quaking aspen, and red osier dogwood. Willow poles (>6' tall, 3" dia), primarily pacific willow, scouler willow, and Mackenzie willow, were installed on the low stream banks using a hand held auger. Poles were collected during the dormant season then soaked in water for 8-10 days prior to planting to help initiate root growth. Tree tubes were subsequently placed on many of the trees to help minimize animal damage.

PROJECT TIMELINE: A pretreatment survey was completed in the spring of 1998 to evaluate riparian canopy density and availability of woody debris. The first 900 plants were installed following the initial survey. Additional plantings were done in spring 1999 to fill the remaining prepared sites, followed by installation of tree tubes.

PROJECT GOALS & OBJECTIVES: The principle goal of the project is to improve riparian function by increasing plant diversity through establishment of native woody species that will provide shade and a source of wood for the channel as plantings mature. Target stream canopy density for the site is 90%.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills a portion of the Program commitments for Objective 1, task 1.2 under the FY1998 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_8.5

PROJECT CATEGORY/TREATMENT: Riparian/Planting

PROJECT LOCATION:

Watershed: Lake | Legal: T48N, R6W, S1, SW ¼

Sub Basin (River Mile): RM 8.5-8.8

SITE CHARACTERISTICS:

Slope/Valley gradient: <1% | Valley Type: C4 | Elevations: 2560

Proximity to water: floodplain | Channel type: E5

Other: Project treats 1,476 linear feet of stream channel and associated floodplain.

PROBLEM DESCRIPTION: Reed canarygrass has become well established within the riparian areas of this site to the exclusion of virtually all other species. Although reed canarygrass is providing good stabilization of the streambanks, it is severely inhibiting establishment and/or regeneration of native, woody plant species that provide a more complete suite of riparian functions. The project site is located in an area where significant thermal loading can occur during base flow conditions and the canarygrass community lacks the ability to adequately shade the stream channel. Average canopy density as measured during the pre-treatment survey was 42%, however most of this is provided by herbaceous vegetation and doesn't adequately address temperature issues. Additionally, no measurable in-channel or recruitable woody materials currently exist at the site. Revegetation with native, woody plant species is necessary to aide in reestablishing proper riparian function.

DESCRIPTION OF TREATMENT: A power auger attached to an excavator was used to prepare the planting site by removing reed canary grass stems and rhizomes in 3'diameter plots on 10' centers throughout the site. Removal of rhizomes in this manner was done to reduce competition with planted species and slow recolonization of the site by reed canary grass. A combination of bareroot and containerized stock was shovel planted in the scalped areas. Species included western white pine, mountain alder, thinleaf alder, quaking aspen, and red osier dogwood. Willow poles (>6' tall, 3" dia), primarily pacific willow, scouler willow, and Mackenzie willow, were installed on the low stream banks using a hand held auger. Poles were collected during the dormant season then soaked in water for 8-10 days prior to planting to help initiate root growth. Tree tubes were subsequently placed on many of the trees to help minimize animal damage.

PROJECT TIMELINE: A pretreatment survey was completed in the spring of 1998 to evaluate riparian canopy density and availability of woody debris. The first 900 plants were installed following the initial survey. Additional plantings were done in spring 1999 to fill the remaining prepared sites, followed by installation of tree tubes.

PROJECT GOALS & OBJECTIVES: The principle goal of the project is to improve riparian function by increasing plant diversity through establishment of native woody species that will provide shade and a source of wood for the channel as plantings mature. Target stream canopy density for the site is 90%.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills a portion of the Program commitments for Objective 1, task 1.2 under the FY1998 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_6.7/0.2/0.0

PROJECT CATEGORY/TREATMENT: Riparian/Water Storage

PROJECT LOCATION:

Watershed: Lake	Legal: T48N, R5W, S17, NW ¼
Sub Basin (River Mile): pond drains to RM 6.7	

SITE CHARACTERISTICS:

Slope/Valley gradient: 8%	Valley Type: C2	Elevation: 2560
Proximity to water: Riparian	Channel type: Intermittent	
Other: Project treats storm water runoff from 140 acres of farm ground.		

PROBLEM DESCRIPTION: The subject property is located at the lower end of a 140-acre, unnamed sub watershed flowing to Lake Creek. Landuse is intensive agriculture with a rotation that alternates between annual cropping and continuous sod cover. Soils consist of Taney silt loam with slopes ranging from 3-25%. The soil has a slow infiltration rate when thoroughly wet, runoff is rapid, and the hazard of erosion is high. Sheet and rill erosion under an annual cropping scenario generates 15.1 tons/acre/year of sediment with an estimated 10% delivery to Lake Creek (SCS 1990; CDA Tribe 1998).

DESCRIPTION OF TREATMENT: A large pond was constructed to act as a stilling basin for storm water runoff from 140 acres of farm ground and to allow for storage and subsequent release of clean, cold water. A 280' long embankment impounds water along the natural contours of the site. The resulting pool has a surface area of 1.6 acres and a holding capacity of approximately 13 acre-feet.

PROJECT TIMELINE: Construction was completed 10/98. Dam was seeded and mulched 10/98 and additional planting was completed 2001. Water quality monitoring has been conducted annually since 1999 and water was released in 2000 and 2001.

PROJECT GOALS & OBJECTIVES: Reduce sediment transport from 140 acres of farm ground for the life of the project. Store and release up to 8 acre-feet of water annually to recharge ground water and supplement base flow in Lake Creek.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills the Program commitments for Objective 3, task 3.1 under the FY 1998 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_7.3/0.2

PROJECT CATEGORY/TREATMENT: Upland/Slope Stabilization

PROJECT LOCATION:

Watershed: Lake | Legal: T48N, R5W, S12, SW¼

Sub Basin (River Mile): Hillslope drains to RM 7.3

SITE CHARACTERISTICS:

Slope/Valley gradient: 20% | Valley Type: Ridge top | Elevations: 2740

Proximity to water: upland | Channel type: NA

Other: Project treats 8 hectares of upland habitat

PROBLEM DESCRIPTION: The project site consists of 8 hectares of upland that drain to the mainstem of Lake Creek at river mile 7.3. The forest was cleared from this area in the late 1940's and has had a history of cropping up until the early 1990's. Thirty-five percent of the area is classified as highly erodible, with sheet and rill erosion generating an estimated 74 tons/year of sediment with a delivery rate of 10% and gully erosion generating an estimated 3 tons/year with a delivery rate of 45%.

DESCRIPTION OF TREATMENT: The current landowner has an interest in converting this area back to a native forest community. Conversion of cropland back to native forest is one of the highest restoration priorities in the watershed. This project involved planting conifers in 8 hectares of under stocked upland habitat. Trees were planted to achieve a stocking rate of 400 trees/acre. Species included ponderosa pine, western white pine, western larch and Douglas fir. A total of 1,200 trees were planted 1998 and 2,450 were planted in 1999. Monitoring completed in 1999 indicated survival exceeded 75%. An additional 800 trees were planted in 2001 to fill in the remaining unplanted areas.

The landowner provided cost-shares by preparing the planting sites and providing labor to plant the trees. These activities were conducted as an addendum to an existing landowner contract.

PROJECT TIMELINE: All project activities were completed by 2001.

PROJECT GOALS & OBJECTIVES: Restore prior converted forest habitat back to a native forest community. Reduce sheet and rill erosion and increase water retention. Achieve 70% survival during the first year following planting and maintain a stocking rate of 400 trees/acre.

RELATIONSHIP TO SCOPE OF WORK: This project satisfies a portion of the contractual obligations for Objective 1, task 1.1 in the 1998 and 1999 Scopes of Work; and Implementation Objective 1, task 1c in the 2001 Scope of Work.

BPA PROJECT SUMMARY

PROJECT ID: E_0.1

PROJECT CATEGORY/TREATMENT: Riparian/Planting

PROJECT LOCATION:

Watershed: Evans	Legal: T47N, R2W, S3, NW ¼
Sub Basin (River Mile): RM 0.1 – 0.3	

SITE CHARACTERISTICS:

Slope/Valley gradient: 1%	Valley Type: B2	Elevations: 2160
Proximity to water: floodplain	Channel type: C6	
Other: Project treats approximately 1,300 linear feet of stream channel and associated floodplain		

PROBLEM DESCRIPTION: This site was managed as cropland and irrigated pasture since the late 1960's. The 1,300 feet of mainstem Evans Creek that flows through the property is inadequately buffered from grazing and other agricultural practices. The existing buffer consists primarily of a grass/forb community and remnants of native vegetation, including alder and hawthorn, exist only in isolated clumps. The absence of forest canopy in proximity to the stream allows for increased water temperature, which in turn will cause fish to seek more suitable habitats. The channel has become slightly incised and streambanks are very unstable.

DESCRIPTION OF TREATMENT: This project involved establishing a riparian forest buffer encompassing approximately 6 acres and 1300 feet of stream channel. Conifers and deciduous trees and shrubs were planted and interspersed with existing vegetation to achieve a stocking rate of 400 trees per acre. Planted species included ponderosa pine, western white pine, western larch, engelmann spruce, western red cedar, grand fir, alder, water birch, vine maple, mountain ash, scouler willow, drummond willow, quaking aspen, and red osier dogwood. Initial planting efforts began in 1999 with the landowner performing all site prep activities in the buffer, including burning, disking and weed control. A total of 1,650 live cuttings of willow and dogwood were installed on the lower stream banks during the first year. The remaining buffer areas were planted with 1,500 trees and shrubs during 2000. A year-end survival estimate indicated 83% survival of willow cuttings, 39% survival of dogwood cuttings and 75% survival for conifers. An additional 1,050 trees were planted in 2001 to replace lost trees and fill in all remaining unplanted areas. Tree tubes were installed on all surviving trees in 2001.

The NRCS provided a 75% cost share to the landowner under their Environmental Quality Incentive Program (EQIP). Under the terms of the EQUIP contract with NRCS, the landowner was responsible for sharing the cost of trees and the labor to plant them. The landowner is actively excluding cattle from the forest buffer.

PROJECT TIMELINE: Site prep and initial plantings were installed in 1999. Additional plantings were done in 2000 and 2001.

PROJECT GOALS & OBJECTIVES: Goals for this project include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote bank stabilization; 4) increase riparian species diversity and cover; and 5) enhance stream buffer capacity.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills the Program commitments for implementation Objective 1, task 1.3 under the FY 1999 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_8.2; L_8.2/0.0; L_8.2/0.0/0.0

PROJECT CATEGORY/TREATMENT: Riparian/Planting; Instream/Instream Structure; Upland/Slope Stabilization

PROJECT LOCATION:

Watershed: Lake | Legal: T48N, R6W, S12, NW ¼

Sub Basin (River Mile): RM 8.2

SITE CHARACTERISTICS:

Slope/Valley gradient: <0.5% | Valley Type: C4 | Elevations: 2560

Proximity to water: floodplain | Channel type: C5

Other: Project treats approximately 3,800 linear feet of stream channel and associated floodplain and 0.8 hectares of slope stabilization

PROBLEM DESCRIPTION: This site was managed as cropland and irrigated pasture since the late 1950's and was the last property in the watershed actively withdrawing water from the creek until the time it was enrolled with this enhancement project. The 1,673 ft of mainstem Lake Creek that flows through the property was channelized and cropped to within 10 feet of the normal high water mark. No native vegetation exists within this portion of the floodplain. The 2,083 ft of West Fork Lake Creek that flows through the property was also cropped to the edge of the channel and was heavily grazed up until 1996. Remnants of native vegetation, including alder and hawthorn, exist only in isolated clumps. The channel has become slightly incised and streambanks are very unstable. Mean canopy density was 11% for the Lake Creek segment and 35.7% for the W.F. Lake Creek. Wood debris volumes were 0.34 in^3/ft^2 and 1.43 in^3/ft^2, respectively for the same channel segments.

The channel is a very high width/depth ratio C5 channel type (w/d >19) and has experienced shifts in both lateral and vertical stability as a result of direct channel disturbance. Substrate consists of sand and very fine gravel (d_{50}=2.0mm). In channel woody debris is virtually non-existent (0.34 in^3/ft^2) and pool habitats are poorly developed (mean residual depth<1ft.). The site potential is illustrated in the upstream reference reach where w/d ratio is <5 and residual pool depth=3.9ft.

DESCRIPTION OF TREATMENT: Several treatments were integrated in the implementation plan for this site to improve riparian and instream habitats and adjacent upland features, respectively. The planting plan for riparian areas was designed to help reestablish three riparian communities that were historically present: 1) Lodgepole Pine/Aspen/Cottonwood; 2) Alder/Willow/Cottonwood; and 3) Tufted Hairgrass/Forb. Plant species included Lodgepole pine, ponderosa pine, engelman spruce, white pine, western larch, black cottonwood, quaking aspen, sitka alder, Drummond willow, dogwood, pacific ninebark, tufted hairgrass, Canada bluejoint and common camas. Plant materials were obtained from local seed sources and included a combination of tublings, containerized stock, and live cuttings. A total of 2,890 plants were installed in 1999, and 1,350 and 1,050 additional plants were installed in 2000 and 2001, respectively.

The established stream buffer was enrolled in the Conservation Reserve Program (CRP) offered by the NRCS. The buffer applies to cropland and marginal pastureland adjacent and parallel to perennial streams, up to a maximum buffer width of 250 feet. An annual incentive payment, made to the landowner, is calculated for the site based on the annual soil rental rate and amounts to $84.20/acre on this property.

With respect to instream habitat, this project aims to narrow and deepen the active channel to increase the habitat value for resident fish. Channel narrowing will be accomplished through placement of brush bundles and large, stable log revetments. Pool formation will be promoted by placing both anchored and unanchored logs across the channel to increase local scour and deposition. A secondary benefit of these techniques will be to enhance the natural formation of meander bends that reduce water velocity and promote water retention time. The proposed

activities use materials native to the site in a "soft engineering" approach that minimizes ground disturbance during installation.

Thirty-four logs totaling 3,490 ft^3 (mean dia.=20.5in) were placed in the channel at intervals that approximated 5-7 times the bank full channel width for the upstream reference reach. A brush mattress measuring 1,400 sq. ft. was constructed by hand to help trap sediment, build streambanks, and narrow the active channel where the width/depth ratio was highest. Following placement, the locations of individual logs were mapped and in-channel wood volumes were measured. A random sample of residual channel depths taken before and after treatment indicated a significant increase (t=0.1) in mean depth one year after logs were placed.

Trees and shrubs were planted in the southeast corner of the property to convert approximately 3.5 acres of cropland to a native forest plant association. The species were selected based on community compositions described in *Forest Vegetation of Eastern Washington and Northern Idaho* (Daubenmire and Daubenmire, 1968). The canopy species in this community will be Douglas fir (*Pseudotsuga menzeisii*) and Ponderosa Pine (*Pinus ponderosa*). Ponderosa Pine will probably dominate these communities at initial planting, but the presence of Douglas fir and expected fire suppression in the area will eventually result in a Douglas fir climax community. The primary understory component will be common snowberry (*Symphoricarpos albus*), with a secondary component of serviceberry (*Amelanchier alnifolia*). Bare soil between tree and shrub plantings will be seeded with pinegrass (*Calamagrostis rubescens*) and/or western rye grass (*Elymus glaucus*), two grasses that are typically dominant in this community type. A total of 2,000 trees and shrubs were planted in 1999 and 850 additional trees were planted in 2001 to increase stocking density and replace lost trees.

PROJECT TIMELINE: Annual fish population estimates have been made at the lower end of the project area and immediately upstream since 1996. A pretreatment survey was completed to evaluate riparian canopy density, vegetative cover and woody debris volume. A total of 2,890 plants were installed following the initial survey. Additional plantings were done in spring 2000 and 2001. Monitoring of riparian function is ongoing. LWD installation was completed summer 1999. Annual monitoring of inchannel habitat is ongoing.

PROJECT GOALS & OBJECTIVES: Goals for this project include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote bank stabilization; 4) increase riparian species diversity and cover; and 5) improve instream habitat capacity. Specific objectives for riparian areas are to provide for statistically significant increases in canopy density and overhanging vegetation over the term of the landowner contract. Target canopy closure is 92%. For instream effects, provide statistically significant decrease in width/depth ratio, increase in residual pool volume, and increase in woody debris accumulations during the course of the contract. Monitoring of fish populations aim to detect any change in abundance of cutthroat during summer rearing periods.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills a portion of the Program commitments for implementation Objective 1, task 1.2 under the FY 1999 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: B_6.5

PROJECT CATEGORY/TREATMENT: Instream/Channel Construction; Riparian/Planting; Riparian/Grazing Management

PROJECT LOCATION:

Watershed: Benewah	Legal: T45N, R3W, S4, SW ¼
Sub Basin (River Mile): RM 6.5-6.9	

SITE CHARACTERISTICS:

Slope/Valley gradient: 1%	Valley Type: B2	Elevations: 2640
Proximity to water: Instream	Channel type: F3 (pre-treatment); C3 (post-treatment)	
Other: Project treats 2,280 linear feet of stream channel and associated floodplain		

PROBLEM DESCRIPTION: A splash dam and flume were constructed on this site between the years 1915 and 1920 to convey logs through the Benewah valley downstream to Benewah Lake and the St. Joe River. Following the dismantling of the splash dam, sometime in the 1930's, the creek was straightened and the natural floodplains cleared and drained to develop cropland and pastures adjacent to the creek. Straightening increased the channel gradient, which in turn, increased the channel's ability to convey bed material and subsequently caused the channel to degrade. This deeper, incised channel was vertically separated from its floodplain and unable to sub-irrigate the riparian vegetation it once depended upon for stability. Recent grazing pressure intensified the problem by reducing plant density and diversity. Streambanks were extremely unstable and instream habitats have little value as summer rearing for cutthroat trout.

Results of the pretreatment channel survey help illustrate these problems: sinuosity=1.06; flood prone width at twice maximum bankfull depth (d_{maxbf})=80.2ft.; Entrenchment ratio=1.92; mean bankfull depth(dbf)=1.8ft.; $width_{bf}/depth_{bf}$ ratio=23.2.

DESCRIPTION OF TREATMENT: This project involved design and construction of nearly 2000 feet of meandering stream channel and associated floodplain. The Rosgen (1996) stream classification system was used as a guideline in the determination and design of the new channel. A stable reference reach was used as a template for the design and the discharges and characteristics of the reference reach were analyzed and prorated to the project reach. A HEC-RAS model was used to calculate a dominant discharge based on assumed bankfull water surface elevations, surveyed channel geometry and estimated channel roughness. This dominant discharge was then used to size the new channel. In addition to designing for dynamic equilibrium, the project emphasized the use of riffles and their backwater effects to maintain creek velocities and shear stresses at appropriate levels. Other essential aspects of the design were maintaining consistent channel geometry throughout the site and the use of the bankfull discharge as a critical design feature. Designs were finalized in June 2000.

Implementation of the final design converted the existing degraded channel from an F4 to C4 stream type by increasing the meander width ratio, lowering the bankfull width/depth ratio, and reducing the channel entrenchment. Much of the existing unstable channel and floodplain was filled and regraded. The new channel was built just large enough to convey the bankfull discharge within its banks. The controlling riffle elevations were set at a consistent gradient and the bank heights at all the riffles and bends were built so that the banks would overtop simultaneously during flood events. During construction, ten riffles, 4 j-hook structures, and more than 40 pieces of large wood were placed to enhance streambank stability and instream habitat diversity.

Project costs including design, permitting and construction averaged approximately $71/linear foot.

This riparian planting project was one part of an overall vegetation management plan for the site which comprised four basic components: 1) utilization and transplant of rooted trees and shrubs during channel construction; 2) use of large woody debris and root wads in bank stabilization; 3) establishment of new riparian and upland plant

communities; and 4) riparian fencing. Various plant materials and techniques were used to accomplish the goal of establishing new riparian and upland plant communities, including use of dormant willow poles, containerized trees and shrubs, plugs of emergent aquatic plants, and hydroseeding. A suite of species was selected to fill various micro habitats located between the toe zone of streambanks and transitional/upland areas. A total of 19 different species were used, of which 17 were considered native to the area and 2 were introduced but previously found on the site and were considered naturalized.

Initial efforts installed 1,675 trees and shrubs on the site in fall 2000 following completion of Phase 1 channel construction; 1,500 emergent aquatic plants were planted in August 2001 following completion of Phase 2 construction; and an additional 1,950 plants were planted in fall 2001, followed by hydroseeding. Additional plantings were planned for spring 2002 to finalize this project.

Approximately 2000 feet of new fence was constructed and connected to existing fence lines on site to create a 12-acre riparian pasture that will be managed to protect newly constructed stream channel/floodplain habitats and riparian plantings. The completed fence consisted of 4-strand barbed wire with 6x6 treated posts and cross beams. Fence posts were anchored to a deadman with a ½ inch cable and moveable panels were installed on either end of the enclosure to allow for complete exclusion of livestock while reducing the risk of flood damage to fence lines and lowering the long-term O&M costs. The landowner has assumed O&M responsibilities following the initial installation. Cattle will be excluded from the riparian pasture for at least 5 years to allow for recovery and establishment of riparian plantings.

PROJECT TIMELINE: Project implementation required a site inspection by a certified archaeologist and subsequent clearance by the Tribal Cultural Officer and the SHPO (6/00), as well as a wetland delineation (8/00) and USACOE 404 permit (9/00). Phase I channel reconstruction was completed 10/00 and the remaining Phase II channel work was finished by 7/01. Plantings were completed in fall 2000 and also in 2001. Riparian fencing was completed 9/01.

PROJECT GOALS & OBJECTIVES: Restore the channel and floodplain to a naturally appearing and functioning geometry using native materials. Create a stable creek and riparian environment that will naturally develop into optimal fish habitat. Restore a proper bedload balance within the project reach and minimize the flood potential for adjacent cropland.

Project effectiveness should be evaluated by follow-up measurements of channel bed-form, substrate and fisheries response consistent with recommendations in the RM&E Plan.

RELATIONSHIP TO SCOPE OF WORK: Phase I implementation fulfills a portion of the Program commitments for Objective 2, task 2.1 and Objective 3, task 3.1 under the FY 2000 Scope of Work and Budget Request. Phase II implementation satisfies the Program commitments for Construction and Implementation Objective 1, tasks 1a and 1b in the FY2001 Scope of Work (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: B_8.5/0.2

PROJECT CATEGORY/TREATMENT: Upland/Slope Stabilization

PROJECT LOCATION:

Watershed: Benewah | Legal: T45N, R3W, S17, NW¼

Sub Basin (River Mile): Hillslope drain to RM 8.1

SITE CHARACTERISTICS:

Slope/Valley gradient: 20% | Valley Type: C3 | Elevations: 2760-2860

Proximity to water: forested wetland | Channel type: Intermittent

Other: Project treats 4 hectares of forested wetlands

PROBLEM DESCRIPTION: The project site consists of 4 hectares of upland forest and forested wetlands that drain to the mainstem of Benewah Creek at river mile 8.5. The forest was heavily thinned prior to the current landowners purchase of the property in 1998. The wetlands on site were inadequately buffered from logging activities and the infiltration and storage of water on the site has been compromised. The springs on the site supplement ground water in the Benewah Creek floodplain and because of their proximity to the stream channel, likely play an important role in the dynamics of recharge and discharge at the ground-water/surface-water interface.

DESCRIPTION OF TREATMENT: This project involved planting conifers in 4 hectares of under stocked upland habitat and reestablishing a forest buffer around wetlands on the site. Trees were planted to achieve a stocking rate of 400 trees/acre. Species included western white pine and western larch. A total of 1,050 trees were planted 4/2000. Year-end survival estimates indicated that survival exceeded 80% on the site. The landowner provided cost-shares by preparing the planting sites and providing labor to plant the trees.

PROJECT TIMELINE: All project activities were completed in 2000.

PROJECT GOALS & OBJECTIVES: Improve buffer around forested wetlands to increase water infiltration and storage. Achieve 70% survival during the first year following planting and maintain a stocking rate of 400 trees/acre.

RELATIONSHIP TO SCOPE OF WORK: This project satisfies a portion of the contractual obligations for Objective 4, task 4.2 in the 2000 Scope of Work.

BPA PROJECT SUMMARY

PROJECT ID: L_7.3; L_7.6/0.0

PROJECT CATEGORY/TREATMENT: Riparian/Planting

PROJECT LOCATION:

Watershed: Lake	Legal: T48N, R6W, S12, SE ¼
Sub Basin (River Mile): RM 7.3-7.6	

SITE CHARACTERISTICS:

Slope/Valley gradient: <.5%	Valley Type: C4/C2	Elevations: 2560
Proximity to water: floodplain	Channel type: E4/Intermittant	
Other: Project treats 2,851 linear feet of stream channel and associated floodplain.		

PROBLEM DESCRIPTION: This stream reach is located in a portion of the watershed that historically provided important summer rearing habitat for westslope cutthroat. Many of the coniferous trees were removed from the existing stream buffer prior to passage of the Idaho Forest Practices Act (1974) and stocking density is currently less than 3 trees/acre. Current riparian function is degraded as evidenced by low stream canopy closure, little overhanging vegetation, and low volumes of LWD. The wood that is present in the channel is mostly comprised of small pieces that generally do not function to shape channel morphology or maintain habitat diversity. Also, the existing riparian community offers little potential for providing recruitable large wood in the future.

DESCRIPTION OF TREATMENT: Riparian function will be enhanced along the mainstem of Lake Creek by planting native trees and shrubs in the near bank region and adjacent floodprone areas. A forested buffer will also be established along the lower 500 ft of an intermittent tributary that enters the NW corner of the site.

Plantings consisted of engelmann spruce, Douglas fir, western white pine, ponderosa pine, lodgepole and willow. Plant materials consisted of small tublings, containerized plants and live cuttings. A total of 1,520 trees were planted in 2000 and 1,650 trees were planted in 2001.

PROJECT TIMELINE: Fish abundance and distribution has been monitored at the lower end of this site since 1996. Instream habitat was mapped in 1998. The first plants were installed in 2000.

PROJECT GOALS & OBJECTIVES: Goals for this project include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote bank stabilization; 4) increase riparian species diversity and cover; and 5) enhance stream buffer capacity. Provide for significant increases in canopy density and overhanging vegetation over the term of the landowner contract. Target canopy closure is 92%.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills a portion of the Program commitments for implementation Objective 2, task 2.1 under the FY 2000 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_8.7/0.1

PROJECT CATEGORY/TREATMENT: Riparian/Water Storage

PROJECT LOCATION:

Watershed: Lake	Legal: T48N, R6W, S1, SW ¼
Sub Basin (River Mile): pond drains to RM 8.7	

SITE CHARACTERISTICS:

Slope/Valley gradient: 10%	Valley Type: C2	Elevation: 2560
Proximity to water: Riparian	Channel type: Intermittent	
Other: Project treats storm water runoff from approximately 50 acres of farm ground.		

PROBLEM DESCRIPTION: The subject property is located at the lower end of a 50-acre, unnamed sub-watershed flowing to Lake Creek. Approximately 50% of the forest in the sub-watershed has been cleared for pasture and a portion of the land has a past history of intensive agriculture. Soils consist of Kruse silt loam and Santa silt loam with slopes ranging from 5-35%. Permeability of the soil is slow, runoff is rapid, and the hazard of erosion is high to very high. Sheet and rill erosion is somewhat less than for cropland on the same soil types but generation is still thought to be approximately 9.9 tons/acre/year of sediment with an estimated 5% delivery to Lake Creek (SCS 1990; CDA Tribe 1998). Gully erosion is also a problem.

DESCRIPTION OF TREATMENT: A large pond was constructed to act as a stilling basin for storm water runoff from 50 acres of farm ground and to allow for storage and subsequent release of clean, cold water. A 325' long embankment impounds water along the natural contours of the site. The resulting pool has a surface area of 2.0 acres and a holding capacity of approximately 10 acre-feet.

Six acres immediately above the pond was planted into conifers in spring 2001. A total of 1,300 trees were planted.

PROJECT TIMELINE: Construction was completed 10/00. Dam was seeded and mulched 10/00 and additional planting was completed in spring 2001. No water was released as of 2001.

PROJECT GOALS & OBJECTIVES: Reduce sediment transport from 50 acres of ground for the life of the project. Store and release up to 6 acre-feet of water annually to recharge ground water and supplement base flow in Lake Creek.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills the Program commitments for Objective 4, task 4.1 under the FY 2000 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_5.9/0.4

PROJECT CATEGORY/TREATMENT: Upland/Gully Repair

PROJECT LOCATION:

Watershed: Lake	Legal: 48N, R5W, S17, SW ¼
Sub Basin (River Mile): Site is tributary to RM 5.9	

SITE CHARACTERISTICS:

Slope/Valley gradient: 7%	Valley Type: C2	Elevations: 2560-2600
Proximity to water: 2° tributary	Channel type: intermittent	
Other: Project treats runoff from 300 acres of highly erodible farmland		

PROBLEM DESCRIPTION: The project site is on the lower portion of an unnamed, intermittent tributary to Lake Creek. The site is considered a critical area for non-point source pollution abatement. The stream channel in the project area has headcut as much as seven feet below the existing ground surface along a channel segment approximately 300 feet in length. More than 55% of the total acreage is classified as highly erodible, with sheet and rill erosion generating an estimated 4,530 tons/year of sediment with a delivery rate of 10% and gully erosion generating an estimated 3 tons/year with a delivery rate of 45%.

DESCRIPTION OF TREATMENT: Treatment of gully erosion on the site is a cooperative effort between the Coeur d'Alene Tribe's Fisheries program, the Kootenai Soil and Water Conservation District, and the landowner. Efforts resulted in construction of three grade control structures (completed 9/2000) to reduce sediment generation from active headcuts and one large water and sediment retention basin at the lower end of the gully to reduce delivery of sediment to Lake Creek (completed 10/2001). A planting plan was developed by Tribal staff and reviewed with the Conservation District and the Landowner for approval. The area around the pond was then planted with native vegetation to support the wildlife uses of the pond.

The project design was produced at the expense of the SWCD and implementation was cost-shared between the Tribe (50%), SWCD (25%), and the landowner (25%).

PROJECT TIMELINE: Cost-share agreements and phase one construction was completed by 9/2000. A landowner agreement was completed 7/01 and phase two construction was completed 10/2001. Planting was completed 10/2001.

PROJECT GOALS & OBJECTIVES: The objectives for the project include: 1) correct downcutting in this intermittent tributary to Lake Creek; 2) intercept and retain flood flows and release this water in a manner that will prevent degradation of the channel downstream of the site; 3) intercept and retain sediment generated in the upper portions of this drainage basin; and 4) provide nesting and rearing habitat for waterfowl and shelter and watering for wildlife in general.

RELATIONSHIP TO SCOPE OF WORK: This project satisfies the contractual obligations for implementation Objective 4, task 4.2 in the FY2000 Scope of work and Objective 1, task 1c in the FY2001 Scope of work.

BPA PROJECT SUMMARY

PROJECT ID: L_6.5/0.1

PROJECT CATEGORY/TREATMENT: Riparian/Water Storage

PROJECT LOCATION:

Watershed: Lake	Legal: T48N, R5W, S17, NW ¼
Sub Basin (River Mile): pond drains to RM 6.5	

SITE CHARACTERISTICS:

Slope/Valley gradient: 4%	Valley Type: C2	Elevation: 2560
Proximity to water: Riparian	Channel type: Intermittent	
Other: Project treats storm water runoff from 41 acres of farm ground.		

PROBLEM DESCRIPTION: The subject property is located at the lower end of a 41-acre, unnamed sub watershed flowing to Lake Creek. Landuse is intensive agriculture with a rotation that alternates between annual cropping and continuous sod cover. Soils consist of Taney silt loam with slopes ranging from 3-25%. The soil has a slow infiltration rate when thoroughly wet, runoff is rapid, and the hazard of erosion is high. Sheet and rill erosion under an annual cropping scenario generates 15.1 tons/acre/year of sediment with an estimated 10% delivery to Lake Creek (SCS 1990; CDA Tribe 1998).

DESCRIPTION OF TREATMENT: A large pond was constructed to act as a stilling basin for storm water runoff from 41 acres of farm ground and to allow for storage and subsequent release of clean, cold water. A 300' long embankment impounds water along the natural contours of the site. The resulting pool has a surface area of 2.1 acres and a holding capacity of approximately 12 acre-feet.

PROJECT TIMELINE: Construction occurred over a 16-day period from 10/01/01-10/16/01. Additional planting is scheduled for 2002. Water will be available for selective release beginning in 2002.

PROJECT GOALS & OBJECTIVES: Reduce sediment transport from 41 acres of farm ground for the life of the project. Store and release up to 8 acre-feet of water annually to recharge ground water and supplement base flow in Lake Creek.

RELATIONSHIP TO SCOPE OF WORK: This project fulfills the Program commitments for Construction and Implementation Objective 1, task 1c under the FY 2001 Scope of Work and Budget Request (Contract # 90BP10544).

BPA PROJECT SUMMARY

PROJECT ID: L_5.9/0.4/0.0

PROJECT CATEGORY/TREATMENT: Upland/Slope Stabilization

PROJECT LOCATION:

Watershed: Lake | Legal: T48N, R5W, S17, SW¼

Sub Basin (River Mile): Hillslope drains to RM 5.9

SITE CHARACTERISTICS:

Slope/Valley gradient: 25% | Valley Type: Ridge top | Elevations: 2600-2640

Proximity to water: upland | Channel type: NA

Other: Project treats 4.9 hectares of upland habitat

PROBLEM DESCRIPTION: The project site consists of 4.9 hectares of upland that drain to the mainstem of Lake Creek at river mile 5.9. The forest was cleared from this area in the late 1940's and has had a history of cropping up until the late 1980's. Thirty-seven percent of the area is classified as highly erodible, with sheet and rill erosion generating an estimated 67 tons/year of sediment with a delivery rate of 10% and gully erosion generating an estimated 6 tons/year with a delivery rate of 45%.

DESCRIPTION OF TREATMENT: The current landowner has an interest in converting this area back to a native forest community. Conversion of cropland back to native forest is one of the highest restoration priorities in the watershed. This project involved planting conifers in 4.9 hectares of under stocked upland habitat. Trees were planted to achieve a stocking rate of 400 trees/acre. Species included ponderosa pine, western white pine, and western larch. A total of 1,200 trees were planted 4/2001. Year-end survival estimated indicated that survival exceeded 75%.

The landowner provided cost-shares by preparing the planting sites and providing labor to plant the trees and installing tree tubes following planting. These activities were conducted as an addendum to an existing landowner contract.

PROJECT TIMELINE: All project activities were completed by 2001.

PROJECT GOALS & OBJECTIVES: Restore prior converted forest habitat back to a native forest community. Reduce sheet and rill erosion and increase water retention. Achieve 70% survival during the first year following planting and maintain a stocking rate of 400 trees/acre.

RELATIONSHIP TO SCOPE OF WORK: This project satisfies a portion of the contractual obligations for Implementation Objective 1, task 1c in the 2001 Scope of Work.

Table 37. Summary of enhancement activities related to the FY1999 Scope of Work.

Task	Product Description	Locations (Completion Dates)	Accomplished	Not Accomplished
Objective 1	*Riparian Enhancement*			
Task 1.1	Implement riparian enhancement projects and upland enhancement projects in the Benewah Creek drainage.	B_8.5/0.0 (5/99)	X	
Task 1.2	Implement riparian enhancement projects in the Lake Creek drainage.	L_7.3/0.2 (5/99); L_8.2 (5/99); L_8.2/0.0 (5/99); L_8.2/0.0/0.0 (5/99); L_8.5 (5/99); L_8.8 (5/99);	X	
Task 1.3	Implement riparian enhancement projects and upland enhancement projects in the Alder or Evans Creek drainage.	E_0.1 (4/99)	X	
Objective 2	*Lateral Water Development*			
Task 2.1	Develop sites in the Benewah Creek drainage that will provide high quality rearing habitat for juvenile cutthroat trout.	Unable to identify willing landowners		X
Task 2.2	Develop sites in the Lake Creek drainage that will provide high quality rearing habitat for juvenile cutthroat trout.	L_8.2 (9/99)	X	
Objective 3	*Water Storage Enhancement*			
Task 3.1	Complete water storage structures in the Lake Creek drainage based on recommendations described in the Project Management plan	L_5.2/0.2 (10/99); L_5.4/0.1 (10/99)	X	
Objective 4	*Complete unfinished tasks associated with the FY97 and FY98 scope of works.*			
Task 4.1	Implement riparian enhancement projects projects in the Alder and Evans Creek drainage.	E_0.1 (4/99)	X	
Task 4.2	Implement riparian enhancement projects in the Benewah Creek drainage.	B_8.5/0.0 (5/99)	X	
Objective 5	*Complete NEPA Requirements for all proposed watershed enhancement projects.*			
Task 5.1	Determine the necessary NEPA coverage for all proposed watershed enhancement projects.	USFWS Section 10 Consultation 4/99; USACOE permits complete (8/99)	X	

Table 38. Summary of enhancement activities related to the FY2000 Scope of Work.

Task	Product Description	Locations (Completion Dates)	Accomplished	Not Accomplished
Objective 1	*Complete advanced project planning.*			
Task 1.1	Complete NEPA requirements for all planned enhancement projects.	USFWS Section 10 compliance (2/00); USACOE permits (8/00); SHPO (8/00)	X	
Task 1.2	Engage in advanced scooping of restoration projects with landowners in the target watersheds, targeting high priority areas outlined in the Fisheries Project Management Plan	Developed projects with 4 new landowners	X	
Task 1.3	Develop the provisions of a long-term easement process for application on private lands within the target watersheds.	RFP issued (8/00); Contractor selected (11/00)		X
Objective 2	*Implement riparian enhancement projects.*			
Task 2.1	Implement at least two riparian enhancement projects in either Benewah or Lake Creek watersheds.	B_6.5 (10/00); B_8.5 (4/00); B_8.2 (4/00); L_7.3 (5/00); L_8.2 (5/00)	X	
Task 2.2	Implement at least one riparian enhancement project in either Evans or Alder Creek watersheds.	E_0.1 (4/00)	X	
Task 2.3	Establish a low maintenance tree nursery for culturing native stock that can more effectively compete with established vegetation at riparian enhancement sites.	Site established, tree outplanted (6/00); Site maintained through 2001	X	
Objective 3	*Implement lateral water development projects.*			
Task 3.1	Develop one site in the Benewah or Lake Creek watersheds that will restore elements of floodplain function, provide high quality rearing areas for juvenile trout, or improve available spawning habitat for adult trout.	B_6.5 (10/00)	X	
Objective 4	*Enhance upland water and sediment retention capability.*			
Task 4.1	Complete one water storage structure in Lake Creek drainage based on recommendations described in the Project Management plan.	L_8.7/0.1 (10/00)	X	
Task 4.2	Complete at least one upland enhancement project in the Benewah, Lake, or Alder Creek watershed.	B_8.1/0.0 (5/00); B_8.5/0.0 (5/00); B_8.5/0.2 (4/00); L_5.9/0.4 (9/00)		

Table 39. Summary of enhancement activities related to the FY2001 Scope of Work.

Task	Product Description	Locations (Completion Dates)	Accomplished	Not Accomplished
Objective 1.1	*Complete advanced project planning.*			
Task 1.1a	Complete NEPA requirements for all planned enhancement projects.	USFWS Section 10 compliance (2/01); USACOE permits (8/00); SHPO (8/00)	X	
Task 1.1b	Engage in advanced scooping of restoration projects with landowners in the target watersheds, targeting high priority areas outlined in the Fisheries Project Management Plan	Develop projects with 4 new landowners	X	
Task 1.1c	Develop the provisions of a long-term easement process for application on private lands within the target watersheds.	Held kick-off mtg w/ contractor; digitized data layers; completed access database; ArcIMS interface complete; Report not finalized	X	
Objective 1.2	*Coordinate restoration and management activities.*			
Task 1.2a	Coordinate restoration and management activities with other Tribal programs involved in Natural Resources Management	Held mtgs. on HPP; Developed RMZ recommendations for FMP; Ongoing	X	
Objective 2.1	*Implement habitat restoration projects to increase carrying capacity in target tributaries.*			
Task 2.1a	Implement riparian enhancement projects in either Benewah, Lake, Evans, or Alder Creek watersheds.	B_6.5 (10/01); B_8.5/0.0 (5/01); E_0.1 (4/01); L_5.9/0.4/0.0 (4/01); L_6.0 (4/01); L_7.3 (5/01); L_7.3/0.2 (4/01); L_8.2 (5/01); L_8.2/0.0/0.0 (5/01); L_8.7/0.1 (5/01); L_8.8 (5/01)	X	
Task 2.1b	Develop one site in the Benewah or Lake Creek watersheds that will restore elements of floodplain function, provide high quality rearing areas for juvenile trout, or improve spawning habitat for adult trout.	B_6.5 (10/01)	X	
Task 2.1c	Complete one water storage structure in the Lake Creek drainage based on recommendations described in the Project Management plan.	L_5.9/0.4 (10/01); L_6.5/0.1 (10/01);	X	

EVALUATION OF PROJECT ACTIVITIES

The need to address limiting factors related to elevated summer water temperatures, the cumulative effects of sediment loading, loss of wetlands and alteration of runoff patterns has elicited an implementation approach common to all target watersheds. The range of restoration and enhancement measures applied from 1995-2001 include fencing, riparian plantings, addition of large woody debris to streams, construction of wetlands/sediment basins, and complete channel reconstruction. These measures were implemented consistent with the conceptual approach to restoration outlined in the CDA Tribe Fisheries Program Management Plan (Lillengreen et al. 1999). The overall goal of these activities were aimed at modifying existing land management practices through cooperative landowner agreements and then, when deemed necessary, implementating active measures that attempted to facilitate the function of natural ecosystem processes and reestablish the linkages between the aquatic, riparian, and upland environments.

The following sections of this report detail the evaluation methods and preliminary results for key project categories/treatments. More detailed descriptions of the evaluation methods can be found in the CDA Tribe Fisheries Program Research, Monitoring and Evaluation Plan (Vitale et al. 2002) and in its companion document, "Technician Training Reference Manual" (Lamb et al. 2002). *Table 41* provides a summary of the monitoring protocols used in evaluating select projects during this reporting period. This section is concluded with a discussion of guidelines and recommendations for improving project evaluations into the future.

Riparian Plantings

The common objectives for the riparian planting projects described in this report are to increase stream canopy density over time to meet site specific targets for shade (*Table 39*), increase the amount of vegetative cover usable by fish and increase both instream wood volumes the recruitment potential for large woody debris over time. Implementation at each site was preceeded by a riparian function assessment that measured canopy density and shade over the stream channel, vegetative overhang, and large woody debris volumes in the active channel and in the floodprone area. References to monitoring protocols are shown in *Table 41*.

For the seven project sites where pre-implementation surveys were completed, mean canopy density was 28% (range=11-42); mean vegetative overhang was 3.9ft. (range=1-8), and mean instream wood volumes (>4inch dia) were 5.4in^3/ft^2 (range=0-20.7). None of these sites met the canopy targets for their respective elevation zones and although criteria for woody debris have not been developed at the time of this writing, all sites were considered well below hydraulic and ecologically significant thresholds for woody debris volumes. Three sites were resurveyed 2-3 years following the initial treatments. At each of these sites the mean values for canopy density, vegetative overhang and instream wood volumes all increased slightly but only woody debris volumes were significantly different (P=0.07). The increasing trends for canopy density and vegetative overhang are thought to be attributable to project activities because land management activities were changed as a result of landowner agreements that removed or rested riparian areas from cattle grazing. Based on initial monitoring results, significant differences in canopy density and overhanging vegetation are likely to be expressed in a 10 year post-restoration time frame. Woody debris volumes may continue to increase if these sites remain undisturbed but substantial

recruitment will not attributable to restoration activities without mechanical manipulation for 20+ years.

Table 40. Target stream canopy closure for northern Idaho (from CDA Tribe Fisheries Program Managemetn Plan (Lillengreen et al. 1999).

Elevation Zones (feet)	Target Canopy Cover	
	Bull trout (13° C)	Cutthroat trout (15° C)
>5,200	29	6
5,000-5,199	35	12
4,800-4,999	41	18
4,600-4,799	48	24
4,400-4,599	54	30
4,200-4,399	60	36
4,000-4,199	66	43
3,800-3,999	72	49
3,600-3,799	79	55
3,400-3,599	85	61
3,200-3,399	91	67
3,000-3,199	97	73
2,800-2,999	100	80
2,600-2,799	100	86
2,400-2,599	100	92
2,200-2,399	100	100

Nearly 50,000 trees and shrubs were planted in the treatment watersheds between 1996 and 2001. At planting sites in Lake, Benewah and Evans creeks, mean survival was 70% (n=7sites) and measured growth of live willow pole plantings exceeded several feet per year. Annual survival estimates completed at several sites have been important in providing key information about sources of mortality. The two biggest sources of mortality have been animal damage and dessication. Animal damage has been much more evident with deciduous plantings than for conifers. Efforts to reduce animal damage through use of mechanical protection (tree tubes) has helped increase survival and generally been more successful than using chemical repellants. Where feasible, fencing areas of clumped plantings may be a good alternative for establishing stands of cottonwood, willow and aspen, all of which are selectively broused. Dessication has been a significant problem at all but the wetest sites due to the degraded condition of the riparian community. Competition for available moisture occurs with established vegetation and lack of shading speeds the dessication process. Use of shade cards may be a viable way to increase conifer survival in the most exposed areas. Both types of observed mortality tend to decrease over time as the plantings mature. Several attempts have been made to evaluate the cost-benefits of using larger plant material as a means of reducing mortality. Five-gallon containers are now recognized as the most desirable size for deciduous plant materials and 10cu. inch conifer plugs are typically planted rather than the smaller 5 cu. inch plugs that are available and typically used in the Tribal Forestry Program. Investing in larger balled-burlaped stock should be pursured whenever a good source of materials can be found. When available, larger stock should be planted closer to stream channels so that benefits may be realized in a shorter time.

While it is difficult to quantify the short-term benefits to riparian function, the long-term benefits of healthy riparian plant communities are well documented. Platts and Nelson (1989) described a positive correlation between stream canopy and salmonid biomass in the Intermountain west, citing beneficial effects from thermal regulation and input of allochthonous plant material and terrestrial invertebrates. Input of woody debris from project plantings will provide cover for fish (Boussa 1954; Hartman 1965), serve as shelter from current (Bustard and Narver 1975; Fausch 1984; Bisson et al. 1987), and provide sites from which foraging can be staged while predation risk is reduced (Crowder and Cooper 1982; Huntingford et al. 1988). These benefits are being realized incrementally as plantings begin to mature. Continued monitoring and evaluation will help to further quantify the benefits of these riparian measures.

Constructed Wetlands/Sediment Basins

To date, nearly ten acres of palustrine wetlands have been constructed in the Lake Creek watershed, with a combined storage capacity of approximately 58 acre-feet (*Table 40*). Water depth at full pool ranges from 10-20 feet at each of four sites and the thermocline that develops during summer months keeps water temperatures at or below 17°C for approximately 40% of the storage capacity. The objectives for each of these sites is to store and release water to supplement instream flows and increase ground water infiltration during critical periods in the summer and to reduce sediment transport to Lake Creek from agricultural lands. One working hypothesis for this restoration strategy is that contribution of cool surface water and/or contribution of stored water to the ground water table can translate into hyporhic upwelling that can serve as an attractant to both fish and aquatic insects during critical time frames. Also, reducing fine sediment from sources areas will improve pool quality and other instream habitat features.

Table 41. Summary of wetland/sediment basin characteristics constructed as part of BPA project#1990-044-00.

Project #	Treated Acres*	Surface Acres	Storage Capacity (acre-feet)	Date of Completion
L_5.2/0.2	97	2.5	13	1997
L_5.4/0.1	18	1	7	1997
L_6.7/0.2/0.0	140	1.6	13	1998
L_8.7/0.1	50	2	10	2000
L_5.9/0.4	300	0.5	3	2001
L_6.5/0.1	41	2.1	12	2001
Totals	**646**	**9.7**	**58**	

*Treated acres represent the number of acres upstream of the catchment

Water quality monitoring was completed during 2 seccessive years at two sites (*Table 42*). Hydrolab profiles were taken, water samples were collected and sent to a lab for analysis, and recording thermographs were used to monitor the temperature of discharged water. Temperature profiles from 2 ponds clearly indicate the stratification of the water column during the period of highest ambient air temperatures. None of the chemical constituents tested in water samples exceeded Tribal or EPA water quality standards or the specific tolerances reported for salmonid

fishes (Bell 1973). Two experimental releases of water were made from one pond between 1999-2001. During one such release (August 13-27, 1999) release water reaching Lake Creek ranged from 11-15°C and was 3-8 degrees colder than measured instream water temperatures during the release period. It was noted during this release that evaporative cooling took place such that release water was cooled by up to 2°C as it passed from the release point to Lake Creek (a distance of approx. 500meters). The volume of water reaching Lake Creek was not quantified and the affect on the local ground water table also was not evaluated.

Fisheries response to a second discharge from pond L_6.7/0.2/0.0 was examined in August 2001. A 60-meter long reach centered at the point where pond water entered Lake Creek was sampled by electrofishing at one week intervals before, during and after water release. Migration of fish into and out of the sample reach was not blocked except during the brief sampling efforts. No cutthroat were identified in the sample reach either before or after the releases, but density increased to 0.9 fish/100 sq. meters during the release. The observed increase in habitat use represents a redistribution of fish from other nearby areas and the residence time of the fish found during the release was not determined. Nevertheless there is weak evidence to suggest that management of water releases may have beneficial applications and should continue to be evaluated.

The established network of constructed wetlands may present an opportunity for addressing the short-term peaks in summer water temperatures that effectively limit the distribution of juvenile fish in the watershed. A coordinated release of 0.5 cubic feet/second of water from the existing network could provide cooling effects for more than 18 days during critical summer rearing periods and increase base flow by more than 15 percent. The goal of this project is to double the combined storage capacity of constructed wetlands over the next four years.

Reduction of sediment transport and delivery from source areas has been another overall objective for these projects. In the Lake Creek watershed, where cropland sheet and rill erosion is the principle sediment source, identification and mapping of Highly Erodible Land (HEL) and identification of favorable hydrogeologic conditions has helped to prioritize the placement of the structures described in this report. The constructed wetlands function as large sediment basins to reduce transport of sediment from sheet, rill and gully erosion from up to 300 acres of source area. The construction of these structures beginning in 1997 has reduced annual sediment delivery to Lake Creek from a total of 646 acres of farmland. Several researchers have examined the trapping efficiency of similar structures and suggest that removal efficiencies as high as 75% for TSS can be achieved (Tatlovich 1998; Schueler 1992; Yu 1998; unpublished data NRCS). Assuming a trapping efficiency of 75%, total delivery of sediment to Lake Creek has decreased from 1801.8 tons of sediment/year to 450 tons/year. Partnership projects implemented by the NRCS have reduced delivery by comparable amounts from more than 600 additional acres of HEL in the watershed.

Construction of wetlands similar to those described here is an important strategy that warrents continued research and evaluation. While, the effectiveness of similar structures in treating non-point source runoff is well established (Yu et .al. ; Athanas 1988; Liao 1996), the use of water releases as a means of creating local refugia from elevated stream temperatures has not been well documented and necessitates additional monitoring efforts. At a minimum, these projects help to replace wetlands that were lost during conversion of primarily forested habitat to agricultural uses in the Lake Creek watershed. Restoring lost wetland functions (e.g., sediment and water

storage, nutrient cycling, increasing ground water infiltration, invertebrate production, etc.) is an important enhancement tool that has a high probability of benefiting stream habitats and biological communities.

Instream Habitat Enhancement and Channel Construction

Several projects in Benewah, Lake and Evans creeks have been initiated to improve instream habitat structure, stabilize eroding streambanks, and correct other problems associated with channel morphology that were induced by either direct manipulation or past land management practices. Rock barbs were installed in Evans Creek (E_1.3; E_1.6) to redirect flow away from unstable banks, a brush revetment was built in Benewah Creek (B_8.5) to reduce streambank erosion, large wood was added to Lake Creek (L_8.2), and a large scale channel reconstruction was completed in Benewah Creek (B_6.5). Some monitoring of habitat structure, substrate, channel morphology and fish population response has occurred at several sites but monitoring effort has not been applied consistently across all projects. Monitoring results are described below for projects L_8.2 and B_6.5. The two projects in Evans Creek were evaluated through photo documentation and are not reported here.

Project L_8.2 was implemented in the Lake Creek watershed to rehabilitated a 600 meter long stream reach which had been cleaned and straightened and was completely devoid of woody debris. Pre-project monitoring included 3-years of fish evaluations, substrate characterization, measurement of longitudinal channel profile and woody debris measurements. Specific monitoring protocols are referenced in *Table 41*. Annual population surveys indicated a complete absence of cutthroat trout prior to construction, mean residual pool depth was 1.3 ft., and no large woody debris was present in the treatment reach. A total of 44 individual logs with a combined biomass of approximately 47 tons were introduced to the test reach to approximate historic volumes of debris at the site. In addition, a 3,000 sq. ft. brush mattress was constructed by hand to introduce fine woody debris and to help narrow and deepen a particularly degraded section where the $width_{bf}/depth_{bf}$ ratio was >100. One year after construction, average residual pool depth increased by 15 percent, substrate conditions showed a shift from sand (D_{63}<2mm) to a mixture of predominantly fine gravels (D_{50}<11.3mm), and cutthroat trout from 3 different year classes were observed at the site. Approximately 80% of all fish observed in the reach were associated with scour pools created by wood placed on site. Ninety percent of the logs placed on site remained stable and were present in their original locations 2 years after placement. Measured woody debris volumes were $108in^3/ft^2$ of surface area. Whether fry carrying capacity for the entire stream reach increased cannot be assessed from our experiment. A redistribution of existing fish could have produced a similar result, but it is logical that if locally improved habitat attracts fish away from unimproved parts of the stream, then the fish that remain in the improved parts have better chances for survival, growth, and production.

Project B_6.5 was implemented in the Benewah Creek watershed in 2000 and 2001 to correct several problems associated with direct manipulation of the stream channel. The creek had been straightened and the natural floodplains cleared and drained to develop cropland and pastures adjacent to the creek. Straightening increased the channel gradient, which in turn, increased the channel's ability to convey bed material and subsequently caused the channel to degrade. This deeper, incised channel was vertically separated from its floodplain and unable to sub-irrigate the riparian vegetation it once depended upon for stability. Results of the pretreatment channel survey help illustrate these problems: sinuosity=1.06; flood prone width at twice maximum

bankfull depth (d_{maxbf})=80.2ft.; Entrenchment ratio=1.92; mean bankfull depth(dbf)=1.8ft.; $width_{bf}/depth_{bf}$ ratio=23.2. Implementation of the final restoration design converted the existing degraded channel from an F4 to C4 stream type by increasing the sinuosity (from 1.06 to 1..3), meander width ratio (from <2 to 5.2) and floodprone width (from 80.2ft. to 152ft.), lowering the bankfull width/depth ratio (from 23.2 to 19), and increasing the channel entrenchment ratio (floodprone width/bankfull width) from 1.92 to 2.8. Much of the existing unstable channel and floodplain was filled and regraded. The new channel was built just large enough to convey the bankfull discharge within its banks. The controlling riffle elevations were set at a consistent gradient and the bank heights at all the riffles and bends were built so that the banks would overtop simultaneously during flood events. During construction, ten riffles, 4 j-hook structures, and more than 40 pieces of large wood were placed to enhance streambank stability and instream habitat diversity. The new channel was mapped through measurement of longitudinal profiles, channel substrate, and cross sections so that all measures of channel morphology and stability will be repeatable in the future.

The most recent instream and channel enhancement projects are more effectively facilitating the function of natural ecosystem processes and reestablishing the linkages between the aquatic, riparian, and upland environments. They have also been much more thoroughly monitored pre- and post-implementation than earlier projects. These actions are apparently addressing limiting factors at both the reach and microhabitat scales and are based on a large body of peer reviewed scientific literature. As such they serve as good models for designing, implementing, and monitoring future restoration/enhancement projects.

Future RM&E Needs

No formal performance criteria were established for project activities during this reporting period, however there is a clear need for well defined effectiveness monitoring criteria and parameters for evaluating these criteria. The recent effort to finalize an RM&E Plan for this project was an attempt to formulate specific objectives, tasks and methods for evaluating project effectiveness and tracking trends in biological and water quality criteria. *Table 43* is excerpted from the RM&E plan and provides a description of effectiveness criteria and monitoring parameters that will be used to evaluation specific projects in the future. These same criteria should be used to determine the need for maintenance at existing project sites. By applying these criteria consistently across all project activities evaluation of project performance will become more standardized and repeatable in the future.

Table 42. Monitoring attributes and parameters/protocols

Attribute	Parameter/Protocol	Frequency (time/year)	Equipment
I. Water Column			
a. Temperature	Recording Thermograph	Continuous during summer	Recording Thermograph
b. Water Quality Profile	Hydrolab, Inc. (1997)	Every 2 weeks	Hydrolab
c. Discharge	Peck et al. (2001); Rantz (1982)	Every 2 weeks	Flow meter
d. Shade	Canopy Density/Densiometer; Platts et al. (1987)	Once every 3 years	Densiometer
II Stream Channel/ Streambank			
a. Channel Morphology	Longitudinal Profile; Rod and Level; Peck et al. (2001)	Annually for selected sites	Rod and level
	Channel Cross Section; Rod and Level or Sag Tape Methods; Platts et al. (1987)	Annually for selected sites	Rod and level
	Width/Depth ratio; Platts (1983); 3 point method; Rosgen (1996)	Annually for selected sites	Tape and rod
b. Channel Stability	Sediment Supply; Pfankuch (1975)	Once every 3 years	
c. Streambank Stability	Channel Cross-SectionsRod and Level; Rosgen (1996)	Annually for selected sites	Tape
d. Substrate Sedimentation	Particle Size Distribution - Percent Fines/Pebble Count; Wolman (1954); Rosgen (1996)	Once every 3 years	Rulers
e. Vegetative Overhang	Vegetative Overhang (at transect); Platts et al. (1987)	Once every 3 years	Measuring rod and tape
f. Streambank Angle/ Undercut	Streambank Undercut (at transect); Platts et al. (1987)	Once every 3 years	Measuring rod
g. Woody Debris	Platts et al. (1987)	Once every 3 years	
III. Streambank Vegetation			
a. Vegetative Composition	Green Line Survey; Winwood (2000)	Once every 3 years	Measuring tape
b. Woody Species Regeneration	Woody Species Regeneration; USDA Forest Service (1992)	Once every 3 years	Measuring tape and 2 meter rod
IV. Biological Evaluation			
a. Fish Community	Fish Communities; Peck (2001)	Annually	Electrofishing unit, nets, weighing scales

Table 43. Measured water quality parameters from constructed wetland ponds in Lake Creek.

		Site ID	L_6.7/0.2/0.0	L_6.7/0.2/0.0	L_5.2/0.2	L_5.2/0.2	Trip Blank	
		Sample Date	7/30/99 (btm)	7/30/99 (top)	7/30/99 (top)	7/30/99 (btm)	7/30/99	
Analaysis Parameters	**Method**	**Units**						
Physical Properties								
Total Dissolved Solids	EPA 160.1	mg/L						
Total Suspended Solids	EPA 160.2	mg/L	4.90	5.40	2.22	9.39	<2.000	
Turbidity	EPA 180.1	NTU	6.55	5.21	2.16	5.13	0.184	
Hardness as CaCO3	EPA 200.7	mg/L						
Inorganic, Non-Metallics								**WQC_a**
Chloride, Cl	EPA 300.0	mg/L	0.652	0.580	35.3	35.2	0.113	230.0
Fluoride, F	EPA 300.0	mg/L	0.140	0.117	0.361	0.364	0.026	No
Nitrate as N	EPA 300.0	mg/L	0.020	<0.005	0.006	0.039	0.005	10.0
Nitrite as N	EPA 300.0	mg/L	0.007	<0.005	<0.005	<0.005	<0.005	
Total Phosphorous	EPA 200.7	mg/L						No
ortho-Phosphate as P	EPA 300.0	mg/L	0.026	0.031	<0.010	<0.010	<0.010	No
Sulfate	EPA 300.0	mg/L	6.01	7.42	3.19	3.27	<0.030	
TKN	EPA 351.4	mg/L	0.272	0.242	0.248	0.202	<0.100	

[a] Coeur d'Alene Tribe Water Quality Criteria; Chronic criteria: EPA CWA 304(a) Criteria Continuous Concentration (CCC)

	Date/Time	Depth (m)	Dissolved O_2	Temp (°C)	pH	Cond	TDS	DO Sat (%)
Site L_6.7/0.2/0.0	7/30/99 0:00	0.2	4.23	23.1	7.16	165	0.11	49
(constructed 9/98)	7/30/99 0:00	0.8	1.75	21.7	7.03	168	0.11	19.7
	7/30/99 0:00	1.3	0.52	20.7	6.94	163	0.11	5.8
	7/30/99 0:00	1.8	0.21	18.8	6.91	160	0.10	2.2
	7/30/99 0:00	2.3	0.22	16.4	6.88	168	0.11	2.3
	7/30/99 0:00	2.8	0.25	13.5	6.83	173	0.11	2.3
	7/30/99 0:00	3.3	0.42	12.0	6.76	203	0.13	3.8
Site L_5.2/0.2	8/24/01 0:00	0.5		22.9	9.8	251		
(constructed 9/97)	8/24/01 0:00	1.0	10.6	17.6	9.4	251		
	8/24/01 0:00	1.5	7.69	17	9.08	253		
	8/24/01 0:00	2.0	3.9	16.7	7.76	275		
	8/24/01 0:00	2.5	0.16	14.7	6.48	363		
	8/24/01 0:00	3.0	0.16	12.6	6.35	375		
	8/24/01 0:00	3.5	0.18	11.5	6.31	387		
	8/24/01 0:00	4.0	0.22	11.3	6.29	406		

Table 44. Summary of effectiveness criteria and monitoring parameters recommended for evaluating future enhancement activities in select watersheds on the Coeur d'Alene Reservation.

Projects	Effectiveness Criteria	Monitoring Parameters
Category: Fish Passage	• Area of habitat made accessible • No unforeseen adverse effects on habitat such as incision or channel instability or sedimentation • Increased attraction flows during migration periods (for barrier modifications)	• Instream habitat upstream from barrier • Channel slope and width/depth ratios up and downstream from barrier to next control points • Streamflow volume and velocity at inlet and outlet during periods of migration
Category: Instream Habitat Restoration Project Types: Install Structures, Install Gravel	• Project increases targeted habitat parameters within the project reach such as pools, cover, or dissolved oxygen or decreases temperature • Project does not impair natural movement of LWD or nutrients downstream • No unforeseen adverse effects on habitat features, substrate, channel geometry or fish passage • Project increases amount of suitable spawning habitat at specified flows	• Instream habitat within project reach • Water temperature and dissolved oxygen content • Large woody debris within and downstream from project reach • Instream substrate composition • Residual pool depth
Category: Instream Habitat Restoration Project Types: Remove Structures, Construct Channel/ Breach Dikes	• Stream stabilizes and establishes properly functioning geometry and pattern, in relation to Rosgen stream type • No unforeseen adverse erosion or sedimentation or channel instability • Stream re-connects to formerly abandoned floodplain • Peak flows do not cause adverse erosion or sedimentation, and/or peak flows are modified • Sustained increase in number, area, type and quality of instream habitat units • Increased streambank vegetation, reduced fine sediment deposition, and reduced water temperature during low flows • No reduction in the diversity and quality of instream habitat units over time through a broad range of stream flows	• Channel pattern, sinuosity, slope and width/depth ratios • Instream habitat and cover within project reach • Frequency of overbank flooding • Riparian cover • Instream substrate composition • Water temperature

Projects	Effectiveness Criteria	Monitoring Parameters
Category: Streambank Stabilization	• Reduced bank erosion • Improved channel geometry e.g., reduced width/depth ratio • Reduced fine sediment in reach • Increased riparian vegetation	• Bank stability • Width/depth ratios • Instream substrate composition • Riparian cover
Category: Land Use Control	• Increased riparian vegetation • Increased riparian connectivity • Increased bank stability • Improved channel geometry e.g., reduced width/depth ratio • Reduced fine sediment in reach • Improved water quality including nutrients, pathogens, temperature and dissolved oxygen • Others as appropriate for conservation easements	• Riparian cover • Riparian corridor continuity • Bank stability • Width/depth ratios • Instream substrate composition • Water quality
Category: Vegetation Control	• Reduced relative abundance of exotic plants • Increased relative abundance of native plants • Increased native plant species richness Reduced barren ground • Increased riparian canopy cover • If clearing encroachment is involved, reduced vegetation within bankful channel • If clearing encroachment is involved, increased availability of spawning gravels	• Riparian vegetation composition and cover
Category: Plant or Manage Riparian Vegetation	• Riparian tree composition meets planting or management objectives • Increased riparian canopy cover • Advancement in riparian successional stage • Increased riparian corridor continuity and patch size	• Riparian vegetation composition and cover • Riparian corridor continuity and width • Increased frequency of species with soil binding qualities
Category: Restore Flows	• Modify hydrograph to increase low flows and achieve natural peak flow regime • Decreased water temperature during low flows • No adverse of changes in flow on downstream sites	• Streamflow above and below project reach • Water temperature

Projects	Effectiveness Criteria	Monitoring Parameters
Category: Slope Stabilization Project Types: Soil engineering, bioengineering	• Reduced likelihood of slope failure • Decrease in soil erosion from site • Decreased sediment load near site during peak flow events • If planting involved, reduced bare ground If a large portion of a watershed is treated, reduced sediment yields	• Slope stability • Erosion rate • Turbidity in runoff from site • Vegetation cover • Watershed sediment yield
Category: Gully Repair	• Improved channel geometry e.g., reduced width/depth ratio • No offsite adverse effects on downstream channels such as incision or channel instability • Reduced erosion and sediment yield • Reduced flood flows in channel Increased vegetation cover	• Channel slope and width/depth ratios within and downstream from project area • Erosion rate from treated area • Sediment yield • Streamflow • Vegetation cover
Category: Road Upgrading Project Types: Road Surfacing, Drainage Improvements, Partial Decommissioning	• Reduced erosion rate from road surface • Reduced number or probability of road related slope failures • No offsite adverse effects on erosion or sedimentation • Improved stream discharge regime and reduced sediment yield in immediately adjacent watercourses • If a large portion of a watershed is treated, reduced actual sediment yield • If a large portion of a watershed is treated, stream discharge regime approaches natural variability and magnitudes	• Erosion rate from road surface • Slope stability • Runoff rate • Turbidity in runoff from site • Watershed sediment yield • Streamflow
Category: Road Upgrading Project Type: Full Road Decommissioning	• Reduced number or probability of road related slope failures • Reduced erosion from site • Increased infiltration rate on road surface • Reduced sediment yield in immediately adjacent watercourses • No offsite adverse effects on erosion or sedimentation	• Erosion rate from road surface • Slope stability • Runoff rate • Turbidity in runoff from site • Watershed sediment yield • Infiltration rate on road surface

TROUT PONDS

Since harvest of fish remains an ongoing subsistence activity for many Tribal members, there is a need to reduce fishing pressure on wild fish stocks while giving restoration efforts a chance to benefit the ecosystem. Over the last several years, poor fishing conditions have severely limited the ability of the Tribal Community to harvest desirable fish species in any acceptable numbers. The Coeur d' Alene Tribe has made the difficult decision to maintain a strict wild fish management policy for traditional fishing areas, primarily important cutthroat trout streams on the Reservation. The emphasis is to restore these areas in order to optimize conditions for expansion of wild stocks (restoration of habitat). However, substantial increases to these populations to support any sizable harvest goals are not expected for some time.

Since the Coeur d'Alene Tribe decided to close streams to harvest in sensitive drainages on the Reservation as the principal method of protecting and promoting wild stock expansion, a hatchery oriented "put and take" fisheries program using rainbow trout was implemented. To provide for reasonable harvest of desired species in the near future it was decided that a series of trout fishing ponds located in strategic areas would best serve the need for an alternative fishery on an interim basis. To protect the integrity of the wild fish restoration projects none of these ponds are to be placed in drainages where restoration is occurring. This will minimize the chance of interaction between hatchery and native fish species. Additionally, all ponds will be closed basin fisheries to prevent genetic introgression as well as spread of disease.

Rainbow trout are the preferred species for stocking because the species has one of the highest temperature tolerances (25.5^{o}C) of the salmonid family (Piper et. al. 1982, Miko et. al. 1995), large numbers are produced by federal, state, and private hatcheries, and they are readily available and usually can be delivered on demand.

The primary management goal to determine stocking strategy will be angler satisfaction and success. Angler satisfaction and success is directly correlated to catch and/or harvest rates and fishing effort. Mean catch rates necessary to achieve an excellent fishing success rating would be around 2.88 fish/hour (Miko et. al. 1995). This would be stocking densities of about 12,000 fish/ha. However, researchers have shown that mean catch rates peak at about 0.6-0.7 fish/hour, and catch rates needed for angler satisfaction (trip satisfaction) ratings to be considered excellent are much lower. Weithman and Katti 1979, Hicks et. al. 1983, and Miko et. al. 1995 have shown that stocking densities around 1400 fish/ha will provide good to excellent angler satisfaction ratings, and that anglers would be satisfied with their trip quality even if they were dissatisfied with their fishing success. The management strategy employed by the Coeur d'Alene Tribe will be to provide fish catch rates of about 0.5 fish/hour (1400 fish/ha). This is a conservative management strategy, since averages of 1.0 fish/hour at the Worley pond are currently being achieved.

In a recent evaluation of fishing and hunting licenses sold from 2000 – 2002 the following was concluded. In a sample of licenses sold in 2000 there were 104 fishing licenses sold and 1042 hunting licenses sold. In 2001 there were 4615 fishing licenses sold and 1948 hunting licenses sold. By August of 2002 there were 2182 fishing licenses sold and 352 hunting licenses sold but we would anticipate a large amount of hunting licenses to be sold for the upcoming hunting season starting in early September. It is estimated that prior to 1995 when we started planting fish in Worley pond we sold only about 100 fishing licenses a year. This increase is in part

attributed to BPA's contract with the Tribe to build and support a trout pond program. The increase in license sales cannot wholly be attributed to the incresed ability to harvest fish in the trout ponds. Other factors contributing to license sales include conclusion of the litigation over ownership of the southern portion of the Coeur d'Alene Lake which formalized Tribal ownership as well as increased enforcement on the lake.

1995 - A pilot project was implemented where Worley Pond on the Coeur d' Alene Indian Reservation was stocked with 1000 rainbow trout. Fishing was limited to juveniles under the age of 12, senior citizens, and all enrolled Coeur d' Alene tribal members. Creel surveys were conducted starting June 1, 1995 and ending August 23, 1995. Fishing pressure was most intense just after the pond was opened for fishing. As angler success declined so did the effort. It appears that as long as catch rates are up demand is high. The creel data was summarized and 159 anglers caught 410 fish. The pond was open to fishing for 1008 hours during the sample period. Fish and wildlife personnel conducted creel samples for 408 of those hours or 40.5 % of the available fishing time. Based on this it can be assumed that 40.5% of the fishermen were sampled and 410 fish equated to 40.5 % of the catch. Thus, total catch for the season was estimated to be 1012 fish or all of the available fish.

1996 - On June 15, 1996, 2900 fish were released into Worley Pond and an estimated 100 fish a day were caught over the next 22 days. A late season population estimate was completed in October of 1996. Results from the population estimate indicated that only 325 fish were left.

1997 - Prior to the plant in June of 1997 a small portion of the fish that over wintered in the pond were sampled. These fish appeared to be healthy and in good shape. Growth rates appeared to be the same as what you have in a natural system however, it was much lower than what you would find in a hatchery situation.

In late-June, 1997 (2000) fourteen to twenty-two inch rainbow trout were planted in Worley Pond. These fish were large compared to anybody's standards averaging about 1.2 pounds apiece. Shortly after release the pond saw some fairly heavy fishing pressure as most fishermen were experiencing excellent fishing conditions. Most of the fish were caught in the first three weeks after planting however, there were still some fish left in the pond as of October 14, 1997.

A mark-recapture population estimate was completed between October 6, 1997 and October 14, 1997. Sixty-two rainbow trout were marked during the first sampling period. On the second sampling date 40 fish were captured with 10 of those being recaptured from the first sampling effort. This equates to a total population estimate of 248 fish.

The fishing regulations for Worley pond and all subsequent Tribal trout ponds were changed. Prior to this rule change the Tribal trout ponds were only open to juveniles under the age of 12, senior citizens, and all enrolled Coeur d' Alene tribal members. Worley Pond is open to all fishermen in accordance with the Tribal fish and wildlife code from dawn to dusk, June 1st to November 1st, with a five fish limit.

1998 - In late-June, 1998 (1500) 10-13 inch rainbow trout were planted in Worley Pond. These fish were average to large averaging about 3/4 pounds apiece. Shortly after release the pond saw some fairly heavy fishing pressure as most fishermen were experiencing excellent fishing conditions. Most of the fish were caught in the first month after planting. This year we

purchased a new seine, which captures most all the trout in the pond on the first pass. We conducted our seining on October 14th where we captured only 19 fish. A second pass captured no fish. Thus, we concluded that only 19 or so fish out of 1500 planted were left.

1999 - 1500 fish were planted in Worley Pond on June 17th. Only one plant was completed this year, as the source of fish was limited.

In 1999, Tribal code was further amended to say Tribal trout ponds are open year around with a five fish daily and possession limit.

2000 – (1000) 10 – 13 inch Rainbow trout were planted in Worley pond on June 17, 2000 and an additional (1200) were planted on July 7, 2000. Creel census was completed for the first 11 days and 44 anglers removed 48 fish in 26 hours. Anglers were sampled between the hours of 8-10 AM and twice from 2-4 PM. Each angler averaged about 0.6 hours for 1.1 fish. This average far exceeds our 0.5 fish per hour of angler effort.

2001 – (1000) Rainbow trout were planted in the pond on June 25, 2001 and an additional (1300) were planted on July 17, 2001. Worley pond was drained in anticipation of routine maintenance in the summer of 2002. Only six trout were captured however, it was expected that high summer water temperatures caused some mortality to fish from the second plant. As part of the routine maintenance the pond will be deepened an average of two feet with six holes deepened to 15 feet. A handicapped access pier is also being constructed as part of the overhaul. Additionally, a new water source is also being added to the pond. This source will supply up to 90 gpm of cool (12° C) water to the pond during the hot summer months.

Table 45. Summary of trout pond activities, 1999.

Task	Product Description	Completion Dates	Accomplished	Not Accomplished
Objective 1	*Evaluate existing management plan for compensatory harvest opportunities on Reservation.*		X	
Task 1.1	Review existing management plan and makes necessary changes based on activities completed in FY 98.	October 30, 1998	X	
Objective 2	*Fish stocking strategy.*			
Task 2.1	Prepare, stock, and maintain Worley Pond.	June 1999	X	
Objective 3	*Complete contractual obligation to construct and rehabilitate four ponds from FY97 and FY98.*			
Task 3.1	Four ponds will be constructed and/or rehabilitated in order to provide better opportunity for participation by the local community in fishing activities.	Not completed		Not completed
Objective 4	*Evaluate effectiveness of stocking program.*			
Task 4.1	Creel census and public opinion survey will be conducted for all ponds to determine angler use, attitude towards project, and compensatory effectiveness.	Not completed		Not completed
Task 4.2	Complete population estimates of remaining fish during fourth quarter.	Completed	X	

Table 46. Summary of trout pond activities, 2000.

Task	Product Description	Completion Dates	Accomplished	Not Accomplished
Objective 1	*Implement Fish Stocking Strategy.*			
Task 1.1	Prepare, stock, and maintain Worley Pond. Pond will be cleaned and maintained in FY00.	June 2000	X	
Objective 2	*Construct and/or rehabilitate four ponds for stocking.*			
Task 2.1	Secure power of attorney or lease agreements at the pond sites that have been identified for development	June 2002	X	
Task 2.2	Complete advanced planning to facilitate construction of trout ponds.	June 2000	X	
Task 2.3	Construct and/or rehabilitate a total of four ponds in order to provide better opportunity for participation by the local community in fishing activities.	Not completed		Not completed
M&E Objective 4	*Evaluate effectiveness of stocking program.*			
Task 4.1	Creel census and public opinion survey will be conducted for all ponds to determine angler use, attitude towards project, and compensatory effectiveness.	July 2000	X	
Task 4.2	Complete population estimates of remaining fish.	October 2000	X	

Table 47. Summary of trout pond activities, 2001.

Task	Product Description	Completion Dates	Accomplished	Not Accomplished
O&M Objective 3	*Provide compensatory harvest opportunities for the Reservation Community.*			
Task 3a	Implement the fish stocking strategy at Worley Pond and other "put and take" fishing sites on the Reservation.	June 2001	X	
Task 3b	Conduct activities to prepare and maintain "put and take" fishing sites, including regular removal of garbage and debris and management of nearshore vegetation to provide quality fishing sites.	Summer 2001	X	
M&E Objective 3	*Evaluate effectiveness of stocking program.*			
Task 3a	Conduct a creel census and public opinion survey for all ponds in the program to determine angler use, attitude towards project, and compensatory effectiveness of this action.	*Not accomplished		*Not completed
Task 3b	Calculate population estimates of remaining fish during fourth quarter, FY00.	May 2002	X	
Task 3c	Review the existing management plan and make adaptive changes, as necessary, to ensure that fishing pressure on wild stocks remains at acceptable levels.	May 2002	X	

*It was discussed with previous COTR's to not conduct Creel census on trout ponds given previous results from 2001. BPA (COTR) recommended that only population estimates be conducted. Coeur d'Alene Tribe did not charge BPA for execution of this task.

EDUCATION AND OUTREACH

INTRODUCTION

Early in the planning stages of this project, Tribal staff envisioned the use of outreach to the general public and the development of educational opportunities as a means to facilitate a holistic watershed protection process on the Reservation. The staff held a common belief that responsible management must address the needs of the larger community that collectively affects fish and their habitats. By adopting Tribal recommendations, the Northwest Power Planning Council (NPPC) concurred with this concept and recognized public education and outreach to be a necessary and integral component of fisheries enhancement efforts on the Coeur d' Alene Reservation (NWPPC 1995).

There are several challenges to implementing an effective outreach/education program on the Reservation. These challenges are functions of demographics and geography, economy and culture. The majority of the Reservation is undeveloped and its population centers (Worley, Plummer, St. Maries, Tensed, and DeSmet) are widely distributed and further separated by its geographical barriers. While the quality of the surrounding environment has recently been attracting people and businesses, that very economic vitality can threaten environmental quality. Also, the cultural differences between Tribal members and more recent settlers are sometimes pronounced. To overcome potential barriers, the project's education and outreach vision was to help bridge the gap among all people of the Reservation community through various community building efforts performed cooperatively by the Outreach Specialist and other staff as needed. The common threads to draw on are shared resources and a shared rural lifestyle. In this setting, cultivating a better understanding of Tribal culture among non-Indians is as important as making science more understandable and accessible.

This report covers the three-year period of 1999, 2000, and 2001. Across the three-year period, objectives and tasks have been slightly modified but the general goals have remained the same. The first objective focuses to improve awareness of project activities within the Reservation community. This objective is accomplished through several tasks: 1) publishing a quarterly newsletter, and by 2) participation in watershed and inter-agency work groups. The second objective focuses on providing education and raising awareness for natural resource issues in the local schools and communities of northern Idaho. This objective is accomplished through: 1) continual participation and development in an educational forum to share projects, 2) encouraging community participation in and garnering landowner support for stream restoration opportunities on Reservation lands, and 3) providing opportunity for summer internships to local high school students. This report discusses accomplishments associated with each objective and task, evaluates the overall effectiveness of education and outreach efforts, and provides performance criteria to use in the future to evaluate this portion of the contract.

Purpose and Need

The purpose for the Outreach Specialist is to inform and communicate in layman terms with local schools, reservation communities, watershed landowners and stakeholders about past and present restoration activities in the target watersheds. The need exists to share knowledge on the importance of efforts to increase survival rates for the Westslope cutthroat trout in the lakes, rivers, creeks, and streams. The Project has conducted activities pertaining to tributary habitat restoration, studies on Coeur d'Alene Lake (including water quality analysis and fish stock status

assessments), and transportation in order to support this effort. Westslope cutthroat trout are of great cultural significance to the Tribe and are one of the few native fish still surviving on the Coeur d'Alene Reservation. It is of great importance to the Tribe that these native fish species are given an opportunity to thrive for future generations to enjoy as tribal ancestors did long ago. The Outreach Specialist fulfills the role for improved public relations that includes but is not limited to conveying the unique perspectives of the Tribe on natural resource management, history, culture, and sacred traditions, all of which are integrally connected.

ACCOMPLISHMENTS

Objective 1 and Tasks

The Outreach Specialist position improves awareness of project activities within the Reservation community. One of the most consistent ways to distribute information about project activities is through publication of quarterly issues of the newsletter entitled *Watershed Wrap.*

Newsletter

Publication of the *Watershed Wrap* began in the summer of 1997, and it continues to run strong and uninterrupted after five years of circulation. There are between 1,800 to 2,200 copies printed with each subsequent issue. Of this number, approximately 1,100 to 1,500 are distributed by U.S. mail to all local tribal governments, landowners, natural resource organizations, and the tribal membership. The 500 remaining newsletters are hand delivered for distribution at various local area businesses. The Newsletter describes activities being conducted within the targeted watersheds and any other activities exemplifying education and outreach efforts on the Coeur d'Alene Reservation. The newsletter explains the types of restoration efforts done by the Fisheries Program, introduces new employees, and profiles local fish and wildlife species, as well as research studies conducted on Reservation lakes, streams, and creeks.

This information sharing between the Program and community is necessary to increase mutual environment-based knowledge, build workgroup participation and garner support from landowners and stakeholders alike. It also gives people insight about how projects help safeguard the environment.

Watershed Work Groups (WWG)

Watershed Work Groups are based in each of their respective natural watershed boundaries see table 25-27. Initially, the Outreach Specialist compiled mailing lists based on names and addresses obtained through county assessors' offices and distributed an information packet in order to introduce them to the project activities. The direct mailing was another way to inform the public about what was going on in these specific watersheds. The Fisheries Program identified four main watersheds on the Reservation: Lake, Benewah, Evans, and Alder Creeks. The two watershed working groups that have been established thus far exist in the Lake Creek and Benewah Creek drainages.

The Lake Creek Work Group is the largest, however, the majority of its landowners live off the reservation. For that reason, it is difficult to arrange face-to-face meetings with this group. Thus, the newsletter is particularly effective in the Lake Creek area. A special edition of the *Watershed Wrap* newsletter was prepared and sent to the Lake Creek group members giving them all information specific to that watershed. Biannual meetings of the WWG were held in late winter and late summer beginning in 1997 and continued through the reporting dates covered by this

report. See table 25-27 the topics discussed at these meetings were addressed in the special edition of the newsletter. It included: restoration update, fish hatchery update, an update of the Idaho Department of Transportation highway realignment from Mica to Worley, Lake Creek TMDL Issues, an update of the University of Idaho USDA grant, soil erosion, NRCS state funded programs, updates on research activities, and identifying opportunities and concerns. Over the last three years, an average of ten residents, representing local businesses and agencies attended each meeting.

The Benewah Creek Work Group was easier to assemble given the existence of an established group known as the Benewah Valley Association, which has been meeting every other month for over forty years. The Fisheries Program incorporated its participation through its Outreach Specialist into this highly organized and very active group in order to exchange information concerning the various management activities planned by the Coeur d'Alene Tribe and other agencies. Fisheries program personnel presented pertinent information to the group as project phases occurred. Approximately twelve to twenty-five residents attended these meetings quarterly.

Inter-agency Working Groups

The Coeur d'Alene Tribe's Natural Resource Program has come to understand the need for improved communication between all Tribal programs and local agencies concerning natural resource projects on and around the Reservation. In the spring of 1999, the Outreach Specialist assisted in the formation of an inter-agency working group. This group consists of all the Tribal Natural Resource Programs, the Natural Resource Conservation Services of Benewah, Kootenai, and Spokane counties, the U.S. Forest Service, the U.S. Fish & Wildlife Service, the Army Corps of Engineers, community clubs, businesses, and any interested individuals concerned about local watersheds and restoration efforts. See tables 25-27

The main purpose of the inter-agency working group is to exchange information and communicate the who, what, where, when, how, and why's of projects planned or completed on or near the Reservation. This forum allows the participants to draw on their cumulative technical expertise to provide peer review of all resource issues, including the projects developed as part of the Tribe's Fisheries Enhancement Project. Inter-agency Work Group participation has ranged between approximately fifteen to twenty-five people each meeting. Meetings are held quarterly to discuss ongoing projects in all agencies.

The Fisheries Program strives to have close communication with the different agencies regarding all projects. The group has developed a matrix summarizing general information for all ongoing projects. Review of the matrix at each meet helps participants coordinate complimentary efforts as well as avoid duplication and overlap. In addition, the group brings in keynote speakers to address issues of concern. Speakers that were invited during this reporting period included: Gregg Rayner, district regulatory officer with U.S. Army Corps of Engineers; Tim King from the Resource Conservation and Development Cooperative, who spoke about carbon credits for restoration or reforestation work on any lands; and Joseph J. Ulliman, Professor of Remote Sensing, who spoke about problems related to the aquifer in the northern Idaho region.

Miscellaneous Meetings Attended

The Outreach Specialist routinely attends meetings that deal with watershed use and restoration efforts on private, public, state, and county lands that affect our watersheds or restoration efforts

on the reservation. These meetings offer a distinct opportunity for the Outreach Specialist to promote the efforts of the Fisheries program outside the boundaries of the Reservation. This is done through presentations and posterboard displays that share restoration project efforts taking place on the Reservation. The *Watershed Wrap* newsletter is also made available to all attendees at these meetings. Participation during the 1999-2001 period included the following forums:

1. 24th National Indian Timber Symposium in Lewiston, Idaho. Symposium theme: *Modern Management of Traditional Lands: Sustaining the Future*. Posterboard display and discuss restoration project efforts. Symposium attended by over 250 participants. Date: April 24, 2000

2. Upper Columbia Resource Conservation and Development (RC& D), *Requirements for planting in riparian zones and watersheds?* The Outreach Specialist made a presentation regarding the necessity for collection of local seed for targeted restoration efforts. Attendance included 35 participants. Date: December 12-10, 2000

3. Washington State Lake Protection Association, 15th Annual Conference on Lakes, Reservoirs, and Watersheds. Posterboard display and discuss restoration project efforts. Attendance: 80-100 participants. Date: April 2, 2001

4. Lake Roosevelt Forum sponsored conference *Toward Ecosystem Based Management: Breaking down the Barriers in the Columbia River Basin and Beyond*. The Outreach Specialist gave presentations at two workshops: Remarkable People, Remarkable Opportunities; and Culture, Education and Community Capacity Building for Watershed Protection and Restoration. Attendance included approximately 200 participants. Date: April 26, 2001.

5. Water Quality Standards and Restoration. Posterboard display and discuss restoration efforts. Attendance: 45 participants. Date: September 1, 2001

6. 58th Annual National Congress of American Indians. Posterboard display and discussion of restoration efforts. Attendance: 350 participants. Date: November 1, 2001.

7. Affiliated Tribes of Northwest Indians hosted by Coeur d'Alene Tribe. Posterboard display and discussion of restoration efforts. Attendance: 125 participants. Date: November 26-30, 2001.

8. Annual Meetings of the Inland Empire Reforestation Workgroup. Gathered information to support restoration work in the target watersheds. Dates: February 1999, 2000, and 2001.

Objective 2 and Tasks

The Outreach Specialist position provides educational opportunities and raises community awareness of natural resource issues in the local schools in northern Idaho to improve both student and teacher participation in project activities. The Outreach Specialist participated in the development of new educational forums for the local community to disseminate information about stream restoration opportunities on the Reservation. The Outreach Specialist also supervised summer interns that were provided for through a cooperative effort between the Tribe's Education Department and this Fisheries Enhancement Project. The internships offer high school students hands on experience with the implementation and monitoring of restoration projects and encourage youth to continue their educational endeavors toward natural resource careers.

Water Awareness Week (WAW)

Over the years Water Awareness Week continues to be one of the most successful outreach activities conducted by the Tribe. Water Awareness Week consists of several small workshops designed to expose sixth grade middle school students to natural resource topics such as soil typing, water quality assessments, plant and animal identification, wildlife behavior and adaptation to habitat, fisheries sampling, and tribal culture, language, and sacred traditions.

Recently, the Outreach Specialist expanded the curriculum for the Water Awareness Week to include the Coeur d'Alene Tribal history, culture, language, and sacred traditions. It is now one of the most popular workstations. The Outreach Specialist is responsible for planning and facilitating this workshop, which is held in various locations throughout the State of Idaho. The Bonneville Power Administration provides sponsorship and continues to be an active partner in successfully carrying out this workshop each year. The entire week offers morning and afternoon sessions that accommodate an annual attendance averaging about 400 students.

Summer Interns

Summer interns were hired consistently over the three year period from June 1999 to August 2001: 1999 - eight interns, 2000 - ten interns, and 2001 -seven interns. The Fisheries Program coordinates with the Tribal Youth Program to bring on these temporary seasonal employees each year. In 2000, the Youth Program split the summer work schedule to consist of two six-week work sessions. Overall a total of twenty-five tribal youth have completed an internship with the Fisheries Program. The interns are exposed to all aspects of the Program, from the planning phase to implementation of projects on the ground, to assisting in local day camps and etc. The interns attend workshops and assist with presentations at local schools throughout the school year. The interns are given assignments that are designed to develop leadership, employment, communication, and interpersonal skills. An intern program for college and university level students is also being planned.

School Functions

With the increase in workshops, camps, and club activities, the public has become more interested in natural resource issues and awareness for the educational opportunities that exist through the Outreach Specialist's efforts. The Reservation schools and many of the schools within northern Idaho are making requests for assistance to develop environmental awareness curricula. The Outreach Specialist is working closely with these local teachers to develop different types of natural resource curricula that pertain to local watershed restoration work. Contacts have been made by Kootenai High School, Plummer/Worley Schools, and the Coeur d'Alene Tribal School. Collaborating with the area educators is important in developing age appropriate and cognitive sensitive curricula related to natural resources. It is important to integrate science, culture, and interpersonal skills when producing and presenting environmental education curricula. The Outreach Specialist position is a valuable tool for educating communities about the importance of the ecological functions of the environment.

Other Youth Groups

The Outreach Specialist identified that a need existed within the community for youth groups to be formed with organized agencies. The Outreach Specialist has worked to encourage youth participation in various clubs and organizations including: Girl Scouts, 4-H, and a Coeur d'Alene Tribal Youth Culture club. At the same time the Outreach Specialist re-established Tribal involvement in the U.S. Forest Service's Inter-Tribal Natural Resources Summer Youth

camp. The Youth Camp encourages participation of tribal youth in an effort to expose them to possible careers in the natural resources field.

Miscellaneous Educational Forums Attended

The Outreach Specialist facilitates or participates in meetings to educate the students, teachers, and the general public. These forums facilitate a mutual sharing of information about what the Fisheries program does to enhance habitat while exposing young minds and the general public to what conditions existed before restoration work in area watersheds. They include:

1. Forest Service Natural Resources Inter-Tribal Youth Camp. The U.S. Forest Service sponsors an annual camp for developing youth interest in natural resource careers. Activities are designed to develop employment skills, tools and equipment usage, and build both teamwork and leadership skills. Attendance: 35 students from local tribes, including Kalispell, Kootenai, Nez Perce, and Coeur d'Alene. Dates: June 2000 and 2001.

2. 4-H Youth Activities Camp, Benewah County Fairgrounds. The Outreach Specialist facilitated and delivered numerous workshops modeled after Kids In The Creek. Students searched for macroinvertebrates in the creek in order to identify important indicator species. Attendance: 100 students from six local schools ranging in ages from five to seventeen. Dates: August 2000 and 2001.

3. Fisheries curriculum developed for workshops for local schools. The Outreach Specialist developed and delivered a natural resource curriculum for students in the first through twelfth grades. The first lesson plan developed is about the study of trees. The second has a broader scope, is less in depth and includes study topics on soil and water, plant and animal identification, wildlife behavior and adaptation, fisheries, and the tribal culture and language. This workshop is designed for the classroom and is typically scheduled during the school term. See table 25-27

4. Fundamentals on "How to catch a fish" taught by Coeur d'Alene Tribal Fisheries. The Fisheries program teaches basic skills to first time fishermen. The children are taught about various types of poles, tackle, and bait to use including how to bait the hook. The children learn how to catch, play, and tire out the fish, followed by learning how to clean and properly prepare it for consumption. Average attendance: approximately 120 students. Date: Annually - April and May.

5. Restoration Efforts - Tree Planting with Local Schools. Each spring and fall the local community and students from the area participate in tree planting and habitat restoration efforts in Benewah and Lake Creek watersheds. The students and community volunteers also assist with habitat restoration as well as construction on these sites. Attendance: averages 130 students. Date: Annually - April and September.

6. Annual Tribal Water Potato Day Celebration on the Shores of Lake Coeur d'Alene. The Fisheries program staff assisted with this celebrated Tribal Holiday. Each staff member manages a workstation and teaches the youth about different aspects of natural resources and the Coeur d' Alene Tribe's cultural ways. They also participate in a traditional food gathering ceremony where they harvest the water potatoes. Attendance: averages 100 people. Date: Last Friday of October 1999, 2000, and 2001.

7. Working with University of Idaho Extension Office collaborating with the 4-H program. The Outreach Specialist works in collaboration with the 4-H program to facilitate various workshops in the local schools. The programs introduced to the youth are called Talking with TJ, Team Work or Team Building, and Conflict Resolution. Attendance: averages 25 students per session or 150 total students to date. Date: twice annually - Fall-Sept, Oct, Nov and Winter-Jan, Feb, Mar.

8. Healing Lodge of the Seven Nations. The Outreach Specialist has been tasked with setting up different types of learning field trips to expose the students to the natural resources on the Reservation. Attendance: average 15 students. Date: scheduled four times a year (April, July, October and December).

9. Girl Scout Program, Girl Power Group in Plummer. The Outreach Specialist assists the Girl Scout coordinator in teaching the youth about dealing with contemporary issues and current events that impact the youth's lives and encourages them to utilize critical thinking skills daily. The Outreach Specialist also teaches the girls about natural resources. Attendance: 8-15 girls (age eleven through fourteen). Date: October 1999 and continues to meet every two weeks.

10. Benewah County Fair in St. Maries. The Outreach Specialist has put on numerous workshops teaching people about the local northwest native Indians and their relationship to the earth and its natural resources. The Fisheries program works closely in joint efforts with tribal departments of language and historical preservation to unify multiple aspects of interest about the Coeur d'Alene Tribe and its members. One major theme utilized is to convey interconnection between the culture, its traditions, and natural resources. Another task is to model traditional regalia and talk about what aboriginal regalia were comprised of and what it means to Native American people. In addition to display of dancing regalia, the demonstration includes traditional dance accompanied by drumming and singing. This provides the foundation to better understand the interrelationship with Indian people and the natural resources. It also helps to foster the cooperative work efforts necessary to this project's progress. Attendance: over 200 hundred people. Date: August 2000 and 2001

11. First Annual Spokane Tribe Strong Heart Youth Sobriety Culture Camp in Wellpinit. This was a natural resources job training workshop emphasizing work ethics, leadership skills, balancing cultures, and teamwork. Attendance: Seven interns participated. Date: August 2001.

12. Natural Resource Day Camp. The Fisheries program gives demonstrations to area youth on how to beach seine, electroshock fish, and gillnet to accomplish specific tasks that relate to the Fisheries project. Attendance: 30-40 people. Date: August 2000 and 2001.

TAG RETURN OUTREACH

The Tribe has embarked on an ambitious mark-receptive study in Lake Coeur d'Alene and tributaries. To date we have tagged 1,321 fish with 76 recaptures. As part of this study we have an education and Outreach component. When a tag is returned, we will send the fisherman a packet of information and a letter telling them the history of the tagged fish.

Contents of the packets include:

- An Announcement to Anglers. Brief information on what to do if you catch a tagged fish (see Figure 80). This poster has all the information needed to fill out the form properly and return address to the Fisheries office. The location of poster is shown in Figure 84.
- A Basic Tag Information Form. This is the basic tag information form that is filled out by office personal (see Figure 81) The Fisheries program will look over the form to make sure all the information is filled out properly. If some information is missing we will call the person back to get the rest of the information. The returned tags help us determine the fisheries population as well as possible migratory routes and timing.

The program has been tagging fish since 1994. Tags are put into a database program to keep track of all information relating to that specific fish and all information received from the person that had caught one of our tagged fish is also enter into the database. A form letter is sent to all angler that provide tag return information (Figure 82). Information returned to the angler includes: what species of fish, where the fish was tagged and released and relationship to where the fishermen caught it, what date it was tagged, length and weight, how old the fish was at time of capture and a tag return map (Figure 83).

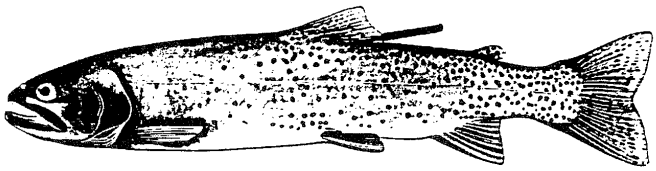
ATTENTION ANGLERS

The Coeur d'Alene Tribe of Indians and The Bonneville Power Administration are collaborating on fish marking projects on Lake Coeur d'Alene, Benewah Lake, Chatcolet Lake, Round Lake, Hidden Lake and their respective tributaries within the boundary of the Coeur d'Alene Indian Reservation.

Marking efforts help determine the fisheries population as well as the possible migratory routes. Targeted species of this effort include Cutthroat trout although, all trout species hybrid as well, Whitefish, Kokanee and Chinook salmon, Northern Pike, Largemouth Bass and Channel Catfish have all been marked and recorded.

Numbered Floy tags are (CDAT ###### , EWU ######) have been used to mark these species of fish.

Numbered Floy Tag



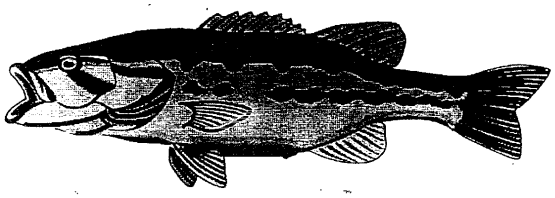
IF YOU CATCH A TAGGED FISH
PLEASE RECORD THE FOLLOWING DATA:

TAG COLOR	**TAG NUMBER**
FISH SPECIES	**DATE OF CATCH**
LENGTH OF FISH	**LOCATION OF CATCH**
WEIGHT (if possible)	

If you release the fish, please leave the tag in place and record the above information. Anglers providing marking information will be sent a letter telling the date, location, and size of the fish upon its catch and release into the water system.

PLEASE SEND INFORMATION TO:
COEUR D'ALENE TRIBE FISH, WATER AND WILDLIFE
850 A ST.
P.O. BOX 408
PLUMMER ID. 83851
PH: (208) 686-5302
FAX: (208) 686-3021

Figure 86. Notice to anglers providing tag return instructions.



TAG NUMBER_____ TAG COLOR_____ CDA OR EWU

SPECIES_____

BODY OF WATER_____ LOCATION_____

DATE CAUGHT_____

LENGTH AND WEIGHT_____

WAS FISH HARVESTED: Y N IF NOT, WAS TAG CLIPPED: Y N

NAME_____

ADDRESS _____

_____

PHONE _____

TODAYS DATE _____

(OFFICE USE)

WHERE TAGGED _____

WHEN TAGGED _____

SIZE AT TAGGING _____

Figure 87. Basic tag information form.

Coeur d'Alene Tribe
Fish, Water and Wildlife Program

850 A STREET
P.O. BOX 408
PLUMMER, IDAHO 83851
(208) 686-5302 • Fax (208) 686-3021
10/31/00

To: Joe Fisherman
P.O. Box 007
St. Maries, ID 83861

Re: Tag return

Dear Fishermen,

The Coeur d'Alene Tribe Fish, Water and Wildlife Program is currently conducting an extensive fish habitat survey on Lake Coeur d'Alene, Benewah Lake, Chatcolet Lake, Round Lake, Hidden Lake, St. Joe River and their respective tributaries within the boundary of the Coeur d'Alene Indian Reservation.

Targeted species include all trout species (cutthroat, rainbow, bull, eastern brook and all hybrids), kokanee and chinook salmon, northern pike, largemouth bass, channel catfish and mountain whitefish. We are tagging a number of fish from each of these species in order to determine habitat preferences and seasonal movement patterns.

Tag returns help us determine the fisheries population as well as possible migratory routes. We thank you for your cooperation and help. Without anglers like yourself this valuable information would be difficult to get.

Thank you for your time and effort.

The **Largemouth Bass**, tag number **(CDA #501196)** was tagged during a night shock and released on **7/13/98** at T7R1, Chippy Point. The length and weight of this fish was **280mm/11.02 inches, 324g/.71 pounds**. The location of where this fish was tagged and released in relationship to you catching it is highlighted on the map. This largemouth bass was **6 years old** when it was sampled.

We have enclosed a flyer and a map of our ongoing study. Feel free to share this with others. Once again, thanks for your cooperation and assistance.

Sincerely,

Ron Peters,
Coeur d'Alene Tribe Fisheries Manager

Figure 88. Angler form letter.

Tag Return Map

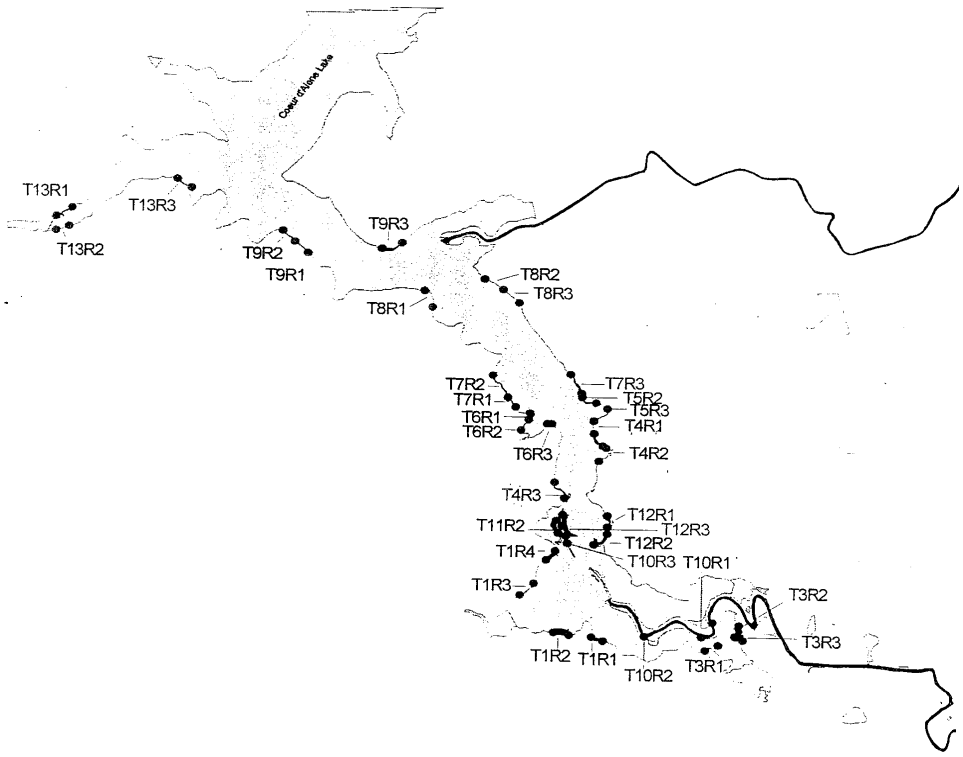


Figure 89. Tag return map.

	LOCATION	FLYER
1	Benewah tressel road	1
2	Benewah trail @ Hwy 5	1
3	PeeDee Pt. Access	1
4	Rockford Bay Launch	1
5	Rockford Bay Store	1
6	Lowemeister Bay Launch	1
7	Loff's Bay Launch	1
8	Mica Bay Launch	1
9	Boothe Park Launch	1
10	Higgins Point Launch	1
11	Mineral Ridge Launch @ wolf lodge bay	1
12	Bell Bay need 3 on the docks	1
14	Harlow Point Launch	1
15	Harrison Resort Launch	1
16 17	Steamboat Trader Sporting Goods @ Harrison	2
18 19	Round Lake Launch on the North side of the lake	1
20	Round Lake tressel trail on East shore	1
21	Fins and Feathers in CDA	1
22	Tom's Sportco in CDA	1
23	Blue Goose in St. Maries	2
24	HiWay Motel in Plummer	1
25	Conoco at Evans Creek	1
26	Rose Lake Conoco Station	1
	Total	25

as of 3/20/00

Figure 90. Locations of flyers (Attention Anglers) posted around Coeur d'Alene Lake.

OUTREACH/EDUCATION EFFECTIVENESS

The Coeur d'Alene Tribal Fisheries Program has fulfilled its education and outreach goals and objectives through efforts made by the Outreach Specialist position. The measure of effectiveness can generally be gauged by the number of engagements that the Outreach Specialist's accommodated based on work dates available in the calendar year. Stakeholders' interest often times was generated by referrals from past participants in the educational forums.

The effort to raise awareness is a long-term proposition that must be developed over time through relationships with the Coeur d'Alene Tribe and its Fisheries staff. This, in turn, instills the needed trust to have community members open not only their minds to new concepts but also their properties for project implementation. The wide variety of forums (i.e., local K-8 students and teachers, reservation communities, landowners, stakeholders, high school students, and professionals from local agencies) for educating and outreach require the Outreach Specialist to match topic content with layman terms for efficient and concise communications. Project activities pertaining to habitat restoration, lake studies, water quality, and resource management are best conveyed by means of site tours, time-elapsed visual aids (photos, slides), charted data with annual comparisons, and introductions of the Reservation management decision makers.

The Outreach Specialist position promotes the connection held between wild native fish stocks and the Coeur d'Alene Reservation community. It is an ongoing effort to remind the community that their actions have effects on the resources around them. It is our responsibility to speak for those who cannot speak and take care of those resources that can't take care of themselves. The community of the Coeur d'Alene Reservation and the Westslope Cutthroat trout have a mutual duty to thrive for future generations. This responsibility is entrusted to the wisdom of the current generation.

The Outreach Specialist position is essential to this Project as it clearly increases the depth of knowledge to the community that would otherwise be unavailable. The position is responsible for scheduling community meetings, preparing agendas, gathering keynote speakers, and preparing presentations in order to facilitate the meetings. The *Watershed Wrap* newsletter, the most consistently employed education and outreach resource on the Reservation, is published quarterly with the corresponding change in seasons. It is through these prescribed duties that projects as well as program knowledge is shared with stakeholders on the Reservation as well as with those from adjacent communities. The Outreach Specialist generates excitement within a wide range of community members that encourages participation in and creates interest for natural resource management efforts. A unique opportunity to educate society at large is fulfilled through the efforts of the Outreach Specialist regarding the need to provide restored habitat for wild stocks of fish and the secondary habitat usage that occurs in these project areas.

The Outreach Specialist position is crucial in maintaining effective relationships and developing future programs. Community support and involvement in future projects comes from a solid understanding of the activities of the Fisheries Program. The Bonneville Power Administration Program empowers this community to reach its goals to provide more effective educational programming when it commits its dollars to this region. The Fisheries Program is appreciative of the financial assistance that has been received for this position.

PERFORMANCE CRITERIA

Performance criteria for the outreach/education component of this project were satisfied based on deliverables outlined in the 1999, 2000, and 2001 scopes of work. The measures of effectiveness were based on assumptions about workgroup participation, the numbers of individuals contacted through mailings, attendance at a given event, and community participation in educational forums held at numerous area schools on and adjacent to the Reservation.

It is the future intention that the Outreach Specialist create performance criteria on a case-by-case basis for evaluating education and outreach effectiveness and to modify the program objectives and tasks accordingly. The Outreach Specialist analyzed each task for effectiveness and ideas were generated to expand future performance criteria that may be further developed in the next scope of work.

Objective 1

Newsletter

Criteria: Did the newsletter improve awareness within the local communities and businesses about fisheries habitat restoration?

Yes. The Newsletter was effective in getting information out to the public on and off the reservation. This was based on oral feedback from participants at the different educational forums. In the past this was not well documented. However, in the future, a concerted effort by the Outreach Specialist and other fisheries staff will be made to log all contacts, their nature, follow-up actions (if required), and final outcomes. In addition, performance criteria will be supported by improved quality of news articles (thought provoking and integrity building), timely and consistent distribution to vending locations and improved accountability to track mailing (successful delivery and address updating), and provide means for recipient to comment in writing (postcard insert) back to the program.

Watershed Working Groups

Criteria: Are watershed working group meetings effective forums to educate and outreach to the Reservation community?

Yes. These workgroup meetings provide the opportunity for landowners to volunteer their time and land for watershed restoration projects. Through this process, five different landowners offered to have their properties included in the program's restoration efforts. The attendance logs and contacts are kept with meeting minutes.

The future performance criteria will be measured by an increase in number of landowners involved in restoration projects on Lake and Benewah Creek drainages. Future restoration projects can be initiated, completed, and summarized. Survey forms will be developed and made available at the Watershed Working Groups for participants to provide comments, suggestions, or questions regarding the activities of the program.

Inter-Agency Meetings

Criteria: Are inter-agency work group meetings beneficial to the natural resources programs that participate?

Yes. The participation by agencies has increased the knowledge, coordination of projects, and has allowed cost shares at approximately $600,000 to supplement BPA funding in coordinated projects. Nine projects in three of the four target watersheds have included direct cooperation with Natural Resource Conservation Service (NRCS) and the local soil conservation district office.

The future performance criteria will be documented in meeting sign-in sheets, agendas and written notes, by written letters of support, and executed memoranda of agreement.

Miscellaneous Meetings Attended

Criteria: Does the Outreach Specialist's attendance to miscellaneous meetings (as outlined above) promote the education and outreach cause?

Yes. The Outreach Specialist's attendance at all workshops, classes, and events provided opportunities to make presentations and to present posterboard displays and newsletters. Distributing written and verbal information at these events has provided a wider audience information and many have expressed interest in restoration activities. The events listed have resulted in many other agencies and landowners measuring their projects based on work done on the Coeur d'Alene Reservation projects. Many requests for additional information regarding funding sources and contractor services were made.

In the future, performance will be measured by number of guest book entries that visit the posterboard displays as well as through an evaluation form to be made available at workshops, classes, and events to measure quality of the information provided.

Objective 2

Water Awareness Workshop

Criteria: Was the Water Awareness Workshop an effective educational forum to increase awareness?

Yes. Water Awareness Week consists of small workshops that facilitate discussion of station topics, i.e., soils, water quality, plant and animal identification, wildlife behavior and adaptation to habitats, fisheries, and the tribal culture and language. The impact of this workshop has been significant. It created high interest within the participating schools and resulted in developing similar workshops throughout the school year. Local area schools that have participated in WAW have commented that it is "the best one around". Local area schools have recommended to other schools in northern Idaho that the Coeur d' Alene Reservation WAW is the workshop to attend. Through word of mouth, many private schools and home schooling families are participating in the workshops. Attendance has increased from an estimated 40 students the first year with only two stations to over 400 students and seven workstations.

Future performance criteria will be written documentation to record workshop stations and presenters; attendance numbers by schools, students, teachers, parents, and school staff; contacts logged regarding requests to attend, follow-up, and outcomes. The teachers will be asked to follow-up with comments or suggestions.

Summer Interns

Criteria: Did internships provide educational opportunities that lead to greater awareness for the students?

Yes. To date we have hired several prior interns to both seasonal and full-time positions in either the fisheries, wildlife, water resources or forestry programs..

The future performance criteria can be measured by recording the number of interns and follow-up surveys (to be developed) that may include tracking future career direction. Student grade point average variations, graduation dates, and short-term goals will be documented.

School Functions

Criteria: Were school functions effective forums for raising awareness?

The effectiveness of participating in local area schools is significant. The Reservation schools and many of the schools within northern Idaho are requesting assistance with development and presentation of environmental awareness curricula. In 2001, the Outreach Specialist's involvement was requested in the development of forest and fisheries management curricula in Kootenai High School, Plummer/Worley School District, and the Coeur d'Alene Tribal K-8 School. The requests for participation in Career Day assemblies at various schools including Coeur d'Alene School District has increased.

The measure of future performance will be obtained through an exit evaluation to be done by randomly selected teachers and students. The evaluation will speak to appropriateness and cognitive sensitivity for integration to science, culture, and interpersonal curricula.

Other Youth Groups

Criteria: Were youth groups effective forums for raising awareness?

The effectiveness of the Youth Outreach Specialist is demonstrated by the successful development of local youth groups and organizations on the Reservation. Sociological research shows that youth participation in organized activities is essential for success in all aspects of life. The Outreach Specialist's efforts encouraged the creation of a Girl Scout Club, a 4-H Club, and a Coeur d'Alene Tribal Youth Culture and Activities Club. Participation by Coeur d'Alene Tribal youth is consistent and structured activities to encourage the youth to consider careers in the natural resources field.

The future performance criteria will include consistent reporting in the following areas: club participation, attendance at community events, participation in the planning processes, and the number of new youth activities established.

Miscellaneous Educational Forums Attended

Criteria: Does the Outreach Specialist's attendance to miscellaneous educational forums (as outlined above) promote the education and outreach cause?

The function of the forums are to educate teachers and students about Fisheries projects that can simultaneously integrate the Coeur d'Alene Tribal history, culture, language, and sacred traditions. Presentations include the use of age appropriate materials and visual aids to increase understanding of the material. This is a critical component of the Outreach Specialist's lesson plan and encourages a deeper understanding of the relationship between culture and the natural environment.

The future performance criteria will be measured by contact logs that quantify specific contacts made to request the Outreach Specialist to present at workshops as well as document overall performance measured by anecdotal information in the form of letters and comments.

Table 48. Summary of outreach/education activities, 1999.

Task	Product Description	Completion Dates	Accomplished	Not Accomplished
Task 1.1	***Develop and participate in an educational forums for the local community regarding stream enhancement/restoration opportunities***			
A.	Interact with area schools so that students and teachers become aware of and participate in, restoration projects. Work involved coordination of Water Awareness Week (WAW) and interaction with the Plummer/Worley school district (P/W) and Tribal school (T).	2/15 5/3-7 (WAW); 6/15, 6/22, 6/29 (P/W); 7/6, 7/13, 8/10, 8/13 10/5, 10/6 (P/W, T); 10/24, 10/29 (T)	**X**	
B.	Hosted meetings, workshops and other events for the reservation community. A record was kept describing participation with schools, community groups and individuals (S/CG/I), Tribal programs (T), and other agencies (A).	2/3, 2/9-11, 7/14, 7/26 (A); 7/23 (A, T); 11/16 (S/CG/I)	**X**	
	Sponsored internships (I) for high school students interested in natural resources. Held several meetings (M) to organize and coordinate the internship program with the local schools and the Natural Resources Department.	6/15 – 8/28 (I); 11/23, 12/5 (M)	**X**	
	Published quarterly newsletters	3/19, 6/19, 9/21, 12/19	**X**	
Task 1.2	***Form functional watershed work groups comprised of private landowners, agency, and other interested parties.***			
	Hosted watershed working group meetings.	2/23, 10/26 (Lake Creek); 3/21, 10/15 (Benewah Creek)	**X**	
Task 1.3	***Coordinate restoration and management activities with other Tribal programs involved in natural resource management.***			
	Participated in interdisciplinary team meetings related to forestry, fish and wildlife and other natural resource issues.	7/22, 10/21	**X**	

Table 49. Summary of outreach/education activities, 2000.

Objective/Task	Product Description	Completion Dates	Accomplished	Not Accomplished
Objective 1:	***Improve awareness of program activities within the Reservation community.***			
Task 1.1:	Published a quarterly newsletter	3/19, 6/19, 9/19, 12/19	**X**	
Task 1.2:	Coordinated meetings with watershed work groups in two watersheds and hosted several additional meetings with other agencies (A) and community groups (CG) interested in restoration activities and promoting cooperative opportunities on the reservation.	2/9, 3/23 (Lake Creek); 1/25, 3/26, 10/22 (Benewah Creek); 2/7, 2/21 (CG); 3/1 (A)	**X**	
Task 1.3	Coordinated restoration and management activities with other Coeur d'Alene Tribal programs (IRMP) involved in natural resource management as well as with other Indian Tribes (ATNI).	2/23, 3/7, 6/28, 10/25, 11/14, 12/6 (IRMP); 9/18-22 (ATNI);	**X**	
Objective 2:	***Provide educational opportunities in the local schools to improve student/teacher involvement in Program activities.***			
Task 2.1:	Continued to participate in and develop an education forum for the local community regarding stream restoration opportunities on the Reservation. Kept a record describing participation with schools (S), other youth groups (YG), community groups (CG), agencies (A) and individuals (I).	1/10 (CG), 2/15 (I); 2/17 (YG,CG); 2/22, 2/29, 3/13, 3/15 (A); 3/8, 4/1 (S); 4/17 – 21 (YG); 5/1-5 (S); 5/17, 5/18, 5/25 (S); 6/23 (CG,YG); 7/21 (CG); 8/25-26 (S, A); 9/24, 9/26, 10/3, 10/24, 10/31, 11/14 (S); 12/13 (CG)	**X**	
	Held several meetings (M) to organize and coordinate the internship program with the local schools and the Natural Resources Department. Sponsored internships (I) for high school students interested in natural resources. Enrolled and supervised kids in a Natural Resource Youth Camp (NR camp) sponsored by the Forest Service.	3/14, 3/24, 4/7, 4/15, 10/18, 11/22 (M); 6/15 - 8/28 (I); 6/19-24 (NR camp)	**X**	

Table 50. Summary of outreach/education activities, 2001.

Task	Product Description	Completion Dates (in SOW)	Accomplished	Not Accomplished
Objective 1:	*Improve Awareness of Program activities within the Reservation community.*			
Task 1a:	Publish a quarterly newsletter	3-19, 6-19, 9-19, 12-19	X	
Task 1b:	Continued meeting with watershed working groups in two watersheds. Provided a forum for local stakeholders to participate in the restoration activities.	3-15 letter to update Lake Creek group; 2-21, 3-25, 5-20, 8-19 Benewah Creek	X	
Objective 2:	*Provide educational opportunities in the local schools to improve student/teacher involvement in Program activities.*			
Task 2a:	Continued to participate in and develop an education forum for the local community regarding stream restoration opportunities on the Reservation. Kept a record describing participation with schools, community groups and individuals. Dates from schools (S), Plummer(P), Tribal(T), Worley(W), St. Maries(SM), Kootenai(K), Harrison(H) community groups (CG) youth groups (Y)Other-Agency Groups(A) and individuals (I) meeting attended, Integrated Resource Management Process (IRMP). community groups (CG) Other-Agency Groups and individuals (A), Water Awareness Week (WAW) meeting attended.	2-2,9,16,23,28(S)W; 2-01,15(CG)2-15(S,A) 2-27-01(S)W3-06(S)W 3-09(S)T3-13(S)WAW 3-21(CG,A)IRMP 5-01,4(S)WAW 5-09,16, 23(S)P 5-16(CG,A)IRMP 5-7,17,31(S,CG)P 6-8(CG)Camp 7-11(S) SM NR day Camp 7-17,18(CG)Tribes NR Camp 8-7,8,9(CG,A) 8-16(CG,A) NR, Culture 9-25(S,A)Tribal 9-26,27,28(A) 10-4,11,18,25(S)W 11-26, 27, 28, 29, 30 (A) NCAI; 12-7,12(CG,A)IRMP	X	
Task 2b:	Provided summer internships for high school students to assist with implementation of restoration projects. Attended meetings that concerned summer youth interns (SYI) and youth employment in the Natural Resource (NR) programs (YE).	2/7, 2/16, 2/7, 2/21 (YE); 3/7, 3/13 (YE) NR; 4-02,06(YE); 5-15(S,YE) St. M; 5-24(YE)NR camp; 5-25(YE) W job fair; 6/19-24(YE)NR camp; 11-15(A)NR camp	X	
Other Related Tasks	Coordinated meetings with an Inter Agency working group.	03-25, 09-26	X	

Table 51. Partial list of collaborators and participants in the Fisheries Program outreach and education forums.

Objective/Task	Participants/Affiliation
Planning and Coordination	
Interagency Work Group	NRCS, University of Idaho Extension Office, Farm Service Agency, Benewah County Soil Conservation District, Kootenai County Soil Conservation District, Spokane County Soil Conservation District, Coeur d'Alene Tribal Programs: Fish & Water, Wildlife, Land Services, Forestry, GIS, Air Quality, Fire Management, Environmental Health Program, TERO, Planning and Development Corporation, Transportation, Pesticides Enforcement, Cultural & Language Programs
IRMP	Coeur d'Alene Tribal Programs: Fish & Water, Wildlife, Land Services, Forestry, GIS, Air Quality, Fire Management, Environmental Health Program, TERO, Planning and Development Corporation, Transportation, Pesticides Enforcement, Cultural & Language Programs; City of Plummer, Potlatch Corporation, Spokane Business Owners Association, Benewah and Kootenai County Commissioners, Mayor of St. Maries, City of Worley, Camp Fire Organization, Terragraphics, University of Idaho Extension Office, Bennett Lumber Company, URS Corporation
Watershed Work Groups (Benewah Creek/Lake Creek)	240 local residents, NRCS, Kootenai County SCD, Benewah County SCD, Spokane County SCD, IDFG, Idaho Transportation Department, Coeur d'Alene Tribal Programs: Fish & Water, Wildlife, Land Services, Air Quality, Environmental Health Program, Planning and Development Corporation, Transportation
Secondary Education	
Water Awareness Week	Plummer/Worley School District, Coeur d'Alene Tribal School, Lakes Middle School, Post Falls Middle School, Woodland Middle School, Canfield Middle School, St. Maries Middle School, Harrison Middle School, South Side Middle School, Sagle Middle School, Home School Students Association, Tribal Youth Activities Program, U of I Extension Program
Summer Internships	32 Tribal youth (ages 14-18)
Other Educational Forums	Girl Scout Program of Coeur d'Alene, Camp Fire Boys and Girls of the Inland Empire, Cub Scouts of America, US Forest Service, Native Project Program of Spokane, NW Indian Youth Conference, St. Maries Kiwanis Club, Healing Lodge of the Seven Nations, University of Idaho Indian Studies Program, IDFG, Tribal Education Program, BPA, EPA, IDEQ, CRITFC, CBFWA, Washington State Department of Ecology, USFWS, Bureau of Indian Affairs
Project Implementation	24 landowners, Plummer/Worley Middle/High Schools, Kootenai High School, St. Maries Middle/High Schools, 32 Tribal interns, WSU Center for Environmental Education, East Side Highway District

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APPENDICES

Table A-1. Summarized Secchi Disk data for all Coeur d'Alene Lake stations for 1999 - 2001.

Measurement units = meters nd = no data

Note: since lake monitoring typically takes plance over two to three days, the date given below is the earliest date shown in the original data.

HABITAT AREAS	LAKE SITES	1999 26-Feb	11-Mar	24-Mar	8-Apr	23-Apr	6-May	24-May	18-Jun	30-Jun	20-Jul	26-Jul	9-Aug	24-Aug	8-Sep	29-Sep	6-Oct	20-Oct	15-Nov
Shallow Water	09 Round Lake	nd	nd	nd	nd	0.9 (B)	0.9 (B)	0.6 (B)	0.3 (B)	0.9 (B)	0.6 (B)	0.6 (B)	0.4 (B)	0.6 (B)	0.6 (B)	0.4 (B)	0.5 (B)		
	11 Chatcolet Lake shallow	nd	nd	nd	nd	nd	0.9 (B)	0.6 (B)	0.4 (B)		0.5 (B)	0.5 (B)	0.4 (B)	0.4 (B)	0.6 (B)	0.3 (B)			
Shallow Bays	01 Rockford Bay	nd	2.1	1.9	2.2	3.0	4.5	3.9	3.1	3.4	5.6	6.0	6.5	9.0	8.7	8.7	nd	10.2	6.1
	02 Windy Bay shallow	nd	2.0	2.0	2.0	2.7	4.6	3.5	3.3	4.0	5.5	nd	7.5	8.1	6.9	9.0	nd	6.8	5.9
	06 Carey Bay	1.2	1.1	1.4	2.2	2.6	3.9	4.6	3.1	3.1	4.9	5.5	7.0	6.9	6.0	5.8	5.5	5.0	5.0
Deep, open water	03 Windy Bay deep	nd	2.0	2.0	2.0	2.6	4.7	4.2	4.0	4.0	6.5	7.1	7.7	10.0	8.1	10.2	nd	9.1	8.8
	05 Mid Lake Coeur d'Alene	nd	1.1	1.8	2.0	2.9	3.9	4.2	3.1	4.2	4.4	5.0	5.1	6.9	6.1	6.0	6.5	5.4	6.0
	07 Conkling Park	0.9	1.5	1.7	2.4	2.1	3.9	3.8	2.3	2.8	3.4	4.0	7.0	7.5	5.8	3.8	4.4	4.6	5.0
Shallow chain lakes	08 Hidden Lake	nd	nd	nd	2.2	2.4	3.6	4.0	2.2	2.6	4.1	3.9	nd	4.6	3.6	2.5	3.2	2.5	3.1
	10 Chatcolet Lake deep	0.9	1.5	1.5	2.1	2.2	4.4	4.1	2.4	3.0	3.4	3.0	5.5	3.8	3.7	2.5	2.1	2.5	3.0
	12 Benewah Lake	nd	nd	nd	1.1	1.2	1.9	2.5	2.5	3.0	4.3	4.0	2.8	2.8	2.6	2.3	3.1	nd	nd
Rivers	04 Coeur d'Alene River	nd	1.4	1.9	2.2	2.1	3.8	1.5	3.1	3.2	4.6	3.9	5.8	6.1	6.5	5.5	nd	6.0	6.5
	13 St. Joe River	1.4	2.8	1.7	2.7	2.8	4.0	1.4	0.4	3.6	3.7	3.5	2.6	3.0	3.8	2.6	2.6	2.6	2.6

LAKE SITES	2000 22-Mar	11-Apr	8-May	25-May	8-Jun	20-Jun	5-Jul	19-Jul	7-Aug	22-Aug	6-Sep	19-Sep
09 Round Lake	nd	0.6 (B)	0.9 (B)	0.7 (B)	nd	0.8 (B)	0.7 (B)	0.8 (B)	0.8 (B)	1.5 (B)	1.0 (B)	1.0 (B)
11 Chatcolet Lake shallow	nd	0.6 (B)	0.9 (B)	0.8 (B)	nd	0.8 (B)	0.6 (B)	0.6 (B)	0.8 (B)	0.8 (B)	0.8 (B)	0.7 (B)
01 Rockford Bay	2.8	nd	3.0	nd	nd	4.9	5.8	8.5	9.0	10.0	8.5	8.4
02 Windy Bay shallow	2.0	nd	3.0	3.8	nd	4.0	5.0	8.2	10.0	10.8	7.5	6.8
06 Carey Bay	1.7	2.0	2.9	3.1	nd	4.1	5.1	7.2	9.3	8.0	4.9	5.0
03 Windy Bay deep	2.5	nd	2.9	3.5	nd	4.4	5.0	10.8	12.0	10.5	9.1	7.0
05 Mid Lake Coeur d'Alene	1.1	2.0	2.8	3.1	nd	4.5	3.8	7.0	10.0	8.0	4.4	5.1
07 Conkling Park	1.1	1.9	2.8	2.8	nd	3.1	3.0	6.2	8.8	6.0	4.6	4.2
08 Hidden Lake	nd	2.1	3.0	2.6	3.2	2.6	3.1	5.0	4.0	3.5	2.6	3.3
10 Chatcolet Lake deep	1.5	2.1	3.1	3.0	nd	2.4	2.7	4.5	5.5	4.0	2.6	2.4
12 Benewah Lake	nd	1.0	1.8	2.0	3.5	2.2	2.9	4.0	3.0	3.0	2.5	3.0
04 Coeur d'Alene River	3.0	2.6	2.8	3.1	nd	4.7	3.1	6.0	8.0	7.0	4.9	4.8
13 St. Joe River	2.2	2.5	3.0	2.9	4.0	3.8	3.9	4.1	3.5	5.0	3.3	1.1

LAKE SITES	2001 15-May	31-May	13-Jun	25-Jun	10-Jul	23-Jul	9-Aug	24-Aug	5-Sep	1-Oct	19-Oct
09 Round Lake	0.9 (B)	1.0 (B)	1.0 (B)	1.0 (B)	1.4 (B)	1.2 (B)	1.5 (B)	1.8 (B)	nd	1.0 (B)	1.0 (B)
11 Chatcolet Lake shallow	1.0 (B)	1.0 (B)	1.2 (B)	1.3 (B)	0.5 (B)	1.1 (B)	0.9 (B)	1.0 (B)	nd	0.5 (B)	0.5 (B)
01 Rockford Bay	3.0	5.3	4.3	5.2	5.3	7.0	10.0	7.9	8.0	8.7	7.3
02 Windy Bay shallow	4.5	4.1	4.5	3.8	4.6	5.8	9.1	8.9	6.5	6.7	6.4
06 Carey Bay	3.0	2.4	3.9	5.0	4.6	7.2	7.6	6.6	5.8	6.5	4.3
03 Windy Bay deep	4.0	4.9	3.8	3.4	5.8	10.0	10.6	8.8	7.6	8.5	6.9
05 Mid Lake Coeur d'Alene	2.8	3.2	4.1	4.8	5.0	7.1	9.2	6.2	5.2	7.4	3.5
07 Conkling Park	2.8	2.1	3.1	4.7	5.0	7.6	7.5	6.2	3.7	6.0	3.7
08 Hidden Lake	2.1	2.0	3.0	3.4	4.4	4.4	4.8	3.5	nd	2.9	2.5
10 Chatcolet Lake deep	2.0	2.3	2.7	2.7		4.7	3.9	5.5	nd	2.2	2.0
12 Benewah Lake	1.5	3.1	3.2	4.3	4.4	3.6	4.0	nd	nd	1.9	2.0
04 Coeur d'Alene River	3.1	3.2	3.7	5.0	4.8	5.5	6.5	7.1	5.4	7.5	4.5
13 St. Joe River	2.3	2.8	3.2	3.9	1.9	2.8	2.5	3.5	nd	1.9	2.0

Table A-2. Summarized Dissolved Oxygen data for all Coeur d'Alene Lake stations for 1999 - 2001.

Mean and high-low range of DO values Measurement units = mg/L nd = no data

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

HABITAT AREAS	LAKE SITES	1999 Depth (m)	2/26 Mean	2/26 Range (H-L)	3/11		4/8		4/23		5/6		5/24		6/18		6/30		7/20		7/26		8/9		8/24		9/8		9/29
Shallow Water	**09 Round Lake**	0.4 - 0.9	nd	nd	nd	nd	nd	nd	11.3	11.4-11.1	12.1	12.2-12.1	12.0	12.1-12.0	11.4	11.5-11.4	14.2	16.04-12.67	9.7	9.77-9.68	9.4	9.54-9.33	8.3	8.35-8.34	10.8	10.85-10.82	8.4	8.45-8.44	9.3
	11 Chatcolet Lake shallow	0.4 - 0.9	nd	nd	nd	nd	nd	nd	nd	nd	12.2	12.2-12.1	12.0	12.1-11.9	11.5	11.6-11.4	nd	nd	9.9	9.97-9.77	9.7	9.74-9.65	9.7	9.71-9.54	11.6	11.57-11.53	8.5	8.54-8.39	9.6
Shallow Bays	**01 Rockford Bay**	12.2 - 13.8	12.1	12.2-12.0	12.1	12.1-12.0	11.50	11.7-11.4	11.2	11.3-11.2	12.0	12.1-12.0	12.0	12.4-11.7	11.4	12.1-11.1	10.9	11.32-10.37	9.5	9.7-8.99	10.3	10.49-9.58	9.9	10.49-9.22	9.0	9.59-7.78	9.3	9.38-9.28	9.4
	02 Windy Bay shallow	14.4 - 15.8	11.9	12.0-11.9	12.0	12.1-12.0	11.56	11.6-11.5	11.2	11.2-11.1	12.0	12.0-11.9	12.4	12.6-12.2	11.6	12.2-10.8	10.9	11.18-10.39	9.5	9.81-9.06	10.5	10.79-10.09	9.8	10.5-9.2	9.1	9.71-7.38	9.2	9.45-7.34	9.4
	06 Carey Bay	11.0 - 13.4	11.8	11.8-11.7	11.6	11.6-11.2	11.04	11.4-10.6	10.9	11.1-10.7	11.6	11.9-11.3	11.5	12.1-10.8	11.4	11.8-10.6	nd	nd	9.4	9.8-8.7	10.3	11.54-8.47	9.4	9.95-7.46	11.8	12.51-9.23	8.3	9.29-5.81	8.7
Deep Open Water	**03 Windy Bay deep**	29.7 - 30.7	11.8	11.8-11.3	11.8	11.9-11.6	11.60	11.8-11.4	11.2	11.3-11.1	11.9	12.0-11.9	11.8	12.2-11.3	11.1	11.8-10.6	10.7	11.12-10.18	9.1	9.74-8.69	10.0	10.82-9.24	9.3	10.62-8.45	8.5	9.46-7.63	8.6	9.28-7.41	8.8
	05 Mid Lake Coeur d'Alene	18.1 - 18.9	11.8	11.8-11.7	11.5	11.6-11.5	11.11	11.3-10.4	10.9	11.2-10.8	11.6	11.9-11.0	11.5	11.7-10.4	11.0	11.7-10.4	10.5	11.21-8.66	9.0	9.77-8.24	9.8	11.33-7.13	9.2	10.36-6.72	8.3	9.27-7.4	8.2	9.43-6.37	8.0
	07 Conkling Park	13.6 - 15.5	11.9	12.0-11.9	11.8	11.9-11.8	11.33	11.5-10.8	10.9	11.0-10.6	11.7	11.9-11.6	11.5	11.7-10.9	11.1	11.7-9.84	nd	nd	9.0	9.8-7.19	10.0	11.56-7.94	9.0	9.89-6.17	10.8	12.4-6.28	7.9	9.3-5.77	7.7
Shallow Chain Lakes	**08 Hidden Lake**	7.2 - 8.3	nd	nd	nd	nd	11.29	11.5-11.2	10.9	11.0-10.7	11.7	11.8-11.4	11.8	11.9-11.6	11.0	11.4-9.85	nd	nd	9.4	11.22-4.88	9.2	11.55-3.41	6.8	9.83-.18	8.9	11.97-.14	7.6	9.56-.3	9.4
	10 Chatcolet Lake deep	8.8 - 10.5	11.9	11.9-11.8	12.0	12.0-11.9	11.53	11.7-11.3	11.0	11.2-10.9	11.8	11.9-11.8	11.2	11.8-10.2	10.7	11.0-10.0	nd	nd	8.3	9.81-5.4	7.5	10.13-4.42	7.0	9.64-1.97	6.7	12.83-.16	7.0	9.31-.23	9.3
	12 Benewah Lake	3.9 - 4.6	nd	nd	nd	nd	10.67	11.0-10.1	9.6	10.0-7.29	10.5	10.5-10.4	10.0	11.9-5.48	11.1	11.3-10.1	nd	nd	9.5	10.23-6.45	9.3	10.98-9.54	8.4	10.54-.36	10.3	13.58-.13	8.6	8.89-8.11	9.3
Rivers	**04 Coeur d'Alene River**	9.3 - 12.0	11.7	11.8-11.7	11.7	11.8-11.7	11.10	11.2-11.1	10.8	10.8-10.7	11.8	11.9-11.8	11.3	11.3-11.2	10.5	10.6-10.3	10.6	10.69-10.5	9.2	9.6-8.82	10.4	10.83-9.64	9.2	9.81-8.41	8.7	9.15-6.48	9.4	9.46-9.37	9.3
	13 St. Joe River	9.3 - 12.1	12.1	12.2-12.1	12.1	12.2-12.1	11.68	11.7-11.7	11.4	11.5-11.4	12.1	12.2-12.0	12.1	12.2-12.0	11.5	11.7-11.4	nd	nd	9.5	9.49-9.46	9.0	9.02-8.97	7.8	8.54-7.1	10.9	11.25-10.17	7.9	8.03-7.84	8.8
	OVERALL MEAN =		11.9		11.8		11.3		10.9		11.8		11.6		11.2		11.3		9.3		9.7		8.8		9.7		8.4		9.0
	Standard Deviation =		0.1		0.2		0.3		0.5		0.4		0.6		0.3		1.4		0.4		0.8		1.0		1.5		0.7		0.6

LAKE SITES	2000 Depth (m)	3/22 Mean	3/22 Range (H-L)	4/11		5/8		5/25		6/8		6/20		7/5		7/19		8/7		8/22		9/6		9/19	
09 Round Lake	0.6 - 1.5	nd	nd	12.1	12.17-12.06	11.3	11.37-11.11	10.7	10.9-10.58	nd	nd	10.7	10.9-10.58	8.8	8.96-8.71	7.1	7.34-6.89	6.4	6.59-6.17	6.9	7.8-5.52	5.2	5.56-4.98	11.7	11.81-11.51
11 Chatcolet Lake shallow	0.6 - 0.9	nd	nd	12.3	12.45-12.15	11.5	11.54-11.49	11.4	11.44-11.34	nd	nd	10.5	10.54-10.5	10.6	10.66-10.56	8.2	8.26-8.16	8.0	8.2-7.79	10.1	10.22-9.79	5.2	5.31-5.08	9.0	9.01-9.01
01 Rockford Bay	10.4 - 13.6	12.7	12.85-12.63	nd	nd	8.3	8.67-7.93	nd	nd	nd	nd	10.6	10.83-10.42	9.3	9.52-9	9.9	10.76-7.99	8.9	9.78-8.36	9.2	9.22-9.03	8.8	9.16-6.65	9.7	9.78-9.67
02 Windy Bay shallow	14.8- 16.2	12.6	12.72-12.56	nd	nd	9.3	9.9-8.82	11.4	12.06-10.8	nd	nd	10.3	10.74-9.31	9.5	10.13-8.06	9.5	10.57-6.56	8.6	9.23-7.67	9.2	9.58-8.68	8.2	9.18-6.18	9.7	9.93-8.92
06 Carey Bay	12.4 - 13.4	12.6	12.81-11.92	11.5	11.76-11.46	10.6	11.62-8.67	10.2	10.45-9.55	nd	nd	9.9	10.37-9	11.1	11.66-10.33	9.2	9.99-6.49	8.3	9.14-5.33	8.8	9.32-6.51	8.3	9.29-5.31	9.6	10.32-6.13
03 Windy Bay deep	30.2 - 31.4	13.1	13.15-13.05	nd	nd	8.5	9.02-8.16	10.6	11-10.06	nd	nd	10.2	10.89-9.59	9.2	9.87-7.89	9.4	10.53-8.47	8.3	9.57-6.27	8.7	9.94-7.38	8.2	9.11-7	8.5	9.8-6.95
05 Mid Lake Coeur d'Alene	18.2 - 19.4	12.7	12.84-12.65	10.3	10.77-9.97	8.3	8.89-7.96	10.0	10.39-9.32	nd	nd	9.8	10.41-9.15	10.6	12.01-8.85	8.4	9.66-7.05	8.6	9.96-6.66	8.5	9.42-5.52	8.0	9.36-5.82	8.7	10.22-6.19
07 Conkling Park	14.7 - 15.8	12.7	12.84-12.4	11.7	11.89-11.09	10.7	11.32-8.93	10.4	11.08-9.92	nd	nd	9.6	10.44-8.66	10.5	11.72-7.37	8.7	10.42-5.48	7.6	9.22-4.42	7.9	9.32-3.22	8.4	9.31-5.27	8.9	10.29-3.6
08 Hidden Lake	7.9 - 8.5	nd	nd	11.8	12.3-10.53	11.2	11.38-9.93	10.9	11.46-10.32	9.87	10.56-8	10.1	10.65-8.22	9.6	11.52-5.17	7.5	10.31-.73	6.6	10.87-.18	6.0	9.15-.12	6.6	8.35-.25	6.7	11.14-.19
10 Chatcolet Lake deep	10.1 - 10.9	12.8	12.96-12.42	12.4	12.65-12.25	10.9	11.28-9.51	11.1	11.33-10.66	nd	nd	10.2	10.54-9.37	8.8	10.66-5.72	6.6	8.99-2.48	6.4	11.88-.37	5.5	9.3-.11	5.4	8.07-.3	7.1	10.46-.42
12 Benewah Lake	4.6 - 5.1	nd	nd	10.3	11.07-8.22	8.9	10.17-4.46	8.1	9.55-1.2	8.4	10.43-1.55	8.3	10.65-2.41	9.4	11.5-1.55	8.2	9.85-.73	7.6	8.77-.53	8.0	9.54-4.26	7.4	8.47-5.9	9.3	11.89-2.64
04 Coeur d'Alene River)	9.9 - 12.	12.9	12.94-12.82	11.4	11.43-11.19	8.0	8.23-7.87	10.5	10.64-10.3	nd	nd	9.9	10.35-8.44	10.7	11.42-9.67	9.2	10.66-8.12	8.7	9.56-8.25	9.2	9.27-8.73	9.1	9.25-8.82	9.9	10.02-9.86
13 St. Joe River	10.0-11.5	12.8	12.82-12.75	12.1	12.3-12.05	11.8	11.88-11.71	11.7	11.93-11.44	10.6	10.66-10.54	10.4	10.47-10.4	9.7	9.78-9.16	7.7	8.1-7.32	6.0	7.73-4.34	7.5	7.67-7.12	7.1	7.37-6.43	8.6	9.57-8.21
OVERALL MEAN =		12.8		11.6		9.9		10.6		9.6		10.0		9.8		8.4		7.7		8.1		7.4		9.0	
Standard Deviation =		0.1		0.8		1.4		0.9		1.1		0.6		0.8		1.0		1.0		1.3		1.4		1.2	

LAKE SITES	2001 Depth (m)	5/15 Mean	5/15 Range (H-L)	5/31		6/13		6/25		7/10		7/23		8/9		8/24		9/5		10/1		10/19	
09 Round Lake	0.9 - 1.8	10.8	10.78-10.78	10.0	10.01-10.01	10.6	10.7-10.51	10.5	10.57-10.52	8.6	8.7-8.53	10.0	10.08-8.82	9.5	9.96-9.08	8.2	8.54-7.83	8.5	8.54-8.45	9.8	9.93-9.75	10.8	10.98-10.62
11 Chatcolet Lake shallow	0.4 - 1.5	10.7	10.74-10.74	10.2	10.15-10.15	10.4	10.4-10.3	10.1	10.17-10	9.5	9.47-9.47	11.8	13.2-10.46	13.8	13.85-13.84	6.9	6.91-6.91	8.7	8.73-8.72	9.7	9.71-9.71	11.7	11.69-11.69
01 Rockford Bay	11.2 - 16.0	11.4	11.88-10.93	11.4	11.82-11.13	10.7	10.96-9.97	11.0	11.23-10.95	10.5	11.2-9.94	9.8	10.81-8.96	9.3	9.42-9.16	9.1	9.91-8.87	11.0	11.51-10.24	10.0	10.09-9.93	9.5	9.63-9.36
02 Windy Bay shallow	14.4 - 15.9	11.4	11.76-11.09	10.7	11.05-10.28	11.0	11.28-10.64	10.9	11.29-9.34	10.3	11.08-9.12	10.0	11.33-8.15	9.5	9.63-9.25	9.3	10.06-8.98	10.0	11.09-7.36	9.6	10.23-7.12	9.2	9.38-9.1
06 Carey Bay	9.4 - 13.0	10.3	10.8-9.6	10.7	11.4-10.2	10.9	11.2-9.8	11.2	12.3-10.6	11.0	11.6-10.4	10.3	10.7-10.1	9.4	9.8-9.2	8.6	9.2-6.5	9.1	10.2-6.9	9.7	10.0-9.2	6.6	9.2-4.7
03 Windy Bay deep	26.2 - 31.0	10.3	10.78-9.59	10.7	11.41-10.18	10.9	11.22-9.82	11.2	12.34-10.6	11.0	11.58-10.41	10.3	10.72-10.1	9.4	9.76-9.17	8.6	9.21-6.46	9.1	10.18-6.92	9.7	9.97-9.19	6.6	9.15-4.73
05 Mid Lake Coeur d'Alene	15.6 - 19.0	10.4	11.09-9.56	10.5	11.13-9.71	10.2	10.75-9.73	10.5	12.14-7.8	10.0	11.54-7.09	9.6	11.07-5.59	9.2	10.45-6.29	8.2	9.81-5.07	8.9	10.23-6.54	8.4	9.77-4.01	8.2	9.43-7.05
07 Conkling Park	12.0 - 15.9	10.7	11.14-9.56	10.3	11.38-9	10.5	11.2-9.23	11.2	12.36-10.46	10.2	11.6-6.11	9.5	10.84-6.32	8.9	9.68-5.12	8.3	8.81-5.64	8.2	9.79-4.45	9.5	10.02-7.24	7.2	9.54-4.36
08 Hidden Lake	6.7 - 8.1	9.3	10.45-6.07	8.7	10.34-4.42	7.2	10.48-.99	7.3	10.82-.16	7.7	10.44-.66	7.8	11.31-.46	8.2	10.41-.32	6.4	8.75-.14	8.6	10.11-3.68	10.3	10.44-9.98	10.1	10.15-9.78
10 Chatcolet Lake deep	9.4 - 12.0	10.9	11.33-10.41	9.7	10.31-8.02	9.4	10.6-6.43	8.2	10.34-4.74	nd	nd	6.7	9.97-.2	5.3	9.5-.13	4.7	8.91-.11	6.4	9.16-.09	8.1	11.24-.93	10.1	10.18-9.96
12 Benewah Lake	3.8 - 4.9	8.1	9.09-5.96	8.3	10.16-1.98	9.8	10.85-6.83	10.9	11.52-10.54	9.6	10.20-8.15	8.9	11.17-2.08	9.9	10.65-8.55	6.9	9.32-3.25	9.4	9.61-8.82	10.6	10.75-10.21	10.6	10.66-10.46
04 Coeur d'Alene River	7.8 - 11.4	10.6	10.91-9.92	10.3	10.84-10	10.5	10.85-9.83	10.5	11.13-9.9	10.4	11.45-9.70	9.5	9.62-9.12	9.3	9.87-9.17	8.7	8.95-8.03	9.9	10.01-9.61	10.0	10.08-9.79	9.5	9.92-9.39
13 St. Joe River	15.0 - 20.4	11.2	11.28-11.02	10.3	12.27-9.78	9.8	10.11-9.62	9.6	9.81-9.41	7.3	8.78-5.6	5.7	8.93-.28	4.3	7.78-.09	3.5	7.34-.1	6.1	7.88-.12	9.0	9.34-8.94	9.9	10.03-9.82
OVERALL MEAN =		10.5		10.2		10.1		10.2		9.7		9.2		8.9		7.5		8.7		9.6		9.2	
Standard Deviation =		0.9		0.8		1.0		1.2		1.2		1.6		2.3		1.8		1.3		0.7		1.6	

Table A-3. Summarized Temperature data for all Coeur d'Alene Lake stations for 1999 - 2001.

Mean and surface to bottom range of temperatures

Note: since sampling of all siotes takes place over two to three days, only the earliest sampled date is give nd = no data

HABITAT AREAS	LAKE SITES	1999 Depth (m)	2/26 Mean	2/26 Range (S-B)	3/11	3/11	3/24	3/24	4/8	4/8	4/23	4/23	5/6	5/6	5/24	5/24	6/18	6/18	6/30	6/30	7/20	7/20	7/26	7/26	8/9	8/9	8/24	8/24
Shallow Water	09 Round Lake	0.4 - 0.9	nd		nd		nd		nd		6.2	6.6-6.0	6.8	6.9-6.8	8.7	8.6-8.6	10.7	10.9-10.4	10.6	10.6-10.6	16.8	16.9-16.7	18.8	18.9-18.7	21.8	21.9-21.8	19.3	19.3-19.3
	11 Chatcolet Lake shallow	0.4 - 0.9	nd		nd		nd		nd		nd		6.5	6.5-6.5	8.5	8.5-8.5	10.1	10.1-10.1	nd		17.3	17.7-16.9	18.5	18.5-18.4	23.2	23.3-23.2	20.5	20.5-20.5
	Hab. Area mean=												6.7		8.6		10.4		10.6		17.1		18.7		22.5		19.9	
	Hab. Area SD=																						0.2		1.0		0.8	
Shallow Bays	01 Rockford Bay	12.2 - 13.8	2.4	2.4-2.5	3.1	2.9-3.4	4.4	4.7-4.5	4.9	5.5-4.5	6.4	7.1-5.7	6.6	8.5-5.6	10.2	14.2-8.5	10.2	12.7-9.1	11.9	12.4-11.2	17.0	19.5-14.5	nd		19.8	22.2-13.9	19.5	21.6-12.7
	02 Windy Bay shallow	14.4 - 15.8	2.6	2.7-2.6	2.9	2.7-3.1	4.4	4.9-4.2	4.8	4.9-4.7	6.8	7.5-5.4	5.9	7.4-5.5	10.4	13.6-8.3	11.9	14.4-8.8	11.2	12.0-10.2	16.5	19.0-13.5	17.3	19.2-14.3	19.5	22.6-12.6	18.1	20.8-12.6
	06 Carey Bay	11.0 - 13.4	2.7	2.7-2.7	3.2	3.2-3.0	5.0	6.4-4.9	5.0	5.4-5.0	7.2	9.0-6.0	7.5	8.9-6.9	9.2	17.0-6.8	12.2	18.1-8.5	11.8	13.9-9.2	16.9	21.8-13.4	14.5	18.8-10.5	18.0	21.2-13.1	19.7	21.9-15.9
	Hab. Area mean=		2.6		3.1		4.6		4.9		6.8		6.7		9.9		11.4		11.6		16.8		15.9		19.1		19.1	
	Hab. Area SD=		0.2		0.2		0.3		0.1		0.4		0.8		0.6		1.1		0.4		0.3		2.0		1.0		0.9	
Deep Open Water	03 Windy Bay deep	29.7 - 30.7	2.6	2.7-2.6	2.9	3.0-2.9	4.1	4.2-4.1	5.0	5.3-4.5	6.3	7.9-5.0	5.8	7.4-5.4	8.9	13.4-7.2	10.3	17.2-7.1	10.1	12.1-6.9	12.9	19.8-7.6	13.4	19.8-7.6	14.2	22.9-7.8	14.1	21.3-8.1
	05 Mid Lake Coeur d'Alene	18.1 - 18.9	2.6	2.6-2.5	3.1	3.3-3.1	4.8	5.7-4.3	5.4	6.0-4.6	6.5	8.0-5.1	6.9	9.3-5.5	8.6	12.3-6.0	11.1	18.4-7.7	11.7	14.8-7.9	14.9	21.3-8.7	14.6	20.5-9.1	17.2	22.6-9.9	15.8	21.3-10.1
	07 Conkling Park	13.6 - 15.5	2.9	3.0-2.9	3.4	3.4-3.3	5.3	5.9-4.5	5.5	6.0-4.7	7.0	8.3-5.8	7.4	8.5-7.0	9.0	13.2-6.6	11.6	16.3-8.4	12.1	14.2-10.6	16.8	21.2-12.6	13.5	18.1-10.1	17.6	21.5-11.8	18.3	21.8-11.5
	Hab. Area mean=		2.7		2.7		4.7		5.3		6.6		6.7		8.8		11.0		11.3		14.9		13.8		16.3		16.1	
	Hab. Area SD=		0.2		0.3		0.6		0.2		0.4		0.8		0.2		0.6		1.1		2		0.7		1.9		2.1	
Shallow Chain Lakes	08 Hidden Lake	7.2 - 8.3	nd		nd		nd		5.6	6.0-5.4	7.2	8.9-6.7	7.9	9.7-7.5	10.7	12.7-10.2	12.2	13.3-9.4	11.6	13.0-10.7	18.9	19.7-12.0	18.5	20.6-12.3	18.4	22.6-12.8	19.2	22.4-13.4
	10 Chatcolet Lake deep	8.8 - 10.5	3.0	2.9-3.3	3.2	3.2-3.2	5.6	6.3-5.0	6.0	6.4-5.3	7.1	8.7-6.0	7.1	7.7-6.6	9.4	12.7-7.9	11.5	14.8-8.4	10.8	13.1-9.7	15.6	19.3-12.2	16.3	19.7-12.3	19.2	22.8-13.7	18.1	22.1-12.9
	12 Benewah Lake	3.9 - 4.6	nd		nd		nd		6.9	7.6-6.3	9.4	11.0-8.1	9.7	11.2-9.0	13.4	20.2-10.4	15.2	19.1-11.3	14.7	17.0-12.2	18.8	21.6-14.7	19.0	20.8-15.2	22.1	24.0-17.8	21.1	22.4-18.4
	Hab. Area mean=		3.0		3.2		5.6		6.2		7.9		8.2		11.2		13.0		12.4		17.8		17.9		19.9		19.5	
	Hab. Area SD=								0.7		1.3		1.3		1.0		2.0		2.1		1.9		1.4		1.9		1.5	
Rivers	04 Coeur d'Alene River	9.3 - 12.0	3.1	3.1-3.1	3.4	3.4-3.4	5.4	5.4-5.3	6.2	6.6-5.8	8.4	8.5-7.9	7.9	8.6-7.4	11.3	12.4-9.9	16.1	17.9-13.3	13.6	14.2-13.1	17.3	21.0-13.0	17.4	20.2-14.7	20.7	24.1-13.7	19.1	21.2-11.6
	13 St. Joe River	9.3 - 12.1	2.9	2.9-2.9	2.7	2.7-2.7	5.0	5.0-5.1	5.3	5.3-5.3	5.8	5.8-5.7	5.9	5.8-5.8	8.5	8.5-8.5	10.0	10.0-10.0	10.1	10.1-10.1	16.4	16.7-16.4	18.2	18.7-18.1	21.4	22.5-20.8	19.0	19.8-17.9
	Hab. Area mean=		3.0		3.1		5.2		5.8		7.1		6.9		9.9		13.1		11.9		16.9		17.8		21.1		19.1	
	Hab. Area SD=		0.1		0.5		0.3		0.6		1.8		1.4		2		4.3		2.5		0.6		0.6		0.5		0.1	
	OVERALL MEAN =		2.8		3.1		4.9		5.5		7.0		7.1		9.8		11.8		11.6		16.6		16.7		19.5		18.6	
	Standard Deviation =		0.2		0.2		0.5		0.6		1.0		13.1		1.4		1.9		1.4		1.5		2.1		2.4		1.9	

LAKE SITES	2000 Depth (m)	3/22	4/11	4/11	5/8	5/8	5/25	5/25	6/8	6/20	6/20	7/5	7/5	7/19	7/19	8/7	8/7	8/22	8/22	9/6	9/6	9/19	9/19
09 Round Lake	0.6 - 1.5	nd	7.3	7.3-7.3	8.0	8.0-8.0	9.6	9.6-9.6	nd	13.0	13.0-13.0	17.4	17.4-17.4	19.8	19.8-19.8	23.3	23.3-23.3	21.2	21.4-21.0	17.8	17.8-17.8	17.8	17.7-17.8
11 Chatcolet Lake shallow	0.6 - 0.9	nd	7.4	7.4-7.4	7.6	7.6-7.6	9.7	9.7-9.7	nd	13.3	13.3-13.3	17.2	17.2-17.2	20.2	20.2-20.2	22.3	22.3-22.2	19.5	19.5-19.5	16.7	16.7-16.7	15.1	15.1-15.1
Hab. Area mean=			7.4		7.8		9.7			13.2		17.3		20.0		22.8		20.4		17.3		16.5	
Hab. Area SD=			0.1		0.1		0.1			0.1		0.1		0.3		0.7		1.2		0.8		1.9	
01 Rockford Bay	10.4 - 13.6	3.9	nd	4.0-3.9	8.7	10.2-8.1	nd		nd	13.6	15.2-12.6	16.9	18.4-12.6	18.1	21.1-13.3	20.3	22.6-14.7	20.0	20.8-14.9	17.7	18.5-11.8	16.6	17.0-16.2
02 Windy Bay shallow	14.8- 16.2	4.0	nd	4.1-4.4	8.6	9.7-7.5	9.7	11.2-8.7	nd	12.1	13.7-9.5	15.5	17.9-11.3	16.5	20.5-10.8	18.4	22.3-9.8	18.9	20.2-12.9	15.3	18.3-9.1	16.3	16.6-15.5
06 Carey Bay	12.4 - 13.4	5.2	6.7	7.0-4.9	8.4	8.0-6.3	10.1	11.3-6.8	nd	12.8	14.2-7.5	14.6	17.4-12.6	17.2	21.3-11.8	18.9	22.9-11.5	19.4	21.5-15.6	17.2	18.4-13.4	17.1	17.8-14.9
Hab. Area mean=		4.4	6.7		8.6		9.9			12.8		15.7		17.3		19.2		19.4		16.7		16.7	
Hab. Area SD=		0.7					0.3			0.8		1.2		0.8		1.0		0.6		1.3		0.4	
03 Windy Bay deep	30.2 - 31.4	4.3	nd	4.9-4.2	8.0	10.1-6.6	9.4	12.1-7.2	nd	10.6	14.6-6.5	11.9	17.9-6.9	12.1	21.1-6.4	13.6	22.7-6.8	13.6	21.2-6.5	11.9	18.5-6.6	12.9	17.0-6.9
05 Mid Lake Coeur d'Alene	18.2 - 19.4	5.4	6.7	5.9-5.3	7.5	8.8-5.9	9.4	10.5-5.7	nd	11.5	14.0-6.7	12.5	18.1-7.8	14.7	22.2-9.2	16.5	23.2-8.9	16.9	21.3-8.8	15.4	18.3-9.7	14.9	17.7-8.8
07 Conkling Park	14.7 - 15.8	5.5	6.9	5.9-5.4	7.8	9.6-5.9	10.5	10.4-5.7	nd	11.6	14.4-7.2	13.5	15.5-8.3	16.5	17.9-9.8	17.3	20.8-10.8	17.9	23.2-9.9	16.9	21.3-10.7	16.5	18.6-11.0
Hab. Area mean=		5.1	6.8		7.8		9.8			11.2		12.6		14.4		15.8		16.1		14.7		14.8	
Hab. Area SD=		0.7	0.1				0.6			0.6		0.8		2.2		1.9		2.3		2.6		1.8	
08 Hidden Lake	7.9 - 8.5	nd	7.7	9.7-6.8	8.7	9.7-8.1	11.9	12.2-11.2	12.7	12.9	15.3-11.5	15.4	18.7-12.2	18.0	22.3-13.1	20.1	24.3-13.3	19.0	21.4-13.9	17.6	17.9-15.6	16.7	18.7-15.3
10 Chatcolet Lake deep	10.1 - 10.9	5.7	7.3	6.6-5.2	8.3	9.0-5.6	10.2	10.7-7.6	nd	12.4	12.9-8.0	14.0	14.5-10.4	16.0	18.0-10.5	18.5	21.5-11.6	17.4	23.7-11.5	16.4	20.7-11.9	16.1	17.6-12.2
12 Benewah Lake	4.6 - 5.1	nd	9.9	12.4-7.7	10.6	12.8-8.0	13.7	17.5-9.4	15.8	14.8	18.6-10.4	17.1	18.0-11.7	20.3	18.7-13.0	22.9	22.8-14.4	19.8	24.7-17.6	17.0	21.3-19.3	17.4	17.1-16.9
Hab. Area mean=		5.7	8.3		9.2		11.9		14.3	13.4		15.5		18.1		20.5		18.7		17.0		16.7	
Hab. Area SD=			1.4				1.8		2.2	1.3		1.6		2.2		2.2		1.2		0.6		0.7	
04 Coeur d'Alene River)	9.9 - 12.	5.8	8.1	6.2-5.6	9.8	9.3-7.6	12.2	10.2-9.4	nd	14.2	14.1-8.7	15.6	16.4-10.1	19.1	18.3-12.3	21.8	22.8-15.4	20.4	23.5-16.9	18.0	18.4-17.2	17.1	17.2-17.0
13 St. Joe River	10.0-11.5	4.6	6.8	4.6-4.6	7.2	6.8-6.8	9.3	7.2-7.2	12.1	11.8	9.4-9.3	16.6	12.1-12.1	19.4	12.0-11.8	22.5	20.0-18.2	20.8	23.8-20.9	17.8	21.5-20.6	15.7	17.8-17.8
Hab. Area mean=		5.2	7.5		8.5		10.8		12.1	13.0		16.1		19.3		22.2		20.6		17.9		16.4	17.9-15.1
Hab. Area SD=		0.8	0.9				2.1			1.7		0.7		0.2		0.5		0.3		0.1		1	
OVERALL MEAN =		4.9	7.5		8.4		10.5			12.7		15.2		17.5		19.7		18.8		16.6		16.2	
Standard Deviation =		0.7	1.0		0.9		1.4			1.2		1.8		2.4		2.9		2.0		1.7		1.3	

LAKE SITES	2001 Depth (m)	5/15	5/31	5/31	6/13	6/13	6/25	6/25	7/10	7/23	7/23	8/9	8/9	8/24	8/24	9/5	9/5	10/1	10/1	10/19	10/19
09 Round Lake	0.9 - 1.8	9.1	9.1-9.1	12.6	12.6-12.6	12.2	12.2-12.2	16.9	16.9-16.9	22.3	22.6-22.1	22.5	22.7-22.2	22.4	22.7-22.1	21.7	21.8-21.7	19.9	20.0-19.9	16.9	17.0-16.7	10.5	10.6-10.5
11 Chatcolet Lake shallow	0.4 - 1.5	9.3	9.3-9.3	12.7	12.7-12.7	12.1	12.1-12.1	16.8	16.8-16.7	22.6	22.6-22.6	22.4	22.9-21.9	23.9	24.0-23.8	21.3	21.3-21.3	19.3	19.3-19.3	16.8	16.8-16.8	8.3	8.3-8.3
Hab. Area mean=		9.2		12.7		12.2		16.9		22.5		22.5		23.2		21.5		19.6		16.9		9.4	
Hab. Area SD=		0.1		0.1		0.1		0.1		0.2		0.1		1.1		0.3		0.4		0.1		1.6	
01 Rockford Bay	11.2 - 16.0	6.1	8.0-5.7	9.3	10.3-8.6	11.8	12.3-11.3	15.7	16.0-15.4	17.6	20.8-12.2	17.3	21.7-10.1	20.8	21.5-20.3	19.6	20.8-15.7	16.5	18.7-14.0	17.2	17.4-16.8	12.1	12.2-11.8
02 Windy Bay shallow	14.4 - 15.9	6.3	7.2-5.9	12.6	15.8-8.8	11.3	12.0-10.6	14.5	15.9-10.5	16.6	21.1-99	16.4	20.9-9.6	20.0	21.3-16.3	18.5	20.4-13.7	15.0	18.1-9.6	16.1	17.2-11.7	11.8	12.2-11.9
06 Carey Bay	9.4 - 13.0	8.8	10.6-6.3	11.0	15.1-8.1	11.8	12.5-9.7	15.4	18.2-12.3	17.2	19.8-14.1	20.2	21.8-18.4	20.5	22.2-18.6	19.2	21.3-11.5	16.7	19.7-10.9	17.1	17.2-16.9	10.7	12.3-9.3
Hab. Area mean=		7.1		11.0		11.6		15.2		17.1		18.0		20.4		19.1		16.1		16.8		11.5	
Hab. Area SD=		1.5		1.7		0.3		0.6		0.5		2.0		0.4		0.6		0.9		0.6		0.7	
03 Windy Bay deep	26.2 - 31.0	6.5	7.4-5.7	8.8	14.2-7.2	10.2	12.7-7.2	12.4	15.4-7.6	12.2	21.6-7.0	12.1	21.0-6.9	14.1	21.4-7.1	13.4	20.7-7.1	12.3	18.3-7.1	12.1	17.2-7.1	11.3	12.2-7.6
05 Mid Lake Coeur d'Alene	15.6 - 19.0	8.3	11.2-5.6	8.8	16.1-6.5	10.6	13.6-7.8	12.9	18.4-8.0	15.2	21.4-8.5	17.2	21.0-8.9	17.7	22.4-9.4	16.4	21.5-9.4	15.1	19.7-9.4	15.2	17.2-9.6	10.4	12.3-7.4
07 Conkling Park	12.0 - 15.9	9.6	10.7-7.9	10.9	15.0-7.0	10.8	12.9-8.3	15.0	18.4-12.2	16.0	21.1-9.6	18.1	20.9-11.8	19.3	22.0-10.3	18.8	21.4-11.7	15.5	19.6-10.1	16.8	17.3-15.4	10.6	12.1-9.2
Hab. Area mean=		8.1		9.5		10.5		13.4		14.5		15.8		17.0		16.2		14.3		14.7		10.8	
Hab. Area SD=		1.6		1.2		0.3		1.4		2		3.2		2.7		2.7		1.7		2.4		0.5	
08 Hidden Lake	6.7 - 8.1	9.9	10.7-8.5	12.2	14.1-9.4	12.1	13.9-10.2	14.8	18.6-11.3	18.5	23.7-12.7	18.9	22.0-13.8	21.1	23.5-16.7	20.0	21.1-14.9	19.9	20.2-19.2	16.6	17.0-16.4	10.7	10.8-10.5
10 Chatcolet Lake deep	9.4 - 12.0	9.9	10.3-9.6	11.1	14.2-9.2	12.4	13.3-10.8	14.4	17.6-11.8	nd		17.8	21.7-12.6	18.1	22.8-12.5	17.9	21.5-12.3	18.8	20.1-15.1	16.2	16.5-15.4	10.8	10.9-10.3
12 Benewah Lake	3.8 - 4.9	11.9	13.1-10.3	14.9	16.5-10.7	14.0	14.8-12.3	18.4	19.6-15.4	20.9	23.8-16.5	21.0	22.7-18.8	22.5	23.7-20.9	21.2	21.5-20.9	20.0	20.1-20.0	15.5	15.9-15.2	9.3	9.4-9.1
Hab. Area mean=		10.6		12.7		12.8		15.9		20.9		19.2		20.6		19.7		19.6		16.1		10.3	
Hab. Area SD=		1.2		2		1		2.2		1.7		1.7		2.2		1.7		0.7		0.6		0.8	
04 Coeur d'Alene River	7.8 - 11.4	9.6	11.7-8.6	13.3	16.3-9.1	11.4	13.7-9.0	15.9	18.9-13.0	19.0	22.7-15.3	20.5	21.6-18.8	20.9	22.8-18.6	20.6	20.8-20.3	18.9	19.1-18.0	17.0	17.4-16.7	11.8	12.2-10.3
13 St. Joe River	15.0 - 20.4	8.5	8.6-8.5	12.3	12.5-12.2	12.4	12.4-12.4	16.7	17.1-16.3	19.3	22.7-17.3	19.6	21.6-16.6	19.4	21.9-16.1	19.5	21.9-15.9	20.1	20.5-18.1	16.5	16.8-16.4	10.1	10.2-10.0
Hab. Area mean=		9.1		12.8		11.9		16.3		19.2		20.1		20.2		20.1		19.5		16.8		11.0	
Hab. Area SD=		0.8		0.7		0.7		0.6		0.2		0.6		1.1		0.8		0.8		0.4		1.2	
OVERALL MEAN =		8.8		11.6		11.8		15.4		18.1		18.8		20.1		19.1		17.5		16.2		10.6	
Standard Deviation =		1.7		1.8		1.0		1.7		3		2.8		2.5		2.3		2.5		1.4		1.0	

Table A-4. Summarized pH data for all Coeur d'Alene Lake stations for 1999 - 2001.

Mean and high - low range of pH values Measurement units = pH units nd = no data

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

		1999																																				
HABITAT AREAS	LAKE SITES	Depth (m)	2/26		3/11		3/24		4/8		4/23		5/6		5/24		6/18		6/30		7/20		7/26		8/9		8/24		9/8		9/29		10/6		10/20		11/14	
			Mean	Range (H-L)																																		
Shallow Water	09 Round Lake	0.4 - 0.9	nd	nd	nd	nd	nd	nd	nd	nd	7.10	7.1-7.1	7.2	7.2-7.2	7.0	7.0-7.0	7.0	7.0-7.0	7.6	8.3-7.3	7.1	7.1-7.1	7.1	7.1-7.1	7.1	7.1-7.1	7.0	7.0-7.0	7.1	7.1-7.1	7.2	7.2-7.2	7.0	7.0-7.0	nd	nd	nd	nd
	11 Chatcolet Lake shallow	0.4 - 0.9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7.2	7.2-7.2	7.0	7.0-7.0	6.9	7.0-6.9	nd	nd	7.2	7.2-7.2	7.2	7.2-7.2	7.5	7.5-7.5	7.4	7.5-7.4	7.1	7.1-7.1	7.2	7.2-7.2	nd	nd	nd	nd	nd	nd
Shallow Bays	01 Rockford Bay	12.2 - 13.8	7.0	7.1-7.0	7.0	7.0-6.9	6.9	7.0-6.8	7.1	7.2-7.1	7.1	7.1-7.0	7.1	7.1-7.1	7.3	7.5-7.2	7.0	7.6-6.8	7.1	7.3-6.9	7.5	7.5-7.1	7.6	7.7-7.0	7.6	7.7-6.9	7.3	7.7-6.6	7.4	7.5-7.3	7.2	7.2-7.2	nd	nd	7.2	7.2-7.1	6.8	9.8-6.8
	02 Windy Bay shallow	14.4 - 15.8	7.1	7.2-7.0	7.0	7.1-7.0	7.0	7.1-6.9	7.1	7.2-7.1	7.1	7.2-7.1	7.1	7.1-7.1	7.4	7.8-7.0	7.3	7.7-6.8	7.1	7.3-6.9	7.5	7.6-7.0	7.7	7.8-7.2	7.5	7.6-6.8	7.3	7.6-6.5	7.3	7.4-6.6	7.1	7.1-7.0	7.1	7.1-7.1	6.9	6.9-6.9	6.9	6.9-6.9
	06 Carey Bay	11.0 - 13.4	7.0	7.0-6.9	6.9	6.9-6.8	6.90	7.0-6.8	7.1	7.2-7.0	7.1	7.3-7.0	7.2	7.3-7.0	7.1	7.4-6.8	7.2	7.5-6.9	7.1	7.4-6.7	7.5	7.7-7.0	7.2	7.8-6.5	7.4	7.8-6.6	7.3	7.7-6.6	7.0	7.4-6.4	7.0	7.1-6.7	7.1	7.2-7.0	7.1	7.1-6.9	7.0	7.1-6.9
Deep Open Water	03 Windy Bay deep	29.7 - 30.7	7.2	7.2-7.0	7.1	7.1-7.0	7.0	7.1-7.0	7.2	7.2-7.1	7.1	7.2-7.0	7.1	7.1-7.1	7.2	7.5-7.0	7.1	7.5-6.8	7.0	7.3-6.8	7.2	7.6-6.7	7.2	7.7-6.6	7.1	7.7-6.6	6.8	7.6-6.5	6.9	7.5-6.6	6.8	7.2-6.3	nd	nd	6.8	7.0-6.3	6.8	6.8-6.4
	05 Mid Lake Coeur d'Alene	18.1 - 18.9	7.1	7.1-7.1	6.9	6.9-6.9	7.0	7.0-6.9	7.1	7.2-7.0	7.1	7.2-7.0	7.2	7.3-6.9	7.1	7.3-6.8	7.1	7.4-6.8	7.1	7.4-6.7	7.2	7.6-6.7	7.3	7.7-6.5	7.3	7.7-6.5	6.9	7.5-6.4	6.9	7.5-6.4	6.8	7.1-6.2	7.0	7.3-6.2	6.9	7.0-6.2	7.0	7.2-6.6
	07 Conkling Park	13.6 - 15.5	6.9	6.9-6.9	6.9	7.0-6.9	7.0	7.0-6.9	7.2	7.3-7.0	7.1	7.2-6.9	7.2	7.3-7.1	7.1	7.3-6.8	7.1	7.4-6.7	7.2	7.4-6.9	7.4	7.5-6.7	7.0	7.7-6.4	7.2	7.8-6.5	7.1	7.6-6.4	6.9	7.3-6.4	6.8	7.2-6.3	7.1	7.2-7.0	7.1	7.2-7.1	7.0	7.1-6.9
Shallow Chain Lakes	08 Hidden Lake	7.2 - 8.3	nd	nd	nd	nd	nd	nd	7.2	7.2-7.1	7.1	7.2-7.1	7.2	7.3-7.2	7.2	7.3-7.1	7.1	7.2-6.7	7.1	7.4-6.8	7.2	7.6-6.4	7.2	8.1-6.3	7.3	8.2-6.5	7.3	8.1-6.5	7.2	7.5-6.7	7.3	7.4-7.2	7.3	7.5-6.8	7.4	7.4-7.3	7.1	7.1-7.0
	10 Chatcolet Lake deep	8.8 - 10.5	6.9	6.9-6.8	6.9	6.9-6.9	7.0	7.1-7.0	7.1	7.2-7.1	7.1	7.2-7.0	7.2	7.2-7.1	7.0	7.3-6.7	7.0	7.3-6.7	7.0	7.4-6.7	6.9	7.5-6.4	6.9	7.6-6.3	7.5	8.4-6.3	7.2	8.7-6.4	7.1	7.5-6.6	7.3	7.4-7.3	7.4	8.0-6.7	7.4	7.6-7.2	7.2	7.2-7.0
	12 Benewah Lake	3.9 - 4.6	nd	nd	nd	nd	nd	nd	6.9	7.0-6.8	6.9	7.0-6.6	7.0	7.0-7.0	7.1	7.4-6.4	7.4	7.9-6.9	7.2	7.8-6.5	7.6	8.4-6.7	7.5	8.0-6.5	8.3	9.1-6.5	8.1	9.1-6.5	7.2	7.3-7.1	7.2	7.2-7.1	7.1	7.4-6.8	nd	nd	nd	nd
Rivers	04 Coeur d'Alene River	9.3 - 12.0	7.0	7.0-7.0	6.9	7.0-6.9	7.0	7.0-7.0	7.1	7.2-7.1	7.2	7.2-7.2	7.2	7.2-7.2	7.1	7.1-6.9	7.3	7.4-7.0	7.2	7.3-7.0	7.4	7.6-6.9	7.6	7.8-7.0	7.3	7.7-6.8	7.2	7.5-6.4	7.6	7.6-7.5	7.2	7.2-7.1	7.2	7.2-7.2	7.1	7.1-7.0	7.1	7.1-6.9
	13 St. Joe River	9.3 - 12.1	6.9	6.9-6.8	7.0	7.0-6.9	7.1	7.1-7.0	7.2	7.2-7.2	7.1	7.1-7.0	7.2	7.2-7.2	7.1	7.1-7.1	6.9	7.0-6.9	7.1	7.1-7.1	7.0	7.1-7.0	7.0	7.0-7.0	7.1	7.3-6.9	7.0	7.0-6.9	7.0	7.0-7.0	7.1	7.1-7.1	6.9	6.9-6.9	7.0	7.0-7.0	6.9	6.9-6.9
	OVERALL MEAN =		7.01		6.95		6.99		7.12		7.09		7.16		7.13		7.11		7.15		7.28		7.27		7.40		7.22		7.13		7.09		7.12		7.09		6.98	
	Standard Deviation =		0.11		0.07		0.06		0.09		0.07		0.07		0.12		0.16		0.16		0.22		0.26		0.32		0.32		0.21		0.18		0.15		0.20		0.13	

	2000																										
LAKE SITES	Depth (m)	3/22		4/11		5/8		5/25		6/8		6/20		7/5		7/19		8/7		8/22		9/6		9/19	
		Mean	Range (H-L)																						
09 Round Lake	0.6 - 1.5	nd	nd	7.0	7.1-7.0	6.8	6.8-6.8	6.8	6.8-6.8	nd	nd	nd	nd	7.2	7.2-7.2	7.1	7.1-7.1	7.8	7.8-7.7	7.6	7.7-7.4	7.0	7.0-7.0	8.3	8.3-8.3
11 Chatcolet Lake shallow	0.6 - 0.9	nd	nd	7.0	7.0-7.0	6.8	6.8-6.8	6.8	6.8-6.8	nd	nd	7.2	7.2-7.2	7.2	7.2-7.2	7.8	7.8-7.8	9.2	9.2-9.1	9.4	9.4-9.3	6.9	6.9-6.9	7.1	7.1-7.1
01 Rockford Bay	10.4 - 13.6	6.8	6.9-6.8	nd	nd	6.8	6.9-6.7	nd	nd	nd	nd	7.3	7.3-7.1	7.3	7.5-6.7	7.4	7.5-7.0	7.5	7.7-7.1	7.4	7.5-6.8	7.2	7.4-6.4	7.4	7.5-7.2
02 Windy Bay shallow	14.8- 16.2	6.9	6.9-6.8	nd	nd	nd	nd	6.8	7.0-6.7	nd	nd	7.1	7.3-6.7	7.3	7.5-6.7	7.2	7.6-6.5	7.3	7.7-6.5	7.3	7.6-6.7	7.0	7.5-6.4	7.3	7.5-7.0
06 Carey Bay	12.4 - 13.4	6.9	7.0-6.8	7.0	7.0-6.9	6.8	7.1-6.6	6.7	7.0-6.5	nd	nd	7	7.3-6.7	7.1	7.4-6.8	7.4	7.7-6.5	7.1	7.7-6.5	7.3	7.7-6.8	7.1	7.6-6.5	7.5	8.0-6.6
03 Windy Bay deep	30.2 - 31.4	6.9	7.0-6.8	nd	nd	6.8	7.0-6.6	6.8	7.0-6.6	nd	nd	6.9	7.4-6.7	6.9	7.5-6.5	6.8	7.5-6.4	6.9	7.6-6.5	6.9	7.5-6.4	6.7	7.5-6.4	6.9	7.5-6.4
05 Mid Lake Coeur d'Alene	18.2 - 19.4	6.9	7.0-6.9	7.0	7.0-6.8	6.7	7.1-6.6	6.7	7.0-6.5	nd	nd	6.9	7.4-6.6	7.0	7.4-6.5	7.0	7.7-6.4	7.1	7.8-6.5	7.1	7.8-6.4	7.0	7.6-6.3	7.2	8.0-6.3
07 Conkling Park	14.7 - 15.8	6.9	6.9-6.9	7.0	7.0-6.8	6.8	7.0-6.5	6.8	7.0-6.5	nd	nd	6.8	7.2-6.5	7.0	7.3-6.4	7.2	7.6-6.3	7.0	7.6-6.4	7.1	7.8-6.5	7.2	7.7-6.3	7.6	8.2-6.4
08 Hidden Lake	7.9 - 8.5	nd	nd	7.0	7.0-6.9	6.9	6.9-6.8	6.9	7.0-6.8	6.8	7.1-6.4	7.0	7.3-6.7	7.0	7.5-6.4	7.3	7.9-6.3	7.9	8.7-6.9	7.7	8.5-6.9	7.2	7.5-6.6	7.5	8.4-6.5
10 Chatcolet Lake deep	10.1 - 10.9	6.9	6.9-6.8	6.9	6.9-6.7	6.8	6.9-6.7	6.7	6.9-6.4	nd	nd	7.0	7.2-6.8	6.8	7.4-6.3	6.9	8.0-6.2	7.5	8.5-6.4	7.4	8.5-6.6	7.1	7.5-6.7	7.3	8.2-6.5
12 Benewah Lake	4.6 - 5.1	nd	nd	6.6	6.9-6.3	6.6	6.8-6.2	6.6	7.0-6.1	6.8	7.3-6.1	7	7.5-6.4	7.4	7.9-6.3	8.2	9.0-6.4	8.0	8.7-6.4	7.5	7.8-6.9	7.3	7.3-7.3	7.9	9.0-6.5
04 Coeur d'Alene River)	9.9 - 12.	6.9	6.9-6.9	7.0	7.0-6.9	6.9	7.0-6.8	6.9	7.0-6.6	nd	nd	7.1	7.4-6.8	7.2	7.4-6.7	7.4	7.7-7.1	7.5	7.8-7.0	7.5	7.7-7.1	7.5	7.6-7.3	7.6	7.7-7.5
13 St. Joe River	10.0-11.5	6.9	6.9-6.9	7.1	7.1-7.0	6.8	6.8-6.8	6.8	6.8-6.8	6.9	6.9-6.9	7.1	7.2-7.1	7	7.1-7.0	7.0	7.1-6.9	6.9	7.2-6.7	7.1	7.1-7.1	7	7.0-7.0	7.1	7.3-7.0
OVERALL MEAN =		6.89		6.96		6.79		6.78		6.83		7.03		7.11		7.28		7.52		7.48		7.09		7.44	
Standard Deviation =		0.03		0.13		0.08		0.09		0.06		0.14		0.18		0.38		0.63		0.62		0.20		0.37	

	2001																								
LAKE SITES	Depth (m)	5/15		5/31		6/13		6/25		7/10		7/23		8/9		8/24		9/5		10/1		10/19	
		Mean	Range (H-L)																						
09 Round Lake	0.9 - 1.8	7.3	7.3-7.3	7.3	7.3-7.3	7.1	7.1-7.1	7.1	7.1-7.1	7.2	7.2-7.2	7.5	7.5-7.4	7.8	7.8-7.7	7.0	7.0-7.0	7.2	7.2-7.2	7.2	7.2-7.2	7.2	7.2-7.2
11 Chatcolet Lake shallow	0.4 - 1.5	7.2	7.2-7.2	7.9	7.9-7.9	7.1	7.1-7.1	7.0	7.0-7.0	7.5	7.5-7.5	8.4	8.8-8.0	9.6	9.6-9.5	6.8	6.8-6.8	7.2	7.2-7.2	7.3	7.3-7.3	8.8	8.8-8.8
01 Rockford Bay	11.2 - 16.0	7.1	7.2-7.0	7.2	7.3-7.2	7.4	7.4-7.2	7.4	7.6-6.9	7.4	7.6-6.9	7.4	7.7-6.9	7.8	7.8-7.8	7.6	7.7-7.4	7.6	7.7-7.3	7.4	7.4-7.3	7.1	7.2-7.0
02 Windy Bay shallow	14.4 - 15.9	7.1	7.2-7.0	7.4	7.4-7.2	7.3	7.3-7.1	7.6	7.6-7.2	7.2	8.1-6.3	7.5	7.6-6.9	7.9	7.8-7.3	7.6	7.7-7.2	7.5	7.8-6.7	7.3	7.5-6.6	7.0	7.0-7.0
06 Carey Bay	9.4 - 13.0	7.0	7.2-6.8	7.3	7.4-7.0	7.3	7.4-7.1	7.7	8.1-7.4	8.1	8.3-7.8	7.8	8.0-7.6	7.9	8.0-7.6	7.7	7.8-6.9	7.3	7.7-6.6	7.2	7.3-7.1	6.6	6.9-6.4
03 Windy Bay deep	26.2 - 31.0	7.1	7.2-7.0	7.1	7.4-6.9	7.1	7.4-6.8	7.5	7.8-6.8	7.2	8.0-6.6	7.0	7.8-6.5	7.3	8.0-6.5	7.2	7.8-6.5	7.1	7.9-6.6	6.9	7.5-6.4	6.9	7.0-6.4
05 Mid Lake Coeur d'Alene	15.6 - 19.0	7.0	7.2-6.8	7.1	7.4-6.9	7.1	7.3-6.8	7.5	7.5-6.7	7.7	8.1-6.7	7.5	7.8-6.5	7.6	7.9-6.7	7.4	7.8-6.5	7.2	7.9-6.5	7.1	7.3-6.4	6.7	6.9-6.4
07 Conkling Park	12.0 - 15.9	7.1	7.2-6.9	7.0	7.3-6.8	7.1	7.2-6.7	7.6	8.0-7.2	7.9	8.3-6.9	7.5	7.8-6.6	7.8	8.1-6.8	7.5	7.8-6.8	7.1	7.7-6.5	7.2	7.4-6.9	6.8	7.1-6.4
08 Hidden Lake	6.7 - 8.1	7.0	7.2-6.8	6.9	7.2-6.6	6.9	7.2-6.3	7.1	7.6-6.2	7.5	8.0-6.5	7.4	8.0-6.3	8.1	8.6-6.7	7.4	7.8-6.4	7.7	8.2-6.8	7.4	7.4-7.3	7.2	7.2-7.1
10 Chatcolet Lake deep	9.4 - 12.0	7.1	7.1-7.1	7.0	7.2-6.9	7.1	7.3-6.6	6.8	7.2-6.3	nd	nd	7.3	7.9-6.3	7.5	8.5-6.5	7.3	8.1-6.3	7.2	7.6-6.6	7.0	7.1-6.6	7.3	7.3-7.2
12 Benewah Lake	3.8 - 4.9	6.9	7.0-6.9	7.1	7.3-6.8	7.3	7.5-6.8	8.0	8.3-7.6	8.3	8.9-7.3	8.6	9.0-7.5	9.1	9.2-8.6	7.8	8.5-6.8	7.8	7.8-7.6	7.4	7.4-7.3	7.1	7.2-7.1
04 Coeur d'Alene River	7.8 - 11.4	7.0	7.2-6.9	7.3	7.5-7.1	7.2	7.3-6.9	7.5	7.7-7.5	8.0	8.2-7.8	7.6	7.8-7.3	7.7	7.9-7.5	7.5	7.6-7.3	7.6	7.8-7.4	7.3	7.4-7.3	7.0	7.1-6.9
13 St. Joe River	15.0 - 20.4	7.3	7.3-7.2	7.2	7.2-7.2	7.0	7.1-7.0	7.0	7.1-6.9	6.9	7.4-6.6	6.7	7.0-6.3	6.8	7.2-6.4	6.5	6.9-6.3	7.0	7.1-6.6	7.0	7.2-7.0	7.0	7.0-7.0
OVERALL MEAN =		7.09		7.22		7.15		7.37		7.58		7.55		7.92		7.33		7.35		7.21		7.13	
Standard Deviation =		0.12		0.25		0.14		0.34		0.43		0.50		0.72		0.37		0.26		0.17		0.54	

Table A-5. Summarized Conductivity data for all Coeur d'Alene Lake stations for 1999 - 2001.

Mean and surface to bottom range of Conductivity values Measurement units = us/cm nd = no data

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

HABITAT AREAS	LAKE SITES	1999 Depth (m)	2/26 Mean	2/26 Range (H-L)	3/11	3/11	3/24	3/24	4/8	4/8	4/23	4/23	5/6	5/6	5/24	5/24	6/18	6/18	6/30	6/30	7/20	7/20	7/26	7/26	8/9	8/9	8/24	8/24
Shallow Water	09 Round Lake	0.4 - 0.9	57.0	64.8-55.3	56.5	57.8-55.9	56.0	56.3-55.7	47.0	49.3-45.8	46.2	49.7-42.1	49.2	50.6-48.2	42.5	45.3-38.5	41.8	48.8-33.6	38.3	45-35.1	39.3	44-36.4	37.8	41.6-35.4	42.9	46.8-39.5	39.0	43.5-36
	11 Chatcolet Lake shallow	0.4 - 0.9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	35.5	35.6-35.4	31.2	31.3-31.1	24.8	24.9-24.8	nd	nd	35.3	35.4-35.2	38.0	38-37.9	49.1	49.2-49	52.6	52.7-52.5
Shallow Bays	01 Rockford Bay	12.2 - 13.8	51.8	52.8-50.4	54.1	54.6-53.5	50.3	51.6-49.5	48.1	48.6-47.6	47.0	48.5-45.4	48.5	50.5-45.2	40.8	43.1-38.0	39.4	40.3-38.3	35.3	36.4-34.9	37.6	38.2-36.9	36.7	37.4-36.1	42.3	43.5-40.1	41.1	45.3-13
	02 Windy Bay shallow	14.4 - 15.8	60.8	62.0-60.2	57.0	57.6-56.5	55.4	56.4-53.8	48.3	48.4-48.0	45.0	48.3-43.3	49.1	50.5-48.3	43.3	44.7-41.0	39.1	42.9-37.0	35.8	36.8-35.3	37.5	38-36.9	36.1	37.3-34.9	42.2	43.6-40.1	39.1	41.3-36.5
	06 Carey Bay	11.0 - 13.4	51.7	56.2-49.3	43.1	46.5-42.4	45.2	47.1-44.5	36.9	38.3-36.4	39.8	46.0-7.4	38.0	40.4-36.7	43.2	47.9-40.1	35.1	37.4-32.0	32.0	39.1-30.6	36.1	37.4-35	35.1	36.4-34.1	42.1	45.7-38.3	44.1	46.2-39.8
Deep Open Water	03 Windy Bay deep	29.7 - 30.7	57.0	64.8-55.3	56.5	57.8-55.9	56.0	56.4-55.7	47.0	49.3-45.8	46.2	49.7-42.1	49.2	50.6-48.2	42.5	45.2-38.5	41.8	48.4-33.6	38.3	45-35.1	39.3	44-36.4	37.8	41.6-35.4	42.9	46.8-39.5	39.0	43.5-36
	05 Mid Lake Coeur d'Alene	18.1 - 18.9	51.7	52.4-51.1	40.5	41.1-40.2	44.8	45.5-44.4	36.9	37.7-35.3	42.0	49.0-37.5	38.5	48.6-36.0	40.1	46.8-33.1	36.9	44.0-30.6	31.7	40.6-28	36.4	40.9-33.3	35.9	40.4-33	40.6	45.4-37.7	39.7	43.3-36.8
	07 Conkling Park	13.6 - 15.5	37.7	38.2-37.4	43.4	43.8-43.1	41.1	44.7-38.2	38.6	39.8-36.6	37.1	44.1-33.7	36.6	39.6-35.6	40.8	47.8-34.2	32.2	38.4-28.7	31.2	32.9-30.7	35.4	36.8-34.5	34.9	36.2-32.5	41.7	56-38.1	43.8	47.3-40.4
Shallow Chain Lakes	08 Hidden Lake	7.2 - 8.3	nd	nd	nd	nd	nd	nd	37.3	37.7-36.9	34.9	37.5-33.7	35.7	36.0-35.5	34.9	35.4-34.4	29.1	31.3-28.1	30.5	31.3-29.8	32.0	33.7-29.6	30.9	34.9-10.36	41.6	62.7-34	43.7	65.4-36.7
	10 Chatcolet Lake deep	8.8 - 10.5	35.9	40.3-34.9	43.5	44.1-43.1	36.6	37.5-36.0	39.0	40.7-38.1	34.6	37.2-32.4	35.2	35.3-35.0	35.1	37.1-33.1	27.8	31.8-25.6	30.6	31.1-30.1	33.3	34.3-31.8	33.9	35.9-31.7	40.6	46.4-36.8	44.4	54.4-40.1
	12 Benewah Lake	3.9 - 4.6	nd	nd	nd	nd	nd	nd	28.5	29.0-28.3	30.9	33.3-29.9	32.6	32.9-32.4	35.8	39.1-34.4	32.4	34.9-29.5	33.6	36.9-32.6	35.8	41-34.5	37.0	46.1-35.5	46.6	63.7-43.8	48.3	62.5-44.8
Rivers	04 Coeur d'Alene River	9.3 - 12.0	58.0	59.0-57.3	52.1	52.5-51.7	44.9	45.3-44.2	45.0	50.6-11.2	33.5	36.6-6.6	38.7	39.7-38.2	33.2	33.7-32.6	38.8	39.8-38.0	38.8	40.1-36.2	44.3	56.9-35.3	42.0	60.7-35.1	46.8	61.2-39.5	46.5	51.3-37.6
	13 St. Joe River	9.3 - 12.1	34.4	34.8-34.1	49.0	49.3-48.8	36.4	36.7-36.2	42.6	43.1-42.3	34.2	34.7-33.9	35.6	36.1-35.1	31.0	31.3-30.7	24.7	34.8-34.4	32.6	32.9-32.3	35.8	35.9-35.7	38.5	39-38.2	49.2	49.5-48.8	52.2	52.4-52.1
	OVERALL MEAN =		49.6		49.58		46.67		41.27		39.28		40.19		38.03		34.125		34.05		36.77		36.49		43.73		44.12	
	Standard Deviation =		9.874		6.478		7.519		6.093		5.798		6.31		4.631		6.1069		3.122		3.047		2.641		3.078		4.71	

LAKE SITES	2000 Depth (m)	3/22 Mean	3/22 Range (H-L)	4/11	4/11	5/8	5/8	5/25	5/25	6/8	6/8	6/20	6/20	7/5	7/5	7/19	7/19	8/7	8/7	8/22	8/22	9/6	9/6	9/19	9/19
09 Round Lake	0.6 - 1.5	50.6	51.4-47.1	nd	nd	40.2	41.1-39.7	nd	nd	39.4	40-38.9	40.0	40.8-37.5	40.4	42.3-37.7	42.15	43.6-39.3	nd	nd	42.9	43.6-38.8	44.9	45.8-40.2	48.1	48.7-47.6
11 Chatcolet Lake shallow	0.6 - 0.9	nd	nd	35.6	35.6-35.5	33.6	33.6-33.5	27.9	28-27.8	nd	nd	35.1	35.2-35.1	43.2	43.2-43.1	45.03	45.1-45	57.9	58.1-57.6	65.4	65.6-65.3	59.0	59-58.9	59.7	59.8-59.5
01 Rockford Bay	10.4 - 13.6	50.6	51.4-47.1	nd	nd	40.2	41.1-39.7	nd	nd	nd	nd	39.4	40-38.7	40.0	40.8-37.5	40.45	42.3-37.7	42.2	43.6-39.3	42.9	43.6-38.8	44.9	45.8-40.2	48.1	48.7-47.7
02 Windy Bay shallow	14.8- 16.2	58.0	59.1-57.1	nd	nd	40.5	41.6-39.4	38.9	39.3-38.5	nd	nd	39.4	40.4-38.5	39.2	40.2-38	40.14	41.7-38.3	42.7	44.9-39.2	42.7	44-38.4	43.9	45.9-40	48.9	49.5-48.5
06 Carey Bay	12.4 - 13.4	44.5	47.6-43.2	39.3	40.2-38.4	37.4	45.1-34.9	36.1	40.5-32.7	nd	nd	35.0	38-33.5	40.1	42.1-37.6	41.46	45.3-37.4	43.2	46.9-40	48.5	50.8-43.8	46.6	48.5-41.8	53.0	54.1-51.4
03 Windy Bay deep	30.2 - 31.4	54.5	56.6-52.8	nd	nd	39.7	43.5-37.4	38.9	42.1-37.5	nd	nd	40.7	45.2-38.7	41.2	45.5-37.7	41.78	45.3-38.3	43.0	45.8-38.9	42.6	44.7-38	44.6	46.4-40.7	47.7	49.3-45
05 Mid Lake Coeur d'Alene	18.2 - 19.4	42.3	43.3-41.8	35.6	41-33.5	37.9	47.3-31.3	36.9	43.9-30	nd	nd	37.1	43.4-32.5	41.5	45.6-40.1	40.46	43.8-37.1	42.8	47.2-38.9	44.1	49.8-38.8	46.1	49.4-41.9	51.3	55.8-45.4
07 Conkling Park	14.7 - 15.8	41.5	42.8-40.9	36.9	40.4-35.1	37.6	49.1-32.4	34.0	41.1-29.6	nd	nd	35.8	41.5-32.7	39.8	43-37	41.28	44.7-37.8	43.1	47.1-39.1	48.6	54.4-43.7	47.3	49.7-40.9	50.1	51.9-47.9
08 Hidden Lake	7.9 - 8.5	nd	nd	34.1	34.4-33.4	32.3	32.6-31.7	30.1	30.3-29.7	32.9	33.8-32	34.1	34.6-33.7	38.2	40.3-35.8	38.07	42.8-34.1	51.5	94-40.4	60.2	107.5-50.9	52.7	84.7-48	51.9	58.2-49
10 Chatcolet Lake deep	10.1 - 10.9	39.0	40.7-38.5	34.8	36.1-32.2	32.5	33.1-31.6	30.6	33.9-29.4	nd	nd	34.0	34.6-33.3	38.5	41.4-35.9	37.85	41.6-34.4	44.7	55.6-38.1	52.6	70.4-46.7	52.8	75.3-47.6	55.4	62.1-53.6
12 Benewah Lake	4.6 - 5.1	nd	nd	28.4	28.8-27.9	34.2	36-33.2	34.1	42.1-31.7	35.9	47.6-33.6	37.8	44.7-35.6	42.8	57-39.4	45.32	62.5-42.4	50.8	64-48.4	54.2	57.4-53.5	51.3	51.6-50.8	52.0	55.9-50.3
04 Coeur d'Alene River)	9.9 - 12.	46.8	47.6-46	42.0	42.7-41.4	37.1	39.1-32.7	35.7	38.3-33.4	nd	nd	38.9	52.7-34.7	45.1	64.7-39.4	46.14	55.1-39.8	48.6	64-41.4	51.1	58.5-48.5	60.2	85.4-52.3	59.7	62.8-55.5
13 St. Joe River	10.0-11.5	40.0	40.4-39.2	34.8	35.6-34.3	33.5	34.1-33.3	27.9	28.3-27.6	31.3	31.7-30.7	34.4	34.8-33.7	43.7	43.9-43.5	46.43	46.8-46.2	55.0	55.4-53	62.2	62.6-61.8	58.1	58.7-57.6	56.8	57.5-56.2
OVERALL MEAN =		46.78		35.72		36.67		33.73		34.86		37.05		41.05		42.04		47.12		50.61		50.17		52.50	
Standard Deviation =		6.45		3.74		3.08		4.04		3.55		2.43		2.10		2.87		5.47		7.96		5.92		4.23	

LAKE SITES	2001 Depth (m)	5/15 Mean	5/15 Range (H-L)	5/31	5/31	6/13	6/13	6/25	6/25	7/10	7/10	7/23	7/23	8/9	8/9	8/24	8/24	9/5	9/5	10/1	10/1	10/19	10/19
09 Round Lake	0.9 - 1.8	30.8	30.8	31.5	31.5	38.8	38.8-38.7	46.6	46.6-46.5	54.6	54.7-54.5	55.3	56.1-54.5	56.3	56.4-56.2	65.4	65.6-65.1	60.2	60.3-60.1	68.0	68.1-67.8	63.7	63.8-63.5
11 Chatcolet Lake shallow	0.4 - 1.5	30.8	30.8	31.6	31.6	38.8	38.8-38.7	46.3	46.4-46.1	54.4	54.4	56.5	56.7-56.3	62.4	62.5-62.3	66.0	66.0	59.2	59.2	68.2	68.2	60.3	60.3
01 Rockford Bay	11.2 - 16.0	55.4	56.3-54.6	51.0	51.7-49.8	44.8	45.8-44.1	48.1	48.5-47.8	49.8	51.1-48.3	54.6	66.2-45.5	47.3	47.7-46.8	nd	nd	46.2	48.3-44.7	56.6	56.9-56.1	54.1	54.7-53.7
02 Windy Bay shallow	14.4 - 15.9	58.1	59.4-57	45.4	50.9-41.2	45.2	46.2-44.2	48.2	50.2-47.2	44.9	49.0-40.2	49.7	57.3-46.1	48.0	48.9-45.7	nd	nd	46.9	48.2-45	56.3	57.4-52.9	56.6	57-56.1
06 Carey Bay	9.4 - 13.0	46.4	55.3-41.3	42.4	48.5-36.9	42.2	44.9-39.9	46.5	49.2-45.5	49.3	50.4-47.2	48.2	49.7-47.5	49.1	50.1-47.2	nd	nd	48.4	51.1-45.5	60.3	60.6-59.7	56.7	58.2-54.8
03 Windy Bay deep	26.2 - 31.0	56.4	56.8-55.5	50.9	53.9-42.6	46.4	50.4-43	48.9	52.5-47	51.1	54.2-48.1	46.9	50.1-42.6	47.5	49.7-44.3	nd	nd	47.2	48.8-44.6	55.6	58.1-52.9	55.4	56.7-52.3
05 Mid Lake Coeur d'Alene	15.6 - 19.0	46.4	58.4-37.8	49.1	54.5-33.8	43.9	49.2-37.8	48.5	52.1-45.7	49.4	52.2-47.2	48.5	49.1-47.7	48.0	50.9-43.9	nd	nd	48.4	51.4-44.9	59.5	61.2-54.7	56.5	58.8-52.2
07 Conkling Park	12.0 - 15.9	37.5	48.1-33.7	41.9	52.5-33.5	41.9	47-35.9	45.4	46.9-44.1	49.3	52.5-48.2	46.4	48.1-44.3	48.8	50.1-45.5	nd	nd	49.3	52.9-45.9	60.6	61.7-58.3	56.8	59-54.7
08 Hidden Lake	6.7 - 8.1	36.1	38.2-35.4	32.5	33.1-31.7	33.8	34.1-32	39.6	42.4-35.7	43.8	48.5-38.5	47.8	49.4-46.8	47.2	48.9-43.5	60.6	93.4-54.6	51.3	52-50.9	60.3	60.6-59.6	57.9	58.2-57.5
10 Chatcolet Lake deep	9.4 - 12.0	33.1	34.7-31.2	32.2	33-31.3	35.8	37.2-33.6	41.1	44.1-38.7	nd	nd	52.9	56.8-45.3	52.1	68.2-45	66.7	90.8-52.6	54.6	68.3-51	64.1	81.2-61.3	59.1	60.1-58.6
12 Benewah Lake	3.8 - 4.9	36.5	37.2-35.9	37.6	44.9-35.5	36.8	39.2-35.8	41.8	43.3-41.3	46.4	47.1-45.4	55.9	63.1-53.5	46.5	47.3-45.3	54.2	57.4-52.7	49.3	49.6-49.1	58.6	58.7-58.3	55.4	55.5-55.1
04 Coeur d'Alene River	7.8 - 11.4	38.6	39.5-37.6	44.1	49.9-34.9	44.3	46.6-42.3	50.7	55.9-46.6	53.2	72.1-48.0	52.9	58.2-45.7	54.3	57.3-46.8	60.2	67.9-57.7	53.5	54.9-49.5	65.9	76.7-61.6	67.7	101.6-60.2
13 St. Joe River	15.0 - 20.4	30.3	30.4-30.1	31.4	31.8-30.7	39.1	39.6-38.8	46.7	47.4-45.8	52.7	55.0-50.5	63.9	74.1-56.1	60.1	89.3-53.5	73.2	112.4-63.2	61.0	64.6-59.4	68.5	69.2-68	64.0	64.5-63.2

Table A-6. Summarized Dissolved Phosphorus data for all Coeur d'Alene Lake stations for 1999 - 2001.

"Upper" are results from the 1 meter depth; "Lower" are results from a composite sample below the thermocline.

Measurement units = mg/L

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

		1999																	
HABITAT AREAS	**LAKE SITES**	3/11		4/8		5/24		6/30		7/26		8/24		9/29		10/20		11/14	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
Shallow Water	**09 Round Lake**	nd	nd	nd	nd	<0.010	nd	<0.020	nd	<0.020	nd	<0.010	nd	<0.010	nd	nd	nd	nd	nd
	11 Chatcolet Lake shallow	nd	nd	nd	nd	<0.010	nd	nd	nd	<0.020	nd	<0.010	nd	<0.010	nd	nd	nd	nd	nd
Shallow Bays	**01 Rockford Bay**	<0.020	<0.020	<0.020	<0.020	<0.010	nd	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	02 Windy Bay shallow	<0.020	<0.020	<0.020	<0.020	<0.010	nd	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	06 Carey Bay	<0.020	<0.020	<0.020	<0.020	<0.010	nd	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Deep Open Water	**03 Windy Bay deep**	<0.020	<0.020	<0.020	<0.020	<0.010	nd	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	05 Mid Lake Coeur d'Alene	<0.020	<0.020	<0.020	<0.020	<0.010	nd	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	07 Conkling Park	<0.020	<0.020	<0.020	<0.020	<0.010	nd	<0.020	nd	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Shallow Chain Lakes	**08 Hidden Lake**	nd	nd	<0.020	<0.020	<0.010	nd	<0.020	nd	<0.020	<0.020	<0.010	<0.010	<0.010	nd	<0.010	<0.010	<0.010	<0.010
	10 Chatcolet Lake deep	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	0.058	nd	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	12 Benewah Lake	nd	nd	<0.020	<0.020	<0.010	nd	<0.020	nd	<0.020	nd	<0.010	nd	<0.010	nd	nd	nd	nd	nd
Rivers	**04 Coeur d'Alene River**	<0.020	<0.020	<0.020	<0.020	<0.010	nd	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	13 St. Joe River	<0.020	nd	<0.020	<0.020	<0.010	nd	<0.020	nd	<0.020	nd	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010

		2000													
HABITAT AREAS	**LAKE SITES**	3/22		5/8		6/8		6/20		7/19		8/22		9/19	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
Shallow Water	**09 Round Lake**	nd	nd	<0.020	nd	nd	nd	<0.020	nd	<0.020	nd	<0.020	nd	0.135	nd
	11 Chatcolet Lake shallow	nd	nd	<0.006	nd	nd	nd	<0.006	nd	<0.006	nd	<0.006	nd	<0.006	nd
Shallow Bays	**01 Rockford Bay**	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	02 Windy Bay shallow	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	06 Carey Bay	<0.006	0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Deep Open Water	**03 Windy Bay deep**	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	05 Mid Lake Coeur d'Alene	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	07 Conkling Park	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Shallow Chain Lakes	**08 Hidden Lake**	nd	nd	<0.006	<0.006	<0.006	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	10 Chatcolet Lake deep	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	12 Benewah Lake	nd	nd	<0.006	<0.006	<0.006	nd	<0.006	<0.006	<0.006	<0.006	<0.006	nd	<0.006	nd
Rivers	**04 Coeur d'Alene River**	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	13 St. Joe River	<0.006	<0.006	<0.006	<0.006	<0.006	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006

		2001											
HABITAT AREAS	**LAKE SITES**	5/15		6/13		7/10		8/9		9/5		10/1	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
Shallow Water	**09 Round Lake**	0.011	nd	<0.005	nd	<0.005	nd	0.012	nd	<0.005	nd	<0.005	nd
	11 Chatcolet Lake shallow	0.011	nd	<0.005	nd	<0.005	nd	0.014	nd	<0.005	nd	<0.005	nd
Shallow Bays	**01 Rockford Bay**	<0.010	nd	<0.006	nd	<0.006	<0.006	<0.006	nd	<0.006	<0.006	<0.006	nd
	02 Windy Bay shallow	<0.010	nd	<0.006	nd	<0.006	<0.006	<0.006	<0.006	<0.006	nd	<0.006	<0.006
	06 Carey Bay	<0.010	nd	<0.006	nd	<0.006	nd	<0.006	nd	<0.006	<0.006	<0.006	nd
Deep Open Water	**03 Windy Bay deep**	<0.010	nd	<0.006	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	05 Mid Lake Coeur d'Alene	<0.010	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
	07 Conkling Park	<0.010	nd	<0.006	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	nd
Shallow Chain Lakes	**08 Hidden Lake**	<0.010	<0.010	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	nd	<0.006	nd
	10 Chatcolet Lake deep	<0.010	nd	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	nd
	12 Benewah Lake	<0.010	<0.010	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	nd	<0.006	nd
Rivers	**04 Coeur d'Alene River**	<0.010	nd	<0.006	nd	<0.006	<0.006	<0.006	<0.006	<0.006	nd	<0.006	nd
	13 St. Joe River	<0.010	nd	<0.006	<0.006	<0.006	nd	<0.006	nd	<0.006	<0.006	<0.006	nd

Table A-7. Summarized Total Phosphorus (TP) data for all Coeur d'Alene Lake stations for 1999 - 2001.

"Upper" are results from the 1 meter depth; "Lower" are results from a composite sample below the thermocline.
Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = mg/L
nd = no data

1999

HABITAT AREAS	LAKE SITES	3/11		4/8		5/24		6/30		7/26		8/24		9/29		10/20		11/14	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
Shallow Water	**09 Round Lake**	nd	nd	nd	nd	nd	nd	0.007	nd	<0.005	nd	0.006	nd	0.015	nd	nd	nd	nd	nd
	11 Chatcolet Lake shallow	nd	nd	nd	nd	<0.005	nd	nd	nd	0.006	nd	<0.005	nd	0.013	nd	nd	nd	nd	nd
Shallow Bays	**01 Rockford Bay**	<0.005	<0.005	<0.005	<0.005	<0.005	nd	0.005	0.007	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	0.013
	02 Windy Bay shallow	<0.005	<0.005	<0.005	<0.005	<0.005	nd	0.006	0.005	0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	06 Carey Bay	0.011	0.010	<0.005	<0.005	<0.005	nd	<0.005	<0.005	<0.005	<0.005	0.006	0.006	<0.005	<0.005	<0.005	0.007	0.007	0.007
Deep Open Water	**03 Windy Bay deep**	<0.005	<0.005	<0.005	<0.005	<0.005	nd	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	05 Mid Lake Coeur d'Alene	0.007	0.006	<0.005	<0.005	<0.005	nd	<0.005	<0.005	0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.008	0.008	<0.005
	07 Conkling Park	<0.005	0.009	<0.005	<0.005	<0.005	nd	<0.005	nd	<0.005	<0.005	0.006	0.010	0.005	0.010	0.006	0.007	0.006	0.006
Shallow Chain Lakes	**08 Hidden Lake**	nd	nd	<0.005	<0.005	<0.005	nd	<0.005	nd	0.005	<0.005	0.007	0.009	0.007	nd	<0.005	<0.005	0.006	0.006
	10 Chatcolet Lake deep	0.007	0.011	<0.005	<0.005	<0.005	<0.005	<0.005	nd	0.008	<0.005	0.009	0.016	0.009	0.008	0.006	0.005	0.005	<0.005
	12 Benewah Lake	nd	nd	0.013	0.010	<0.005	nd	0.007	nd	0.007	nd	0.011	nd	0.012	nd	nd	nd	nd	nd
Rivers	**04 Coeur d'Alene River**	<0.005	0.010	<0.005	<0.005	<0.005	nd	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	13 St. Joe River	<0.005	nd	<0.005	<0.005	<0.005	nd	<0.005	nd	0.007	nd	<0.005	0.008	0.007	0.007	0.006	0.006	<0.005	<0.005

2000

HABITAT AREAS	LAKE SITES	3/22		5/8		6/8		6/20		7/19		8/22		9/19	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
Shallow Water	**09 Round Lake**	nd	nd	<0.005	nd	nd	nd	<0.005	nd	<0.005	nd	<0.005	nd	0.135	nd
	11 Chatcolet Lake shallow	nd	nd	<0.005	nd	nd	nd	<0.005	nd	0.017	nd	0.018	nd	0.031	nd
Shallow Bays	**01 Rockford Bay**	<0.005	0.011	<0.005	<0.005	nd	nd	0.008	<0.005	<0.005	<0.005	0.031	0.019	0.006	0.006
	02 Windy Bay shallow	0.012	0.025	<0.005	<0.005	nd	nd	<0.005	0.041	<0.005	0.007	0.022	0.012	0.007	0.017
	06 Carey Bay														
Deep Open Water	**03 Windy Bay deep**	0.015	0.011	<0.005	<0.005	nd	nd	<0.005	<0.005	0.009	0.008	0.007	0.024	0.007	0.007
	05 Mid Lake Coeur d'Alene	0.015	0.015	<0.005	<0.005	nd	nd	0.050	<0.005	<0.005	<0.005	0.025	0.023	0.009	0.009
	07 Conkling Park	<0.005	<0.005	<0.005	<0.005	nd	nd	0.013	<0.005	0.009	0.007	0.012	0.019	0.021	0.018
Shallow Chain Lakes	**08 Hidden Lake**	nd	nd	<0.005	<0.005	0.031	nd	0.012	0.009	0.012	0.007	0.020	0.077	0.038	0.072
	10 Chatcolet Lake deep	<0.005	<0.005	<0.005	<0.005	nd	nd	<0.005	<0.005	0.011	0.017	0.045	0.106	0.018	0.039
	12 Benewah Lake	nd	nd	<0.005	<0.005	0.006	nd	0.016	0.006	0.020	0.011	0.024	nd	0.042	nd
Rivers	**04 Coeur d'Alene River)**	0.012	0.022	<0.005	0.005	nd	nd	<0.005	<0.005	<0.005	<0.005	0.021	0.019	0.008	0.009
	13 St. Joe River	<0.005	<0.005	<0.005	<0.005	0.015	nd	<0.005	0.010	0.019	<0.005	0.027	0.015	0.043	0.017

2001

HABITAT AREAS	LAKE SITES	5/15		6/13		7/10		8/9		9/5		10/1	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
Shallow Water	**09 Round Lake**	0.007	nd	<0.005	nd	<0.005	<0.005	<0.005	nd	<0.005	<0.005	<0.005	nd
	11 Chatcolet Lake shallow	0.011	nd	<0.005	nd	0.008	nd	0.012	nd	0.0	nd	0.026	nd
Shallow Bays	**01 Rockford Bay**	0.007	nd	<0.005	nd	<0.005	<0.005	<0.005	nd	<0.005	<0.005	<0.005	nd
	02 Windy Bay shallow	0.013	nd	<0.005	nd	<0.005	<0.005	<0.005	nd	<0.005	<0.005	0.007	<0.005
	06 Carey Bay	0.021	nd	<0.005	nd	<0.005	nd	<0.005	nd	<0.005	<0.005	0.008	nd
Deep Open Water	**03 Windy Bay deep**	0.007	nd	<0.005	nd	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	<0.005
	05 Mid Lake Coeur d'Alene	0.015	nd	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.026	<0.005	0.014	<0.005
	07 Conkling Park	0.023	nd	<0.005	nd	<0.005	0.010	<0.005	0.016	0.007	<0.005	0.014	nd
Shallow Chain Lakes	**08 Hidden Lake**	0.024	0.013	<0.005	0.017	0.006	0.015	<0.005	<0.005	<0.005	nd	0.010	nd
	10 Chatcolet Lake deep	0.013	nd	0.006	0.019	<0.005	0.032	<0.005	0.171	0.014	0.057	0.017	nd
	12 Benewah Lake	0.030	0.031	0.050	0.010	<0.005	0.006	<0.005	0.007	0.012	nd	0.038	nd
Rivers	**04 Coeur d'Alene River**	0.010	nd	<0.005	nd	<0.005	<0.005	<0.005	<0.005	<0.005	nd	0.007	nd
	13 St. Joe River	0.010	nd	<0.005	<0.005	<0.005	nd	<0.005	nd	0.016	0.088	0.017	nd

Table A-8. Summarized Chlorophyll a data for all Coeur d'Alene Lake stations for 1999 - 2001.

"Upper" refers to a composite sample from above the thermocline, "Lower" refers to a composite sample from below the thermocline.

Note: analysis results that were below detection (<0.001) are reported here as 0.001 to allow calculation of mean and standard deviation.

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = µg/L

nd = no data

1999

	LAKE SITES	Depth (m)	3/11		4/8		5/24		6/30		7/26		8/24		9/29		10/20		11/14	
			"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
Shallow Water	**09 Round Lake**	0.4 - 0.9	nd	nd	nd	nd	0.700	nd	4.11	nd	0.01	nd	0.670	nd	2.59	nd	nd	nd	nd	nd
	11 Chatcolet Lake shallow	0.4 - 0.9	nd	nd	nd	nd	0.65	nd	nd	nd	4.15	nd	0.67	nd	2.60	nd	nd	nd	nd	nd
Shallow Bays	**01 Rockford Bay**	12.2 - 13.8	2.54	1.96	2.54	3.37	1.50	nd	1.45	2.99	2.34	0.750	1.38	1.96	1.96	0.01	1.36	1.41	0.690	1.69
	02 Windy Bay shallow	14.4 - 15.8	0.60	3.12	2.05	0.74	0.76	nd	2.73	2.81	0.01	0.01	0.01	0.01	1.43	0.69	0.01	0.98	0.69	0.68
	06 Carey Bay	11.0 - 13.4	1.98	0.66	0.01	0.63	2.06	0.69	2.07	0.69	0.71	0.76	1.41	0.68	nd	nd	0.66	3.43	2.40	0.70
Deep Open Water	**03 Windy Bay deep**	29.7 - 30.7	2.72	1.24	3.48	0.68	0.66	nd	2.10	0.66	0.01	1.14	1.32	0.01	1.41	0.67	0.01	2.08	0.01	1.38
	05 Mid Lake Coeur d'Alene	18.1 - 18.9	0.67	1.39	0.67	0.67	0.68	nd	0.01	0.01	1.49	0.69	0.01	2.59	1.33	nd	2.08	2.07	2.00	0.70
	07 Conkling Park	13.6 - 15.5	0.01	1.39	2.07	1.99	0.01	nd	0.01	nd	0.01	0.67	0.71	2.13	3.26	0.65	2.78	4.71	3.21	1.99
Shallow Chain Lakes	**08 Hidden Lake**	7.2 - 8.3	nd	nd	0.01	0.01	2.01	nd	1.31	nd	1.11	2.13	16.10	6.79	4.20	nd	4.85	3.72	3.36	4.61
	10 Chatcolet Lake deep	8.8 - 10.5	0.67	0.68	0.63	0.63	0.66	1.40	0.71	nd	0.01	2.20	3.42	2.82	6.46	5.87	7.89	7.87	2.64	2.06
	12 Benewah Lake	3.9 - 4.6	nd	nd	5.34	3.19	2.04	nd	2.88	nd	0.01	nd	12.50	nd	2.82	nd	nd	nd	nd	nd
Rivers	**04 Coeur d'Alene River**	9.3 - 12.0	1.86	0.01	2.07	1.92	0.66	nd	0.01	0.66	2.13	0.73	2.04	0.01	1.34	3.18	1.37	1.32	3.49	0.01
	13 St. Joe River	9.3 - 12.1	1.38	nd	2.04	1.34	1.35	nd	0.01	nd	0.01	nd	0.75	1.25	3.39	2.09	2.31	2.01	0.01	0.70
	OVERALL MEAN =		1.23	1.10	1.73	1.12	1.02	1.16	1.09	0.77	0.72	1.14	3.24	1.99	2.84	2.14	2.70	3.25	2.03	1.52
	Standard Deviation =		0.90	0.98	1.17	0.66	0.65	0.50	1.09	1.07	1.31	0.76	4.84	2.17	1.73	2.06	2.55	2.14	1.40	1.37

2000

LAKE SITES	Depth (m)	3/22		5/8		6/8		6/20		7/19		8/22		9/19	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
09 Round Lake	0.6 - 1.5	nd	nd	1.45	nd	nd	nd	0.01	nd	0.60	nd	0.65	nd	0.72	nd
11 Chatcolet Lake shallow	0.6 - 0.9	nd	nd	0.01	nd	nd	nd	0.01	nd	0.62	nd	0.66	nd	2.59	nd
01 Rockford Bay	10.4 - 13.6	0.70	0.01	0.66	0.01	nd	nd	0.68	1.35	0.01	0.63	0.01	1.35	0.68	0.65
02 Windy Bay shallow	14.8- 16.2	1.28	0.71	0.70	0.01	nd	nd	0.67	3.68	1.39	2.00	0.01	0.01	0.70	0.01
06 Carey Bay	12.4 - 13.4	0.68	1.45	2.03	2.66	nd	nd	1.36	0.01	0.01	0.01	1.43	1.32	0.67	2.74
03 Windy Bay deep	30.2 - 31.4	0.67	1.37	1.34	0.01	nd	nd	2.11	1.35	0.01	0.01	0.01	0.01	0.70	0.01
05 Mid Lake Coeur d'Alene	18.2 - 19.4	2.07	0.67	2.81	1.32	nd	nd	1.37	2.14	0.67	1.24	0.01	0.01	1.37	0.69
07 Conkling Park	14.7 - 15.8	1.33	0.70	1.37	0.01	nd	nd	0.01	0.01	0.01	1.16	2.03	0.01	2.71	0.72
08 Hidden Lake	7.9 - 8.5	nd	nd	0.01	0.69	0.63	nd	0.01	1.12	2.14	3.34	3.30	10.50	5.13	4.00
10 Chatcolet Lake deep	10.1 - 10.9	1.33	2.07	0.01	0.01	nd	nd	0.58	0.67	0.67	1.25	3.54	2.05	12.40	2.69
12 Benewah Lake	4.6 - 5.1	nd	nd	2.75	1.41	1.25	nd	1.15	1.23	3.34	4.21	7.66	nd	7.24	nd
04 Coeur d'Alene River)	9.9 - 12.	0.69	1.43	0.65	0.70	nd	nd	0.01	0.01	0.01	0.64	0.01	0.66	0.01	1.38
13 St. Joe River	10.0-11.5	1.34	2.13	1.32	0.01	0.01	nd	0.01	0.01	0.01	0.01	0.64	1.32	nd	0.01
OVERALL MEAN =		1.16	1.30	1.19	0.61	0.63	nd	0.69	1.01	0.77	1.40	1.59	1.99	3.04	1.36
Standard Deviation =		0.50	0.73	0.99	0.89	0.62	nd	0.70	1.14	0.99	1.45	2.30	3.20	3.83	1.42

2001

LAKE SITES	Depth (m)	5/15		6/13		7/10		8/9		9/5		10/1	
		"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"	"Upper"	"Lower"
09 Round Lake	0.9 - 1.8	0.01	nd	2.19	nd	1.54	nd	0.01	nd	2.08	nd	2.86	nd
11 Chatcolet Lake shallow	0.4 - 1.5	0.69	nd	0.70	nd	0.80	nd	3.60	nd	1.38	nd	3.60	nd
01 Rockford Bay	11.2 - 16.0	1.34	nd	2.66	nd	0.01	2.71	2.24	nd	0.01	2.10	0.07	nd
02 Windy Bay shallow	14.4 - 15.9	0.68	nd	3.36	nd	0.01	1.48	1.47	1.39	0.01	nd	0.01	0.01
06 Carey Bay	9.4 - 13.0	1.39	nd	1.46	nd	0.01	nd	0.74	nd	2.27	0.73	1.39	nd
03 Windy Bay deep	26.2 - 31.0	0.68	nd	3.43	nd	0.70	0.01	1.35	1.48	1.51	1.39	1.38	0.01
05 Mid Lake Coeur d'Alene	15.6 - 19.0	0.73	nd	0.70	0.68	0.01	1.51	0.01	2.24	0.73	1.42	1.40	1.41
07 Conkling Park	12.0 - 15.9	0.74	nd	1.47	nd	0.01	3.01	2.84	4.23	2.76	0.01	1.40	nd
08 Hidden Lake	6.7 - 8.1	2.08	2.02	1.44	5.60	0.73	4.77	0.70	5.47	3.01	nd	3.60	nd
10 Chatcolet Lake deep	9.4 - 12.0	1.36	nd	1.41	3.47	1.43	5.60	1.50	1.42	5.01	3.52	2.97	nd
12 Benewah Lake	3.8 - 4.9	2.84	2.91	0.69	2.21	1.50	1.46	2.24	4.36	5.60	nd	9.30	nd
04 Coeur d'Alene River	7.8 - 11.4	0.01	nd	2.90	nd	0.01	2.08	2.19	0.75	0.01	nd	0.07	nd
13 St. Joe River	15.0 - 20.4	2.17	nd	0.70	0.01	4.29	nd	1.54	nd	3.18	0.01	1.43	nd
OVERALL MEAN =		1.20	2.61	1.81	2.58	0.82	2.57	1.55	2.75	2.30	1.25	2.19	0.71
Standard Deviation =		0.84	0.63	1.02	2.24	1.20	1.75	1.06	1.76	1.80	0.96	2.46	0.99

Table A-9. Average discharge and base flows for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001. All flows in cubic feet per second (CFS).

	1999		2000		2001	
STREAM SITES	Average Discharge*	Base Flow**	Average Discharge*	Base Flow**	Average Discharge*	Base Flow**
Alder Cr.	36.48	1.49	24.97	4.11	8.34	0.36
N. Fork Alder Cr	18.73	nd	10.21	1.43	2.95	0.11
.						
Upper Benewah	7.74	0.72	5.38	0.45	2.52	0.20
Three Mile Benewah	77.59	3.47	42.81	6.44	1.32	0.04
Nine Mile Benewah Cr.	nd	nd	37.68	3.46	11.16	0.72
W. Fork Benewah Cr.	5.26	0.34	4.56	1.16	9.98	0.25
Schoolhouse Cr.	5.47	0.01	3.92	0.33	1.34	0.00
Whitetail Cr.	4.91	0.26	1.63	0.16	1.28	0.00
Windfall Cr.	6.37	0.01	3.51	0.49	2.08	0.00
Cherry Cr.	8.90	0.50	5.30	0.66	1.49	0.04
Evans Cr	26.16	7.31	28.22	5.86	6.42	1.20
Upper Evans Cr.	19.04	7.94	nd	nd	4.84	1.03
E. Fork Evans Cr.	2.00	1.11	6.44	0.50	nd	nd
Fighting Cr.	2.85	0.10	11.55	1.75	2.69	0.09
Hangman Cr.	141.03	51.62	nd	nd	nd	nd
Little Hangman Cr.	23.14	0.60	0.87	nd	nd	nd
Indian Cr.	4.60	0.44	5.48	1.20	2.49	0.08
Moctileme Cr.	nd	nd	4.22	0.45	3.65	0.08
Upper Lake Cr.	41.51	3.50	50.01	7.14	7.18	0.06
Lower Lake Cr.	nd	nd	174.22	6.60	51.86	9.03
Bozard Cr.	11.31	0.14	10.33	4.76	4.12	0.10
Plummer Cr.	28.75	0.90	7.81	1.24	16.21	0.03
Little Plummer Cr.	3.38	0.80	5.35	0.30	5.28	0.61
N. Fork Rock Cr.	nd	nd	nd	nd	0.80	0.00
Hatchery	1.83	0.19	9.12	0.46	4.77	0.00
Willow Cr.	nd	nd	7.14	1.62	1.62	0.07

* Average of all available data for year

** Lowest flow recorded during August - September period.

Table A-10. Summary of Temperature data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken) Measurement units = mg/L

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given nd = no data

1999	SAMPLE DATES							
STREAM SITES	**2/10**	**3/10**	**3/26**	**4/12**	**4/27**	**5/12**	**6/2**	**7/13**	**9/21**
Alder Cr.	0.17	1.42	3.54	4.78	5.09	5.89	8.55	15.91	3.66
N. Fork Alder Cr	0.13	2.67	nd	4.66	5.32	5.44	7.94	15.10	6.48
Upper Benewah	0.15	3.28	4.19	5.31	5.39	6.28	7.92	17.35	11.9
Three Mile Benewah	0.15	3.89	4.39	2.96	4.68	5.41	9.66	14.89	7.28
W. Fork Benewah	1.02	3.99	4.34	5.77	6.00	7.04	8.61	20.49	14.06
Schoolhouse Cr.	0.18	2.35	4.01	4.19	5.09	5.59	8.17	13.51	7.3
Whitetail Cr.	0.15	1.08	4.39	3.74	4.33	4.89	8.06	12.95	8.12
Windfall Cr.	0.13	1.43	4.29	4.39	4.46	5.34	8.42	15.07	10.68
Cherry Cr.	2.23	3.43	nd	4.21	nd	4.96	8.99	15.37	6.05
Evans Cr	2.03	3.71	3.84	3.63	nd	4.89	7.71	13.51	7.02
Upper Evans Cr.	nd	nd	nd	3.04	nd	4.24	6.15	10.39	6.21
E. Fork Evans Cr.	nd	nd	nd	2.70	nd	4.04	7.81	12.15	6.69
Fighting Cr.	0.32	3.78	3.41	3.44	nd	3.83	7.83	12.28	8.76
Hangman Cr.	0.49	5.49	3.11	5.21	6.54	9.73	14.7	20.04	7.92
Little Hangman Cr.	0.42	6.74	2.97	6.28	8.19	10.8	13.9	18.24	6.17
Indian Cr.	0.15	3.66	3.46	2.42	4.69	5.31	7.25	11.75	5.09
Moctileme Cr.	0.58	7.24	4.36	7.38	8.55	10.0	12.9	16.39	nd
Upper Lake Cr.	0.18	nd	nd	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	0.36	nd	nd	nd	nd	nd	nd	nd	nd
Bozard Cr.	0.23	2.72	1.86	2.70	nd	3.53	7.38	11.87	7.76
Plummer Cr.	0.51	3.88	5.31	7.07	9.20	8.01	11.2	16.44	5.42
Lower Little Plummer Cr.	nd	nd	nd	nd	8.94	6.82	12.0	14.06	6.23
N. Fork Rock Cr.	0.41	3.59	6.12	nd	nd	6.33	11.9	14.92	12.77
Hatchery	nd	nd	4.28	4.86	nd	8.19	10.6	15.19	nd
Willow Cr.	nd	nd	nd	6.05	nd	5.90	9.50	17.22	nd

Table A-10. Summary of Temperature data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = mg/L

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

2000	SAMPLE DATES														
STREAM SITES	**2/23**	**3/3**	**3/17**	**3/30**	**4/3**	**4/13**	**4/18**	**5/3**	**5/15**	**6/1**	**6/27**	**7/14**	**7/27**	**8/7**	**8/29**	**9/8**
Alder Cr.	nd	nd	2.76	2.95	2.88	nd	8.96	8.38	nd	14.33	16.70	18.77	20.02	14.60	15.66	nd
N. Fork Alder Cr	nd	nd	nd	nd	3.90	nd	8.21	7.69	nd	13.42	14.4	17.11	17.29	14.49	13.21	nd
.																
Upper Benewah	nd	nd	nd	nd	5.29	nd	8.37	8.63	9.19	13.39	16.73	17.6	19.2	15.17	12.27	nd
Three Mile Benewah	2.64	4.31	3.06	3.94	4.53	7.96	7.46	8.97	11.12	13.75	13.54	22.46	16.65	14.51	15.31	nd
Nine Mile Benewah Cr.	2.26	4.16	2.65	4.81	3.78	7.22	7.19	7.89	9.84	11.55	14.42	20.27	19.1	16.41	15.62	nd
W. Fork Benewah Cr.	nd	nd	nd	nd	5.98	nd	9.54	7.93	8.2	12.88	15.59	16.45	17.77	13.48	10.85	nd
Schoolhouse Cr.	nd	nd	nd	4.10	3.45	nd	7.61	7.65	10.41	11.63	15.56	13.39	14.53	13.12	9.99	nd
Whitetail Cr.	nd	nd	nd	5.16	3.81	nd	7.76	7.84	10.5	11.17	12.12	16.75	14.66	nd	11.9	nd
Windfall Cr.	nd	nd	nd	4.73	2.93	nd	7.97	7.88	10.38	12.23	14.36	nd	16.78	14.49	14.2	nd
Cherry Cr.	nd	nd	nd	nd	5.51	nd	6.20	6.14	8.53	9.19	12.58			14.04	9.14	11.89
Evans Cr	nd	nd	nd	nd	nd	6.38	7.08	8.38	8.4	7.25	12.40	nd	15.61	15.97	13.12	nd
Upper Evans Cr.	nd	nd	nd	nd	nd	5.20	5.92	nd	6.79	7.74	9.86	nd	nd	12.97	12.06	nd
E. Fork Evans Cr.	nd	nd	nd	nd	nd	5.41	6.58	7.7	7.32	7.05	10.53	nd	13.5	13.81	13.05	nd
Fighting Cr.	nd	nd	nd	nd	nd	7.03	6.43	6.48	8.08	7.41	12.30	nd	13.75	16.16	11.13	nd
Hangman Cr.	nd	nd	2.97	5.08	8.96	10.94	10.56	13.34	13.93	16.04	20.47	20.66	20.08	19.89	13.80	13.77
Little Hangman Cr.	nd	nd	nd	4.68	9.18	12.56	nd	12.68	13.95	14.83	19.43	17.48	17.78	18.29	12.41	11.96
Indian Cr.	nd	nd	nd	4.85	4.41	6.86	nd	7.45	7.12	7.78	10.82	12.02	13.45	nd	14.51	10.07
Moctileme Cr.	nd	nd	nd	4.41	9.63	12.23	nd	12.28	12.66		17.04	17.75	16.68	17.17	10.85	11.81
Upper Lake Cr.	nd	nd	nd	nd	nd	9.36	6.15	5.83	7.86	7.74	nd	nd	13.85	15.85	11.32	nd
Lower Lake Cr.	nd	nd	nd	nd	nd	7.02	5.22	6.59	nd	8.83	14.71	15.73	16.11	20.28	14.52	nd
Bozard Cr.	nd	nd	nd	nd	6.35	nd	5.54	5.54	6.79	7.17	11.13	nd	13.29	nd	9.54	nd
Plummer Cr.	nd	nd	nd	nd	6.19	nd	nd	9.1	11.15	13.19	17.31	16.23	20.09	nd	13.94	nd
Little Plummer Cr.	nd	nd	nd	nd	7.5	nd	6.07	8.12	10.02	12.38	21.32	15.01	nd	nd	nd	nd
N. Fork Rock Cr.	nd	nd	nd	nd	8.46	nd	nd	nd	11.12	13.32	18.12	18.75	13.87	nd	nd	nd
Hatchery	1.37	3.12	2.8	3.22	nd	11.16	nd	nd	14.11	nd	12.65	13.83	13.92	nd	nd	nd
Willow Cr.	nd	nd	nd	nd	nd	6.69	5.64	nd	10.77	9.34	15.96	nd	16.08	15.97	12.99	nd

Table A-10. Summary of Temperature data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = mg/L

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

2001	SAMPLE DATES														
STREAM SITES	**3/28**	**4/2**	**4/18**	**5/7**	**5/21**	**6/4**	**6/21**	**7/2**	**7/18**	**8/10**	**8/27**	**9/13**	**9/26**	**10/9**	**11/1**	**11/7**
Alder Cr.	nd	2.90	4.25	10.71	12.61	8.55	16.43	16.05	15.21	21.32	14.92	16.99	9.84	6.39	6.00	nd
N. Fork Alder Cr	nd	2.88	4.03	9.99	11.57	8.15	14.63	14.42	13.44	17.56	13.16	nd	9.88	6.33	5.88	nd
Upper Benewah	nd	2.89	4.16	9.69	12.63	7.46	16.7	14.39	15.21	17.25	12.25	13.82	10.77	6.90	nd	nd
W. Fork Benewah Cr.	nd	2.54	4.06	9.26	13.08	7.48	17.34	15.47	15.81	19.56	13.23	13.65	11.01	7.07	nd	nd
Three Mile Benewah	nd	2.59	5.33	7.74	9.4	9.46	13.54	nd	16.67	18.00	17.55	10.69	10.24	6.69	7.51	3.25
Nine Mile Benewah Cr.	3.57	2.32	4.08	7.14	9.47	9.1	15.26	nd	16.95	19.75	16.46	14.81	10.85	6.63	6.69	3.77
Schoolhouse Cr.	nd	2.50	3.42	7.50	8.36	7.27	11.72	11.65	12.41	13.22	10.31	10.83	9.33	5.58	nd	nd
Whitetail Cr.	nd	2.26	3.54	6.82	8.85	7.75	11.72	11.92	13.98	14.44	12.97	12.44	10.03	5.97	nd	nd
Windfall Cr.	4.21	2.35	3.72	7.94	10.68	8.17	14.76	13.27	16.46	18.07	nd	nd	nd	6.22	nd	nd
						nd	nd	12.92	12.04	15.38	12.56	10.41	11.58	6.3	6.97	4.14
Cherry Cr.	nd	3.86	4.92	8.91	11.56											
Evans Cr	nd	3.69	4.12	6.92	11.30	8.08	nd	12.46	13.19	17.57	15.11	12.24	11.51	7.33	7.26	4.91
Upper Evans Cr.	nd	nd	2.84	nd	9.63	6.80	9.48	10.04	11.5	13.5	12.1	10.79	6.04	6.19	nd	nd
E. Fork Evans Cr.	nd	nd	3.10	nd	10.56	7.3	10.10	10.91	12.12	14.28	13.56	11.37	nd	6.32	6.66	nd
Fighting Cr.	nd	3.17	5.83	6.87	9.85	9.22	11.48	13.15	15.24	16.37	12.03	14.81	11.16	4.8	nd	1.4
Hangman Cr.	6.08	3.46	8.80	10.75	17.42	15.41	23.59	23.19	17.25	19.30	16.22	12.84	13.16	8.2	5.61	nd
Little Hangman Cr.	6.69	3.08	8.89	10.37	17.01	14.90	17.24	22.12	15.34	19.25	15.68	13.04	12.71	7.08	5.28	nd
Indian Cr.	nd	nd	3.98	5.99	9.67	8.52	13.14	12.77	11.15	15.31	13.68	10.77	10.92	7.06	6.8	nd
Moctileme Cr.	6.51	2.28	8.49	9.09	14.85	13.50	17.04	20.22	15.64	19.26	14.13	11.1	12.4	7.16	nd	nd
Upper Lake Cr.	nd	nd	4.22	6.9	nd	13.08	nd	nd	nd	14.83	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	nd	4.13	6.58	10.16	11.97	11.7	15.73	16.31	nd	17.83	nd	15.43	15.87	3.54	nd	nd
Bozard Cr.	nd	2.66	3.32	5.96	8.58	12.10	11.07	13.26	13.63	14.15	11.28	nd	11.2	4.41	4.17	nd
Plummer Cr.	4.26	nd	3.77	12.44	16.48	nd	13.83	16.51	20.95	17.08	nd	nd	11.98	6.72	7.47	nd
Little Plummer Cr.	nd	3.38	6.64	12.24	nd	nd	11.89	20.05	nd	nd	nd	nd	nd	nd	nd	nd
N. Fork Rock Cr.	nd	5.55	10.26	12.92	13.1	12.02	16.01	16.72	nd	nd	16.33	nd	nd	7.01	nd	4.91
Hatchery	nd	3.78	10.87	nd	nd	nd	19.03	12.58	nd	nd	13.53	nd	nd	nd	nd	nd
Willow Cr.	nd	5.8	5.88	9.36	14.36	11.29	11.25	13.96	13.5	16.36	14.23	nd	11.44	5.95	7.26	nd

Table A-11. Summary of Dissolved Oxygen data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = mg/L

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

1999	SAMPLE DATES								
STREAM SITES	**2/10**	**3/10**	**3/26**	**4/12**	**4/27**	**5/12**	**6/2**	**7/13**	**9/21**
Alder Cr.	13.16	12.84	11.91	11.70	10.92	11.83	11.23	10.07	13.16
N. Fork Alder Cr	13.08	12.25	nd	11.56	10.79	11.92	11.41	10.13	11.89
Upper Benewah	13.38	nd	11.71	11.73	10.92	11.80	11.45	9.37	13.98
Three Mile Benewah	13.52	11.98	11.87	12.34	11.19	12.24	11.03	9.93	15.59
W. Fork Benewah	13.15	11.85	11.56	11.54	10.71	11.72	11.16	8.42	13.02
Schoolhouse Cr.	12.92	12.19	11.52	11.54	10.87	11.87	11.03	9.02	5.52
Whitetail Cr.	12.76	12.73	11.6	11.90	11.10	12.19	11.13	9.07	7.82
Windfall Cr.	12.92	12.58	11.52	11.65	11.12	12.31	11.67	8.91	10.97
Cherry Cr.	13.10	12.14	12.12	11.67	nd	12.87	11.42	10.89	12.26
Evans Cr	12.88	10.63	12.31	12.33	nd	12.58	11.94	10.28	11.85
Upper Evans Cr.	nd	nd	nd	12.48	nd	12.73	12.18	11.08	11.57
E. Fork Evans Cr.	nd	nd	nd	12.65	nd	12.71	11.71	10.56	11.6
Fighting Cr.	12.75	9.38	12.02	11.97	nd	12.65	11.34	10.11	10.92
Hangman Cr.	12.65	7.77	11.73	11.44	10.50	10.67	9.76	9.38	9.98
Little Hangman Cr.	12.78	12.65	13.04	13.24	11.56	10.40	9.18	9.95	9.92
Indian Cr.	13.40	10.27	11.87	12.25	11.00	11.93	11.53	10.67	12.28
Moctileme Cr.	12.76	13.54	12.67	13.49	12.53	12.66	9.19	7.75	nd
Upper Lake Cr.	12.43	nd	nd	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	13.27	nd	nd	nd	nd	nd	nd	nd	nd
Bozard Cr.	12.89	6.91	12.25	11.92	nd	12.55	11.55	10.49	10.79
Plummer Cr.	13.03	11.97	11.78	11.22	10.98	12.08	11.16	9.55	11.11
Lower Little Plummer Cr.	nd	nd	nd	nd	10.45	12.15	10.66	10.45	11.43
N. Fork Rock Cr.	13.78	nd	12.44	11.07	nd	10.45	7.87	8.35	3.72
Hatchery	nd	nd	11.84	10.88	nd	nd	10.93	8.54	nd
Willow Cr.	nd	nd	nd	11.59	nd	12.24	11.27	9.37	nd

Table A-11. Summary of Dissolved Oxygen data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = mg/L

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

2000	SAMPLE DATES															
STREAM SITES	**2/23**	**3/3**	**3/17**	**3/30**	**4/3**	**4/13**	**4/18**	**5/3**	**5/18**	**6/1**	**6/27**	**7/14**	**7/27**	**8/9**	**8/29**	**9/8**
Alder Cr.	nd	11.85	12.14	12.72	12.92	nd	11.44	8.80	nd	9.89	9.57	9.06	9.53	10.74	10.72	nd
N. Fork Alder Cr	nd	nd	nd	nd	11.49	nd	10.60	11.04	nd	10.45	10.08	9.69	9.91	10.84	9.93	nd
.																
Upper Benewah	nd	nd	nd	nd	10.69	11.98	nd	11.03	11.78	10.03	8.03	9.08	9.18	9.65	10.01	nd
Three Mile Benewah	13.19	12.63	13.26	13.58	13.41	11.45	12.02	11.07	11.03	10.16	8.53	7.98	9.33	10.55	8.68	nd
Nine Mile Benewah Cr.	12.88	12.49	13.34	12.76	13.79	11.86	12.06	10.68	11.73	11.32	9.68	9.30	8.73	8.85	9.69	nd
W. Fork Benewah Cr.	nd	nd	nd	nd	11.87	nd	11.17	9.71	11.61	10.44	9.14	9.04	8.7	10.34	10.53	nd
Schoolhouse Cr.	nd	nd	nd	13.14	11.86	nd	10.94	9.37	10.84	10.64	9.3	9.18	6.6	7.67	8.25	nd
Whitetail Cr.	nd	nd	nd	12.64	13.18	nd	12.01	8.87	11.44	10.28	9.28	7.19	6.85	5.88	nd	nd
Windfall Cr.	nd	nd	nd	13.07	13.41	nd	11.73	11.41	11.7	11.31	10.11	8.95	9.21	6.55	nd	nd
Cherry Cr.	nd	nd	nd	nd	12.27	nd	10.65	12.94	11.88	6.20	10.62	nd	nd	9.69	8.85	11.39
Evans Cr	nd	nd	nd	nd	nd	12.60	10.98	8.80	9.99	7.58	10.13	nd	9.33	10.23	10.22	nd
Upper Evans Cr.	nd	nd	nd	nd	nd	12.60	11.71	nd	12.88	7.10	11.26	nd	nd	10.49	10.21	nd
E. Fork Evans Cr.	nd	nd	nd	nd	nd	12.42	12.73	11.02	12.81	7.08	10.99	nd	19.77	10.34	10.30	nd
Fighting Cr.	nd	nd	nd	nd	nd	12.68	12.02	11.81	9.98	11.24	9.62	nd	8.35	10.01	9.65	nd
Hangman Cr.	nd	nd	12.64	12.67	11.45	10.77	10.82	8.88	8.9	5.97	7.68	6.74	6.20	8.19	5.85	10.5
Little Hangman Cr.	nd	nd	nd	13.72	11.84	9.35	nd	8.53	8.00	8.1	10.49	5.92	5.31	8.51	6.75	10.09
Indian Cr.	nd	nd	nd	12.67	13.79	nd	12.09	10.40	11.59	6.88	10.7	9.77	8.09	9.52	nd	10.80
Moctileme Cr.	nd	nd	nd	12.68	12.94	10.05	nd	9.46	9.42	nd	9.25	7.44	8.00	9.66	9.13	10.06
Upper Lake Cr.	nd	nd	nd	nd	nd	11.54	12.50	11.96	11.13	8.00	nd	nd	8.07	9.11	8.50	nd
Lower Lake Cr.	nd	nd	nd	nd	nd	11.69	12.77	12.60	nd	8.35	10.07	nd	8.83	9.72	8.38	nd
Bozard Cr.	nd	nd	nd	nd	12.52	nd	11.74	12.50	12.21	7.67	10.39	8.8	9.53	nd	9.95	nd
Plummer Cr.	nd	nd	nd	nd	12.61	nd	nd	12.23	11.43	11.252	9.84	nd	6.71	6.63	5.00	nd
Little Plummer Cr.	nd	nd	nd	nd	12.56	nd	13.12	11.42	11.40	10.70	9.26	nd	11.00	nd	nd	nd
N. Fork Rock Cr.	nd	nd	nd	nd	11.15	nd	nd	nd	8.34	nd	6.75	nd	2.78	1.69	6.64	nd
Hatchery	nd	11.9	12.89	12.88	nd	10.21	nd	nd	8.08	nd	2.48	3.23	4.69	nd	nd	nd
						.										
Willow Cr.	nd	nd	nd	nd	nd	12.27	13.21	nd	11.31	6.71	9.52	nd	8.81	9.86	9.72	nd

Table A-11. Summary of Dissolved Oxygen data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = mg/L

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

2001		SAMPLE DATES														
STREAM SITES	3/28	4/2	4/18	5/8	5/21	6/4	6/21	7/2	7/18	8/10	8/27	9/13	9/26	10/9	11/1	11/7
Alder Cr.	nd	13.32	12.23	10.47	10.43	11.47	10.10	9.9	11.02	10.24	10.8	9.91	11.15	12.00	11.80	nd
N. Fork Alder Cr	nd	12.66	12.46	12.54	10.72	11.54	9.92	9.93	10.94	9.32	10.18	nd	10.36	11.34	12.11	nd
Upper Benewah	nd	12.74	12.95	11.00	10.22	11.80	9.37	9.88	10.31	9.10	10.25	9.57	10.66	11.33	nd	nd
W. Fork Benewah Cr.	nd	13.22	12.12	11.15	10.73	11.91	8.90	9.45	10.01	8.56	9.83	9.31	10.13	11.12	nd	nd
Three Mile Benewah	nd	13.02	12.22	12.55	11.20	11.86	9.93	nd	10.97	9.69	9.65	9.39	10.5	12.15	9.75	nd
Nine Mile Benewah Cr.	14.53	14.34	12.40	11.91	11.48	11.82	9.21	nd	10.91	8.70	9.42	9.51	8.66	11.54	11.13	11.7
Schoolhouse Cr.	nd	12.64	12.21	11.44	11.57	11.72	9.94	9.61	10.4	7.44	8.28	5.51	7.14	8.56	nd	nd
Whitetail Cr.	nd	13.23	12.13	11.49	11.07	11.51	9.70	9.49	9.99	2.94	6.37	6.77	5.54	8.39	nd	nd
Windfall Cr.	12.26	13.18	12.75	12.05	11.76	11.95	9.73	9.72	10.86	6.91	nd	nd	nd	10.19	nd	nd
Cherry Cr.	nd	12.24	12.50	11.65	10.92	nd	10.52	9.99	10.83	6.51	9.29	9.59	9.76	11.74	10.06	11.29
Evans Cr	nd	12.51	12.52	11.63	11.15	11.90	10.14	9.96	10.79	9.41	9.74	10.34	10.24	11.26	9.94	11.49
Upper Evans Cr.	nd	nd	12.59	nd	11.71	12.35	11.02	10.88	11.37	10.02	10.20	10.79	nd	12.08	10.42	nd
E. Fork Evans Cr.	nd	nd	12.65	nd	11.41	12.23	10.79	10.51	11.25	9.93	10.17	10.78	nd	nd	10.49	nd
Fighting Cr.	nd	12.02	12.32	11.35	10.92	10.17	10.44	9.76	10.57	7.88	9.17	9.38	9.37	10.77	nd	13.15
Hangman Cr.	11.98	12.75	11.65	10.24	8.48	10.17	9.00	7.51	6.09	5.53	6.92	4.81	6.5	8.92	nd	10.22
Little Hangman Cr.	13.72	13.46	10.18	10.47	8.64	9.44	6.36	7.32	11.37	7.02	9.55	6.17	9.63	9.98	nd	8.90
Indian Cr.	nd	nd	12.42	11.92	10.84	10.22	10.90	10.21	11.30	9.45	9.93	9.35	10.48	11.12	10.76	nd
Moctileme Cr.	12.03	11.84	10.48	10.89	8.82	9.99	7.00	7.50	10.51	8.55	9.30	10.2	9.44	10.52	nd	nd
Upper Lake Cr.	nd	nd	13.48	10.80	nd	9.71	nd	nd	nd	7.78	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	nd	12.58	12.46	11.26	10.77	10.75	10.26	10.02	nd	11.01	nd	12.39	11.22	12.90	nd	nd
Bozard Cr.	nd	12.11	12.59	11.25	11.44	9.93	10.22	9.19	10.83	8.39	8.98	nd	9.48	10.85	9.43	nd
Plummer Cr.	13.02	nd	13.65	11.16	10.36	nd	9.95	10.21	8.29	5.99	nd	nd	7.08	9.03	9.43	nd
Little Plummer Cr.	nd	12.65	11.54	10.93	nd	nd	10.09	9.11	nd	nd	nd	nd	nd	nd	nd	nd
N. Fork Rock Cr.	nd	13.06	13.14	11.64	7.88	3.58	7.10	2.31	nd	nd	5.22	nd	nd	9.36	nd	9.01
Hatchery	nd	12.46	9.81	nd	nd	nd	8.40	3.60	nd	nd	7.34	nd	nd	nd	nd	nd
Willow Cr.	nd	12.04	12.18	11.06	10.45	11.08	9.68	nd	10.8	9.35	9.57	nd	10.38	11.57	9.72	

Table A-12. Summary of pH data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = pH units Measurement units = pH units

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

1999	SAMPLE DATES							
STREAM SITES	**2/10**	**3/10**	**3/26**	**4/12**	**4/27**	**5/12**	**6/2**	**7/13**	**9/21**
Alder Cr.	7.31	6.97	6.87	7.11	7.09	7.25	7.35	7.81	7.23
N. Fork Alder Cr	7.23	6.88	7.01	6.98	7.07	7.19	7.57	nd	7.4
Upper Benewah	7.13	6.80	6.77	6.94	6.89	6.97	6.95	7.10	7.13
Three Mile Benewah	7.37	7.08	6.91	7.05	7.06	7.16	7.27	7.32	7.35
Nine Mile Benewah Cr.	nd	nd	nd	nd	nd	nd	nd	nd	nd
W. Fork Benewah	7.24	6.86	6.83	7.05	6.96	7.16	7.07	7.04	7.07
Schoolhouse Cr.	6.97	6.69	6.70	6.89	6.98	7.04	7.13	6.99	6.48
Whitetail Cr.	6.91	6.56	6.75	6.85	7.06	6.99	7.00	7.01	6.89
Windfall Cr.	7.05	6.58	6.89	7.15	7.09	7.08	7.19	6.99	6.78
Cherry Cr.	7.50	6.81	6.96	7.01	nd	7.14	7.01	7.75	7.22
Evans Cr	7.03	6.51	6.59	6.73	nd	6.83	6.57	6.69	6.59
Upper Evans Cr.	nd	nd	nd	6.69	nd	6.74	6.55	6.72	6.68
E. Fork Evans Cr.	nd	nd	nd	6.86	nd	6.92	6.91	7.10	6.94
Fighting Cr.	7.23	6.71	6.85	6.86	6.87	7.00	7.09	nd	nd
Hangman Cr.	7.40	6.89	7.18	7.24	7.20	7.38	7.51	7.59	7.56
Little Hangman Cr.	7.32	7.27	7.70	7.87	8.33	8.09	7.64	7.82	7.48
Indian Cr.	7.20	6.74	6.80	6.85	6.86	7.04	7.05	7.25	7.27
Moctileme Cr.	7.45	7.30	7.78	8.09	8.35	8.11	7.50	7.58	nd
Upper Lake Cr.	6.86	nd	nd	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	7.20	nd	nd	nd	nd	nd	nd	nd	nd
Bozard Cr.	6.97	6.49	6.51	6.64	nd	6.67	6.80	7.04	6.78
Plummer Cr.	7.34	6.99	7.28	7.58	7.87	7.62	7.49	7.19	7.04
Lower Little Plummer Cr.	nd	nd	nd	nd	7.44	7.58	7.55	7.65	7.19
N. Fork Rock Cr.	4.39	nd	7.23	7.38	nd	7.27	7.23	7.37	7.00
Hatchery	nd	nd	6.81	6.97	nd	6.75	7.02	7.45	nd
Willow Cr.	nd	nd	nd	6.83	nd	6.88	6.72	7.05	nd

Table A-12. Summary of pH data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = pH units Measurement units = pH units

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

2000	SAMPLE DATES															
STREAM SITES	**2/23**	**3/3**	**3/17**	**3/30**	**4/6**	**4/13**	**4/18**	**5/3**	**5/18**	**6/1**	**6/27**	**7/14**	**7/27**	**8/9**	**8/29**	**9/8**
Alder Cr.	nd	nd	6.62	6.6	6.77	nd	6.82	7.06	nd	7.36	7.56	7.72	7.75	7.51	7.71	nd
N. Fork Alder Cr	nd	nd	nd	nd	6.6	nd	6.64	6.80	nd	7.15	7.44	7.93	7.76	7.52	7.48	nd
.																
Upper Benewah	nd	nd	nd	nd	6.55	nd	6.6	6.79	6.79	7.11	7.08	7.08	7.1	6.72	6.98	nd
Three Mile Benewah	6.87	7.07	6.94	6.8	6.79	6.94	6.89	7.04	7.27	7.28	7.31	7.89	7.45	6.68	7.7	nd
Nine Mile Benewah Cr.	6.52	6.84	6.69	6.73	6.64	6.64	6.55	6.69	6.88	7.09	7.07	7.19	7.17	6.48	7.37	nd
W. Fork Benewah Cr.	nd	nd	nd	nd	6.60	6.70	nd	6.71	6.67	7.08	6.94	7.06	7.20	6.69	7.02	nd
Schoolhouse Cr.	nd	nd	nd	6.63	6.61	nd	6.51	6.63	6.84	7.06	6.93	6.97	6.94	6.49	6.87	nd
Whitetail Cr.	nd	nd	nd	6.72	6.71	nd	6.65	6.74	6.9	6.81	6.92	6.99	6.99	nd	7.12	nd
Windfall Cr.	nd	nd	nd	6.61	6.5	nd	6.64	6.81	7.03	7.05	7.43	nd	7.07	6.5	7.10	nd
Cherry Cr.	nd	nd	nd	nd	6.72	nd	6.74	6.84	7.03	7.1	7.66	nd	nd	7.02	7.21	7.54
Evans Cr	nd	nd	nd	nd	nd	6.49	6.38	7.06	6.41	6.55	6.7	nd	7.05	6.45	6.72	nd
Upper Evans Cr.	nd	nd	nd	nd	nd	6.37	6.31	nd	6.43	6.89	6.87	nd	nd	6.43	6.79	nd
E. Fork Evans Cr.	nd	nd	nd	nd	nd	6.58	6.57	6.8	6.71	6.77	7.07	nd	7.36	6.58	7.03	nd
Fighting Cr.	nd	nd	nd	nd	nd	6.79	6.61	6.8	6.76	6.88	7.13	nd	7.27	6.87	7.03	nd
Hangman Cr.	nd	nd	7.00	7.05	6.95	7.08	6.94	7.2	6.96	7.4	7.32	7.32	7.46	7.54	7.51	7.83
Little Hangman Cr.	nd	nd	nd	7.38	7.28	7.39	nd	7.43	7.31	7.43	7.82	7.44	7.60	7.67	7.55	7.72
Indian Cr.	nd	nd	nd	6.84	6.61	nd	6.67	6.88	6.82	6.93	7.26	7.14	7.30	nd	7.04	7.20
Moctileme Cr.	nd	nd	nd	6.67	7.42	7.53	nd	7.34	7.14	nd	7.67	7.54	7.69	7.70	7.61	7.70
Upper Lake Cr.	nd	nd	nd	nd	nd	6.44	6.20	6.25	6.52	6.49	nd	nd	6.87	6.35	6.73	nd
Lower Lake Cr.	nd	nd	nd	nd	nd	6.68	6.39	6.65	nd	6.89	7.23	7.00	7.27	7.16	7.24	nd
Bozard Cr.	nd	nd	nd	nd	6.44	nd	6.18	6.33	6.53	6.53	6.94	nd	6.84	6.54	6.86	nd
Plummer Cr.	nd	nd	nd	nd	7.18	nd	nd	7.33	7.46	7.48	7.46	nd	7.08	6.79	6.89	nd
Little Plummer Cr.	nd	nd	nd	nd	7.23	nd	7.06	7.19	7.16	7.32	7.56	nd	7.54	nd	nd	nd
N. Fork Rock Cr.	nd	nd	nd	nd	6.90	nd	nd	nd	6.54	nd	6.75	nd	7.09	6.47	7.3	nd
Hatchery	6.51	6.63	6.42	6.70	nd	6.89	nd	nd	6.96	nd	6.76	nd	7.18	nd		
Willow Cr.	nd	nd	nd	nd	6.47	nd	6.4	nd	6.62	6.71	6.91	nd	7.00	6.63	6.91	nd

Table A-12. Summary of pH data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Stated values are mean if more than one result given in raw data tables (typically three readings are taken)

Measurement units = pH units Measurement units = pH units

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

nd = no data

2001		SAMPLE DATES														
STREAM SITES	**3/28**	**4/2**	**4/18**	**5/8**	**5/21**	**6/4**	**6/21**	**7/2**	**7/18**	**8/10**	**8/27**	**9/13**	**9/26**	**10/9**	**11/1**	**11/7**
Alder Cr.	nd	7.01	7.02	7.44	7.18	7.59	7.30	7.65	7.66	8.10	7.97	8.67	7.49	7.37	7.2	nd
N. Fork Alder Cr	nd	6.69	6.91	7.30	7.01	7.54	7.24	7.57	7.50	7.73	7.66	nd	7.31	7.31	6.97	nd
Upper Benewah	nd	6.71	6.77	7.17	6.88	7.31	7.14	7.20	7.06	7.11	7.23	7.29	7.18	7.01	nd	nd
W. Fork Benewah Cr.	nd	6.86	6.84	7.15	6.94	7.39	7.07	7.24	7.08	7.28	7.11	7.14	7.01	6.88	nd	nd
Three Mile Benewah	nd	6.98	6.95	7.38	7.14	7.62	7.08	nd	7.59	7.51	8.11	7.38	7.21	7.31	7.09	7.17
Nine Mile Benewah Cr.	nd	nd	nd	6.73	6.84	nd	6.81	7.10	6.95	7.60	6.98	7.27	6.98	7.17	7.32	7.29
Schoolhouse Cr.	nd	6.87	6.72	7.07	6.83	7.43	6.94	7.11	7.11	6.90	7.15	7.10	6.93	6.73	nd	nd
Whitetail Cr.	nd	6.61	6.78	7.2	6.91	7.33	7.15	7.03	7.08	6.79	7.19	7.2	6.91	6.72	nd	nd
Windfall Cr.	6.57	6.86	6.79	7.21	7.05	7.48	7.12	6.95	7.28	6.55	nd	nd	nd	6.84	nd	nd
Cherry Cr.	7.43	7.21	7.53	7.33	nd	6.97	7.41	6.88	6.79	7.23	7.38	7.21	7.25	nd	7.09	nd
Evans Cr	nd	6.85	6.72	6.84	6.78	7.05	6.79	6.87	6.58	6.95	7.05	6.97	6.59	6.68	nd	6.71
Upper Evans Cr.	nd	nd	6.68	nd	6.78	7.06	6.89	7.05	6.80	7.00	7.11	7.11	nd	6.90	nd	nd
Lower Evans Cr.	nd	nd	6.80	nd	7.07	7.26	7.04	7.30	6.89	7.26	7.45	7.40	nd	7.26	nd	nd
Fighting Cr.	nd	7.07	6.85	7.27	6.95	7.23	6.97	7.19	6.85	6.57	7.09	7.27	6.8	6.86	nd	6.95
Hangman Cr.	7.11	7.03	7.17	7.32	7.13	7.73	7.35	7.45	7.12	7.2	7.55	7.42	7.29	7.49	nd	7.21
Little Hangman Cr.	7.38	7.28	7.17	7.54	7.34	7.75	7.27	7.43	7.65	7.34	7.89	7.52	7.69	7.63	nd	7.31
Indian Cr.	nd	nd	7.00	7.25	6.99	7.41	7.20	7.35	7.23	7.09	7.36	7.26	7.22	7.12	nd	7.06
Moctileme Cr.	7.42	7.04	7.16	7.45	7.29	7.80	7.36	7.52	7.28	7.62	7.8	7.6	7.59	7.64	nd	nd
Upper Lake Cr.	nd	nd	6.50	6.85	nd	7.26	nd	nd	nd	6.72	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	nd	7.13	6.96	7.37	7.05	7.42	nd	7.39	nd	7.21	7.25	7.58	7.74	7.23	nd	nd
Bozard Cr.		6.72	6.6	7.00	6.74	7.40	6.88	nd	6.90	6.81	nd	nd	6.94	6.74	nd	6.66
Plummer Cr.	7.23	nd	7.49	7.81	7.66	nd	7.22	7.75	7.07	6.86	nd	nd	6.73	6.8	6.77	nd
Little Plummer Cr.	nd	7.37	7.44	7.74	nd	nd	7.12	7.78	nd	nd	nd	nd	nd	nd	nd	nd
N. Fork Rock Cr.	nd	7.4	7.27	7.32	7.30	7.01	6.98	7.28	nd	nd	7.51	nd	nd	6.96	nd	5.80
Hatchery	nd	5.7	6.56	nd	nd	nd	7.3	6.76	nd	nd	5.86	nd	nd	nd	nd	nd
Willow Cr.	nd	7.04	6.74	7.03	6.92	7.11	6.96	7.23	6.78	6.94	7.21		6.74	6.89	6.87	nd

Table A-13. Summary of Dissolved Phosphorus data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = mg/L

nd = no data

STREAM SITES	1999	SAMPLE DATES 3/10	3/26	4/12	4/27	5/12	6/2	7/13	9/21	10/1
Alder Cr.		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	nd	nd
N. Fork Alder Cr										
Upper Benewah		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Three Mile Benewah		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	0.029	nd
W. Fork Benewah		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Schoolhouse Cr.		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Whitetail Cr.		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Windfall Cr.		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Cherry Cr.		<0.020	<0.020	nd	nd	<0.010	<0.010	<0.020	nd	0.011
Evans Cr		<0.020	<0.020	nd	nd	<0.010	<0.010	<0.020	nd	<0.010
Upper Evans Cr.		nd	nd	<0.020	nd	<0.010	nd	<0.020	<0.010	nd
E. Fork Evans Cr.		nd	nd	nd	nd	nd	nd	nd	nd	<0.010
Fighting Cr.		<0.020	<0.020	<0.020	nd	<0.010	nd	<0.020	<0.010	nd
Hangman Cr.		<0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Little Hangman Cr.		0.020	<0.020	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Indian Cr.		<0.020	nd	<0.020	nd	<0.010	<0.010	<0.020	<0.010	nd
Moctileme Cr.		0.020	<0.020	nd	nd	nd	nd	nd	nd	nd
Upper Lake Cr.		nd	nd	nd	nd	nd	nd	nd	nd	nd
Lower Lake Cr.		nd	nd	nd	nd	nd	nd	nd	nd	nd
Bozard Cr.		<0.020	<0.020	<0.020	nd	<0.010	nd	<0.020	<0.010	nd
Plummer Cr.		<0.020	<0.020	<0.020	<0.010	0.024	0.024	<0.010	<0.010	<0.010
Lower Little Plummer Cr.		<0.020	<0.020	nd	nd	<0.010	<0.010	<0.020	nd	0.011
N. Fork Rock Cr.		<0.020	<0.020	<0.020	nd	<0.010	nd	0.028	0.012	nd
Hatchery		nd	nd	<0.020	nd	nd	nd	<0.010	nd	nd
Willow Cr.		nd	nd	nd	nd	nd	nd	nd	nd	nd

Table A-13. Summary of Dissolved Phosphorus data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = mg/L

nd = no data

STREAM SITES	2000	SAMPLE DATES 3/3	3/17	3/30	4/3	4/13	4/18	5/3	5/15	6/1	6/27	9/26
	2/23											
Alder Cr.	nd	nd	nd	nd	<0.006	<0.006	nd	nd	<0.006	nd	nd	<0.006
N. Fork Alder Cr	nd	nd	nd	nd	<0.006	<0.006	nd	nd	<0.006	nd	nd	<0.006
.												0.008
Upper Benewah	nd	nd	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	nd	nd	nd
Three Mile Benewah	<0.010	<0.010	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	nd	nd	0.011
Nine Mile Benewah Cr.	<0.010	<0.010	<0.006	<0.006	<0.006	<0.006	0.006	<0.006	<0.006	nd	nd	0.014
W. Fork Benewah Cr.	nd	nd	nd	nd	<0.006	<0.006	<0.006	<0.006	<0.006	nd	nd	<0.006
Schoolhouse Cr.	nd	nd	nd	nd	<0.006	0.009	<0.006	<0.006	<0.006	nd	nd	<0.006
Whitetail Cr.	nd	nd	nd	nd	<0.006	0.020	<0.006	<0.006	<0.006	nd	nd	<0.006
Windfall Cr.	nd	nd	nd	nd	<0.006	0.014	<0.006	<0.006	<0.006	<0.006	nd	<0.006
Cherry Cr.	nd	nd	nd	nd	<0.006	nd	<0.006	<0.006	<0.006	nd	nd	nd
Evans Cr	nd	nd	nd	nd	nd	<0.006	<0.006	<0.006	<0.006	nd	nd	nd
Upper Evans Cr.	nd	nd	nd	nd	nd	<0.006	<0.006	<0.006	<0.006	nd	nd	nd
E. Fork Evans Cr.	nd	nd	nd	nd	nd	<0.006	<0.006	<0.006	<0.006	nd	nd	nd
Fighting Cr.	nd	nd	nd	nd	nd	<0.006	0.006	<0.006	<0.006	nd	nd	<0.006
Hangman Cr.	nd	nd	0.025	0.040	0.011	<0.006	0.024	0.017	<0.006	nd	nd	<0.006
Little Hangman Cr.	nd	nd	nd	0.028	0.022	0.014	0.059	<0.006	<0.006	nd	nd	0.024
Indian Cr.	nd	nd	nd	<0.006	<0.006	nd	<0.006	<0.006	<0.006	nd	nd	<0.006
Moctileme Cr.	nd	nd	nd	0.029	0.018	0.014	0.070	0.014	<0.006	nd	nd	0.032
Upper Lake Cr.	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bozard Cr.	nd	nd	nd	nd	<0.006	nd	<0.006	<0.006	<0.006	nd	nd	0.011
Plummer Cr.	nd	nd	nd	nd	<0.006	nd	0.030	0.022	<0.006	nd	nd	0.032
Little Plummer Cr.	nd	nd	nd	nd	0.016	nd	0.012	<0.006	<0.006	nd	nd	0.020
N. Fork Rock Cr.	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hatchery	0.138	0.021	0.019	nd	nd	0.015	nd	nd	nd	nd	nd	nd
Willow Cr.	nd	nd	nd	nd	nd	<0.006	<0.006	<0.006	<0.006	nd	<0.006	<0.006

Table A-13. Summary of Dissolved Phosphorus data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = mg/L

nd = no data

STREAM SITES	2001	SAMPLE DATES					
	3/28	**4/2**	**4/18**	**5/7**	**5/21**	**8/10**	**9/13**
Alder Cr.	<0.010	<0.010	<0.010	<0.010	<0.010	nd	<0.006
N. Fork Alder Cr	nd	<0.010	<0.010	<0.010	<0.010	nd	<0.006
Upper Benewah	<0.010	0.016	<0.010	<0.010	<0.010	nd	<0.006
W. Fork Benewah Cr.	<0.010	0.030	<0.010	0.020	<0.010	nd	<0.006
Three Mile Benewah	0.019	0.027	<0.010	<0.010	<0.010	nd	<0.006
Nine Mile Benewah Cr.	0.016	<0.010	<0.010	<0.010	<0.010	nd	<0.006
Schoolhouse Cr.	0.017	0.031	<0.010	<0.010	<0.010	nd	<0.006
Whitetail Cr.	<0.010	0.019	<0.010	<0.010	0.015	nd	<0.006
Windfall Cr.	0.028	<0.010	<0.010	<0.010	<0.010	nd	nd
Cherry Cr.	<0.010	<0.010	0.043	<0.010	0.022	nd	0.007
Evans Cr	<0.010	<0.010	0.016	<0.010	<0.010	nd	<0.006
Upper Evans Cr.	nd	nd	nd	nd	<0.010	nd	<0.006
E. Fork Evans Cr.	nd	nd	nd	nd	<0.010	nd	<0.006
Fighting Cr.	0.028	0.028	0.022	<0.010	0.022	0.020	nd
Hangman Cr.	0.033	0.022	0.033	nd	nd	<0.006	<0.006
Little Hangman Cr.	0.046	0.029	0.037	0.035	0.036	<0.006	0.025
Indian Cr.	0.019	nd	<0.010	0.023	0.025	nd	<0.006
Moctileme Cr.	0.032	0.042	0.028	0.043	0.036	0.045	0.027
Upper Lake Cr.	0.017	<0.010	<0.010	<0.010	nd	nd	nd
Lower Lake Cr.	0.087	0.019	0.029	<0.010	<0.010	nd	0.042
Bozard Cr.	<0.010	<0.010	<0.010	<0.010	<0.010	nd	nd
Plummer Cr.	0.064	0.032	0.022	0.048	0.036	nd	nd
Little Plummer Cr.	nd	0.021	0.023	0.026	nd	nd	nd
N. Fork Rock Cr.	nd	0.122	0.090	0.070	0.023	nd	nd
Hatchery	nd	0.122	0.090	0.070	0.023	nd	nd
Willow Cr.	<0.010	<0.010	0.021	<0.010	0.022	nd	nd

Table A-14. Summary of Total Phosphorus data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = mg/L
nd = no data

STREAM SITES	1999	SAMPLE DATES						
	3/10	**3/26**	**4/12**	**4/27**	**5/12**	**6/2**	**7/13**	**9/21**
Alder Cr.	<0.005	0.007	<0.005	nd	0.026	<0.005	0.017	nd
N. Fork Alder Cr	nd	nd	nd	nd	nd	nd	nd	nd
Upper Benewah	<0.005	<0.005	<0.005	nd	<0.005	<0.005	0.013	0.011
Three Mile Benewah	0.032	0.022	0.009	nd	0.009	0.011	0.020	0.015
W. Fork Benewah	0.006	<0.005	<0.005	nd	<0.005	<0.005	0.012	0.025
Schoolhouse Cr.	0.014	0.012	0.006	nd	0.008	0.014	0.022	0.023
Whitetail Cr.	0.022	0.030	0.018	nd	0.029	0.034	0.037	0.029
Windfall Cr.	0.028	0.025	0.017	nd	0.008	0.019	0.031	0.017
Cherry Cr.	0.023	0.009	nd	nd	0.014	0.011	0.015	0.024
Evans Cr	<0.005	<0.005	nd	nd	<0.005	<0.005	<0.005	<0.005
Upper Evans Cr.	Nd	nd	<0.020	nd	<0.020	nd	0.022	0.031
E. Fork Evans Cr.	Nd	nd	nd	nd	nd	nd	nd	0.007
Fighting Cr.	0.009	0.006	<0.005	nd	0.010	nd	0.025	0.035
Hangman Cr.	0.035	0.031	0.013	nd	<0.005	<0.005	0.030	0.026
Little Hangman Cr.	0.058	0.043	0.025	nd	<0.005	0.024	0.038	0.037
Indian Cr.	0.034	nd	0.012	nd	<0.005	<0.005	0.007	0.021
Moctileme Cr.	0.089	0.007	nd	nd	nd	nd	nd	nd
Upper Lake Cr.	Nd	nd	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	Nd	nd	nd	nd	nd	nd	nd	nd
Bozard Cr.	<0.005	<0.005	<0.005	nd	<0.005	nd	0.011	0.029
Plummer Cr.	0.039	0.017	0.016	nd	0.035	0.027	0.033	0.013
Lower Little Plummer Cr.	0.023	0.009	nd	nd	0.014	0.011	0.015	0.024
N. Fork Rock Cr.	0.055	0.020	0.011	nd	0.024	nd	0.077	0.081
Hatchery	nd	nd	0.020	0.047	nd	nd	0.086	nd
Willow Cr.	Nd	nd	nd	nd	nd	nd	nd	nd

Table A-14. Summary of Total Phosphorus data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = mg/L
nd = no data

2000	SAMPLE DATES										
STREAM SITES	**2/23**	**3/3**	**3/17**	**3/30**	**4/3**	**4/13**	**4/18**	**5/3**	**5/15**	**6/1**	**6/27**
Alder Cr.	nd	nd	nd	nd	nd	<0.005	<0.005	nd	0.035	nd	0.023
N. Fork Alder Cr	nd	nd	nd	nd	nd	0.021	<0.005	nd	0.015	nd	0.023
.											
Upper Benewah	nd	nd	nd	nd	0.020	0.226	<0.005	<0.005	0.013	nd	0.041
Three Mile Benewah	0.062	0.038	0.054	0.084	0.035	0.013	0.017	0.007	0.016	nd	0.021
Nine Mile Benewah Cr.	<0.020	<0.020	<0.020	0.053	<0.020	0.028	<0.020	<0.020	0.175	nd	<0.020
W. Fork Benewah Cr.	nd	nd	nd	nd	0.006	0.199	<0.005	<0.005	0.025	nd	0.014
Schoolhouse Cr.	nd	nd	nd	nd	0.011	0.199	0.089	<0.005	0.068	nd	0.023
Whitetail Cr.	nd	nd	nd	nd	0.043	0.263	0.028	0.016	0.047	nd	0.031
Windfall Cr.	nd	nd	nd	nd	0.027	0.248	0.028	0.009	0.038	nd	0.042
Cherry Cr.	nd	nd	nd	nd	0.022	nd	0.02	<0.005	0.047	nd	nd
Evans Cr	nd	nd	nd	nd	nd	0.135	0.005	<0.005	0.010	nd	nd
Upper Evans Cr.	nd	nd	nd	nd	nd	0.009	<0.005	<0.005	0.045	nd	nd
E. Fork Evans Cr.	nd	nd	nd	nd	nd	<0.005	<0.005	<0.005	0.021	nd	nd
Fighting Cr.	nd	nd	nd	nd	nd	0.033	0.048	<0.005	0.043	nd	0.035
Hangman Cr.	nd	nd	0.089	0.184	0.053	0.029	0.076	0.059	0.053	nd	0.053
Little Hangman Cr.	nd	nd	nd	0.115	0.113	0.067	0.805	0.131	0.074	nd	0.024
Indian Cr.	nd	nd	nd	0.052	0.030	<0.005	<0.005	0.020	nd	nd	0.038
Moctileme Cr.	nd	nd	0.056	0.088	0.079	0.134	0.102	0.080	nd	nd	0.038
Upper Lake Cr.	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Lower Lake Cr.	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bozard Cr.	nd	nd	nd	nd	0.046	nd	<0.005	<0.005	0.016	nd	0.023
Plummer Cr.	nd	nd	nd	nd	0.030	nd	0.065	0.018	0.058	nd	0.032
Little Plummer Cr.	nd	nd	nd	nd	0.062	nd	0.056	<0.005	0.038	nd	0.027
N. Fork Rock Cr.	nd	nd	nd	nd	0.219	nd	nd	nd	0.065	nd	0.115
Hatchery	0.224	0.091	0.091	0.065	nd	0.101	nd	nd	nd	nd	nd
Willow Cr.	nd	nd	nd	nd	nd	<0.005	0.009	<0.005	0.026	<0.005	0.008

Table A-14. Summary of Total Phosphorus data for streams monitored on the Coeur d'Alene Reservation, 1999 - 2001.

Note: since sampling of all sites takes place over two to three days, only the earliest sampled date is given

Measurement units = mg/L
nd = no data

2001	SAMPLE DATES							
STREAM SITES	3/28	4/2	4/18	5/7	5/21	6/4	8/10	9/13
Alder Cr.	0.032	0.020	0.020	0.015	0.026	nd	nd	0.009
N. Fork Alder Cr	nd	0.021	0.026	0.017	0.016	nd	nd	0.024
Upper Benewah	0.018	0.123	0.027	0.021	0.006	nd	nd	<0.005
W. Fork Benewah Cr.	0.064	0.030	0.029	0.021	0.014	nd	nd	0.036
Three Mile Benewah	nd	0.053	0.030	0.096	0.024	nd	nd	0.021
Nine Mile Benewah Cr.	nd	0.043	0.025	0.027	0.030	nd	nd	0.012
Schoolhouse Cr.	0.082	0.031	0.050	0.026	0.019	nd	nd	0.865
Whitetail Cr.	0.086	0.084	0.132	0.057	0.045	nd	nd	0.034
Windfall Cr.	nd	0.083	<0.005	0.038	0.032	nd	nd	nd
Cherry Cr.	0.052	0.050	0.043	0.039	0.033	nd	nd	0.007
Evans Cr	0.211	0.010	0.016	0.031	<0.005	nd	nd	<0.005
Upper Evans Cr.	nd	nd	nd	nd	<0.005	nd	nd	<0.005
E. Fork Evans Cr.	nd	nd	nd	nd	<0.005	nd	nd	<0.005
Fighting Cr.	0.072	0.056	0.040	0.034	0.050	nd	nd	0.055
Hangman Cr.	0.163	0.125	0.070	0.106	0.088	nd	0.208	0.134
Little Hangman Cr.	0.220	0.161	0.103	0.123	0.080	nd	0.080	0.073
Indian Cr.	0.102		0.041	0.125	0.019	0.011	nd	0.013
Moctileme Cr.	0.190	0.116	0.082	0.114	0.087	nd	0.078	0.042
Upper Lake Cr.	0.030	0.049	0.030	0.015	nd	nd	nd	nd
Lower Lake Cr.	0.135	0.056	0.037	0.021	0.026	nd	nd	0.083
Bozard Cr.	0.031	0.045	0.020	0.034	0.015	nd	nd	nd
Plummer Cr.	nd	0.073	0.072	0.072	0.055	nd	nd	nd
Little Plummer Cr.	nd	0.055	0.068	0.056	nd	nd	nd	nd
N. Fork Rock Cr.	nd	0.330	0.165	0.109	0.080	nd	nd	nd
Hatchery	0.357	0.156	0.093	nd	nd	nd	nd	nd
Willow Cr.	0.194	0.016	0.021	0.030	0.008	nd	nd	<0.005

Table B-1. Habitat Suitability Index summary for monitored Coeur d'Alene Lake sampling stations, 1999 - 2001

HSI variable V1 -- Average Maximum Water Temperature

Temp. units in degrees C

* NOTE all May values are max for site - no stratification present. All other values are max recorded for depth interval given.

	1999					2000					2001				
LAKE SITES	DEPTHS (m)	early May MAX TEMP	V1	early August MAX TEMP	V1	DEPTHS (m)	early May MAX TEMP	V1	early August MAX TEMP	V1	DEPTHS (m)	early May MAX TEMP	V1	early August MAX TEMP	V1
09 Round Lake	0 m - bottom	6.9	**0.80**	21.9	**0.00**	0 m - bottom	8.0	**0.90**	23.3	**0.00**	0 m - bottom	9.1	**0.94**	22.7	**0.00**
11 Chatcolet Lake shallow	0 m - bottom	6.5	**0.76**	23.2	**0.00**	0 m - bottom	7.6	**0.85**	22.3	**0.00**	0 m - bottom	9.3	**0.94**	24.0	**0.00**
01 Rockford Bay	0 - 9 m	8.5	**0.90**	22.2	**0.00**	0 - 9 m	10.3	**0.96**	22.6	**0.00**	0 m - bottom	8.0	**0.88**	21.5	**0.04**
	9 - 12 m			19.4	**0.50**	9 - 12 m			19.0	**0.60**					
	12 - bottom			13.9	**1.00**	12 - bottom			14.7	**1.00**					
02 Windy Bay shallow	0 - 9 m	7.4	**0.82**	22.6	**0.00**	0 - 7 m	9.7	**0.95**	22.3	**0.00**	0 m - bottom	7.2	**0.84**	21.3	**0.09**
	9 - 12 m			18.7	**0.70**	7 - 10 m			21.2	**0.10**					
	12 - bottom			17.2	**0.90**	10 - bottom			17.3	**0.85**					
06 Carey Bay	0 - 9 m	8.9	**0.94**	21.2	**0.10**	0 - 4 m	11.8	**1.00**	22.9	**0.00**	0 m - bottom	10.6	**0.99**	22.2	**0.00**
	9 - 12 m			15.4	**1.00**	4 - 7 m			21.1	**0.10**					
	12 - bottom			13.1	**1.00**	7 - bottom			16.9	**0.90**					
03 Windy Bay deep	0 - 9 m	7.4	**0.85**	22.9	**0.00**	0 - 7 m	10	**0.96**	22.7	**0.00**	0 - 12 m	7.3	**0.82**	21.4	**0.05**
	9 - 12 m			16.6	**0.92**	7 - 16 m			20.5	**0.28**	12 - 22 m			19.2	**0.50**
	12 - bottom			13.8	**1.00**	16 - bottom			9.2	**0.96**	22 - bottom			8.1	**0.90**
05 Mid Lake Coeur d'Alene	0 - 12 m	9.3	**0.95**	22.6	**0.00**	0 - 7 m	10.5	**0.96**	23.2	**0.00**	0 - 12 m	11.2	**1.00**	22.4	**0.00**
	12 - 14 m			16.1	**0.97**	7 - 12 m			18.6	**0.66**	12 - 15 m			15.5	**1.00**
	14 - bottom			10.2	**0.98**	12 - bottom			12.4	**1.00**	15 - bottom			11.0	**1.00**
07 Conkling Park	0 - 5 m	8.5	**0.90**	21.5	**0.05**	0 - 7 m	10.4	**0.96**	23.2	**0.00**	0 - 13 m	10.7	**0.98**	22.0	**0.00**
	5 - 7 m			19.2	**0.55**	7 - 12 m			18.3	**0.68**	13 - bottom			14.5	**1.00**
	7 - bottom			17.2	**0.85**	12 - bottom			11.8	**1.00**					
08 Hidden Lake	0 - 3 m	9.7	**0.95**	22.6	**0.00**	0 - 4 m	9.7	**0.95**	24.3	**0.00**	0 m - bottom	10.7	**0.98**	23.5	**0.00**
	3 - 6 m			19.4	**0.55**	4 - 7 m			18.5	**0.72**					
	6 - bottom			13.4	**1.00**	7 - bottom			13.3	**1.00**					
10 Chatcolet Lake deep	0 - 5 m	7.7	**0.85**	22.8	**0.00**	0 - 4 m	10.7	**0.98**	23.7	**0.00**	0 - 6 m	10.3	**0.96**	22.8	**0.00**
	5 - 8 m			17.7	**0.85**	4 -8 m			18.9	**0.64**	6 - 10 m			18.7	**0.60**
	8 - bottom			14.2	**1.00**	8 - bottom			12.0	**1.00**	10 - bottom			12.9	**1.00**
12 Benewah Lake	0 - 3 m	11.2	**1.00**	24.0	**0.00**	0 - 3.5 m	12.8	**1.00**	24.7	**0.00**	0 m - bottom	13.1	**1.00**	23.7	**0.00**
	3 - bottom			21.7	**0.05**	3.5 - bottom			20.9	**0.20**					
04 Coeur d'Alene River	0 - 6 m	7.2	**0.80**	24.1	**0.00**	0 - 7 m	10.2	**0.98**	23.5	**0.00**	0 m - bottom	11.7	**1.00**	22.8	**0.00**
	6 - 9 m			19.3	**0.54**	7 - 10 m			20.1	**0.35**					
	9 - bottom			13.7	**1.00**	10 - bottom			16.9	**0.90**					
13 St. Joe River	0 - 3 m	5.8	**0.72**	22.5	**0.00**	0 - 10 m	7.2	**0.80**	23.8	**0.00**	0 - bottom	8.6	**0.95**	21.9	**0.00**
	3 - 5 m			21.1	**0.10**	10 - bottom			20.9	**0.24**					
	5 - bottom			21.0	**0.13**										

Table B-1. Habitat Suitability Index summary for monitored Coeur d'Alene Lake sampling stations, 1999 - 2001

HSI variable V3 -- Average Minimum dissolved oxygen DO units in mg/L

* NOTE all May values are MIN for site - no stratification present. All other values are MIN recorded for depth interval given.

	1999					2000					2001				
LAKE SITES	DEPTHS (m)	early May MIN DO	V3	early August MIN DO	V3	DEPTHS (m)	early May MIN DO	V3	early August MIN DO	V3	DEPTHS (m)	early May MIN DO	V3	early August MIN DO	V3
09 Round Lake	0 m - bottom	12.1	**1.0**	8.4	**0.97**	0 m - bottom	11.1	**1.00**	6.2	**0.50**	0 m - bottom	10.8	**1.00**	9.1	**1.00**
11 Chatcolet Lake shallow	0 m - bottom	12.1	**1.0**	9.5	**1.00**	0 m - bottom	11.1	**1.00**	6.2	**0.50**	0 m - bottom	10.7	**1.00**	13.8	**1.00**
01 Rockford Bay	0 - 9 m	12.0	**1.0**	9.4	**1.00**	0 - 9 m	7.9	**1.00**	8.6	**0.99**	0 m - bottom	11.0	**1.00**	9.2	**1.00**
	9 - 12 m			10.1	**1.00**	9 - 12 m			9.0	**1.00**					
	12 - bottom			9.2	**1.00**	12 - bottom			8.4	**1.00**					
02 Windy Bay shallow	0 - 9 m	11.9	**1.0**	9.2	**1.00**	0 - 7 m	8.8	**1.00**	8.1	**0.95**	0 m - bottom	11.0	**1.00**	9.3	**1.00**
	9 - 12 m			10.4	**1.00**	7 - 10 m			8.6	**0.99**					
	12 - bottom			9.5	**1.00**	10 - bottom			7.7	**0.90**					
06 Carey Bay	0 - 9 m	11.3	**1.0**	9.5	**1.00**	0 - 4 m	8.7	**1.00**	8.5	**0.98**	0 m - bottom	9.8	**1.00**	9.2	**1.00**
	9 - 12 m			8.4	**0.97**	4 - 7 m			9.0	**1.00**					
	12 - bottom			7.5	**1.00**	7 - bottom			5.3	**0.20**					
03 Windy Bay deep	0 - 9 m	11.9	**1.0**	9.2	**1.00**	0 - 7 m	8.2	**1.00**	8.4	**0.97**	0 - 12 m	10.2	**1.00**	9.3	**1.00**
	9 - 12 m			10.6	**1.00**	7 - 16 m			7.5	**0.86**	12 - 22 m			7.5	**0.83**
	12 - bottom			8.6	**1.00**	16 - bottom			6.3	**0.96**	22 - bottom			7.8	**1.00**
05 Mid Lake Coeur d'Alene	0 - 12 m	11.0	**1.0**	9.0	**1.00**	0 - 7 m	8.0	**1.00**	8.5	**0.98**	0 - 12 m	9.6	**1.00**	9.1	**1.00**
	12 - 14 m			9.0	**1.00**	7 - 12 m			9.0	**1.00**	12 - 15 m			8.8	**1.00**
	14 - bottom			6.7	**1.00**	12 - bottom			6.1	**0.95**	15 - bottom			6.3	**0.96**
07 Conkling Park	0 - 5 m	11.6	**1.0**	9.5	**1.00**	0 - 7 m	8.9	**1.00**	8.3	**0.95**	0 - 13 m	9.6	**1.00**	8.5	**0.98**
	5 - 7 m			9.9	**1.00**	7 - 12 m			7.3	**0.80**	13 - bottom			5.1	**0.75**
	7 - bottom			6.2	**0.50**	12 - bottom			4.4	**0.40**					
08 Hidden Lake	0 - 3 m	11.4	**1.0**	9.2	**1.00**	0 - 4 m	9.9	**1.00**	9.1	**1.00**	0 m - bottom	6.8	**1.00**	0.3	**0.00**
	3 - 6 m			9.7	**1.00**	4 - 7 m			5.2	**0.06**					
	6 - bottom			0.2	**0.00**	7 - bottom			0.2	**0.00**					
10 Chatcolet Lake deep	0 - 5 m	11.8	**1.0**	9.2	**1.00**	0 - 4 m	9.5	**1.00**	10.8	**1.00**	0 - 6 m	10.9	**1.00**	8.5	**0.98**
	5 - 8 m			3.5	**0.00**	4 -8 m			10.9	**1.00**	6 - 10 m			0.1	**0.00**
	8 - bottom			2.0	**0.00**	8 - bottom			9.5	**1.00**	10 - bottom			0.1	**0.00**
12 Benewah Lake	0 - 3 m	10.4	**1.0**	9.9	**1.00**	0 - 3.5 m	4.5	**1.00**	7.9	**0.91**	0 m - bottom	5.7	**0.90**	8.6	**0.99**
	3 - bottom			0.4	**0.00**	3.5 - bottom			0.5	**0.00**					
04 Coeur d'Alene River	0 - 6 m	11.8	**1.0**	8.7	**1.00**	0 - 7 m	7.9	**1.00**	8.3	**0.95**	0 m - bottom	9.9	**1.00**	8.7	**1.00**
	6 - 9 m			9.5	**1.00**	7 - 10 m			8.5	**0.98**					
	9 - bottom			8.4	**1.00**	10 - bottom			9	**1.00**					
13 St. Joe River	0 - 3 m	12.0	**1.0**	8.5	**0.99**	0 - 10 m	11.7	**1.00**	5.1	**0.04**	0 - bottom	11.0	**1.00**	0.1	**0.00**
	3 - 5 m			7.6	**0.90**	10 - bottom			4.4	**0.00**					
	5 - bottom			7.1	**0.77**										

Table B-1. Habitat Suitability Index summary for monitored Coeur d'Alene Lake sampling stations, 1999 - 2001

HSI variable V13 -- Annual Maximum pH

	1999					2000					2001				
* NOTE all May values are MIN for site - no stratification present. All other values are MIN recorded for depth interval given.															
LAKE SITES	DEPTHS (m)	early May MAX pH	V13	early August MAX pH	V13	DEPTHS (m)	early May MAX pH	V13	early August MAX pH	V13	DEPTHS (m)	early May MAX pH	V13	early August MAX pH	V13
09 Round Lake	0 m - bottom	7.2	**1.0**	7.1	**1.00**	0 m - bottom	6.8	**1.00**	7.8	**1.00**	0 m - bottom	7.3	**1.0**	7.8	**1.0**
11 Chatcolet Lake shallow	0 m - bottom	7.2	**1.0**	7.5	**1.00**	0 m - bottom	6.8	**1.00**	9.2	**0.27**	0 m - bottom	7.2	**1.0**	9.5	**0.0**
01 Rockford Bay	0 - 9 m	7.2	**1.0**	8.0	**1.00**	0 - 9 m	6.9	**1.00**	7.7	**1.00**	0 m - bottom	7.2	**1.0**	7.8	**1.0**
	9 - 12 m			7.9	**1.00**	9 - 12 m			7.4	**1.00**					
	12 - bottom			7.1	**1.00**	12 - bottom			7.1	**1.00**					
02 Windy Bay shallow	0 - 9 m	7.1	**1.0**	7.8	**1.00**	0 - 7 m	6.8	**1.00**	7.8	**1.00**	0 m - bottom	7.2	**1.0**	8.1	**1.0**
	9 - 12 m			7.7	**1.00**	7 - 10 m			7.6	**1.00**					
	12 - bottom			7.3	**1.00**	10 - bottom			7.1	**1.00**					
06 Carey Bay	0 - 9 m	7.3	**1.0**	7.8	**1.00**	0 - 4 m	7.1	**1.00**	7.7	**1.00**	0 m - bottom	7.2	**1.0**	8	**1.0**
	9 - 12 m			7.3	**1.00**	4 - 7 m			7.4	**1.00**					
	12 - bottom			6.7	**1.00**	7 - bottom			7.0	**1.00**					
03 Windy Bay deep	0 - 9 m	7.1	**1.0**	7.9	**1.00**	0 - 7 m	7.0	**1.00**	7.6	**1.00**	0 - 12 m	7.2	**1.0**	8.0	**1.0**
	9 - 12 m			7.4	**1.00**	7 - 16 m			7.2	**1.00**	12 - 22 m			8.0	**1.0**
	12 - bottom			7.1	**1.00**	16 - bottom			6.6	**1.00**	22 - bottom			6.6	**1.0**
05 Mid Lake Coeur d'Alene	0 - 12 m	7.3	**1.0**	7.7	**1.00**	0 - 7 m	7.1	**1.00**	7.8	**1.00**	0 - 12 m	7.2	**1.0**	8.0	**1.0**
	12 - 14 m			7.0	**1.00**	7 - 12 m			7.3	**1.00**	12 - 15 m			7.7	**1.0**
	14 - bottom			6.7	**1.00**	12 - bottom			6.7	**1.00**	15 - bottom			7.0	**1.0**
07 Conkling Park	0 - 5 m	7.3	**1.0**	7.8	**1.00**	0 - 7 m	7	**1.00**	7.6	**1.00**	0 - 13 m	7.2	**1.0**	8.1	**1.0**
	5 - 7 m			7.5	**1.00**	7 - 12 m			7.1	**1.00**	13 - bottom			7.1	**1.0**
	7 - bottom			7.4	**1.00**	12 - bottom			6.4	**1.00**					
08 Hidden Lake	0 - 3 m	7.3	**1.0**	8.2	**0.97**	0 - 4 m	6.9	**1.00**	8.7	**0.66**	0 m - bottom	7.2	**1.0**	8.6	**0.8**
	3 - 6 m			8.0	**1.00**	4 - 7 m			9.1	**0.30**					
	6 - bottom			6.4	**1.00**	7 - bottom			6.9	**1.00**					
10 Chatcolet Lake deep	0 - 5 m	7.2	**1.0**	8.5	**0.80**	0 - 4 m	6.9	**1.00**	8.5	**0.80**	0 - 6 m	7.1	**1.0**	8.6	**0.8**
	5 - 8 m			6.8	**1.00**	4 -8 m			8.6	**0.77**	6 - 10 m			8.0	**1.0**
	8 - bottom			6.3	**1.00**	8 - bottom			6.4	**1.00**	10 - bottom			6.6	**1.0**
12 Benewah Lake	0 - 3 m	7.0	**1.0**	9.1	**0.42**	0 - 3.5 m	6.8	**1.00**	8.7	**0.68**	0 m - bottom	7.0	**1.0**	9.2	**0.3**
	3 - bottom			7.1	**1.00**	3.5 - bottom			7.5	**1.00**					
04 Coeur d'Alene River	0 - 6 m	7.2	**1.0**	7.8	**1.00**	0 - 7 m	7.0	**1.00**	7.8	**1.00**	0 m - bottom	7.2	**1.0**	7.9	**1.0**
	6 - 9 m			7.4	**1.00**	7 - 10 m			7.4	**1.00**					
	9 - bottom			7.0	**1.00**	10 - bottom			7.2	**1.00**					
13 St. Joe River	0 - 3 m	7.2	**1.0**	7.3	**1.00**	0 - 10 m	6.9	**1.00**	7.2	**1.00**	0 - bottom	7.3	**1.0**	7.2	**1.0**
	3 - 5 m			7.2	**1.00**	10 - bottom			6.7	**1.00**					
	5 - bottom			7.0	**1.00**										

Table B-2 Data summary for Coeur d'Alene stream HSI calculations. **Page 1**

HSI variable V1 -- Average Maximum Water Temperature (Temp. unit in degrees C)

STREAM SITES	1999 ANNUAL MAX TEMP	1999 V1	2000 ANNUAL MAX TEMP	2000 V1	2001 ANNUAL MAX TEMP	2001 V1
Alder Cr.	15.91	**1.00**	20.02	**0.40**	21.32	**0.20**
N. Fork Alder Cr	15.10	**1.00**	17.29	**0.86**	17.56	**0.85**
Upper Benewah	17.35	**0.85**	19.20	**0.60**	17.25	**0.86**
Three Mile Benewah	14.89	**1.00**	22.46	**0.00**	19.56	**0.43**
Nine Mile Benewah	nd		20.27	**0.35**	18.00	**0.8**
W. Fork Benewah	20.49	**0.15**	17.77	**0.86**	19.75	**0.48**
Schoolhouse Cr.	13.51	**1.00**	15.56	**1.00**	13.22	**1.00**
Whitetail Cr.	12.95	**1.00**	16.75	**0.90**	14.44	**1.00**
Windfall Cr.	15.07	**1.00**	16.78	**0.90**	18.07	**0.80**
Cherry Cr.	15.37	**1.00**	14.04	**1.00**	15.37	**1.00**
Evans Cr	13.51	**1.00**	15.97	**1.00**	17.57	**0.80**
Upper Evans Cr.	10.39	**0.96**	12.97	**1.00**	13.5	**1.00**
E. Fork Evans Cr.	12.15	**1.00**	13.81	**1.00**	14.28	**1.00**
Fighting Cr.	12.28	**1.00**	16.16	**1.00**	16.37	**0.93**
Hangman Cr.	20.04	**0.40**	20.66	**0.23**	23.59	**0.00**
Little Hangman Cr.	18.24	**0.74**	19.43	**0.54**	22.12	**0.00**
Indian Cr.	11.75	**1.00**	14.51	**1.00**	15.31	**1.00**
Moctileme Cr.	16.39	**0.98**	17.75	**0.80**	20.22	**0.34**
Upper Lake Cr.	nd	nd	15.85	**1.00**	14.83	**1.00**
Lower Lake Cr.	nd	nd	20.28	**0.36**	17.83	**1.00**
Bozard Cr.	11.87	**1.00**	13.29	**1.00**	14.15	**1.00**
Plummer Cr.	16.44	**0.97**	20.09	**0.36**	20.95	**0.20**
Lower Little Plummer Cr.	14.06	**1.00**	21.32	**0.10**	20.05	**0.36**
N. Fork Rock Cr.	14.92	**1.00**	18.75	**0.64**	16.72	**1.00**
Hatchery	15.19	**1.00**	14.11	**1.00**	19.03	**0.60**
Willow Cr.	17.22	**0.94**	16.08	**1.00**	16.36	**1.00**

Table B-2 Data summary for Coeur d'Alene stream HSI calculations. **Page 2**

HSI variable V3 -- Average Minimum dissolved oxygen (DO units in mg/L)

	1999		**2000**		**2001**	
STREAM SITES	ANNUAL MIN DO	**V3**	ANNUAL MIN DO	**V3**	ANNUAL MIN DO	**V3**
Alder Cr.	10.9	**1.00**	8.80	**0.99**	9.91	**1.00**
N. Fork Alder Cr	10.8	**1.00**	9.69	**1.00**	9.32	**1.00**
Upper Benewah	9.37	**1.00**	8.03	**0.92**	9.10	**1.00**
Three Mile Benewah	9.93	**1.00**	7.98	**0.91**	8.56	**1.00**
Nine Mile Benewah	nd		8.73	**0.99**	9.39	**1.00**
W. Fork Benewah	8.42	**0.97**	8.70	**0.99**	8.66	**0.98**
Schoolhouse Cr.	9.02	**1.00**	6.60	**0.64**	5.51	**0.20**
Whitetail Cr.	9.07	**1.00**	5.88	**0.57**	2.94	**0.00**
Windfall Cr.	8.91	**0.99**	6.55	**0.59**	6.91	**0.68**
Cherry Cr.	10.89	**1.00**	6.20	**0.47**	6.51	**0.59**
Evans Cr	10.28	**1.00**	7.58	**0.85**	9.41	**1.00**
Upper Evans Cr.	11.08	**1.00**	7.10	**0.74**	10.02	**1.00**
E. Fork Evans Cr.	10.56	**1.00**	7.08	**0.74**	9.93	**1.00**
Fighting Cr.	10.11	**1.00**	8.35	**0.95**	7.88	**0.91**
Hangman Cr.	9.38	**1.00**	5.97	**0.39**	4.81	**0.00**
Little Hangman Cr.	9.18	**1.00**	5.31	**0.15**	6.17	**0.44**
Indian Cr.	10.67	**1.00**	6.88	**0.68**	9.35	**1.00**
Moctileme Cr.	7.75	**0.88**	7.44	**0.83**	7.00	**0.72**
Upper Lake Cr.	nd	nd	8.00	**0.93**	7.78	**0.90**
Lower Lake Cr.	nd	nd	8.35	**0.95**	10.02	**1.00**
Bozard Cr.	6.91	**0.68**	7.67	**0.90**	8.39	**0.95**
Plummer Cr.	9.55	**1.00**	5.00	**0.00**	5.99	**0.40**
Lower Little Plummer Cr.	10.45	**1.00**	9.26	**1.00**	9.11	**1.00**
N. Fork Rock Cr.	3.72	**0.00**	1.69	**0.00**	2.31	**0.00**
Hatchery	8.54	**0.99**	3.23	**0.00**	3.60	**0.00**
Willow Cr.	9.37	**1.00**	6.71	**0.60**	9.35	**1.00**

Table B-2 Data summary for Coeur d'Alene stream HSI calculations. **Page 3**

HSI variable V13 -- Annual Maximum or Minimum pH *

	1999		**2000**		**2001**	
STREAM SITES	ANNUAL MAX pH	**V13**	ANNUAL MAX pH	**V13**	ANNUAL MAX pH	**V13**
Alder Cr.	7.81	**1.00**	7.75	**1.00**	8.67	**0.72**
N. Fork Alder Cr	7.57	**1.00**	7.93	**1.00**	7.73	**1.00**
Upper Benewah	7.13	**1.00**	7.11	**1.00**	7.31	**1.00**
Three Mile Benewah	7.37	**1.00**	7.89	**1.00**	7.39	**1.00**
Nine Mile Benewah	nd		7.37	**1.00**	7.62	**1.00**
W. Fork Benewah	7.24	**1.00**	7.20	**1.00**	7.60	**1.00**
Schoolhouse Cr.	7.13	**1.00**	7.06	**1.00**	7.43	**1.00**
Whitetail Cr.	7.06	**1.00**	7.12	**1.00**	7.33	**1.00**
Windfall Cr.	7.19	**1.00**	7.43	**1.00**	7.48	**1.00**
Cherry Cr.	7.75	**1.00**	7.66	**1.00**	7.41	**1.00**
Evans Cr	7.03	**1.00**	7.06	**1.00**	7.05	**1.00**
Upper Evans Cr.	6.74	**1.00**	6.89	**1.00**	7.11	**1.00**
E. Fork Evans Cr.	7.10	**1.00**	7.36	**1.00**	7.45	**1.00**
Fighting Cr.	7.23	**1.00**	7.27	**1.00**	7.27	**1.00**
Hangman Cr.	7.59	**1.00**	7.83	**1.00**	7.73	**1.00**
Little Hangman Cr.	8.33	**0.90**	7.82	**1.00**	7.75	**1.00**
Indian Cr.	7.27	**1.00**	7.30	**1.00**	7.41	**1.00**
Moctileme Cr.	8.35	**0.88**	7.70	**1.00**	7.80	**1.00**
Upper Lake Cr.	6.86	**1.00**	6.87	**1.00**	7.26	**1.00**
Lower Lake Cr.	7.20	**1.00**	7.27	**1.00**	7.74	**1.00**
Bozard Cr.	7.04	**1.00**	6.94	**1.00**	7.40	**1.00**
Plummer Cr.	7.87	**1.00**	7.48	**1.00**	7.75	**1.00**
Lower Little Plummer Cr.	7.65	**1.00**	7.54	**1.00**	7.78	**1.00**
N. Fork Rock Cr.	4.39	**0.00**	7.09	**1.00**	7.51	**1.00**
Hatchery	7.45	**1.00**	7.18	**1.00**	5.70	**0.12**
Willow Cr.	7.05	**1.00**	7.00	**1.00**	7.23	**1.00**

* (Max or min pH used based on which gave lower SI value)

Table B-2 Data summary for Coeur d'Alene stream HSI calculations. **Page 4**

HSI variable V14 -- Base Flow (Lowest flow as percentage of average annual daily flow)

	1999		2000		2001	
STREAM SITES	ANNUAL BASE %	V14	ANNUAL BASE %	V14	ANNUAL BASE %	V14
Alder Cr.	4.1	**0.08**	16.5	**0.32**	4.3	**0.08**
N. Fork Alder Cr	nd		14.0	**0.28**	3.7	**0.08**
Upper Benewah	9.3	**0.18**	8.4	**0.17**	7.9	**0.16**
Three Mile Benewah	4.5	**0.08**	15.0	**0.32**	3.0	**0.05**
Nine Mile Benewah	nd		9.2	**0.18**	6.5	**0.14**
W. Fork Benewah	6.5	**0.14**	25.4	**0.52**	2.5	**0.04**
Schoolhouse Cr.	0.2	**0.04**	8.4	**0.17**	0.0	**0**
Whitetail Cr.	5.3	**0.11**	9.8	**0.19**	0.0	**0**
Windfall Cr.	0.2	**0.04**	14.0	**0.28**	0.0	**0**
Cherry Cr.	5.6	**0.11**	12.5	**0.24**	2.7	**0.05**
Evans Cr	27.9	**0.60**	20.8	**0.41**	18.7	**0.37**
Upper Evans Cr.	41.7	**0.85**	nd		21.3	**0.42**
E. Fork Evans Cr.	55.5	**1.00**	7.8	**0.15**		
Fighting Cr.	3.5	**0.07**	15.2	**0.32**	3.4	**0.05**
Hangman Cr.	36.6	**0.72**	nd		nd	
Little Hangman Cr.	2.6	**0.04**	nd		nd	
Indian Cr.	9.6	**0.2**	21.9	**0.42**	3.2	**0.05**
Moctileme Cr.	nd	nd	10.7	**0.22**	2.2	**0.04**
Upper Lake Cr.	8.4	**0.18**	14.3	**0.30**	0.8	**0.01**
Lower Lake Cr.	nd	nd	3.8	**0.08**	17.4	**0.034**
Bozard Cr.	1.2	**0.01**	46.1	**0.96**	2.4	**0.04**
Plummer Cr.	3.1	**0.05**	15.9	**0.33**	0.2	**0.01**
Lower Little Plummer Cr.	23.7	**0.46**	5.6	**0.11**	11.6	**0.23**
N. Fork Rock Cr.	nd	nd	nd		0.0	**0.00**
Hatchery	10.4	**0.22**	5.0	**0.1**	0.0	**0.00**
Willow Cr.	nd	nd	22.7	**0.42**	4.3	**0.08**

Alder Creek Cutthroat Trout			Summer 96					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100sq.m**	**Total N**	**95%CI**
Mainstem	1	7,052	595	3	0	0.5	36	0
	2	1,825	334	0	0	0.0	0	0
	3	9,446	334	3	0	0.9	85	0
	4	4,158	334	1	0	0.3	12	0
	5	5,064	669	14	1	2.1	106	7
	6	1,823	334	6	0	1.8	33	0
	7	16,860	780	21	0	2.7	454	0
	8	4,916	409	2	0	0.5	24	0
	9	12,635	446	1	0	0.2	28	0
N.F.Alder	1	4,475	427	0	0	0.0	0	0
	2	1,403	242	0	0	0.0	0	0
	3	2,058	223	0	0	0.0	0	0
	4	2,503	74	2	0	2.7	67	0
Totals		74,216	5,202	53	1	1.0	845	7

Benewah Creek Cutthroat Trout			Summer 96					
Tributary	**Reach**	**Total Area (sq. m)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100sq.m**	**Total N**	**95%CI**
Mainstem	1	7,422	279	1	0	0.4	27	0
	2	9,419	632	5	3	0.8	75	45
	3	5,588	669	14	1	2.1	117	6
	4	16,104	465	5	2	1.1	173	69
	5	2,318	NS	NS	NS	NS	NS	NS
	7	5,040	NS	NS	NS	NS	NS	NS
	8	5,656	279	4	0	1.4	81	0
	9	5,648	1,152	12	8	1.0	59	41
	10	25,981	985	14	1	1.4	369	33
	11	1,399	260	3	0	1.2	16	0
South Fork	13	6,915	111	6	0	5.4	372	0
Bull		3,685	130	25	1	19.2	708	31
West Fork		3,205	149	28	4	18.8	604	86
Whitetail		5,204	149	33	1	22.2	1,155	30
Windfall		5,531	186	27	2	14.5	804	51
Totals		109,115	5,444	177	23	3.3	4,560	391

NS = Not Sampled

Evans Creek Cutthroat Trout			Summer 96					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100sq.m**	**Total N**	**95%CI**
Mainstem	1	4,977	260	0	0	0.0	0	0
	2	7,227	446	18	2	4.0	292	25
	3	1,970	260	4	0	1.5	30	0
	4	10,127	669	37	5	5.5	560	77
	5	2,692	223	23	2	10.3	278	19
	6	1,178	223	5	0	2.2	26	0
	7	2,231	427	29	11	6.8	151	56
E.F.Evans		3,990	56	6	0	10.8	429	0
R.F.Evans		2,099	186	36	10	19.4	407	111
S.F.Evans		1,126	149	23	7	15.5	174	51
Totals		37,616	2,898	181	36	6.2	2,348	340

Lake Creek Cutthroat Trout			Summer 96					
Tributary	**Reach**	**Total Area (sq. m)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100sq.m**	**Total N**	**95%CI**
Mainstem	1	5,396	186	1	0	0.5	29	0
	2	4,684	0	NS	NS	NS	NS	NS
	3	5,458	0	NS	NS	NS	NS	NS
	4	2,696	297	22	0	7.4	199	0
	5	2,555	372	18	0	4.8	124	0
	6	11,668	632	31	1	4.9	573	15
	7	13,284	669	16	0	2.4	318	0
	8	9,715	167	7	0	4.2	407	0
West Fork		6,270	149	44	3	29.6	1,856	113
Bozard		11,085	232	25	1	10.8	1,193	32
Totals		72,810	2,703	164	4	6.1	4,699	161

Alder Creek Brook Trout			Summer 96					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100sq.m**	**Total N**	**95%CI**
Mainstem	1	7,052	595	1	0	0.2	12	0
	2	1,825	334	0	0	0.0	0	0
	3	9,446	334	0	0	0.0	0	0
	4	4,158	334	1	0	0.3	12	0
	5	5,064	669	4	0	0.6	30	0
	6	1,823	334	6	0	1.8	33	0
	7	16,860	780	78	7	10.0	1,685	158
	8	4,916	409	34	4	8.3	409	48
	9	12,635	446	33	2	7.4	935	56
N.F.Alder	1	4,475	130	5	2	3.8	172	69
	2	1,403	121	3	0	2.5	35	0
	3	2,058	223	13	6	5.8	120	54
	4	2,503	74	9	27	*	*	*
Totals		74,216	4,784	187	48	3.9	3,443	384

Benewah Creek Brook Trout			Summer 96					
Tributary	**Reach**	**Total Area (sq. m)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100sq.m**	**Total N**	**95%CI**
Mainstem	1	7,422	279	0	0	0.0	0	0
	2	9,419	632	0	0	0.0	0	0
	3	5,588	669	0	0	0.0	0	0
	4	16,104	465	0	0	0.0	0	0
	5	2,318	NS	NS	NS	NS	NS	NS
	7	5,040	NS	NS	NS	NS	NS	NS
	8	5,656	279	8	0	2.9	164	0
	9	5,648	1,152	1	0	0.2	11	0
	10	25,981	985	6	0	0.6	156	0
	11	1,399	260	1	0	0.4	6	0
South Fork	13	6,915	111	0	0	0.0	0	0
Bull		3,685	130	0	0	0.0	0	0
West Fork		3,205	149	3	*	*	*	*
Whitetail		5,204	149	1	0	0.7	36	0
Windfall		5,531	186	0	0	0.0	0	0
Totals		109,115	5,444	20	0	0.4	373	0

NS = Not Sampled

Alder Creek Cutthroat Trout				Summer 97				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	771	3	0	0.5	35	0
	2	1,825	353	1	0	0.3	5	0
	3	9,446	390	3	0	0.8	76	0
	4	4,158	390	42	9	10.8	447	93
	5	5,064	744	6	0	1.0	51	0
	6	1,823	409	3	0	1.6	29	0
	7	16,860	1,246	17	0	1.8	303	0
	8	4,916	428	5	0	1.8	88	0
	9	12,635	446	11	13	4.2	531	366
N.F.Alder	1	4,475	446	0	0	0.0	0	0
	2	1,403	242	0	0	0.0	0	0
	3	2,058	242	0	0	0.0	0	0
	4	2,503	130	0	0	0.0	0	0
Totals		74,216	6,237	91	22	1.5	1,566	459

Benewah Creek Cutthroat Trout				Summer 97				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,422	NS	NS	NS	NS	NS	NS
	2	9,419	930	6	0	0.0	0	0
	3	5,588	558	20	2	0.2	11	19
	4	16,104	706	2	0	0.0	0	0
	5	2,318	372	3	0	0.8	19	0
	8	5,656	837	2	0	0.0	0	0
	9	5,648	409	9	0	2.4	136	0
	10	25,981	483	3	0	2.7	701	0
	11	1,399	372	4	0	1.1	15	0
South Fork	13	6,915	204	1	0	0.5	35	0
Bull	0	3,685	186	32	6	7.5	276	123
Coon	0	2,149	214	23	3	11.8	254	35
School House	0	2,741	121	8	2	6.6	181	35
West Fork	2	3,205	130	13	1	10.0	321	24
Whitetail	0	5,204	335	6	0	5.9	307	0
Windfall	0	5,531	186	20	2	10.8	597	59
Totals		108,966	6,042	152	16	2.5	2,853	295

Evans Creek Cutthroat Trout				Summer 97				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	4,977	NS	NS	NS	NS	NS	NS
	2	7,227	558	6	1	1.1	79	13
	3	1,970	372	2	0	1.0	20	0
	4	10,127	744	32	1	6.6	668	12
	5	2,692	465	26	3	7.8	210	17
	6	1,178	279	23	5	8.3	98	20
	7	2,231	242	30	2	12.4	277	21
E.F.Evans		3,990	223	5	2	2.2	88	35
R.F.Evans		2,099	65	21	10	32.3	--	326
S.F.Evans	1, 2	1,126	242	12	1	7.2	81	6
Totals		37,616	3,188	157	25	4.9	1,521	449

NS = Not Sampled

Lake Creek Cutthroat Trout				Summer 97				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	5,396	130	2	0	0.0	0	0
	2	4,684	NS	NS	NS	NS	NS	NS
	3	5,458	NS	NS	NS	NS	NS	NS
	4	2,696	400	8	0	2.1	57	0
	5	2,555	428	8	0	0.5	13	0
	6	11,668	771	3	0	0.4	47	0
	7	13,284	483	3	0	0.0	0	0
	8	9,715	260	20	0	0.0	0	0
Bozard	0	11,085	297	122	12	10.8	1197	446
West Fork	2, 3	6,270	521	107	11	4.7	295	134
Totals		72,810	3,290	273	23	8.3	1,608	580

NS = Not Sampled

Alder Creek Brook Trout				Summer 97				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	771	2	0	0.3	21	0
	2	1,825	353	1	0	0.3	5	0
	3	9,446	390	1	0	0.3	28	0
	4	4,158	390	0	0	0.0	0	0
	5	5,064	744	6	0	1.0	51	0
	6	1,823	409	8	6	4.3	78	26
	7	16,860	1,246	42	12	4.4	741	166
	8	4,916	428	22	8	7.9	388	88
	9	12,635	446	27	3	10.4	1,314	82
N.F.Alder	1	4,475	446	45	16	10.5	479	158
	2	1,403	242	37	11	15.3	215	65
	3	2,058	242	44	14	18.2	375	122
	4	2,503	130	9	4	6.9	173	82
Totals		74,216	6,237	244	74	3.9	3,868	789

Benewah Creek Brook Trout				Summer 97				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,422	NS	NS	NS	NS	NS	NS
	2	9,419	930	0	0	0.0	0	0
	3	5,588	558	0	0	0.0	0	0
	4	16,104	706	1	0	0.0	0	0
	5	2,318	372	0	0	0.0	0	0
	8	5,656	837	0	0	0.0	0	0
	9	5,648	409	0	0	0.0	0	0
	10	25,981	483	2	0	1.8	468	0
	11	1,399	372	2	0	0.5	7	0
South Fork	13	6,915	204	2	0	1.0	69	0
Bull	0	3,685	186	0	0	0.0	0	0
Coon	0	2,149	214	0	0	0.0	0	0
School House	0	2,741	121	0	0	0.0	0	0
West Fork	2	3,205	130	5	3	3.8	122	74
Whitetail	0	5,204	335	0	0	0.0	0	0
Windfall	0	5,531	186	0	0	0.0	0	0
Totals		108,966	6,042	12	3	0.2	666	74

Alder Creek Cutthroat Trout			Summer 98					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	NS	NS	NS	NS	NS	NS
	2	1,825	NS	NS	NS	NS	NS	NS
	3	9,446	56	2	0	3.6	340	0
	4	4,158	186	6	0	3.2	91	0
	5	5,064	502	0	0	0.0	20	0
	6	1,823	279	2	0	0.7	13	0
	7	16,860	920	13	2.0	1.4	236	36
	8	4,916	353	5	0	1.4	69	0
	9	12,635	353	0	0	0.0	0	0
N.Fork Alder	1	4,475	353	0	0	0.0	0	0
	2	1,403	837	0	0	0.0	0	0
	3	2,058	446	0	0	0.0	0	0
	4	2,503	74	0	0	0.0	0	0
Totals		74,216	4,359	30	2	0.7	769	36

NS = Not sampled

Benewah Creek Cutthroat Trout			Summer 98					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,422	NS	NS	NS	NS	NS	NS
	2	9,419	1,199	1	0	0.1	9	0
	3	5,588	753	10	0	1.3	73	0
	4	16,104	NS	NS	NS	NS	NS	NS
	5	2,318	NS	NS	NS	NS	NS	NS
	8	5,656	948	10	6	1.1	62	35
	9	5,648	558	6	0	1.1	62	0
	10	25,981	939	3	0	0.3	78	0
	11	1,399	335	1	0	0.3	4	0
South East Fork	13	6,915	390	69	10	17.7	1,224	179
West Fork	14	3,205	130	44	8	33.8	1,083	188
Bull	1	3,685	74	14	4	18.8	693	219
Coon	1,2	2,149	NS	NS	NS	NS	NS	NS
School House	1	2,741	223	2	0	0.9	25	0
Whitetail	1	5,204	149	10	2	6.7	349	54
Windfall	1, 2	5,531	242	35	10	14.5	1,300	228
Totals		108,966	5,940	205	40	3.5	4,962	903

NS = Not sampled

Evans Creek Cutthroat Trout			Summer 98					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	4,977	390	4	0	1.0	50	0
	2	7,227	948	21	6	2.2	159	47
	3	1,970	204	8	0	3.9	53	0
	4	10,127	706	20	4	2.8	284	63
	5	2,692	335	16	4	4.8	129	36
	6	1,178	130	12	2	9.2	108	14
	7	2,231	149	12	1	8.1	181	17
E.F.Evans	1	3,990	93	23	10	24.7	495	417
R.F.Evans	1	2,099	74	6	2	8.1	170	43
S.F.Evans	1,2	1,126	112	14	7	12.6	142	75
Totals		37,616	3,142	136	36	4.3	1,771	711

Lake Creek Cutthroat Trout			Summer 98					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	5,396	223	0	0	0	0	0
	4	2,696	539	0	0	0	0	0
	5	2,555	651	0	0	0	0	0
	6	11,668	576	28	7	4.9	572	146
	7	13,284	632	7	0	1.1	146	0
	8	9,715	428	26	1	6.1	593	25
West Fork	9,10	6,270	242	37	5	15.3	2,633	136
Bozard	1,2,3	11,085	279	28	7	10.0	1,109	277
Totals		62,669	3,569	126	21	3.5	5,053	584

Alder Creek Brook Trout			Summer 98					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	837	0	0	0.0	0	0
	2	1,825	363	0	0	0.0	0	0
	3	9,446	56	2	0	3.6	340	0
	4	4,158	186	4	7	2.2	91	155
	5	5,064	502	16	1	3.2	162	13
	6	1,823	279	9	27	3.2	58	175
	7	16,860	920	64	42	7.0	1,180	766
	8	4,916	353	60	14	17.0	836	189
	9	12,635	353	26	8	7.4	935	280
N.F.Alder	1	4,475	353	30	9	8.5	380	118
	2	1,403	837	16	7	1.9	27	12
	3	2,058	446	14	1	3.1	64	5
	4	2,503	74	14	4	18.8	471	149
Totals		74,216	5,558	255	120	4.6	4,544	1,862

Benewah Creek Brook Trout			Summer 98					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,422	NS	NS	NS	NS	NS	NS
	2	9,419	1,199	0	0	0.0	0	0
	3	5,588	753	0	0	0.0	0	0
	4	16,104	NS	NS	NS	NS	NS	NS
	5	2,318	NS	NS	NS	NS	NS	NS
	8	5,656	948	0	0	0.0	0	0
	9	5,648	558	0	0	0.0	0	0
	10	25,981	939	4	7	0.4	104	192
	11	1,399	335	4	0	1.2	17	0
South East Fork	13	6,915	390	11	3	2.8	194	50
West Fork	14	3,205	130	23	2	17.7	567	61
Bull	1	3,685	74	0	0	0.0	0	0
Coon	1,2	2,149	130	0	0	0.0	0	0
School House	1	2,741	223	0	0	0.0	0	0
Whitetail	1	5,204	149	0	0	0.0	0	0
Windfall	1, 2	5,531	242	2	0	0.8	72	0
Totals		108,966	6,070	44	12	0.7	954	302

Alder Creek Cutthroat Trout			Summer 99					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	521	2	0	0.4	28	0
	2	1,825	297	2	0	0.7	13	0
	3	9,446	260	0	0	0	0	0
	4	4,158	186	3	*	*	*	*
	5	5,064	595	9	6	1.5	76	51
	6	1,823	242	17	8	7.0	128	63
	7	16,860	911	10	*	*	*	*
	8	4,916	335	1	0	0	0	0
	9	12,635	390	0	0	0	0	0
N.Fork Alder	1	4,475	279	2	0	1.1	49	0
	2	1,403	195	3	0	1.5	21	0
	3	2,058	428	0	0	0	0	0
	4	2,503	56	0	0	0	0	0
Totals		74,216	4,694	42	14	0.9	315	114

* capture probability 0.5 or less; estimate not used to calculate CIs, density or total number. N is actual total cour

Benewah Creek Cutthroat Trout			Summer 99					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,422	149	2	0	1.3	96	0
	2	9,419	1,041	2	0	0.2	19	0
	3	5,588	465	4	0	0.9	50	0
	4	16,104	446	10	0	2.2	354	0
	5	2,318	NS	NS	NS	NS	NS	NS
	8	5,656	930	7	2	0.8	45	12
	9	5,648	613	2	0	0.7	40	0
	10	25,981	651	15	2	2.3	598	97
	11	1,399	335	8	0	2.4	34	0
South East Fork	13	6,915	270	30	0	11.1	768	0
West Fork	14	3,205	130	8	1	7.7	247	27
Bull	1	3,685	130	5	3	3.8	140	85
Coon	1,2	2,149	93	24	6	25.8	554	128
School House	1	2,741	130	1	0	0.8	22	0
Whitetail	1,2	5,204	84	11	0	15.5	807	0
Windfall	2	5,531	204	40	*	*	*	*
Totals		108,966	5,670	169	14	3.0	3,773	350

* capture probability 0.5 or less; estimate not used to calculate CIs, density or total number. N is actual total coun
NS = Not Sampled

Evans Creek			Summer 99					
Cutthroat Trout								
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	4,977	242	3	0	1.2	60	0
	2	7,227	521	9	0	1.7	123	0
	3	1,970	167	7	1	4.2	83	15
	4	10,127	483	61	17	12.6	1,276	350
	5	2,692	186	16	3	8.6	232	41
	6	1,178	446	15	8	6.7	79	22
	7	2,231	223	31	2	14.7	328	24
E.F.Evans	1	3,990	93	30	2	32.3	1,289	105
R.F.Evans	1	2,099	NS	NS	NS	NS	NS	NS
S.F.Evans	1,2	1,126	167	2	0	1.2	14	0
Totals		37,616	2,528	254	34	10.0	3,482	556

* capture probability 0.5 or less; estimate not used to calculate CIs, density or total number. N is actual total cour
NS = Not sampled

Lake Creek			Summer 99					
Cutthroat Trout								
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	5,396	223	2	0	0.9	49	0
	4	2,696	465	9	0	1.9	51	0
	5	2,555	335	16	1	4.8	123	8
	6	11,668	781	16	1	2.1	245	13
	7	13,284	446	7	0	1.3	173	0
	8	9,715	353	14	1	4.0	389	35
West Fork	8, 9,10	6,270	335	45	8	13.5	846	158
Bozard	1	11,085	307	38	4	12.7	1,408	137
Totals		62,669	3,244	147	15	4.5	3,283	351

Alder Creek Brook Trout			Summer 99					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	521	3	0	0.6	42	0
	2	1,825	297	1	0	0.3	5	0
	3	9,446	260	3	0	1.2	113	0
	4	4,158	186	5	3	2.7	112	67
	5	5,064	595	10	0	1.7	86	0
	6	1,823	242	21	2	86.9	1,584	17
	7	16,860	911	33	3	3.6	607	55
	8	4,916	335	58	7	17.3	850	95
	9	12,635	390	32	15	8.2	1,036	496
N.F.Alder	1	4,475	279	81	16	29.1	1,302	263
	2	1,403	195	19	5	9.7	136	37
	3	2,058	428	14	1	3.3	68	5
	4	2,503	56	27	3	48.4	1,212	124
Totals		74,216	4,694	307	56	6.5	7,154	1,161

Benewah Creek Brook Trout			Summer 99					
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,422	149	0	0	0.0	0	0
	2	9,419	1,041	0	0	0.0	0	0
	3	5,588	465	0	0	0.0	0	0
	4	16,104	446	0	0	0.0	0	0
	5	2,318	446	NS	NS	NS	NS	NS
	8	5,656	930	0	0	0.0	0	0
	9	5,648	613	0	0	0.0	0	0
	10	25,981	651	14	2	2.2	572	78
	11	1,399	335	5	0	2.7	38	0
South East Fork	13	6,915	270	8	*	*	*	*
West Fork	14	3,205	130	10	1	13.1	420	27
Bull	1	3,685	130	2	0	1.5	55	0
Coon	1,2	2,149	93	0	0	0.0	0	0
School House	1	2,741	130	1	0	0.0	0	0
Whitetail	1,2	5,204	84	2	0	2.4	125	0
Windfall	2	5,531	204	8	0	3.9	216	0
Totals		108,966	6,116	50	3	0.8	1,425	105

* capture probability 0.5 or less; estimate not used to calculate CIs, density or total number. N is actual total coun
NS = Not sampled

Alder Creek Cutthroat Trout				Summer 00				
Tributary	**Reach**	**TotalArea (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	NS	NS	NS	NS	NS	NS
	2	1,825	NS	NS	NS	NS	NS	NS
	3	9,446	NS	NS	NS	NS	NS	NS
	4	4,158	NS	NS	NS	NS	NS	NS
	5	5,064	NS	NS	NS	NS	NS	NS
	6	1,823	390	3	0	0.8	15	0
	7	16,860	576	10	0	1.7	287	0
	8	4,916	149	0	0	0.0	0	0
	9	12,635	149	0	0	0.0	0	0
N.Fork Alder	1	4,475	502	0	0	0.0	0	0
	2	1,403	372	0	0	0.0	0	0
	3	2,058	93	0	0	0.0	0	0
	4	2,503	56	0	0	0.0	0	0
Totals		74,216	2,287	10	0	0.4	301	0

NS = Not Sampled

Benewah Creek Cutthroat Trout				Summer 00				
Tributary	**Reach**	**TotalArea (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,422	279	0	0	0	0	0
	2	9,419	744	1	0	0.1	9	0
	3	5,588	558	7	0	1.3	73	0
	4	16,104	576	1	0	0.2	32	0
	5	2,318	372	1	0	0.3	7	0
	8	5,656	483	1	0	0.2	11	0
	9	5,648	539	2	0	0.4	23	0
	10	25,981	521	2	0	0.4	104	0
	11	1,399	316	0	0	0	0	0
South East Fork	1,2,3	6,915	260	35	8	13.5	934	202
West Fork	1,2	3,205	167	5	0	3.0	96	0
Bull	1	3,685	112	9	0	8.1	299	0
Coon	1,2	2,149	74	21	0	22.6	486	0
School House	1	2,741	186	17	5	9.1	249	80
Whitetail	1,2	5,204	335	47	0	14.1	734	0
Windfall	2	5,531	112	50	2	20.7	1145	113
Totals		108,966	5,633	199	15	3.5	4,201	395

Evans Creek Cutthroat Trout				Summer 00				
Tributary	**Reach**	**TotalArea (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	4,977	335	0	0	0.0	0	0
	2	7,227	372	13	5	3.5	253	97
	3	1,970	130	14	4	10.8	213	67
	4	10,127	558	56	*	*	*	*
	5	2,692	372	34	9	9.1	245	66
	6	1,178	223	24	1	10.8	127	6
	7	2,231	297	21	0	7.1	158	0
E.F.Evans	1	3,990	56	10	1	17.9	714	63
R.F.Evans	1	2,099	56	6	0	10.8	227	0
S.F.Evans	1,2	1,126	56	6	0	10.8	122	0
Totals		37,616	2,454	186	21	7.6	2,059	299

* capture probability 0.5 or less; estimate not used to calculate CIs, density or total number. N is actual total coun

Lake Creek Cutthroat Trout				Summer 00				
Tributary	**Reach**	**TotalArea (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	5,396	NS	NS	NS	NS	NS	NS
	4	2,696	NS	NS	NS	NS	NS	NS
	5	2,555	725	0	0	0.0	0	0
	6	11,668	874	6.0	0	0.7	82	0
	7	13,284	446	0	0	0.0	0	0
	8	9,715	335	4.0	0	1.2	117	0
West Fork	9,10	6,270	353	49.0	8	23.9	1499	151
Bozard	1,2,3	11,085	260	59.0	11	22.7	2516	474
Totals		62,669	2,993	118	20	3.9	4,213	625

NS = Not Sampled

Alder Creek Brook Trout			Summer 00					
Tributary	**Reach**	**TotalArea (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	7,052	NS	NS	NS	NS	NS	NS
	2	1,825	NS	NS	NS	NS	NS	NS
	3	9,446	NS	NS	NS	NS	NS	NS
	4	4,158	NS	NS	NS	NS	NS	NS
	5	5,064	NS	NS	NS	NS	NS	NS
	6	1,823	390	17	3	4.4	80	15
	7	16,860	576	74	25	12.8	2,158	731
	8	4,916	149	34	4	22.9	1,126	146
	9	12,635	149	16	10	10.8	1,365	833
N.F.Alder	1	4,475	502	39	3	7.8	349	31
	2	1,403	372	0	0	0	-	0
	3	2,058	93	13	21	*	*	*
	4	2,503	56	10	0	17.9	448	0
Totals		74,216	2,287	203	67.0	8.9	5,526	1,755

* capture probability 0.5 or less; estimate not used to calculate CIs, density or total number. N is actual total coun
NS = Not Sampled

Benewah Creek Brook Trout			Summer 00					
Tributary	**Reach**	**TotalArea (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total #**	**95%CI**
Mainstem	1	7,422	279	0	0	0	0	0
	2	9,419	744	0	0	0	0	0
	3	5,588	558	0	0	0	0	0
	4	16,104	576	0	0	0	0	0
	5	2,318	372	0	0	0	0	0
	8	5,656	483	0	0	0	0	0
	9	5,648	539	0	0	0	0	0
	10	25,981	521	1	0	0.2	52	0
	11	1,399	316	1	0	0.3	4	0
South East Fork	2,3	6,915	260	6	8	2.3	159	203
West Fork	14	3,205	167	4	0	2.4	77	0
Bull	1	3,685	112	0	0	0	0	0
Coon	1,2	2,149	74	0	0	0	0	0
School House	1	2,741	186	4	0	2.2	60	0
Whitetail	1,2	5,204	335	0	0	0	0	0
Windfall	2	5,531	112	0	0	0	0	0
Totals		108,966	5,633	16	8	0.3	352	203

Alder Creek Cutthroat Trout				Summer 01				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total #**	**95%CI**
Mainstem	1	7,052	185	2	0	1.1	76	0
	2	1,825	NS	NS	NS	NS	NS	NS
	3	9,446	NS	NS	NS	NS	NS	NS
	4	4,158	NS	NS	NS	NS	NS	NS
	5	5,064	223	2	0	0.9	45	0
	6	1,823	149	5	*	*	*	*
	7	16,860	650	13	6	2.0	337	150
	8	4,916	334	0	0	0	0	0
	9	12,635	279	4	0	1.4	181	0
N.Fork Alder	1	4,475	297	1	0	0.3	15	0
	2	1,403	167	1	0	0.6	8	0
	3	2,058	112	0	0	0	0	0
	4	2,503	37	0	0	0	0	0
Totals		74,216	2,433	28	5.8	1.2	663	150

Benewah Creek Cutthroat Trout				Summer 01				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total #**	**95%CI**
Mainstem	1	7,422	279	1	0	0.4	27	0
	2	9,419	446	2	0	0.4	42	0
	3	5,588	409	6	0	1.5	82	0
	4	16,104	557	0	0	0	0	0
	5	2,318	223	2	0	0.9	21	0
	8	5,656	409	0	0	0	0	0
	9	5,648	353	0	0	0	0	0
	10	25,981	595	8	*	*	*	*
	11	1,399	242	3	0	1.2	17	0
South East Fork	13	6,915	112	17	3	15.2	1,054	167
West Fork	14	3,205	93	13	7	14.0	449	239
Bull	1	3,685	130	23	7	17.7	651	195
Coon	1,2	2,149	149	11	0	7.4	159	0
School House	1	2,741	93	9	0	9.7	266	0
Whitetail	1,2	5,204	130	45	4	34.6	1,800	172
Windfall	2	5,531	NS	NS	NS	NS	NS	NS
Totals		108,966	4,218	140	21	3.3	4,568	774

* capture probability 0.5 or less; estimate not used to calculate CIs, density or total number. N is actual total co

Evans Creek Cutthroat Trout				Summer 01				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total #**	**95%CI**
Mainstem	1	4,977	186	4	0	2.2	107	0
	2	7,227	372	6	0	1.6	117	0
	3	1,970	223	11	5	4.9	97	40
	4	10,127	93	14	4	15.1	1,526	480
	5	2,692	595	111	16	18.7	503	72
	6	1,178	260	35	4	13.5	159	18
	7	2,231	149	19	4	12.8	285	56
E.F.Evans	1	3,990	65	64	11	98.5	3,929	663
R.F.Evans	1	2,099	74	45	7	60.6	1,271	186
S.F.Evans	1,2	1,126	112	37	1	33.2	374	6
Totals		37,616	2,127	346	50	16.3	8,367	1,520

Lake Creek Cutthroat Trout				Summer 01				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total N**	**95%CI**
Mainstem	1	5,396	242	2	0	0.8	45	0
	4	2,696	465	23	5	5.0	133	27
	5	2,555	334	6	0	1.8	46	0
	6	11,668	539	0	0	0	-	0
	7	13,284	595	8	0	1.3	179	0
	8	9,715	353	9	2	2.5	248	52
West Fork	9,10	6,270	279	49	18	17.6	1,102	407
Bozard	1,2,3	11,085	316	132	1	41.8	4,632	39
Totals		62,669	3,121	229	26	7.3	6,385	525

Alder Creek Brook Trout				Summer 01				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total #**	**95%CI**
Mainstem	1	7,052	185	0	0	0	0	0
	2	1,825	-	NS	NS	NS	NS	NS
	3	9,446	-	NS	NS	NS	NS	NS
	4	4,158	-	NS	NS	NS	NS	NS
	5	5,064	223	6	2	2.7	136	34
	6	1,823	149	7	0	4.7	86	0
	7	16,860	650	63	6	9.7	1,633	156
	8	4,916	334	50	5	15.0	735	71
	9	12,635	279	28	4	10.0	1,269	168
N.F.Alder	1	4,475	297	154	8	51.8	2,318	115
	2	1,403	167	26	3	15.6	218	22
	3	2,058	112	45	3	40.4	831	60
	4	2,503	37	11	0	29.6	740	0
Totals		74,216	2,433	390	30	16.0	7,966	627

Benewah Creek Brook Trout				Summer 01				
Tributary	**Reach**	**Total Area (sq. m.)**	**Area Sampled (sq. m.)**	**N**	**95%CI**	**#/100 sq. m**	**Total #**	**95%CI**
Mainstem	1	7,422	279	0	0	0	0	0
	2	9,419	446	0	0	0	0	0
	3	5,588	409	0	0	0	0	0
	4	16,104	557	0	0	0	0	0
	5	2,318	223	0	0	0	0	0
	8	5,656	409	0	0	0	0	0
	9	5,648	353	0	0	0	0	0
	10	25,981	595	0	0	0	0	0
	11	1,399	242	5	0	2.1	29	0
South East Fork	13	6,915	112	6	2	5.4	372	93
West Fork	14	3,205	93	15	4	16.1	518	131
Bull	1	3,685	130	0	0	0	0	0
Coon	1,2	2,149	149	0	0	0	0	0
School House	1	2,741	93	2	0	2.2	59	0
Whitetail	1,2	5,204	130	0	0	0	0	0
Windfall	2	5,531	NS	NS	NS	NS	NS	NS
Totals		108,966	4,218	28	5	0.7	978	224

NS = Not Sampled

APPENDIX D – MACRO INVERTEBRATE DATA

Table D1. Taxa list, Lake Creek 1999.

		Stream Station	**Station #1 Totals**	**Station #2 Totals**	**Lake Creek Station #3 Totals**	**Station #4 Totals**	**Station #5 Totals**	**Total**
Ephemeroptera	Acentrella insignificans		2	0	15	1	0	18
	Acentrella sp.		0	0	1	0	0	1
	Acentrella turbida		18	0	0	0	0	18
	Ameletus sp.		58	53	69	110	92	382
	Baetidae		0	14	2	2	0	18
	Baetis tricaudatus		22	1	87	2	1	113
	Callibaetis sp.		0	3	0	0	2	5
	Centroptilum sp.		41	66	49	11	4	171
	Cinygmula sp.		73	46	47	13	2	181
	Diphetor hageni		113	136	168	133	31	581
	Drunella flavilinea/coloradensis		158	0	9	0	1	168
	Drunella grandis		2	2	5	2	5	16
	Epeorus albertae		64	0	7	0	0	71
	Epeorus longimanus		16	0	18	7	4	45
	Epeorus sp.		57	0	2	0	0	59
	Ephemerella inermis/infrequens		666	177	380	89	150	1462
	Ephemerellidae		0	0	0	0	3	3
	Heptageniidae		3	1	0	0	0	4
	Leptophlebiidae		3	3	6	4	6	22
	Nixe sp.		10	0	6	0	0	16
	Paraleptophlebia sp.		175	260	254	111	235	1035
	Procloeon sp.		12	3	3	0	2	20
	Pseudocloeon sp.		0	179	24	178	486	867
	Serratella teresa		36	1	122	56	68	283
	Serratella tibialis		1	1	12	8	42	64
	Siphlonurus sp.		0	29	0	1	0	30
	Tricorythodes sp.		3	0	0	0	0	3
Odonata	Aeshna sp.		2	1	2	1	4	10
	Coenagrionidae		0	1	0	0	0	1
Plecoptera	Calineuria californica		47	0	0	0	0	47
	Capniidae		42	40	77	135	48	342
	Isoperla sp.		1	19	13	51	34	118
	Kogotus sp.		0	0	0	1	0	1
	Leuctridae		1	0	0	0	0	1
	Malenka sp.		1	0	0	0	19	20
	Nemouridae		0	0	0	4	4	8
	Perlodidae		0	0	4	8	37	49
	Podmosta sp.		0	0	1	1	1	3
	Pteronarcys californica		4	0	0	0	0	4
	Pteronarcys sp.		6	0	1	0	0	7
	Skwala sp.		10	5	18	1	1	35
	Sweltsa sp.		0	0	0	1	0	1
	Zapada cinctipes		4	0	15	5	2	26
Hemiptera	Corixidae		136	119	141	63	155	614
Coleoptera	Cleptelmis addenda		17	70	185	49	54	375
	Dytiscidae		43	9	22	33	43	150
	Gyrinus sp.		0	0	0	3	0	3
	Helophorus sp.		1	3	0	0	0	4
	Heterlimnius sp.		0	0	0	15	10	25
	Hydraena sp.		0	0	1	1	0	2
	Lara sp.		1	1	4	10	3	19
	Tropisternus sp.		0	0	0	1	0	1
	Zaitzevia sp.		63	5	25	18	32	143
	Narpus sp.		0	0	0	27	6	33

Table D1. Taxa list, Lake Creek 1999.

	Stream	Lake Creek				
	Station	Station #1	Station #2	Station #3	Station #4	Station #5
		Totals	Totals	Totals	Totals	Totals
Megaloptera	Sialis sp.	18	41	22	61	47
Diptera	Ceratopogoninae	18	17	5	10	8
	Chelifera sp.	2	3	2	5	5
	Clinocera sp.	2	2	1	0	0
	Dicranota sp.	0	4	13	10	10
	Dixa sp.	4	0	0	0	0
	Dixella sp.	1	0	0	1	3
	Empididae	0	3	0	1	5
	Hemerodromia sp.	4	0	1	0	0
	Limnophila sp.	2	11	14	18	9
	Meringodixa sp.	0	1	0	1	0
	Pericoma sp.	6	7	1	3	1
	Prosimulium sp.	0	0	2	1	1
	Simulium sp.	7	1	26	369	41
	Syrphidae	0	0	0	1	0
	Tabanidae	4	64	15	29	15
	Tipula sp.	0	0	0	0	1
	Tipulidae	4	0	0	0	1
Chironomidae (family)	Ablabesmyia sp.	4	24	10	26	25
	Brillia sp.	3	10	9	20	20
	Chironomini	1	0	2	0	0
	Cladotanytarsus sp.	1	153	21	5	0
	Corynoneura sp.	3	12	13	18	8
	Cricotopus bicinctus gr.	5	0	9	1	0
	Cricotopus sp.	22	7	2	1	1
	Cryptochironomus sp.	2	11	0	0	0
	Diamesa sp.	0	1	0	2	0
	Eukiefferiella brehmi gr.	0	0	2	0	1
	Eukiefferiella claripennis gr.	0	0	0	3	5
	Eukiefferiella coerulescens gr.	1	0	0	0	0
	Eukiefferiella devonica gr.	13	3	79	4	17
	Eukiefferiella sp.	0	0	1	0	0
	Heleniella sp.	3	0	0	0	0
	Heterotrissocladius sp.	34	236	102	91	93
	Larsia sp.	20	316	106	106	106
	Limnophyes sp.	2	6	0	1	0
	Macropelopia sp.	3	14	1	22	3
	Micropsectra sp.	5	8	60	344	249
	Microtendipes pedellus gr.	2	2	0	0	0
	Microtendipes rydalensis gr.	0	0	0	8	17
	Nanocladius balticus gr.	0	1	0	3	0
	Nanocladius sp.	0	1	1	0	4
	Natarsia sp.	1	2	1	0	0
	Orthocladiinae	0	11	0	0	0
	Orthocladius (Euortho.) rivicola grp.	3	0	2	3	1

Table D1. Taxa list, Lake Creek 1999.

		Stream Station	**Station #1 Totals**	**Station #2 Totals**	**Lake Creek Station #3 Totals**	**Station #4 Totals**	**Station #5 Totals**	**Totals**
Chironomidae	Phaenopsectra sp.		21	6	10	1	8	46
(family), cont.	Polypedilum sp.		27	25	34	149	63	298
	Potthastia gaedii gr.		0	0	0	1	1	2
	Procladius sp.		5	49	1	42	37	134
	Psectrocladius sp.		0	16	2	0	0	18
	Radotanypus sp.		0	0	0	26	12	38
	Rheocricotopus sp.		0	1	2	10	6	19
	Rheotanytarsus sp.		1	0	1	1	1	4
	Stempellinella sp.		5	92	7	39	48	191
	Stenochironomus sp.		0	0	0	1	12	13
	Synorthocladius sp.		9	9	13	36	8	75
	Tanytarsus sp.		12	188	38	24	54	316
	Thienemanniella sp.		11	4	20	6	4	45
	Thienemannimyia gr. sp.		61	40	61	22	121	305
	Tribelos jucundum		0	1	1	23	45	70
	Tvetenia bavarica gr.		7	0	59	44	285	395
	Zavrelimyia sp.		7	30	8	45	16	106
Trichoptera	Amiocentrus aspilus		0	0	0	0	1	1
	Brachycentridae		1	0	0	0	0	1
	Dicosmoecus gilvipes		0	1	10	7	1	19
	Glossosoma sp.		0	2	5	0	0	7
	Helicopsyche sp.		24	0	0	0	0	24
	Hesperophylax sp.		1	0	0	0	0	1
	Hydropsyche sp.		1	0	5	0	0	6
	Hydroptila sp.		0	0	0	1	6	7
	Lepidostoma sp.		1112	4	12	18	11	1157
	Leptoceridae		3	0	0	0	0	3
	Limnephilidae		0	7	2	110	9	128
	Micrasema sp.		0	0	0	1	4	5
	Nectopsyche sp.		1	0	0	0	0	1
	Neophylax rickeri		14	0	5	0	0	19
	Neophylax sp.		1	0	1	0	0	2
	Neotrichia sp.		1	0	0	0	0	1
	Ochrotrichia sp.		0	0	0	1	0	1
	Oecetis sp.		3	0	0	0	0	3
	Onocosmoecus sp.		0	0	0	1	0	1
	Parapsyche almota		0	0	0	0	1	1
	Phryganeidae		0	4	1	5	6	16
	Polycentropidae		0	0	0	2	2	4
	Polycentropus sp.		2	4	7	1	7	21
	Psychoglypha sp.		0	5	1	0	3	9
	Ptilostomis sp.		1	5	20	0	2	28
	Rhyacophila angelita gr.		6	0	5	1	4	16
	Rhyacophila betteni gr.		1	0	0	0	0	1
	Rhyacophila sp.		11	0	4	2	8	25
Hirudinea (class)	Hirudinea		0	1	0	0	0	1
Oligochaeta (class)	Oligochaeta		34	49	17	63	58	221
Nematoda (phylum)	Nematoda		0	1	1	0	1	3
Bivalvia (class)	Bivalvia		0	0	1	0	0	1
	Margaritifera falcata		1	4	23	12	0	40
	Sphaeriidae		14	23	7	101	70	215
Gastropoda (class)	Ferrissia sp.		0	2	0	0	0	2
	Gastropoda		0	1	0	1	1	3
	Physella sp.		14	17	23	22	23	99
Amphipoda	Hyalella azteca		8	122	6	4	3	143
Decapoda	Pacifasticus sp.		1	2	3	0	0	6
Acari (subclass)	Acari		40	34	41	21	33	169
		Station Totals	4791	3520	3183	3393	3335	18222

Table D2. Average metric values, station 1 Lake Creek.

Stream	**Lake Creek**	**Lake Creek**	**Lake Creek**
Site	**Station 1, 06-07-1999, Average**	**Station 1, 08-18-1999, Average**	**Station 1, 10-12-1999, Average**
Abundance Measures			
Corrected abundance	1004.83	2107.43	1994.16
EPT abundance	449.23	1400.43	1566.34
Dominance Measures			
1st dominant taxon	NA	NA	NA
1st Dominant Abundance	393.13	815.63	678.93
2nd dominant taxon	NA	NA	NA
2nd Dominant Abundance	102.10	359.77	448.70
3rd dominant taxon	NA	NA	NA
3rd Dominant Abundance	69.73	220.33	247.64
% 1 dominant taxon	51.16	35.52	39.69
% 2 dominant taxa	62.08	53.83	57.74
% 3 dominant taxa	67.62	64.93	69.36
Richness Measures			
Species richness	38.67	45.00	33.00
EPT richness	18.67	15.67	12.00
Ephemeroptera richness	11.33	9.67	7.33
Plecoptera richness	2.67	4.00	1.67
Trichoptera richness	4.67	2.00	3.00
Chironomidae Richness	10.33	17.67	8.00
Oligochaeta Richness	0.33	1.00	1.00
NCO Richness	28.00	26.33	24.00
Rhyacophila richness	1.67	0.00	0.33
Community Composition			
% Ephemeroptera	27.04	26.10	41.40
% Plecoptera	3.25	1.54	2.41
% Trichoptera	4.14	34.71	29.68
% EPT	34.43	62.35	73.49
% Coleoptera	56.52	18.64	13.13
% Diptera	8.02	11.34	5.36
% Oligochaeta	0.20	0.55	1.33
% Baetidae	5.23	5.72	1.63
% Brachycentridae	0.10	0.00	0.00
% Chironomidae	6.04	10.97	4.11
% Ephemerellidae	13.19	11.84	28.59
% Hydropsychidae	0.07	0.00	0.00
% Odonata	0.00	0.10	0.00
% Perlidae	2.62	0.21	0.17
% Pteronarcyidae	0.57	0.05	0.00
% Simuliidae	0.48	0.00	0.00
Functional Group Composition			
% Filterers	1.22	0.81	0.50
% Gatherers	18.18	18.57	11.22
% Predators	6.86	6.04	7.00
% Scrapers	71.30	20.28	17.45
% Shredders	2.43	48.99	60.33
% Piercer-Herbivores	0.00	0.05	0.00
% Unclassified	0.00	0.00	0.00
Filterer richness	2.00	2.00	1.67
Gatherer richness	14.33	19.33	12.67
Predator richness	9.33	9.67	8.67
Scraper richness	8.33	5.00	4.00
Shredder richness	4.67	7.67	5.00
Piercer-Herbivore Richness	0.00	0.33	0.00
Unclassified	0.00	0.00	0.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	0.89	1.01	0.91
Shannon-Weaver H' (log 2)	2.96	3.35	3.00
Shannon-Weaver H' (log e)	2.05	2.32	2.08
Hilsenhoff Biotic Index	4.06	2.99	2.49
Margalef's Richness	5.62	5.78	4.61
Metals Tolerance Index	3.28	2.39	2.31
Pielou's J'	0.56	0.61	0.60
Simpson's Heterogeneity	0.69	0.79	0.78
DEQ MBI	4.27	4.39	4.08

Table D2. Average metric values, station 2 Lake Creek.

Stream	**Lake Creek**	**Lake Creek**	**Lake Creek**
Site	**Station 2, 06-15-1999, Average**	**Station 2, 08-17-1999, Average**	**Station 2, 10-14-1999, Average**
Abundance Measures			
Corrected abundance	584.60	1838.07	617.04
EPT abundance	191.07	400.64	415.36
Dominance Measures			
1st dominant taxon	NA	NA	NA
1st Dominant Abundance	150.27	437.07	153.43
2nd dominant taxon	NA	NA	NA
2nd Dominant Abundance	123.73	286.10	109.33
3rd dominant taxon	NA	NA	NA
3rd Dominant Abundance	52.60	176.50	67.83
% 1 dominant taxon	24.78	24.84	20.54
% 2 dominant taxa	40.74	39.03	35.05
% 3 dominant taxa	49.91	48.65	44.43
Richness Measures			
Species richness	39.00	38.67	29.33
EPT richness	8.00	7.67	10.33
Ephemeroptera richness	6.00	5.00	5.00
Plecoptera richness	0.00	2.00	2.67
Trichoptera richness	2.00	0.67	2.67
Chironomidae Richness	16.67	20.00	7.67
Oligochaeta Richness	0.67	1.00	0.67
NCO Richness	21.67	17.67	21.00
Rhyacophila richness	0.00	0.00	0.00
Community Composition			
% Ephemeroptera	26.05	12.48	47.16
% Plecoptera	0.00	2.91	2.91
% Trichoptera	1.24	0.25	1.79
% EPT	27.29	15.64	51.86
% Coleoptera	4.33	3.74	14.06
% Diptera	55.90	66.32	25.35
% Oligochaeta	0.59	2.87	0.39
% Baetidae	21.18	2.02	11.42
% Brachycentridae	0.00	0.00	0.00
% Chironomidae	53.80	62.40	20.12
% Ephemerellidae	0.35	6.24	9.10
% Hydropsychidae	0.00	0.00	0.00
% Odonata	0.07	0.05	0.00
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00
% Simuliidae	0.00	0.07	0.00
Functional Group Composition			
% Filterers	4.37	9.46	1.17
% Gatherers	47.39	55.84	48.83
% Predators	27.99	16.57	19.80
% Scrapers	4.23	3.81	11.54
% Shredders	1.93	9.46	14.03
% Piercer-Herbivores	0.00	0.00	0.00
% Unclassified	13.29	0.00	0.19
Filterer richness	3.00	2.67	1.67
Gatherer richness	18.00	17.00	8.33
Predator richness	10.33	11.67	10.00
Scraper richness	3.33	2.00	3.33
Shredder richness	2.67	4.33	4.67
Piercer-Herbivore Richness	0.00	0.00	0.00
Unclassified	0.67	0.00	0.33
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	1.18	1.17	1.16
Shannon-Weaver H' (log 2)	3.94	3.87	3.85
Shannon-Weaver H' (log e)	2.73	2.68	2.67
Hilsenhoff Biotic Index	5.72	5.67	3.99
Margalef's Richness	6.42	5.10	5.07
Metals Tolerance Index	2.12	1.84	1.93
Pielou's J'	0.75	0.74	0.79
Simpson's Heterogeneity	0.89	0.88	0.90
DEQ MBI	3.47	3.32	3.91

Table D2. Average metric values, station 3 Lake Creek.

Stream	**Lake Creek**	**Lake Creek**	**Lake Creek**
Site	**Station 3, 06-07-1999, Average**	**Station 3, 08-17-1999, Average**	**Station 3, 10-14-1999, Average**
Abundance Measures			
Corrected abundance	240.33	2875.51	675.67
EPT abundance	117.67	1350.07	345.00
Dominance Measures			
1st dominant taxon	NA	NA	NA
1st Dominant Abundance	61.00	630.97	123.00
2nd dominant taxon	NA	NA	NA
2nd Dominant Abundance	34.67	345.47	107.00
3rd dominant taxon	NA	NA	NA
3rd Dominant Abundance	29.67	300.37	65.33
% 1 dominant taxon	24.58	24.38	18.58
% 2 dominant taxa	39.98	36.16	32.84
% 3 dominant taxa	50.80	46.52	42.23
Richness Measures			
Species richness	35.00	44.67	38.67
EPT richness	15.33	14.33	11.67
Ephemeroptera richness	9.00	8.67	5.67
Plecoptera richness	1.33	3.33	3.33
Trichoptera richness	5.00	2.33	2.67
Chironomidae Richness	9.67	17.00	12.67
Oligochaeta Richness	0.33	0.67	1.00
NCO Richness	25.00	27.00	25.00
Rhyacophila richness	1.67	0.00	0.00
Community Composition			
% Ephemeroptera	45.46	41.30	31.68
% Plecoptera	0.67	5.56	5.14
% Trichoptera	5.51	1.83	2.33
% EPT	51.63	48.70	39.15
% Coleoptera	20.64	13.12	23.54
% Diptera	17.12	25.83	28.77
% Oligochaeta	0.25	0.38	1.09
% Baetidae	18.10	10.30	4.43
% Brachycentridae	0.00	0.00	0.00
% Chironomidae	14.90	23.59	25.52
% Ephemerellidae	21.61	20.42	8.95
% Hydropsychidae	0.08	0.25	0.00
% Odonata	0.00	0.06	0.13
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.08	0.00	0.00
% Simuliidae	1.73	0.70	0.00
Functional Group Composition			
% Filterers	12.95	2.67	0.79
% Gatherers	57.54	40.22	37.05
% Predators	6.07	8.76	25.14
% Scrapers	18.14	13.05	18.44
% Shredders	1.39	26.95	16.75
% Piercer-Herbivores	0.00	0.00	0.00
% Unclassified	3.76	0.00	0.00
Filterer richness	4.33	2.67	1.33
Gatherer richness	14.00	20.00	15.33
Predator richness	7.33	10.67	11.67
Scraper richness	6.00	4.33	3.33
Shredder richness	2.33	6.00	5.67
Piercer-Herbivore Richness	0.00	0.00	0.00
Unclassified	0.67	0.00	0.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	1.14	1.21	1.26
Shannon-Weaver H' (log 2)	3.78	4.02	4.20
Shannon-Weaver H' (log e)	2.62	2.79	2.91
Hilsenhoff Biotic Index	3.68	3.74	4.14
Margalef's Richness	6.38	5.47	6.30
Metals Tolerance Index	1.94	2.63	2.30
Pielou's J'	0.77	0.73	0.80
Simpson's Heterogeneity	0.89	0.88	0.92
DEQ MBI	4.20	4.32	4.15

Table D2. Average metric values, station 4 Lake Creek.

Stream **Lake Creek** ***Site*** **Station 4, 06-10-1999, Average**	**Lake Creek Station 4, 08-19-1999, Average**	**Lake Creek Station 4, 10-15-1999, Average**
Abundance Measures		
Corrected abundance	631.00	1321.09	200.33
EPT abundance	242.67	280.14	85.67
Dominance Measures		
1st dominant taxon	NA	NA	NA
1st Dominant Abundance	249.17	284.87	49.00
2nd dominant taxon	NA	NA	NA
2nd Dominant Abundance	106.50	144.41	24.67
3rd dominant taxon	NA	NA	NA
3rd Dominant Abundance	43.67	111.02	19.00
% 1 dominant taxon	32.79	20.73	24.29
% 2 dominant taxa	47.30	31.37	35.77
% 3 dominant taxa	55.79	39.58	44.73
Richness Measures		
Species richness	46.00	49.00	34.33
EPT richness	16.33	9.00	7.33
Ephemeroptera richness	8.33	4.67	4.33
Plecoptera richness	3.33	2.67	1.67
Trichoptera richness	4.67	1.67	1.33
Chironomidae Richness	13.67	23.33	12.00
Oligochaeta Richness	1.00	1.00	1.00
NCO Richness	31.33	24.67	21.33
Rhyacophila richness	0.67	0.00	0.00
Community Composition		
% Ephemeroptera	39.30	13.18	19.40
% Plecoptera	1.83	6.78	12.40
% Trichoptera	4.27	0.45	11.25
% EPT	45.39	20.40	43.05
% Coleoptera	9.08	8.63	7.99
% Diptera	38.09	61.04	31.35
% Oligochaeta	0.49	1.50	6.20
% Baetidae	26.20	1.03	1.96
% Brachycentridae	0.00	0.07	0.00
% Chironomidae	9.22	57.87	27.69
% Ephemerellidae	5.94	4.93	2.50
% Hydropsychidae	0.00	0.00	0.00
% Odonata	0.00	0.00	0.18
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00
% Simuliidae	26.77	1.45	0.00
Functional Group Composition		
% Filterers	32.67	4.52	4.33
% Gatherers	31.47	52.87	34.55
% Predators	8.14	18.19	24.67
% Scrapers	7.23	4.09	5.10
% Shredders	5.08	16.62	29.64
% Piercer-Herbivores	0.19	0.00	0.00
% Unclassified	14.61	0.06	0.11
Filterer richness	4.33	4.00	1.33
Gatherer richness	17.67	22.00	13.67
Predator richness	10.67	14.00	11.33
Scraper richness	4.33	2.67	2.00
Shredder richness	6.00	4.33	4.67
Piercer-Herbivore Richness	0.67	0.00	0.00
Unclassified	1.33	0.33	0.33
Diversity/Evenness Measures		
Shannon-Weaver H' (log 10)	1.13	1.31	1.22
Shannon-Weaver H' (log 2)	3.76	4.36	4.06
Shannon-Weaver H' (log e)	2.61	3.03	2.82
Hilsenhoff Biotic Index	4.56	4.39	4.28
Margalef's Richness	7.23	6.69	6.37
Metals Tolerance Index	2.51	2.01	1.72
Pielou's J'	0.68	0.78	0.80
Simpson's Heterogeneity	0.84	0.91	0.90
DEQ MBI	4.05	3.90	3.73

Table D2. Average metric values, station 5 Lake Creek.

Stream **Lake Creek**	**Lake Creek**	**Lake Creek**
Site **Station 5, 06-10-1999, Average**	**Station 5, 08-19-1999, Average**	**Station 5, 10-15-1999, Average**
Abundance Measures		
Corrected abundance	441.33	1615.00	184.33
EPT abundance	268.00	468.00	20.00
Dominance Measures		
1st dominant taxon	NA	NA	NA
1st Dominant Abundance	119.67	412.67	31.00
2nd dominant taxon	NA	NA	NA
2nd Dominant Abundance	54.67	312.33	20.00
3rd dominant taxon	NA	NA	NA
3rd Dominant Abundance	26.33	204.67	16.33
% 1 dominant taxon	28.47	22.87	17.01
% 2 dominant taxa	40.81	39.78	27.91
% 3 dominant taxa	47.01	52.20	36.85
Richness Measures		
Species richness	44.00	42.00	35.00
EPT richness	17.67	10.00	6.33
Ephemeroptera richness	9.33	5.00	3.00
Plecoptera richness	2.67	2.67	2.00
Trichoptera richness	5.67	2.33	1.33
Chironomidae Richness	13.33	18.67	13.33
Oligochaeta Richness	1.00	0.67	1.00
NCO Richness	29.67	22.67	20.67
Rhyacophila richness	1.67	0.00	0.00
Community Composition		
% Ephemeroptera	51.21	28.03	4.45
% Plecoptera	5.62	3.77	5.28
% Trichoptera	4.05	0.98	0.89
% EPT	60.87	32.79	10.62
% Coleoptera	6.48	2.23	9.52
% Diptera	28.26	52.27	52.38
% Oligochaeta	0.32	0.14	9.48
% Baetidae	37.35	0.88	0.34
% Brachycentridae	0.41	0.00	0.00
% Chironomidae	24.83	49.83	48.91
% Ephemerellidae	8.45	9.89	0.91
% Hydropsychidae	0.00	0.07	0.00
% Odonata	0.00	0.21	0.17
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00
% Simuliidae	1.97	0.94	0.00
Functional Group Composition		
% Filterers	6.59	3.97	7.29
% Gatherers	31.31	60.15	32.46
% Predators	19.99	8.54	42.38
% Scrapers	1.53	1.35	4.67
% Shredders	4.64	16.05	10.47
% Piercer-Herbivores	0.49	0.00	0.00
% Unclassified	35.45	0.00	0.18
Filterer richness	4.00	3.33	1.67
Gatherer richness	18.00	16.00	12.00
Predator richness	12.33	12.00	13.33
Scraper richness	3.00	3.00	2.00
Shredder richness	4.33	6.67	4.00
Piercer-Herbivore Richness	1.00	0.00	0.00
Unclassified	1.33	0.00	0.33
Diversity/Evenness Measures		
Shannon-Weaver H' (log 10)	1.18	1.15	1.32
Shannon-Weaver H' (log 2)	3.94	3.81	4.38
Shannon-Weaver H' (log e)	2.73	2.65	3.04
Hilsenhoff Biotic Index	4.62	4.11	5.51
Margalef's Richness	7.13	5.77	6.51
Metals Tolerance Index	1.59	2.08	2.29
Pielou's J'	0.72	0.71	0.85
Simpson's Heterogeneity	0.87	0.88	0.93
DEQ MBI	4.22	3.77	3.39

Table D3. Family level data, pooled metrics, station 1 Lake Creek.

Stream	**Lake Creek**	**Lake Creek**	**Lake Creek**
Site	**Station 1, 06-07-1999, Pooled**	**Station 1, 08-18-1999, Pooled**	**Station 1, 10-12-1999, Pooled**
Abundance Measures			
Corrected abundance	3012.00	6311.00	5993.00
EPT abundance	1346.00	4198.00	4701.00
Dominance Measures			
1st dominant taxon	Elmidae	Lepidostomatidae	Lepidostomatidae
1st Dominant Abundance	1319.00	2409.00	1863.00
2nd dominant taxon	Ephemerellidae	Elmidae	Ephemerellidae
2nd Dominant Abundance	419.00	961.00	1528.00
3rd dominant taxon	Baetidae	Ephemerellidae	Elmidae
3rd Dominant Abundance	265.00	723.00	788.00
% 1 dominant taxon	43.79	38.17	31.09
% 2 dominant taxa	57.70	53.40	56.58
% 3 dominant taxa	66.50	64.86	69.73
Richness Measures			
Species richness	27.00	31.00	31.00
EPT richness	15.00	15.00	13.00
Ephemeroptera richness	5.00	5.00	6.00
Plecoptera richness	3.00	6.00	3.00
Trichoptera richness	7.00	4.00	4.00
Chironomidae Richness	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00
NCO Richness	25.00	29.00	29.00
Rhyacophila richness	1.00	0.00	1.00
Community Composition			
% Ephemeroptera	35.29	26.51	45.35
% Plecoptera	3.29	1.68	1.37
% Trichoptera	6.11	38.33	31.72
% EPT	44.69	66.52	78.44
% Coleoptera	44.29	16.45	13.55
% Diptera	9.53	11.03	3.00
% Oligochaeta	0.43	0.46	0.75
% Baetidae	8.80	6.10	3.17
% Brachycentridae	0.03	0.00	0.00
% Chironomidae	6.77	10.65	2.55
% Ephemerellidae	13.91	11.46	25.50
% Hydropsychidae	0.13	0.00	0.00
% Odonata	0.00	0.13	0.00
% Perlidae	2.86	0.22	0.40
% Pteronarcyidae	0.40	0.06	0.00
% Simuliidae	1.00	0.00	0.00
Functional Group Composition			
% Filterers	2.16	0.17	0.15
% Gatherers	77.52	50.53	53.06
% Predators	6.74	3.47	3.37
% Scrapers	12.98	2.84	9.89
% Shredders	0.60	39.17	32.09
% Piercer-Herbivores	0.00	0.06	0.00
% Unclassified	0.00	0.03	0.03
Filterer richness	5.00	2.00	2.00
Gatherer richness	7.00	9.00	12.00
Predator richness	7.00	8.00	9.00
Scraper richness	4.00	3.00	2.00
Shredder richness	4.00	6.00	4.00
Piercer-Herbivore Richness	0.00	1.00	0.00
Unclassified	0.00	1.00	1.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	0.86	0.89	0.87
Shannon-Weaver H' (log 2)	2.86	2.95	2.90
Shannon-Weaver H' (log e)	1.98	2.04	2.01
Hilsenhoff Biotic Index	3.47	2.75	2.29
Margalef's Richness	3.25	3.43	3.45
Metals Tolerance Index	0.19	0.32	0.22
Pielou's J'	0.60	0.59	0.59
Simpson's Heterogeneity	0.77	0.80	0.81
UIN	99-82	99-83	99-84

Table D3. Family level data, pooled metrics, station 2 Lake Creek.

Stream	**Lake Creek**	**Lake Creek**	**Lake Creek**
Site	**Station 2, 06-15-1999, Pooled**	**Station 2, 08-17-1999, Pooled**	**Station 2, 10-14-1999, Pooled**
Abundance Measures			
Corrected abundance	1757.00	5520.00	1849.00
EPT abundance	574.00	1203.00	1245.00
Dominance Measures			
1st dominant taxon	Chironomidae	Chironomidae	Leptophlebiidae
1st Dominant Abundance	872.00	2962.00	442.00
2nd dominant taxon	Baetidae	Ephemerellidae	Baetidae
2nd Dominant Abundance	487.00	562.00	311.00
3rd dominant taxon	Talitridae	Elmidae	Elmidae
3rd Dominant Abundance	139.00	309.00	297.00
% 1 dominant taxon	49.63	53.66	23.90
% 2 dominant taxa	77.35	63.84	40.72
% 3 dominant taxa	85.26	69.44	56.79
Richness Measures			
Species richness	29.00	22.00	27.00
EPT richness	8.00	6.00	11.00
Ephemeroptera richness	6.00	3.00	5.00
Plecoptera richness	0.00	2.00	2.00
Trichoptera richness	2.00	1.00	4.00
Chironomidae Richness	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00
NCO Richness	27.00	20.00	25.00
Rhyacophila richness	0.00	0.00	0.00
Community Composition			
% Ephemeroptera	31.76	17.63	63.60
% Plecoptera	0.00	3.84	1.62
% Trichoptera	0.91	0.33	2.11
% EPT	32.67	21.79	67.33
% Coleoptera	2.39	5.72	16.66
% Diptera	51.39	57.41	11.79
% Oligochaeta	0.23	4.38	0.32
% Baetidae	27.72	2.39	16.82
% Brachycentridae	0.00	0.00	0.00
% Chironomidae	49.63	53.66	10.01
% Ephemerellidae	0.23	10.18	11.14
% Hydropsychidae	0.00	0.00	0.00
% Odonata	0.17	0.04	0.00
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00
% Simuliidae	0.00	0.13	0.00
Functional Group Composition			
% Filterers	2.11	0.33	0.65
% Gatherers	91.41	83.21	83.72
% Predators	3.41	8.82	3.73
% Scrapers	1.02	0.16	7.79
% Shredders	1.08	3.28	2.54
% Piercer-Herbivores	0.00	0.00	0.00
% Unclassified	0.00	0.00	0.05
Filterer richness	2.00	2.00	2.00
Gatherer richness	9.00	7.00	10.00
Predator richness	10.00	7.00	6.00
Scraper richness	4.00	2.00	3.00
Shredder richness	3.00	3.00	4.00
Piercer-Herbivore Richness	0.00	0.00	0.00
Unclassified	0.00	0.00	1.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	0.70	0.79	0.97
Shannon-Weaver H' (log 2)	2.31	2.63	3.24
Shannon-Weaver H' (log e)	1.60	1.82	2.24
Hilsenhoff Biotic Index	5.48	5.14	3.30
Margalef's Richness	3.75	2.44	3.46
Metals Tolerance Index	0.27	0.42	0.23
Pielou's J'	0.48	0.59	0.68
Simpson's Heterogeneity	0.67	0.69	0.86
UIN	99-85	99-86	99-87

Table D3. Family level data, pooled metrics, station 3 Lake Creek.

Stream	Lake Creek	Lake Creek	Lake Creek
Site	Station 3, 06-07-1999, Pooled	Station 3, 08-17-1999, Pooled	Station 3, 10-14-1999, Pooled
Abundance Measures			
Corrected abundance	721.00	8627.00	2027.00
EPT abundance	353.00	4050.00	1035.00
Dominance Measures			
1st dominant taxon	Elmidae	Chironomidae	Chironomidae
1st Dominant Abundance	168.00	2203.00	438.00
2nd dominant taxon	Ephemerellidae	Ephemerellidae	Elmidae
2nd Dominant Abundance	143.00	1490.00	385.00
3rd dominant taxon	Chironomidae	Elmidae	Leptophlebiidae
3rd Dominant Abundance	143.00	1113.00	330.00
% 1 dominant taxon	23.30	25.54	21.61
% 2 dominant taxa	43.13	42.81	40.60
% 3 dominant taxa	62.97	55.71	56.88
Richness Measures			
Species richness	30.00	28.00	30.00
EPT richness	13.00	12.00	12.00
Ephemeroptera richness	5.00	5.00	5.00
Plecoptera richness	3.00	3.00	3.00
Trichoptera richness	5.00	4.00	4.00
Chironomidae Richness	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00
NCO Richness	28.00	26.00	28.00
Rhyacophila richness	1.00	0.00	0.00
Community Composition			
% Ephemeroptera	43.55	39.71	46.52
% Plecoptera	0.83	5.51	3.11
% Trichoptera	4.58	1.73	1.43
% EPT	48.96	46.95	51.06
% Coleoptera	23.72	13.17	20.37
% Diptera	22.88	27.91	23.19
% Oligochaeta	0.28	0.43	0.64
% Baetidae	18.31	11.24	7.94
% Brachycentridae	0.00	0.00	0.00
% Chironomidae	19.83	25.54	21.61
% Ephemerellidae	19.83	17.27	14.11
% Hydropsychidae	0.14	0.29	0.00
% Odonata	0.00	0.07	0.05
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.14	0.00	0.00
% Simuliidae	2.36	0.79	0.00
Functional Group Composition			
% Filterers	5.69	1.15	0.99
% Gatherers	83.63	76.65	84.36
% Predators	3.33	4.66	4.64
% Scrapers	4.44	2.68	4.83
% Shredders	2.77	6.50	4.09
% Piercer-Herbivores	0.00	0.00	0.00
% Unclassified	0.14	0.00	0.00
Filterer richness	5.00	3.00	3.00
Gatherer richness	8.00	8.00	9.00
Predator richness	8.00	8.00	8.00
Scraper richness	3.00	3.00	3.00
Shredder richness	5.00	5.00	6.00
Piercer-Herbivore Richness	0.00	0.00	0.00
Unclassified	1.00	0.00	0.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	0.92	1.00	1.00
Shannon-Weaver H' (log 2)	3.04	3.33	3.31
Shannon-Weaver H' (log e)	2.11	2.31	2.29
Hilsenhoff Biotic Index	3.60	4.02	3.58
Margalef's Richness	4.41	2.98	3.81
Metals Tolerance Index	0.19	0.59	0.27
Pielou's J'	0.62	0.69	0.67
Simpson's Heterogeneity	0.83	0.86	0.86
UIN	99-88	99-89	99-90

Table D3. Family level data, pooled metrics, station 4 Lake Creek.

Stream	**Lake Creek**	**Lake Creek**	**Lake Creek**
Site	**Station 4, 06-10-1999, Pooled**	**Station 4, 08-19-1999, Pooled**	**Station 4, 10-15-1999, Pooled**
Abundance Measures			
Corrected abundance	1884.00	3967.00	601.00
EPT abundance	725.00	841.00	257.00
Dominance Measures			
1st dominant taxon	Simuliidae	Chironomidae	Chironomidae
1st Dominant Abundance	689.00	2254.00	175.00
2nd dominant taxon	Baetidae	Elmidae	Limnephilidae
2nd Dominant Abundance	485.00	324.00	95.00
3rd dominant taxon	Chironomidae	Leptophlebiidae	Capniidae
3rd Dominant Abundance	187.00	246.00	70.00
% 1 dominant taxon	36.57	56.82	29.12
% 2 dominant taxa	62.31	64.99	44.93
% 3 dominant taxa	72.24	71.19	56.57
Richness Measures			
Species richness	29.00	27.00	29.00
EPT richness	12.00	10.00	9.00
Ephemeroptera richness	6.00	4.00	4.00
Plecoptera richness	2.00	3.00	2.00
Trichoptera richness	4.00	3.00	3.00
Chironomidae Richness	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00
NCO Richness	27.00	25.00	27.00
Rhyacophila richness	1.00	0.00	0.00
Community Composition			
% Ephemeroptera	34.18	14.14	13.64
% Plecoptera	1.33	6.58	12.98
% Trichoptera	2.97	0.48	16.14
% EPT	38.48	21.20	42.76
% Coleoptera	6.58	9.00	5.99
% Diptera	48.62	60.15	33.44
% Oligochaeta	0.58	1.64	5.49
% Baetidae	25.74	1.01	1.16
% Brachycentridae	0.00	0.08	0.00
% Chironomidae	9.93	56.82	29.12
% Ephemerellidae	3.72	5.65	2.66
% Hydropsychidae	0.00	0.00	0.00
% Odonata	0.00	0.00	0.17
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00
% Simuliidae	36.57	1.66	0.00
Functional Group Composition			
% Filterers	41.30	3.18	5.49
% Gatherers	49.15	80.84	53.24
% Predators	4.03	8.22	7.65
% Scrapers	1.43	0.25	2.50
% Shredders	3.93	4.36	29.12
% Piercer-Herbivores	0.11	0.00	0.00
% Unclassified	0.05	0.08	0.67
Filterer richness	3.00	5.00	3.00
Gatherer richness	10.00	8.00	9.00
Predator richness	8.00	8.00	9.00
Scraper richness	2.00	1.00	1.00
Shredder richness	4.00	3.00	4.00
Piercer-Herbivore Richness	1.00	0.00	0.00
Unclassified	1.00	1.00	2.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	0.88	0.78	1.06
Shannon-Weaver H' (log 2)	2.91	2.60	3.53
Shannon-Weaver H' (log e)	2.02	1.80	2.44
Hilsenhoff Biotic Index	4.80	4.92	4.32
Margalef's Richness	3.71	3.14	4.38
Metals Tolerance Index	1.75	0.39	0.47
Pielou's J'	0.60	0.55	0.73
Simpson's Heterogeneity	0.78	0.66	0.86
UIN	99-91	99-92	99-93

Table D3. Family level data, pooled metrics, station 5 Lake Creek.

Stream	**Lake Creek**	**Lake Creek**	**Lake Creek**
Site	**Station 5, 06-10-1999, Pooled**	**Station 5, 08-19-1999, Pooled**	**Station 5, 10-15-1999, Pooled**
Abundance Measures			
Corrected abundance	1324.00	4845.00	553.00
EPT abundance	804.00	1404.00	60.00
Dominance Measures			
1st dominant taxon	Baetidae	Chironomidae	Chironomidae
1st Dominant Abundance	511.00	2726.00	268.00
2nd dominant taxon	Chironomidae	Leptophlebiidae	Oligochaeta
2nd Dominant Abundance	329.00	659.00	52.00
3rd dominant taxon	Ephemerellidae	Ephemerellidae	Elmidae
3rd Dominant Abundance	118.00	395.00	46.00
% 1 dominant taxon	38.60	56.26	48.46
% 2 dominant taxa	63.44	69.87	57.87
% 3 dominant taxa	72.36	78.02	66.18
Richness Measures			
Species richness	26.00	29.00	24.00
EPT richness	13.00	12.00	8.00
Ephemeroptera richness	5.00	5.00	4.00
Plecoptera richness	2.00	3.00	2.00
Trichoptera richness	6.00	4.00	2.00
Chironomidae Richness	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00
NCO Richness	24.00	27.00	22.00
Rhyacophila richness	1.00	0.00	0.00
Community Composition			
% Ephemeroptera	52.49	24.81	4.52
% Plecoptera	4.76	3.34	5.42
% Trichoptera	3.47	0.83	0.90
% EPT	60.73	28.98	10.85
% Coleoptera	6.50	2.70	9.76
% Diptera	28.32	59.32	51.90
% Oligochaeta	0.30	0.19	9.40
% Baetidae	38.60	1.18	0.36
% Brachycentridae	0.38	0.00	0.00
% Chironomidae	24.85	56.26	48.46
% Ephemerellidae	8.91	8.15	0.90
% Hydropsychidae	0.00	0.12	0.00
% Odonata	0.00	0.14	0.18
% Perlidae	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00
% Simuliidae	2.11	1.63	0.00
Functional Group Composition			
% Filterers	4.38	2.64	7.41
% Gatherers	82.18	82.95	71.07
% Predators	8.61	4.48	11.93
% Scrapers	0.38	0.54	2.53
% Shredders	4.00	3.10	4.88
% Piercer-Herbivores	0.45	0.00	0.00
% Unclassified	0.00	0.00	0.18
Filterer richness	4.00	4.00	2.00
Gatherer richness	8.00	9.00	8.00
Predator richness	8.00	8.00	8.00
Scraper richness	1.00	2.00	1.00
Shredder richness	4.00	5.00	3.00
Piercer-Herbivore Richness	1.00	0.00	0.00
Unclassified	0.00	0.00	1.00
Diversity/Evenness Measures			
Shannon-Weaver H' (log 10)	0.87	0.74	0.87
Shannon-Weaver H' (log 2)	2.90	2.46	2.90
Shannon-Weaver H' (log e)	2.01	1.70	2.01
Hilsenhoff Biotic Index	4.03	4.81	5.50
Margalef's Richness	3.48	3.30	3.64
Metals Tolerance Index	0.40	0.54	0.58
Pielou's J'	0.62	0.51	0.63
Simpson's Heterogeneity	0.77	0.65	0.74
UIN	99-94	99-95	99-96

Table D3. Family level data, pooled metrics, lower Lake Creek.

Stream	Lake Creek	Lake Creek	Lake Creek	Lake Creek
Site	Lower, 05-01-1995, Pooled	Lower, 06-01-1994, Pooled	Lower, 07-01-1995, Pooled	Lower, 10-01-1995, Pooled
Abundance Measures				
Corrected abundance	316.00	1113.00	1645.00	1012.00
EPT abundance	31.00	184.00	385.00	825.00
Dominance Measures				
1st dominant taxon	Chironomidae	Elmidae	Simuliidae	Heptageniidae
1st Dominant Abundance	254.00	519.00	732.00	313.00
2nd dominant taxon	Elmidae	Oligochaeta	Chironomidae	Baetidae
2nd Dominant Abundance	28.00	295.00	372.00	213.00
3rd dominant taxon	Ephemerellidae	Chironomidae	Baetidae	Leptophlebiidae
3rd Dominant Abundance	13.00	104.00	128.00	129.00
% 1 dominant taxon	80.38	46.63	44.50	30.93
% 2 dominant taxa	89.24	73.14	67.11	51.98
% 3 dominant taxa	93.35	82.48	74.89	64.72
Richness Measures				
Species richness	9.00	21.00	24.00	17.00
EPT richness	5.00	13.00	13.00	11.00
Ephemeroptera richness	2.00	5.00	3.00	4.00
Plecoptera richness	1.00	3.00	3.00	5.00
Trichoptera richness	2.00	5.00	7.00	2.00
Chironomidae Richness	1.00	1.00	1.00	1.00
Oligochaeta Richness	0.00	1.00	2.00	1.00
NCO Richness	8.00	19.00	21.00	15.00
Rhyacophila richness	1.00	1.00	1.00	0.00
Community Composition				
% Ephemeroptera	6.65	11.50	12.95	67.89
% Plecoptera	1.58	3.23	6.87	12.75
% Trichoptera	1.58	1.80	3.59	0.89
% EPT	9.81	16.53	23.40	81.52
% Coleoptera	8.86	46.81	6.81	6.32
% Diptera	81.01	10.15	68.39	11.96
% Oligochaeta	0.00	26.50	0.91	0.20
% Baetidae	0.00	4.40	7.78	21.05
% Brachycentridae	0.00	0.00	0.91	0.00
% Chironomidae	80.38	9.34	22.61	6.92
% Ephemerellidae	4.11	0.36	0.00	3.16
% Hydropsychidae	0.95	0.45	0.30	0.30
% Odonata	0.00	0.00	0.00	0.00
% Perlidae	1.58	2.96	1.34	1.48
% Pteronarcyidae	0.00	0.09	0.00	0.00
% Simuliidae	0.63	0.09	44.50	2.37
Functional Group Composition				
% Filterers	1.58	0.54	45.78	2.67
% Gatherers	93.35	88.23	41.22	50.49
% Predators	2.22	4.13	3.65	1.58
% Scrapers	2.85	6.47	2.31	30.93
% Shredders	0.00	0.63	6.99	14.33
% Piercer-Herbivores	0.00	0.00	0.00	0.00
% Unclassified	0.00	0.00	0.00	0.00
Filterer richness	2.00	2.00	4.00	2.00
Gatherer richness	3.00	7.00	6.00	7.00
Predator richness	2.00	5.00	5.00	2.00
Scraper richness	2.00	4.00	4.00	1.00
Shredder richness	0.00	3.00	4.00	5.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00
Unclassified	0.00	0.00	0.00	0.00
Diversity/Evenness Measures				
Shannon-Weaver H' (log 10)	0.35	0.69	0.79	0.91
Shannon-Weaver H' (log 2)	1.16	2.28	2.63	3.04
Shannon-Weaver H' (log e)	0.81	1.58	1.82	2.11
Hilsenhoff Biotic Index	5.45	5.13	5.09	3.50
Margalef's Richness	1.39	2.85	3.11	2.31
Metals Tolerance Index	0.03	0.02	1.81	0.09
Pielou's J'	0.37	0.52	0.57	0.74
Simpson's Heterogeneity	0.34	0.70	0.74	0.83
UIN	99-118	99-119	99-120	99-121

Table D3. Family level data, pooled metrics, middle Lake Creek.

Stream	Lake Creek, Middle	Lake Creek, Middle	Lake Creek, Middle	Lake Creek, Middle	Lake Creek, Middle
Site	05-01-1995, Pooled	06-01-1994, Pooled	07-01-1995, Pooled	08-01-1994, Pooled	10-01-1994, Pooled
Abundance Measures					
Corrected abundance	741.00	382.00	741.00	319.00	857.00
EPT abundance	56.00	115.00	157.00	65.00	620.00
Dominance Measures					
1st dominant taxon	Chironomidae	Elmidae	Chironomidae	Chironomidae	Leptophlebiidae
1st Dominant Abundance	569.00	159.00	462.00	186.00	253.00
2nd dominant taxon	Oligochaeta	Oligochaeta	Baeticdae	Leptophlebiidae	Heptageniidae
2nd Dominant Abundance	87.00	54.00	73.00	46.00	140.00
3rd dominant taxon	Limnephilidae	Heptageniidae	Elmidae	Sialidae	Nemouridae
3rd Dominant Abundance	22.00	42.00	70.00	21.00	112.00
% 1 dominant taxon	76.79	41.62	62.35	58.31	29.52
% 2 dominant taxa	88.53	55.76	72.20	72.73	45.86
% 3 dominant taxa	91.50	66.75	81.65	79.31	58.93
Richness Measures					
Species richness	23.00	18.00	19.00	13.00	18.00
EPT richness	11.00	8.00	11.00	4.00	10.00
Ephemeroptera richness	5.00	4.00	5.00	1.00	4.00
Plecoptera richness	2.00	2.00	3.00	2.00	3.00
Trichoptera richness	4.00	2.00	3.00	1.00	3.00
Chironomidae Richness	1.00	1.00	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	1.00	1.00	1.00
NCO Richness	21.00	16.00	17.00	11.00	16.00
Rhyacophila richness	1.00	1.00	1.00	0.00	1.00
Community Composition					
% Ephemeroptera	2.70	23.82	17.81	14.42	51.46
% Plecoptera	0.40	2.36	2.16	3.45	16.10
% Trichoptera	4.45	3.93	1.21	2.51	4.78
% EPT	7.56	30.10	21.19	20.38	72.35
% Coleoptera	1.75	41.62	9.45	4.39	12.25
% Diptera	78.14	13.09	64.51	61.76	7.35
% Oligochaeta	11.74	14.14	4.32	1.88	7.23
% Baetidae	0.94	7.33	9.85	0.00	4.43
% Brachycentridae	0.00	0.00	0.00	0.00	0.00
% Chironomidae	76.79	9.42	62.35	58.31	6.53
% Ephemerellidae	0.81	2.88	0.40	0.00	1.17
% Hydropsychidae	0.54	0.00	0.00	0.00	0.00
% Odonata	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.27	2.09	0.13	0.31	2.80
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.27	2.09	0.40	0.00	0.00
Functional Group Composition					
% Filterers	0.94	2.09	0.40	3.45	0.35
% Gatherers	92.17	78.01	91.63	79.00	61.03
% Predators	1.62	7.07	2.16	13.17	3.73
% Scrapers	0.94	10.99	2.29	0.00	16.34
% Shredders	3.91	1.57	3.51	2.82	18.55
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00
% Unclassified	0.40	0.00	0.00	0.00	0.00
Filterer richness	3.00	1.00	1.00	1.00	2.00
Gatherer richness	6.00	6.00	7.00	4.00	6.00
Predator richness	6.00	6.00	6.00	5.00	5.00
Scraper richness	4.00	1.00	1.00	0.00	1.00
Shredder richness	3.00	3.00	4.00	2.00	4.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00
Unclassified	1.00	0.00	0.00	0.00	0.00
Diversity/Evenness Measures					
Shannon-Weaver H' (log 10)	0.43	0.85	0.63	0.66	0.91
Shannon-Weaver H' (log 2)	1.43	2.81	2.09	2.21	3.03
Shannon-Weaver H' (log e)	0.99	1.95	1.45	1.53	2.10
Hilsenhoff Biotic Index	5.94	4.48	5.24	5.09	3.33
Margalef's Richness	3.33	2.86	2.72	2.08	2.52
Metals Tolerance Index	0.03	0.15	0.04	0.22	0.01
Pielou's J'	0.32	0.67	0.49	0.60	0.73
Simpson's Heterogeneity	0.40	0.78	0.59	0.63	0.84
UIN	99-122	99-123	99-124	99-125	99-126

Table D3. Family level data, pooled metrics, upper Lake Creek.

Stream Site	Lake Creek, Upper 05-01-1995, Pooled	Lake Creek, Upper 06-01-1994, Pooled	Lake Creek, Upper 07-01-1995, Pooled	Lake Creek, Upper 08-01-1994, Pooled	Lake Creek, Upper 10-01-1994, Pooled	Lake Creek, Upper 10-01-1995, Pooled
Abundance Measures						
Corrected abundance	108.00	210.00	89.00	669.00	256.00	969.00
EPT abundance	33.00	47.00	34.00	219.00	6.00	587.00
Dominance Measures						
1st dominant taxon	Chironomidae	Simuliidae	Chironomidae	Chironomidae	Oligochaeta	Baetidae
1st Dominant Abundance	48.00	61.00	44.00	274.00	121.00	146.00
2nd dominant taxon	Oligochaeta	Chironomidae	Leptophlebiidae	Leptophlebiidae	Elmidae	Ephemerellidae
2nd Dominant Abundance	15.00	52.00	19.00	146.00	89.00	136.00
3rd dominant taxon	Heptageniidae	Elmidae	Corixidae	Elmidae	Chironomidae	Heptageniidae
3rd Dominant Abundance	15.00	23.00	5.00	52.00	25.00	134.00
% 1 dominant taxon	44.44	29.05	49.44	40.96	47.27	15.07
% 2 dominant taxa	58.33	53.81	70.79	62.78	82.03	29.10
% 3 dominant taxa	72.22	64.76	76.40	70.55	91.80	42.93
Richness Measures						
Species richness	15.00	14.00	15.00	23.00	10.00	22.00
EPT richness	7.00	9.00	9.00	10.00	5.00	12.00
Ephemeroptera richness	4.00	5.00	4.00	5.00	1.00	5.00
Plecoptera richness	1.00	1.00	3.00	2.00	2.00	4.00
Trichoptera richness	2.00	3.00	2.00	3.00	2.00	3.00
Chironomidae Richness	1.00	1.00	1.00	1.00	1.00	1.00
Oligochaeta Richness	2.00	1.00	2.00	1.00	1.00	1.00
NCO Richness	12.00	12.00	12.00	21.00	8.00	20.00
Rhyacophila richness	1.00	1.00	0.00	0.00	0.00	0.00
Community Composition						
% Ephemeroptera	17.59	16.67	26.97	27.06	0.78	54.08
% Plecoptera	3.70	3.33	6.74	2.69	0.78	5.78
% Trichoptera	9.26	2.38	4.49	2.99	0.78	0.72
% EPT	30.56	22.38	38.20	32.74	2.34	60.58
% Coleoptera	6.48	10.95	1.12	9.72	34.77	2.37
% Diptera	47.22	56.19	52.81	41.11	15.63	28.79
% Oligochaeta	15.74	10.48	2.25	2.99	47.27	4.44
% Baetidae	1.85	4.29	0.00	0.30	0.00	15.07
% Brachycentridae	0.00	0.00	3.37	0.00	0.00	0.00
% Chironomidae	44.44	24.76	49.44	40.96	9.77	12.18
% Ephemerellidae	0.93	1.90	1.12	2.99	0.00	14.04
% Hydropsychidae	0.00	0.00	0.00	0.00	0.00	0.21
% Odonata	0.00	0.00	0.00	0.00	0.00	0.00
% Perlidae	0.00	0.00	2.25	0.00	0.00	0.00
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.93	29.05	0.00	0.00	0.00	9.60
Functional Group Composition						
% Filterers	0.93	29.05	3.37	0.60	0.00	11.56
% Gatherers	69.44	55.24	77.53	77.13	92.58	60.06
% Predators	7.41	3.81	7.87	6.88	0.39	4.13
% Scrapers	13.89	7.62	1.12	3.44	0.78	16.10
% Shredders	7.41	4.29	4.49	2.39	6.25	7.12
% Piercer-Herbivores	0.00	0.00	0.00	0.00	0.00	0.00
% Unclassified	0.93	0.00	0.00	1.94	0.00	1.03
Filterer richness	1.00	1.00	1.00	2.00	0.00	3.00
Gatherer richness	7.00	7.00	6.00	7.00	4.00	8.00
Predator richness	2.00	2.00	4.00	5.00	1.00	4.00
Scraper richness	1.00	1.00	1.00	4.00	1.00	3.00
Shredder richness	3.00	3.00	2.00	3.00	4.00	3.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	0.00	0.00
Unclassified	1.00	0.00	0.00	1.00	0.00	1.00
Diversity/Evenness Measures						
Shannon-Weaver H' (log 10)	0.81	0.88	0.75	0.86	0.55	1.07
Shannon-Weaver H' (log 2)	2.71	2.92	2.50	2.86	1.82	3.55
Shannon-Weaver H' (log e)	1.88	2.02	1.74	1.98	1.26	2.46
Hilsenhoff Biotic Index	5.22	5.27	4.67	4.67	6.05	3.92
Margalef's Richness	2.99	2.43	3.12	3.38	1.62	3.05
Metals Tolerance Index	0.10	1.16	0.37	0.58	0.00	0.52
Pielou's J'	0.69	0.77	0.64	0.63	0.55	0.80
Simpson's Heterogeneity	0.76	0.82	0.71	0.77	0.65	0.90
UIN	99-128	99-129	99-130	99-131	99-132	99-133