TROUT CREEK BIOLOGICAL ASSESSMENT: 2001

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Abstract

The following report is a compilation of historic information, the outcome of a Proper Functioning Condition (PFC) assessment and the results from biological assessments of Trout Creek, Boundary County, Idaho. Located within the Northern Rocky Mountain physiographic province, Trout Creek is part of the lower portion of the Kootenai River subbasin and is one of many tributaries flowing into the lower mainstem Kootenai River in Idaho. The Upper portion of Trout Creek has historically been managed for timber production and harvest. The lower 2.1 km of Trout Creek consists of a split channel that runs through private land and The Nature Conservancy's Ball Creek Preserve. Trout Creek historically supported a healthy fishery that was an important contribution to the Kootenai River ecosystem. Habitat alterations have resulted in a loss of aquatic and riparian resources that not only affect human intrinsic values but also decrease the economic value and usefulness of property. The Kootenai Tribe of Idaho (in conjunction with multiple resource agency and landowner partnerships) is proposing a project that could effectively restore the historic conditions in Trout Creek through aquatic and riparian restoration and rehabilitation while maintaining economic benefits of the property. This multi-phase project has incorporated a Proper Functioning Condition Assessment of basic physical parameters, a baseline assessment of biological parameters, and is proposing physical restoration activities such as re-vegetation and grazing management and a monitoring component that would provide information about the effects of rehabilitation activities. The bioassessment and historic data gathering portions of this project have provided necessary baseline information about he biological and physical status of Trout Creek. Data about fish, macroinvertebrates, periphyton, water quality, and productivity were collected along the main stem of Trout Creek, during spring and fall, 2001. Trout Creek is distinctly divided into three geomorphological sections: 1) an upper forested (high gradient) reach, 2) a transition reach between upper forested and flood plain habitat, and 3) a flood plain reach. The upper forested reach is presently at high functioning condition, supporting healthy populations of westslope cutthroat trout as well as abundant macroinvertebrate and periphyton assemblages. Due to removal of natural in-stream structures, the transition reach is physically unstable. However, this section supports fairly diverse fish, macroinvertebrate and periphyton assemblages. The flood plain reach has been altered significantly by vegetation removal, cattle grazing stream channel incising. A grazing management plan coupled with re-establishment of riparian vegetation and woody debris are prescribed as a means to help restore proper functioning condition to this section of the stream.

Acknowledgements

We would like to thank the late Robert "Bobby" Krause, his family and George Shutes for their desire to restore the functionality of lower Trout Creek. Thank you also to other landowners along Trout Creek (Geral McFarland, John Boyer, David and Marianne Duarte, Virginia Huges, Tony and Diane Lamarsh, Steve and Dana Ergenbright, Philip and Donna Drewson) for their support of this project. The National Riparian Service Team provided the PFC assessment at no cost to the tribe. The NRCS, IDFG, IDEQ, TNC, USFWS, the USFS Bonners Ferry Ranger district, Kootenai Valley Research, Woody Debris Aquatic Research, and KTOI staff provided technical support and review. Thank you to Bonneville Environmental Foundation for funding the biological assessment and to Todd Reeve for providing extensive support with the proposal process.

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Introduction

Located within the Northern Rocky Mountain physiographic province, Trout Creek is part of the lower portion of the Kootenai River subbasin and is one of many tributaries flowing into the lower mainstem Kootenai River in Idaho. Trout Creek originates in the Selkirk mountain range, west of Bonners Ferry, Idaho and is fed at its headwaters by Pyramid and Trout lakes (Figure 1). The lower portion of Trout Creek is divided into two channels that flow through the low gradient Kootenai River flood plain, in the Purcell Trench. It flows easterly into the Purcell Trench, for approximately 16 kilometers, and enters the mainstem Kootenai River at river kilometer 213.

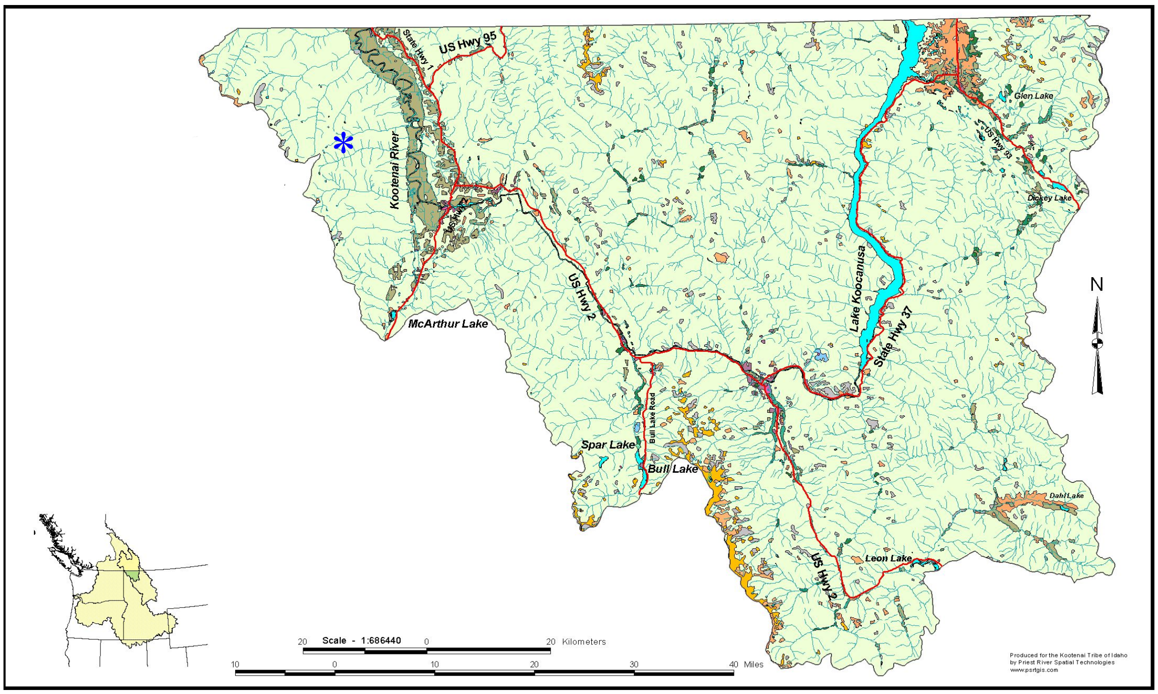

Figure 1. Map of the Kootenai River basin in the United States. Blue asterisk indicates the Trout Creek drainage.

The US Forest Service (USFS) has historically managed the upper Trout Creek watershed for timber production and harvest (L. Allen, USFS Bonners Ferry Ranger District, Idaho, personal communication). Following beetle infestations in the late 1940's roads were built in the upper portion of the watershed to access timber for salvage harvest. In the 1970's, harvesting was also conducted in the middle part of the upper section. An environmental assessment in the late 1980's lead to an early 1990's timber harvest in the lower third of the upper section. In 1998, the USFS restored and obliterated many of the roads that were constructed for these timber harvesting activities so present and ongoing impacts should be minimal. The lower portion of Trout Creek is privately owned and managed for residential, agricultural and timber harvesting purposes by several individuals.

Presence of aquatic organisms in Trout Creek and other Kootenai River tributaries may be limited by several contributing factors (diking, channelizing, hydropower operations and land use activities in the riparian area) and a resulting decline in available food base organisms (KRSS 2000). Although historically abundant, kokanee numbers in the lower Kootenai River system have declined and redband rainbow and westslope cutthroat trout have been proposed for Endangered Species Act (ESA) listing. Bulltrout are presently listed as a threatened species. The burbot population in the lower Kootenai River system is currently undergoing review by the U.S. Fish and Wildlife Service and has been petitioned for ESA listing as well. All of these species were historically common and abundant in Kootenai River tributatires during all or part of their life cycles (KRSS 2000).

The degradation of stream and riparian habitat along the lower section of Trout Creek has resulted from land use practices (Meehan 1991). Riparian vegetation has been eliminated or changed, the stream channel has been widened and aggraded, the water table has been lowered and water temperatures have increased Hydroelectric operations on the mainstem Kootenai River have affected pioneering riparian vegetation species, and have assisted the establishment of xeric tolerant species (KRSS 2000). Alteration of the historic flood plain has eliminated the wetland network that provided productive fisheries resources in Trout Creek and other tributaries of the lower Kootenai River valley (KRSS 2000; Appendix 1a). It is for this reason that fragmentation of wetland habitat is listed in the Kootenai River Subbasin Summary (KRSS 2000) as a primary factor limiting productivity in the lower Kootenai River tributaries and mainstem Kootenai River.

The overall goal for the Kootenai River subbasin is to rehabilitate and protect the abundance, productivity, and diversity of biological communities and habitats within the subbasin (KRSS 2000). With the multitude of federal, state, county, tribal, community and industrial entities involved in subbasin activities, the success of basin-wide protection, restoration and rehabilitation projects depends heavily on coordinated efforts among the interested parties.

In the 1980s and 1990s, Bonneville Power Administration (BPA) funded a series of fish and wildlife studies in the Kootenai subbasin as part the agency's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries (KRSS 2000). The Trout Creek biological assessment and rehabilitation project meaningfully addresses collaborative research and management mandates (requiring coordination and communication of efforts) of the Northwest Power Planning Council (NWPPC), the United States Fish and Wildlife Service (USFWS), Regional Kootenai River Subbasin Summary planning activities (KRSS 2000), the Columbia Basin Fish and Wildlife Authority's (CBFWA) Multi-Year Implementation Plan (MYIP), and the Kootenai River Network (KRN), as well as provincial and federal fisheries and environmental management agencies in British Columbia, Canada. This project also supports and begins to address the following specific objectives and needs stated in the Kootenai River Subbasin Summary Plan (KRSS 2000): 1) significantly reduce the level of sedimentation in five impacted spawning areas by 2004; 2) reconnect five blocked tributaries by 2004; 3) rehabilitate pool, riffle and run frequencies in five streams so they equal that of undisturbed referenced reaches by 2004; 4) Eliminate or reduce negative nonnative species interactions in three streams by 2004; 5) determine the potential of revegetating the varial zone by 2005; 6) remove delta blockages from 50 percent of the tributaries where the blockages are problematic; 7) rehabilitate five percent of historic flood plain habitat by 2005; 8) determine the rehabilitation potential of flood plain and river connectivity by 2005; 9) reduce noxious weeds within the varial zone by 10 percent by 2005; 10) assess the condition of Kootenai River tributary fish spawning, incubation, and juvenile rearing habitat quality and evaluate potential substrate improvement measures by 2005; 11) rehabilitate to a self-sustaining condition populations of threatened, endangered and other declining native species by 2020.

The main objectives and needs of the proposed Trout Creek evaluation and restoration project are to 1) develop an in-depth baseline data file that would indicate the present status of biological assemblages and habitat quality (phase I and ongoing; Figure 2); 2) determine and implement the proper approach for rehabilitation of the fishery and riparian ecosystem (phase II and III); 3) involve the community in the processes of rehabilitation and restoration of natural resources in the lower Kootenai River valley (ongoing); 4) monitor progress of rehabilitation or restoration measures taken (Phase IV) and 5) incorporate interests and needs of all stakeholders. This report provides information up to phase II and the beginning of Phase III of the project.

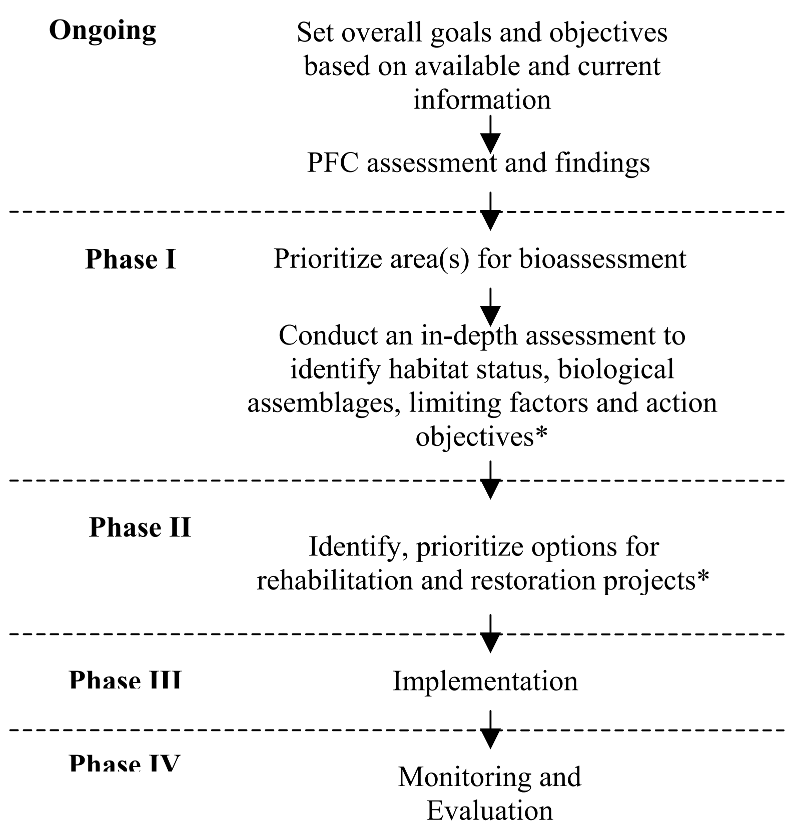

Figure 2. Flow Chart to Restoration of Lower Kootenai River Tributaries.

Materials and Methods

Historic Data and Landowner Information

During the late 1990's, Robert Krause approached the Kootenai Tribe of Idaho with an interest in restoring riparian habitat on property he owned along the lower 2.1 km of Trout Creek's north fork. He recalled his days as a child, when fish in Trout Creek were bountiful and he expressed an interest in attempting to restore history. The potential restoration project fit well into the goals and objectives for the Kootenai River basin and the project was carried forward. Funding was solicited, in 2001, through the Bonneville Environmental Foundation to complete a baseline biological assessment in Trout Creek. Additional partners within the Kootenai River drainage were also approached for matching contributions. Contributions in the form of personnel, technical support and funding were provided by the KTOI environmental program, United States Department of Agriculture Natural Resources Conservation Service (NRCS) and Idaho Department of Fish and Game (IDFG).

Landowner information along Trout Creek was gathered from records at the Boundary County Courthouse. Landowners and other interested parties were contacted through verbal and written means to inform them about the upcoming biological assessment and potential restoration work. They were invited to participate in the process if they so desired. The invitation for participation remains open as the restoration project progresses.

Historic Trout Creek biological data was gathered and summarized from files within the USFS, IDFG, Idaho Department of Environmental Quality (IDEQ), NRCS and the KTOI. Historic anecdotal information was also gathered from landowners and other interested parties.

Spring and Fall Biological Assessments

Sample site establishment –

During 2001, six sample sites measuring 50 m in length (at least 4 times stream width at high flow) were established along the entire length of Trout Creek for the biological assessment. Sample sites were chosen based on information about historic sample locations as well as geomorphological changes in landforms or habitat (Appendix 1b). Due to significant geomorphological and habitat differences, sample site data were grouped and anlayzed by three sections. The three sections consisted of the upper sample sites (TC 3-5), the transition sample site (TC 2) and the flood plain sample sites (TC 1a and 1b).

Sample sites were marked at the upper and lower ends using metal tags and flagging attached to live, healthy trees. Global position locations were also established at the upper and lower ends of each sample site with a GPS unit and sketches of sites were recorded on data sheets. The purpose of the preliminary assessment was to establish biological baseline data in sections throughout the entire length of Trout Creek during fall (October) and spring (June) seasons. Although sample sites in the upper portion of Trout Creek are scheduled to be monitored on a 5-year basis, future annual assessments will focus primarily on area(s) in the lower flood plain section where restoration projects will be initiated (Appendix 1c). Data about fish, macroinvertebrates, periphyton, plankton and water quality were collected during each sample period in June (spring) and October (fall; September for periphyton), 2001 (Appendix 2).

Fish –

The upper and lower ends of each sample site were blocked with a small (3/16 inch) mesh net to enclose the area. Fish were collected with standard 3-pass depletion backpack electroshocking methods (Murphy and Willis 1996; Appendix 2). The backpack shocker was set at H3 and 600 V. Number and species collected were recorded following each pass. Length and weight of each fish was recorded. Scales were collected for age analysis. MICROFISH 3.0 (Van Deventer 1986) software was used to obtain population estimates (# fish/m) for individual fish species captured in each section (upper forested area, transition zone, flood plain zone). Fish density for each species within each section was calculated using the following equation:

$$D(\#/m) = \#\ \text{captured/length of stream sampled}$$

Percent of total catch for each species of fish captured was calculated for each site. Relative weights were also calculated for eastern brook trout and westslope cutthroat trout (Murphy and Willis 1996). Relative weights for westslope cutthroat trout were compared among sample sites.

Fish scales were scraped from the area above the lateral line and below the rear of the dorsal fin on all trout and whitefish (Murphy and Willis 1996). Scales were stored in coin envelopes until impressions were made into acetate slides using a thermostatically regulated Carver (Wasbash, IN) hydraulic press. Scale impressions were viewed by two independent readers in order to obtain age estimates.

Macroinvertebrates –

Macroinvertebrates samples from each site consisted of 9 samples, three each from top, middle and bottom cross-sections within each sample site (Appendix 2). This sampling method allowed for consistent micro-habitat represention within each cross-section. A 0.1 m^2 Hess sampler was used to collect macroinvertebrates during the spring at all sites and from the transition and upper sample sites (TC 2-5) during the fall sampling period. Due to the prevalence of muck, sand and mud substrate in the lower sites (TC 1a and 1b) a Pederson dredge was used to collect macroinvertebrates from these sites during the fall sampling period. Macroinvertebrate samples were preserved in ethyl alcohol and sorted under magnification. Taxonomic identification was subcontracted to Woody Debris Aquatic Research, Bonners Ferry, Idaho.

Macroinvertebrates were identified to species where possible(the majority to genus) and assigned a functional group status (i.e. shredder or scraper etc.) and tolerance value (Clark and Maret 1993, Jensen 1966, Merritt and Cummins 1996, Stewart and Stark 1993, Unsinger 1956, Wiggins 1996). Percent EPT (Emphemeroptera, Plecoptera, Trichoptera), taxa richness, average tolerance and density were calculated for each sample site. Mean biomass was estimated for macroinvertebrates collected at each sample site using the following equation:

$$mww / m^2$$

where:

mww = mean wet weight of top, middle and bottom samples for each site in grams

m^2 = area sampled at each site

Percent community composition for macroinvertebrates in each functional group and each major macroinvertebrate group (i.e. plecoptera, trichoptera etc.) was identified by sample site. Data collected during June (spring) and October (fall) were compared to identify differences.

Periphyton and plankton –

Periphyton samples were collected during June (spring) and September (fall) by scraping a specified area of natural substrate (rock or wood, depending on dominant substrate type at sampling site). Samples were not collected at all sites during both sampling periods and the area scraped varied by sample site. Periphyton samples for chlorophyll analysis were stored frozen in whirl paks placed inside dark brown nalgene bottles to prevent breakdown. Chlorophyll analysis was conducted at the Analytical Sciences Laboratory, Holm Research, University of Idaho using the Winterman/DeMors method for extraction and analysis (Appendix 3). Additional periphyton and plankton samples were collected for taxonomic identification and preserved with Lugols solution and 10% formalin. Taxonomic identification was conducted by Aquatic Taxonomy Specialists, Malinta, Ohio. Soft-bodied phytoplankton and periphyton cells were identified by viewing 300 cell count wet mounts at 400X magnification. Dominant diatom species were identified using sub-sample burnt mounts magnified to 1000X. Diatom data was used as ecological indicators of system status and health.

Dominant algal groups (i.e. Cyanophyta, Chlorophyta, Chrysophyta, Euglenophyta and Bacillariophyta) were identified for each sampling site by calculating proportion of sample represented by each group. Dominant species were identified for each sample site. Algal densities in periphyton samples were calculated for each sample site. The resulting numbers were used to make relative comparisons to each other and do not reflect true densities due to differences in substrate types sampled at each site.

Water Quality –

Grab water samples (500 ml) were collected at each sample site during spring and fall sampling periods to analyze for metals as well as total phosphorous, soluble reactive phosphorous, ammonia, nitrate, nitrite and total nitrogen as measures of nutrient availability. In addition to QA/QC assessment provided by the lab, a duplicate water sample was collected from one sample site in order to validate results. Samples were chilled and shipped immediately to Aquatic Research Incorporated in Seattle, Washington for analysis. Analytical methods included Cold Vapor Atomic Absorption (EPA 245.2) for mercury, Inductively Coupled Plasma method (ICP; EPA 200.7) for cadmium, chromium, cobalt, iron, manganese and nickel, and Gas Flame Atomic Absorption (GFAA; EPA 200) for aluminum, arsenic, copper, lead, selenium and zinc. Blank, spike, standard and replicate analyses used to evaluate quality control were also used to verify instrument calibration and accuracy.

Basic water quality parameters were also recorded using a calibrated Hach Session 156 multiprobe at each sample site during both sampling periods. Parameters measured included surface temperature, specific conductance, dissolved oxygen, pH, and total dissolved solids. Median values were calculated for these general water quality parameters by sample section (ie. upper forested, transition, and floodplain sites). Metal concentrations were reported as range of detection by sample section.

Photo Points and Cross-Sections

Photographs were taken at each sample site throughout the entire length of Trout Creek. In addition, cross-sections and photopoints were established in the lower 2.1 km of the creek (Appendix 1c & 4a). One primary cross-section and photo point has been established in each of the lower portions of the south and north forks. These primary cross-sections contain a staff gage and thermograph in order to establish annual flow and temperature regimes. Staff gages will be calibrated to stream discharge (Q) by measuring velocity at each primary cross-section every two weeks for one year beginning in December, 2001 (Harrelson et al. 1994). In order to monitor progress of restoration efforts throughout the flood plain reach two additional cross-sections and photopoints have been established along the middle and upper sections of the north fork. Upstream, downstream and cross-channel photographs taken at the cross-sections in 2001 (Appendix 4a) and at 3-5 year intervals will be used to document vegetation and physical changes over time. Cross-sections in the north fork were surveyed without benchmarks to establish horizontal and vertical location of the cross-section and delineate channel form changes over time. After reviewing further information about surveying stream channel changes over time, we decided to establish benchmarks as long-term reference points (Harrelson et al. 1994). All cross-sections in the north fork and the cross-section in the south fork will be surveyed again in 2002, using the benchmarks as the initial reference point of the survey.

Proper Functioning Condition Assessment

Early in 2001, an application of interest was submitted to the National Riparian Service Team in order to apply for a PFC assessment on Trout Creek. The team was assembled from a list of potential diverse professionals. The team arrived in Bonners Ferry on August 6, 2001, and a preliminary meeting was held at the Kootenai River Inn to orient the team members and other interested parties. The assessment began at the upper end of Trout Creek on August 7, 2001 and was completed on August 8, 2001 at the confluence with the Kootenai River. The PFC was conducted according to methods cited in Prichard 1998. A final summary of tributary health and status for Trout Creek was provided by the PFC team (Appendix 11).

Groundwork to Begin Restoration

During November, 2001, 145 assorted willows were planted along a 95 meter stretch of riparian zone on the north fork (Appendix 4b). These small whip bundles (bundles of <1 cm diameter sticks), whips (1-2 cm diameter) and sticks (>2 cm diameter) were harvested from naturally occurring stock along the south fork of Trout Creek. All starts were dipped in root growth hormone and planted to approximately 4/5 depth, 1 meter apart. A maximum of 3 tiers were planted along the left and right banks. Poplar fiber matting was staked in place to stabilize the substrate where bank erosion was severe.

Results

Historic Data and Landowner Information

Historic Fish Data

Several biological and habitat studies have been conducted in the Trout Creek watershed, including fish presence and population surveys by IDFG, habitat, spawning, embeddedness and redband genetic surveys conducted by the USFS, kokanee redd surveys conducted by the KTOI, habitat and biological assessment survey conducted by EcoAnalysts Inc. and Beneficial Use Reconnaissance Project (BURP) assessments conducted by IDEQ (Table 1). Very few of these surveys used consistent methods between agencies and none of the data has been combined to form a meta-database. These studies have confirmed the presence of kokanee, rainbow and westslope cutthroat trout, slimy sculpin, mountain whitefish, brook trout, longnose dace, bulltrout, black bullhead, red side shiner and have identified poor quality aquatic and riparian habitat in the lower forks (Partridge 1983, Paragamian 1994, EcoAnalysts 1998b, IDEQ unpublished data, Lydia Allen, USFS Panhandle National Forest, Personal Communication). Burbot (*Lota lota*) have not been detected in Trout Creek for more than 20 years. Recollections by landowners indicate that burbot historically used the lower end of trout creek for spawning. Although kokanee spawners and redds are historically documented, but no kokanee or redds were observed in Trout Creek between 1993 and 2000 (Sue Ireland, KTOI unpublished data). In the spring of 1998, 15,000 kokanee fry that were incubated and hatched at the Kootenai Tribal Hatchery were released into the south fork of Trout Creek. For the first time in over a decade, 8 adult kokanee were observed in the south fork of Trout Creek between September 19-23, 2001.

Historic Macroinvertebrates Data

Historic macroinvertebrate data and metrics consisted of two surveys conducted by EcoAnalysts Inc. (1998b) and IDEQ (1998 unpublished data). Available data are summarized in Table 2. In addition to density measures, metrics of taxa and EPT (Ephemeroptera, Plecoptera and Trichoptera) richness are available as a measure of system perturbation. The Hilsenhoff Biotic Index (HBI) and Metals Tolerance Index (MTI) were calculated as a measure of tolerance or intolerance, with the MTI being specific to tolerance or intolerance of metals (ie. higher score = higher level of stress).

Historic Habitat and Physical Geomorphology Data

Mountains in the Kootenai River subbasin are composed of folded, faulted, and metamorphosed blocks of Precambrian sedimentary rocks of the Belt Series and minor basaltic intrusions (Ferreira et al. 1992). Primary rock types are meta-sedimentary agillites, siltites, and quartzites, which are hard and resistant to erosion. The porous nature of the rock and glaciation have profoundly influenced basin and channel morphology (Hauer et al. 1997), resulting in steep canyon walls and confined stream reaches. Soils in many areas of the lower Kootenai River valley consist of glacial till or loam with moderate to high quantities of boulders, cobbles and gravels.

The upper 7 mile stretch of Trout Creek can be considered relatively stable and undisturbed. Two structure failures were noted during a 1998 USFS stream survey conducted on Forest Service property (above the fork in the main channel; USFS 1998). However, both failures appeared relatively stable at the time of the survey with no apparent active erosion. Stream channels in the forested upper sections are of A and B type (Rosgen) with high gradient (10+%) interspersed by small areas of lower gradient (1-2%; EcoAnalysts 1998a). A majority of the substrate consists of large boulders, with small sections of different channel types including boulder, bedrock and sand type channels. Woody vegetation is relatively abundant in the upper section and consists of old growth conifers (primarily cedar and hemlock) and riparian shrubs (USFS 1998).

Table 1. Historic fish population survey data for Trout Creek, Boundary County, Idaho (IDEQ unpublished data, Paragamian 1994, USFS 1998, Ecoanalysts 1998b). See appendix 4 for fish taxa abbreviations.

Group or agency	Species											
	WCT	BLT	RBT	EBT	KOK redds	KOK	LND	SPD	RSS	BBH	SCU	MWF
USFS (1993 –above tributary fork-summer)												
Number captured	--	--	--	--	N/P	N/P	N/P	N/P	N/P	N/P	N/P	N/P
Population estimate	--	--	--	--	--	--	--	--	--	--	--	--
Density (#/100m^2)	4.50	0.20	0.90	5.00	--	--	--	--	--	--	--	--
USFS (1994 –above tributary fork -summer)												
Number captured	--	--	--	--	N/P	N/P	N/P	N/P	N/P	N/P	N/P	N/P
Population estimate	--	--	--	--	--	--	--	--	--	--	--	--
Density (#/100m^2)	0.39	0.20	0.10	5.29	--	--	--	--	--	--	--	--
IDFG (1993 – below tributary fork-summer)												
Number detected	--	N/P	--	--	N/P	<50*	N/P	N/P	N/P	N/P	--	--
Population estimate	--	--	--	--	--	--	--	--	--	--	--	--
Density (#/100m^2)	0.39	--	0.10	5.29	--	--	0.20	--	--	--	0.72	0.08
IDFG (1980-81 – below tributary fork -fall)												
Number detected	14	--	--	--	<100	--	--	--	--	--	66	--
Population estimate	--	--	--	--	--	--	--	--	--	--	--	--
Density (#/100m^2)	--	--	--	--	--	--	--	--	--	--	--	--
EcoAnalysts (At channel fork – 1998-fall)												
Number captured	23	2	3	N/P	N/P	N/P	N/P	N/P	N/P	N/P	N/P	N/P
Population estimate	26.20	--	--	--	--	--	--	--	--	--	--	--
Density (#/m^2)	0.11	0.01	0.01	--	--	--	--	--	--	--	--	--
EcoAnalysts (North fork – 1998-fall)												
Number captured	N/P	N/P	2	18	N/P	N/P	1	25	23	5	37	1
Population estimate	--	--	--	18.70	--	--	--	32.80	--	--	43.20	--
Density (#/m^2)	--	--	0.03	0.28	--	--	0.02	0.49	0.35	0.08	0.65	0.02
EcoAnalysts (South fork – 1998-fall)												
Number captured	N/P	N/P	N/P	2	N/P	N/P	2	1	1	N/P	53	N/P
Population estimate	--	--	--	--	--	--	--	--	--	--	99.30	--
Density (#/m^2)	--	--	--	0.02	--	--	0.02	0.01	0.01	--	0.83	--
IDEQ (South Fork above bridge – 1994 -fall)	20	1	4	22	N/P	N/P	1	N/P	N/P	N/P	54	3
Number captured	--	--	--	--	--	--	--	--	--	--	--	--
Population estimate	4.5	0.2	0.9	5.0	--	--	0.2	--	--	--	13.4	0.7
Density (#/100 m^2)												

* This estimate was made during 1982 and includes kokanee seen in Trout, Ball, Myrtle and Boulder creeks.

-- Indicates missing data or numbers too low to calculate estimates.

N/P Indicates fish not detected during survey

Moving from the upper to the lower reaches of Trout Creek, the stream character changes dramatically from a high-gradient, bedrock-controlled regime in the forested reach to a low gradient silt/clay regime in the flood plain reach. Approximately 2.1 km above its confluence with the Kootenai River, Trout Creek divides into two channels (north and south forks). At the division, Trout Creek enters a "transition" zone between high gradient, forested country into low gradient flood plain habitat. These forks become part of a network of tributary side channels and sloughs that historically made up the lower Kootenai River valley flood plain. Soils deposited by glaciers and water on the flood plain are, for the most part, deep, well-drained, and productive (KRSS 2000).

The North and South forks of Trout Creek flow through the Kootenai River flood plain and are characterized by low gradient (<1%), sand, silt and gravel substrate, and riparian vegetation consisting of grasses as well as an occasional shrub or tree. Both channels have relatively high banks with a deep, narrow channel (EcoAnalysts 1998). Diking along Trout Creek has been restricted to the upper portion of the south channel and the confluence of the two lower channels along the mainstem Kootenai River. Although nearly all vegetation from the riparian area along both channels has been removed, live woody vegetation and dead woody debris are sporadically dispersed throughout and along the channels, providing minimal cover for aquatic organisms. In addition to native trout, the lower channels of Trout Creek provide potential spawning habitat for kokanee, burbot and several non-game fish species that also use the mainstem Kootenai River for part of their life cycle (Partridge 1983).

Spring and Fall Biological Assessments

Fish –

Eight species of fish, including westslope cutthroat trout (Oncorhynchus clarki), rainbow trout (Oncorhynchus mykiss), bull trout (Salvelinus confluentus), eastern brook trout (Salvelinus fontinalis), sculpin (Cottus sp.), longnose dace (Rhinichthys cataractae), mountain whitefish (Prosopium williamsoni) and longnose sucker (Catostomus catostomus), were detected in Trout Creek during the spring and fall bioassessments (Table 3, Appendix 5, Appendix 6). Fish species distribution varied by sample location, with the greatest diversity occurring in the lower sample sites (Figure 3). Ages of fish ranged between 1 and 5 years, with the exception of one 7-year-old mountain whitefish (Figure 4). Relative weights ranged from 75 to 114 with a median of 101 for eastern brook trout and 71 to 158 with a median of 90 for westslope cutthroat trout. Median relative weights for westslope cutthroat trout by sample site were 88 for TC2, 97 for TC3, 88 for TC4 and 96 for TC5.

Table 2. Historic macroinvertebrate data and metrics (Taxa richness = diversity; EPT = Ephemeroptera, Plecoptera, Trichoperta richness as a response to increasing perturbation; HBI = Hilsenhoff Biotic Index as a measure of tolerance/intolerance; MTI = metals tolerance index) for Trout Creek, Boundary County, Idaho (Ecoanalysts 1998b; IDEQ unpublished data). Data were collected during the fall of 1998.

Sample location	**Density ($\#/m^2$)**	**Dominant taxa/ indications**	**Taxa richness**	**EPT (total # taxa/# EPT taxa; Expressed in %)**	**HBI score**	**MTI score**
South fork (lower site)	2288	Intolerant Facultative Shredders Cold water taxa Moderately stressed community Moderate organic enrichment No metals stress	42	48	4.41	0.61
South fork (upper site)	4519	Intolerant Scrapers Shredders Cold water taxa Healthy environment No organic enrichment problems No metals stress	49	55	3.44	1.02
North fork (lower site)	5212	Facultative Moderately disturbed and stressed Collector-gatherers Shredders Cold water taxa No metals stress	52	40	4.48	1.10
North fork (upper site)	2068	Intolerant Facultative Scrapers Shredders No organic enrichment problems Cold water taxa Moderately disturbed	43	65	2.93	0.67
Main channel	533	Scrapers Shredders Intolerant No organic enrichment problems No metals stress Cold water taxa	26 24[1994] 41[1998]	73	2.61	0.71

Table 3. Fish species, abundance and densities detected by backpack electroshocking during spring and fall, 2001, in Trout Creek, Boundary County, Idaho. Sample sites are grouped by location in the flood plain (TC 1a and 1b), transition zone (TC2) and upper forested area (TC 3-5).

Species	Total collected in spring	Spring population estimate	Density (#/m)	Total collected in fall	Fall population estimate	Density (#/m)
TC 1a and 1b - flood plain *Reach length: 50 m x 2 sites = 100 m total length sampled*						
Oncorhynchus clarki (WCT)	1	--	0.01	0	--	--
Oncorhynchus mykiss (RBT)	4	4	0.04	3	3	0.03
Salvelinus confluentus (BLT)	2	2	0.02	0	--	--
Salvelinus fontinalis (EBT)	5	5	0.03	18		
Cottus sp. (SCU)	47	177	1.18	105	525	3.50
Rhinichthys cataractae (LND)	1	--	--	20	31	0.20
Catosttomus catostomus (LNS)	0	--	--	27	50	0.33
TC 2 – transition zone *Reach length: 50 m x 1 site = 50 m total length sampled*						
Oncorhynchus clarki (WCT)	6	6	0.06	26	44	0.44
Oncorhynchus mykiss (RBT)	2	2	0.02	0	--	--
Salvelinus confluentus (BLT)	1	1	0.01	4	4	0.04
Salvelinus fontinalis (EBT)	0	--	--	1	--	0.01
Prosopium williamsoni (MWF)	3	5	0.03	0	--	--
TC 3-5 – upland forested *Reach length: 50 m x 3 sites = 150 total length sampled*						
Oncorhynchus clarki (WCT)	33	60	0.40	37	37	0.24

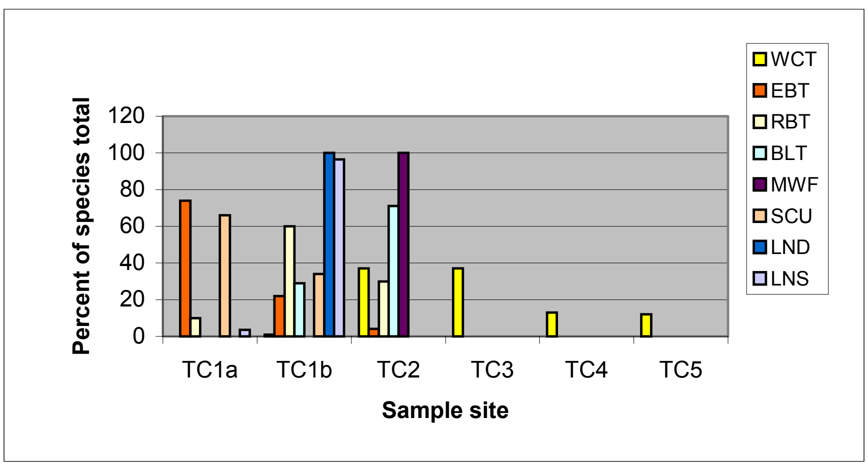

Figure 3. Fish species distribution for 6 samples sites along Trout Creek, Boundary County, Idaho, 2001. See appendix 4 for fish taxa abbreviations.

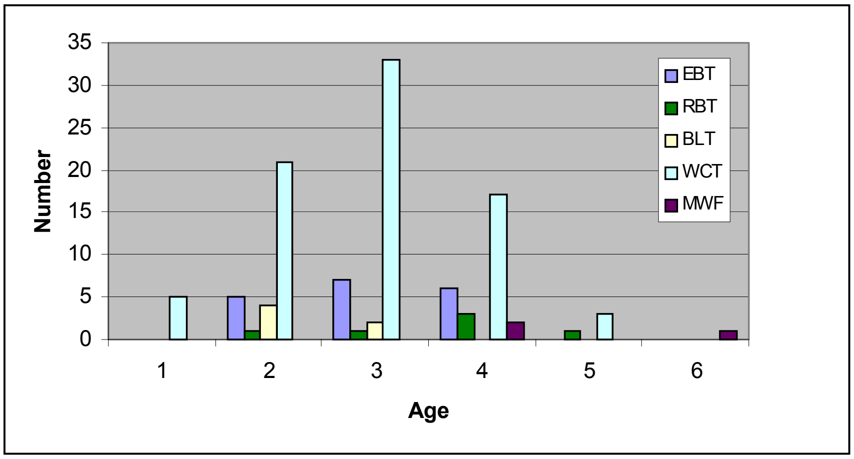

Figure 4. Age histograms of fish captured in Trout Creek, Boundary County, Idaho, 2001. See appendix 4 for fish taxa abbreviations.

Macroinvertebrates –

The upper forested sampling sites possessed higher densities, taxa richness, and EPT ratings than the flood plain sites (Table 4). Average tolerance values and EPT metrics at the transition zone site were comparable to those of the upper forested. However, density and taxa richness were approximately 0.5 times lower in the transition zone than in the upper forested sites. Metrics and taxa richness differed the most between June and October sampling periods for the upper forested sites, being higher in October than in June (Table 4). Tolerance levels for all macroinvertebrates detected ranged between 0 (least tolerant) and 11 (12 being most tolerant) (Appendix 7). Tolerant and intolerant species were distributed throughout all sites. However, tolerance values in the lower flood plain sampling sites were 2-3 times higher in the transition zone or upper forested sampling sites.

Table 4. Density, taxa richness, EPT and tolerance values for 6 sites sampled on Trout Creek, Boundary County, Idaho. June and October, 2001.

Sample Site	Density (#/m^2)		Taxa richness		EPT(%)		Average tolerance value	
	Jun	Oct	Jun	Oct	Jun	Oct	Jun	Oct
TC1A	149.34	369.18	14	14	21.43	7.14	4.48	4.28
TC1B	90.80	105.14	17	14	41.18	28.57	3.08	7.07
TC2	181.60	384.71	33	30	63.64	76.67	2.72	2.60
TC3	162.49	542.41	26	34	88.46	76.47	2.45	1.47
TC4	46.60	636.80	11	39	81.82	64.10	3.23	2.30
TC5	295.10	634.41	27	26	66.67	65.38	3.34	2.41

Macroinvertebrate taxa consisted of representatives from the collector/gatherer, scraper, predator, shredder, plant and collector/filterer functional groups. Although the upper forested and transition sites held higher diversity and a more even distribution of organisms from all functional groups, percent community compositions by taxa were similar for spring and fall sampling periods at all sample sites (Figure 5 & 6). However, community composition by functional group indicated that the flood plain sampling sites (TC1a and TC1b) held a higher proportion of collector-gatherers than the sites in the upper forested or transition zone (Figure 7). Macroinvertebrate biomass measurements were higher in the fall than in the spring, with no apparent trend among sampling sites (Figure 8).

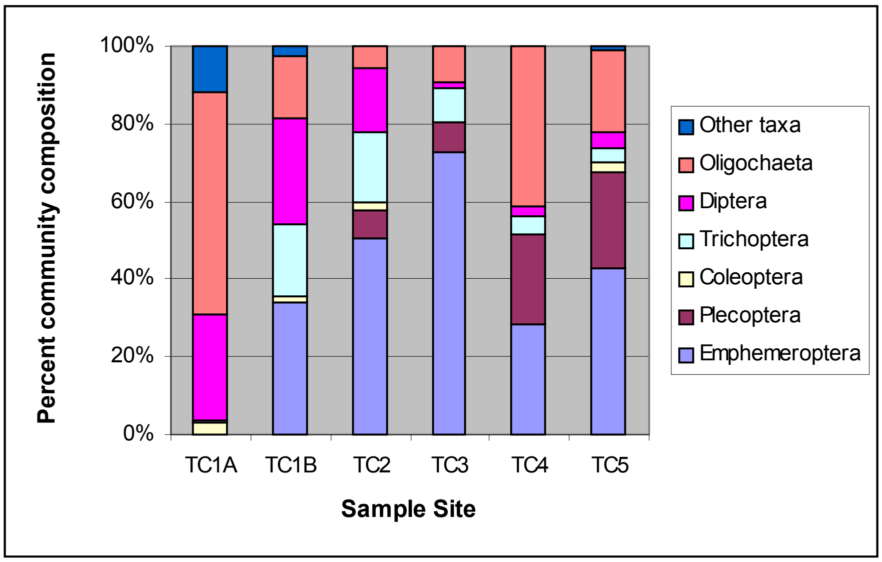

Figure 5. Percent community composition, by major macroinvertebrate taxa for 6 sites on Trout Creek, Boundary County, Idaho, June 2001.

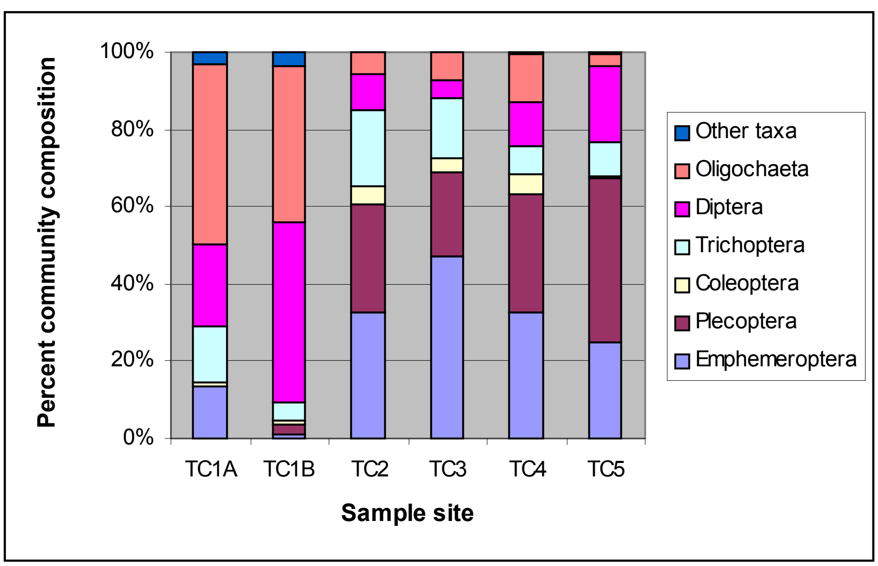

Figure 6. Percent community composition, by major macroinvertebrate taxa for 6 sites on Trout Creek, Boundary County, Idaho October 2001.

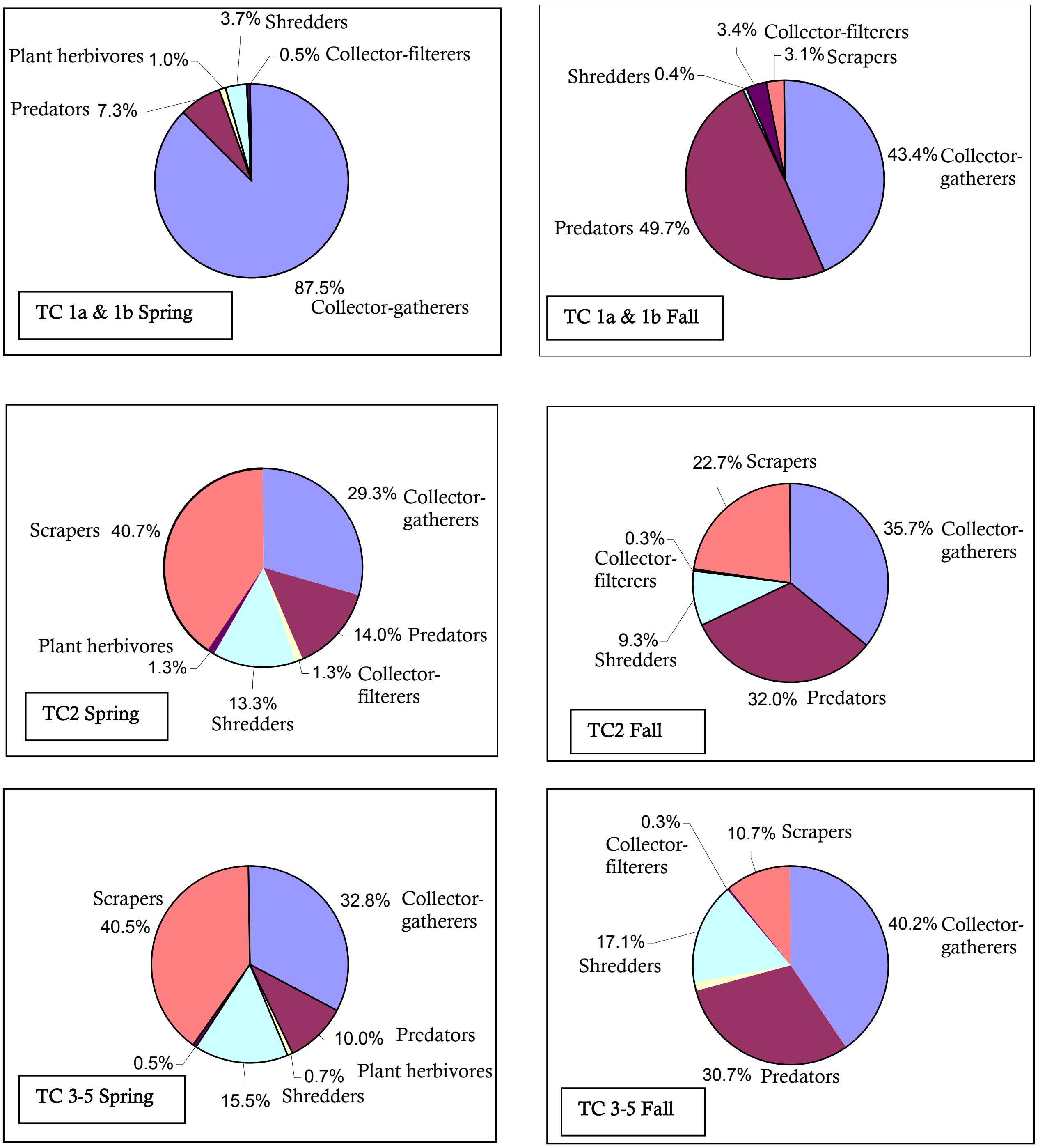

Figure 7. Proportion of macroinvertebrates in each functional group for samples collected during spring and fall, 2001, at floodplain (TC 1a & 1b), transition (TC2) and upland forested (TC 3-5) sites on Trout Creek, Boundary County, Idaho.

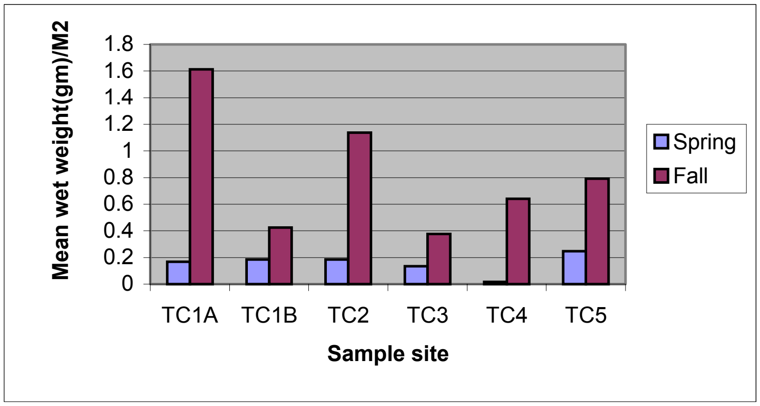

Figure 8. Macroinvertebrate biomass for samples collected at 6 sites along Trout Creek, Boundary County, Idaho, during spring and fall, 2001.

Periphyton and plankton –

Organism identification of periphyton and plankton samples indicated the presence of 5 algal groups including Cyanophyta (blue-greens), Chlorophyta (greens), Bacillariophyta (diatoms), Euglenophyta and Chrysophyta (flagellates; Appendix 8 & 9). Three species of bluegreens, 7 species of greens, 4 species of flagellates and 31 species of diatoms were identified in periphyton samples. Five species of bluegreens, 4 species of greens, 3 species of flagellates and 17 species of diatoms were identified in plankton samples. Periphyton samples were proportionately dominated by greens and diatoms in the lower (TC1a & 1b) and transition zone (TC2) sites. Periphyton samples in the upper forested sites were dominated by bluegreens and greens (TC3), diatoms (TC4) and diatoms and flagellates (TC5; Figure 9). Plankton samples were proportionately dominated by greens and diatoms in the lower and transition sites (Figure 10). Plankton samples from the upper forested sites were dominated by bluegreens and diatoms (TC3), greens and flagellates (TC4), and diatoms and flagellates (TC5). Species identification indicated a mixture of clean and polluted water indicators in periphyton and plankton samples from all sites.

Proportional counts of diatom burnt mounts showed greater diatom species diversity at TC4 in June than at the other sites during June or September (Figure 11). Sample site TC3 had the lowest diversity with *Diatoma mesodon* (48.7%), *Hannea arcus* (21.8%) and *Achnathes minutissima* (15.4%) identified as the dominant diatom species. Chlorophyll analysis of periphton samples showed lower levels in spring than in fall, with the upper two sites having the lowest levels (Table 5).

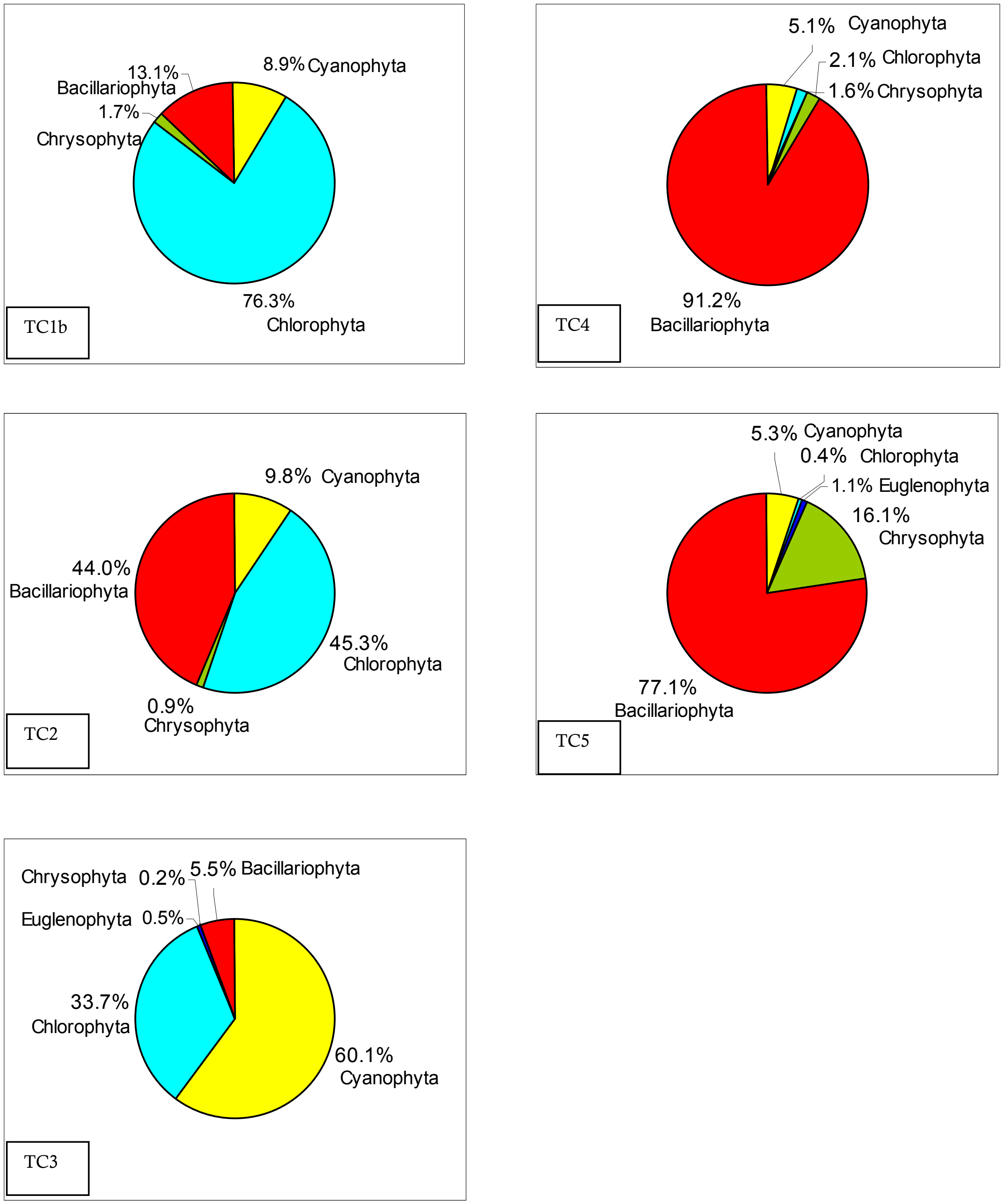

Figure 9. Proportional percent occurrence of algal groups in periphyton samples collected from 5 sites on Trout Creek, Boundary County, Idaho, June and September, 2001.

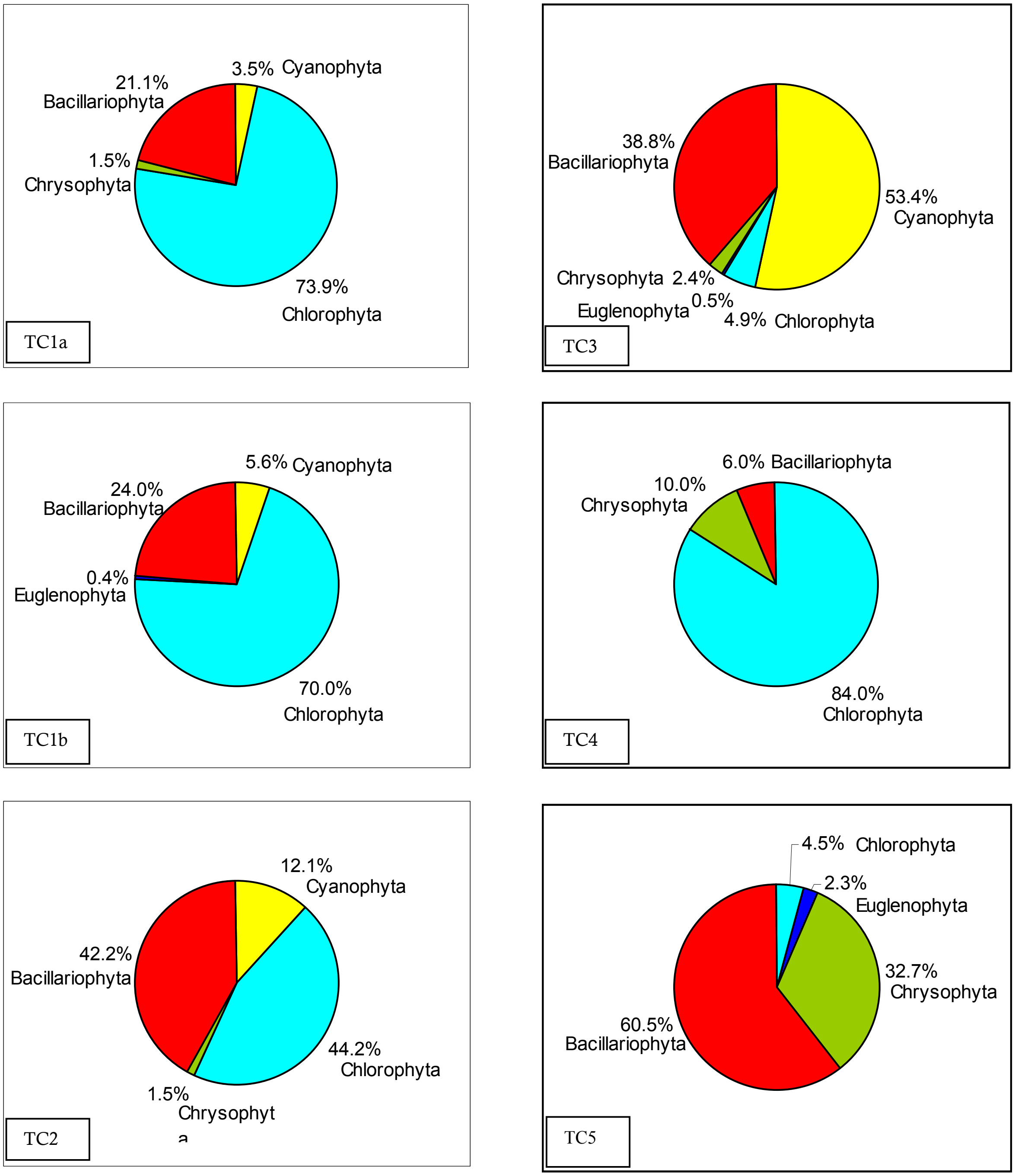

Figure 10. Proportional percent occurrence of algal groups in plankton samples collected from 6 sites on Trout Creek, Boundary County, Idaho, September 2001.

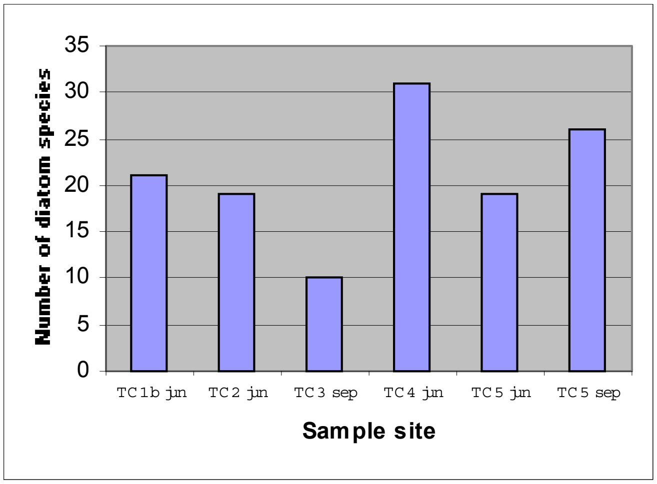

Figure 11. Diatom species diversity for samples collected from 5 sampling sites during two sampling periods in Trout Creek, Boundary County, Idaho, 2001.

Table 5. Chlorophyll content of periphyton samples collected from Trout Creek, Boundary County, Idaho, 2001.

Sample site	Spring			Fall		
	Chlorophyll A/in^2	Chlorophyll B/in^2	Total Chlorophyll /in^2	Chlorophyll A/in^2	Chlorophyll B/in^2	Total Chlorophyll/in^2
TC1a	1.01	0.27	1.28	3.33	1.13	4.47
TC1b	0.09	0.04	0.13	2.30	1.75	4.05
TC2	2.81	1.89	4.70	4.08	2.68	6.75
TC3	--	--	--	5.95	1.75	7.70
TC4	--	--	--	0.62	0.10	0.72
TC5	--	--	--	0.25	0.15	0.40

Water Quality –

Standard water quality parameters were similar throughout sample sites in the upper and lower portions of Trout Creek (Table 6). Water sample analysis indicated extremely low levels of key nutrients, and low levels of zinc, aluminum, copper and cadmium (Tables 7 & 8; Appendix 10).

Table 6. Median values for basic water quality parameters measured during spring and fall, 2001, in Trout Creek, Boundary County, Idaho. Sample sites are grouped by location in the flood plain (TC1a and 1b), transition zone (TC 2) and upland forested area (TC 3-5).

Sample sites	Temperature (C)	Conductivity (us/cm)	DO (mg/l)	pH	Total dissolved solids (mg/l)
TC3 – TC5					
Spring	6.8	16.57	10.19	7.45	8.15
Fall	4.9	34.7	12.31	7.58	16.1
TC2					
Spring	9	21.9	9.65	7.45	10
Fall	6.2	38.2	10.33	7.8	17.8
TC1a, TC1b					
Spring	9.95	24.2	10.17	7.36	11.05
Fall	8.4	37.7	12.14	7.47	17.5

Table 7. Range of dissolved metals detected in water samples collected during spring and fall, 2001, in Trout Creek, Boundary County, Idaho. Sample sites are grouped by location in the flood p lain (TC 1a and 1b), transition zone (TC2) and upper forested area (TC 3-5).

Sample sites	Compound (mg/l)						
	Al	As	Cd	Cr	Co	Cu	Fe
TC3 – TC5							
Spring	0.0352-0.0528	<0.0050	<0.0002	<0.0020	<0.0200	<0.0010	<0.0200
Fall	0.0082-0.0161	<0.0050	<0.0002	<0.0020	<0.0200	0.0027-0.0045	<0.0200
TC 2							
Spring	0.0177	<0.0050	<0.0002	<0.0020	<0.0200	<0.0010	<0.0200
Fall	0.0067	<0.0050	0.00028	<0.0200	<0.0200	0.0079	<0.0200
TC1a, TC1b							
Spring	0.0227-0.0237	<0.0050	<0.0002	<0.0020	<0.0200	<0.0010	<0.0200
Fall	0.0121-0.0251	<0.0050	0.00032	<0.0020	<0.0200	0.0033	<0.0200

Table 7 continued. Range of dissolved metals detected in water samples collected during spring and fall, 2001, in Trout Creek, Boundary County, Idaho. Sample sites are grouped by location in the flood plain (TC 1a and 1b), transition zone (TC2) and upper forested area (TC 3-5).

Sample sites	Compound (mg/l)					
	Pb	Mn	Hg	Ni	Se	Zn
TC3 – TC5						
Spring	<0.0010	<0.0050	<0.0001	<0.0100	<0.0030	0.0130-0.0670
Fall	<0.0010	<0.0050	<0.0001	<0.0100	<0.0030	0.0160-0.0180
TC 2						
Spring	<0.0010	<0.0050	<0.0001	<0.0100	<0.0030	0.016
Fall	<0.0010	<0.0050	<0.00001	<0.0100	<0.0030	0.019
TC1a, TC1b						
Spring	<0.0010	<0.0050	<0.0001	<0.0100	<0.0030	<0.0050-0.0600
Fall	<0.0010	<0.0050	<0.0001	<0.0100	<0.0030	0.020

Table 8. Range of nutrient levels (mg/l) detected in water samples collected during spring and fall, 2001, in Trout Creek, Boundary County, Idaho. Sample sites are grouped by location in the flood plain (TC 1a and 1b), transition zone (TC2) and upper forested area (TC 3-5).

Sample site(s)	Nutrient compound (mg/l)				
	Total Phosphorous	Soluble Reactive Phosphorous	Ammonia	Nitrate + Nitrite	Total Nitrogen
TC3 – TC5					
Spring	<0.002-0.003	<0.001	<0.005	<0.010-0.017	<0.050
Fall	0.003-0.005	<0.001-0.005	<0.005	<0.010-0.013	<0.050-0.057
TC 2					
Spring	0.002	<0.001	<0.005	<0.010	<0.050
Fall	0.003	<0.001	<0.005	<0.010	<0.050
TC1a, TC1b					
Spring	0.004-0.009	<0.001	<0.005	<0.010	<0.050
Fall	0.005-0.014	<0.001-0.003	<0.005	<0.010	<0.050-0.055

Proper Functioning Condition Assessment

The PFC team was able to develop a qualitative assessment depicting the health of Trout Creek. The team separated Trout Creek into 8 major reaches from top to bottom (Appendix 1b, Appendix 11). The results indicate the state of hydrology, vegetation and erosion within each reach.

Reach #1 is the headwaters and is composed of a series of small side tributaries. Due to inaccessibility this reach was not assessed.

Reach #2 follows the headwaters and was rated at Potential Natural Community (PNC). This area could potentially serve as an example of the upper end of the stream system functionality scale.

Reach #3 is approaching PNC but is not quite as mature as reach #2. The area selected for sampling was upstream from an abandoned road crossing where the bridge was removed. The composition of vegetative species is not as diverse and less older woody material is available for recruitment.

Reach #4 is located in the steep canyon section and is approaching PNC but is not quite as mature as reach #2. This reach has very low natural sinuosity, however the boulders provide extra support and dissipate sufficient energy.

Reach #5 is located within the north fork on the alluvial fan transition area between the confined upper main channel and the Kootenai River flood plain. This reach has been exposed to accelerated lateral movement and bedload accumulation associated with wood removal from the stream over time. There is a head cut moving upstream from the flood plain, indicating stream instability. This is a naturally unstable area and the current vegetation and land treatments will probably cause the reach to remain unstable. There is a need for a long-term riparian and channel stabilization strategy that would manage the wood input but encourage its presence. Growth of riparian plant communities in this reach needs to be encouraged.

Reach #6 is located within the lower flood plain section of the north fork. The upper portion of this reach shows a slight downward trend and the lower portion of the reach has no apparent trend. However, aggrading and eroding banks, as well as a history of abandoned frequent flood plain physical damage and early rebuilding of the flood plain are apparent. This reach has high potential for recovery as most of the plants are already present but need to be released. The PFC assessment team suggested that a grazing management plan and supplemental planting of woody species would allow the riparian zone to express itself.

Reach #7 is located within the south fork on the alluvial fan transition area between the confined upper channel and the Kootenai River flood plain. This reach starts at the "forks" and extends downstream to the existing fence line where most of the sand, gravel and cobble deposits are replaced by finer material. The reach has been affected by large woody debris removal over a long time period. The reach becomes low gradient below the bridge and the bedload material that is settling out is smaller. A strong deciduous riparian community is developing on the gravel bars below the bridge. This segment is showing improvement. However, as with the upper portion of the north fork, the reach above the bridge is not improving and can adversely affect the area below the bridge during a high flow event because it will not be able to dissipate the energy adequately.

Reach #8 extends from the fence line below the bridge on the south fork downstream to the mouth. The area has been recently excluded from grazing and is in better condition than the north fork. However, there is little difference in condition between the north and south fork reaches on the Kootenai River flood plain. Although the south fork flood plain reach contains a wider array of young vegetative species than the north fork, it has also been affected by large woody debris removal over time. As with the lower portion of the north fork, the south fork reach also rates low on the functionality scale (ie. Functioning at risk).

Discussion

The bioassessment, historic data collection and PFC portions of this rehabilitation project have provided baseline information about the biological and physical status of Trout Creek. The data have also provided information about weak points and potential avenues of approach for aquatic and riparian habitat restoration. This baseline information is an integral part of planning and progress tracking of restoration and rehabilitation efforts applied to Trout Creek.

Given the difference in geomporphology and available habitat types between the upper and lower reaches of Trout Creek, different aquatic species assemblages would be expected with some overlap occurring in the transition zone (Meehan 1991). Higher abundances of resident trout, cobble-associated macroinvertebrates and lower primary productivity (due to shading) would be expected in the upper reaches (Allen 1995). Fine sediment-associated macroinvertebrates, as well as a wider diversity of fish and macroinvertebrate species, would be expected in the lower reaches (Allen 1995). In fact, the fish species data and presence of a high proportion of collector-gatherer macroinvertebrates at the lower flood plain sites support this thought. The close proximity and easy access to the main stem Kootenai River would also suggest the presence of adfluvial rather than resident fish species in the two forks. Although high spring flows should be sufficient for larger redband rainbow trout migration over the potential barrier above the divergence of the two forks, this barrier may block migration of bull trout and kokanee during fall low flows.

The results of the PFC assessment on Trout Creek indicated that the upper portion of the creek is at or near Potential Natural Community (Appendix 11). However, present and historic habitat alterations (i.e. de-vegetation, woody debris removal, and cattle grazing) have contributed to the degradation of the lower portion of Trout Creek. Although the transition zone is extremely unstable, low gradient and stream sinuosity are preventing the effects of this section from reaching far into the flood plain zone. The flood plain zone is not presently showing a downward trend and has high potential for restoration (Appendix 11).

Environmental condition during and following vegetation planting can affect success of revegetation efforts (Slaney and Zaldokas 1997). Therefore, assessment of survival and growth of fall and spring planted willows should provide a good measurement for seasonal planting success. If plantings are able to establish extensive root systems during the late fall and early spring, they may get a head start and be better able to handle drought conditions in the summer than spring planted willows. Also, fall plantings may be easier to implement than spring plantings due to dryer conditions and thawed ground.

The fish and macroivertebrate surveys conducted prior to this biological assessment indicated a presence of westslope cutthroat in the upper reaches of Trout Creek and a greater diversity of fish species (rainbow, brook and bull trout , mountain whitefish and several non-game species) in the lower reaches. Historic population estimates for mountain whitefish, westslope cutthroat, rainbow, eastern brook and bull trout were comparable to those obtained from this bioassessment. However, with the exception of speckled dace and sculpin in the north and south forks, fish abundance was not very high, suggesting that either Trout Creek is at carrying capacity for its available habitat or some factor(s) is (are) limiting fish population growth. Although published literature (Meehan 1991) suggests that grazing results in lower densities of game fish, no similar pattern was apparent between the forested and lower (rangeland) sites on Trout Creek.

Historic benthic macroinvertebrate metrics suggest a system with areas of low to moderate impacts from organic or metals pollution and ecological disturbances (EcoAnalysts 1998b). Although macroinvertebrate metrics collected during this bioassessment indicate lower than historic densities, taxa richness, %EPT and tolerance values are all within acceptable ranges (personal communication, Charlie Holderman, KTOI). The presence of macroinvertebrates from numerous functional groups suggests that the available habitat is supporting good diversity at sites in the transition and upper forested reaches. The higher levels of diversity (taxa richness) and %EPT coupled with the lower tolerance values for macroinvertebrates collected in the upper reaches support the suggestion of the PFC team that the upper section of Trout Creek is in much better functioning condition than the lower section. Higher water temperatures, minimal cover, greater disturbance and different substrate type (sand, silt, mud) in the lower section are likely the reasons for differences in macroinvertebrate distributions.

Periphyton and plankton samples contained a mixture of clean and polluted water species, suggesting that the level of potential stress due to water quality is either non-existent or similar among sites. Lower species diversity in the upper forested (shaded) sample sites is likely due to cooler water temperatures and limited penetration of sunlight necessary for algal growth (Meehan 1991, Minshall et al. 1985, Vannote et al. 1980). Differences between dominant substrate types in the forested section (cobble and bedrock) and the floodplain (sand, silt and gravel) also potentially affect species diversity (Meehan 1991).

Results of the water quality data indicated the presence of aluminum, copper, cadmium and zinc at low levels but above detection limits. It is questionable whether these detected levels are negatively impacting aquatic life in Trout Creek. Generally, metals such as copper and aluminum have been thought to pose a greater risk to aquatic life at lower pH conditions than those in Trout Creek (Ripley et al. 1996). However, other factors such as temperature and water hardness can also affect the degree of impact that metals may have on aquatic systems and effects can be manifested at different physiological levels depending on these factors. Current Environmental Protection Agency (EPA) chronic criteria for freshwater aquatic life (at 100 mg/l hardness and pH 7-8) are 0.007 mg/l for copper, 0.002 mg/l for cadmium and 0.088 mg/l for zinc (USEPA 1999). Comparable criteria for British Columbia are 0.003 mg/l copper, 0.002 mg/l for cadmium, 0.008 mg/l zinc and 0.05 mg/l aluminum (British Columbia 1998a, 1998b). Levels detected in Trout Creek samples are, in some cases, higher but in general they are within acceptable published criteria ranges.

Although the aquatic organisms in Trout Creek may be able to acclimate to existing levels of the metals detected in Trout Creek samples, the metabolic and energy cost associated with acclimation can potentially reduce growth, swimming and reproductive capacity in these organisms (Marr et al. 1995,Waiwood and Beamish 1978). An apparent metabolic change due to toxic metal exposure may be shown by poor growth rates and habitat avoidance of trout. In addition, a mixture of different metals reduces the toxicity threshold of the individual compounds, making the mixture more toxic than the individual metals alone. Woodward et al. (1995) found that trout from the Clark Fork River in Idaho showed habitat avoidance in water containing a mixture of 0.0006 mg/l cadmium, 0.0065 mg/l copper and 0.032 mg/l zinc. When given the choice, test fish spent only 20% of their time in water containing this metals mixture. Several water samples from Trout Creek exceeded 0.0065 mg/l copper and 0.032 mg/l zinc, indicating the potential for habitat avoidance.

The uncertainty about the effects of existing levels of metals in Trout Creek indicates the necessity for a longer term monitoring program to establish seasonal trend levels and potential effects on aquatic organisms. Water analysis alone does not account for the level of ingestion from contaminated food; therefore, physiological biomarker (monitoring of physiological responses) and tissue residue data from fish and macroinvertebrates is recommended to supplement the water quality data in determining cause and effect relationships that may exist (Farag et al. 1995).

Despite the low levels of nitrogen and phosphorous in Trout Creek, the macroinvertebrate and periphyton populations appear diverse and healthy. Nutrient levels have not likely declined (from historic levels) in the upper portion of Trout Creek; however, a decline in kokanee spawner carcasses in the lower portion has likely resulted in lower than historic nutrient levels during the fall season. It is estimated that a decaying kokanee will input 0.3% and 3.0% wet body weight of phosphorous and nitrogen respectively into a stream system (Ashley 2001, Minshall et. al 1991). With an estimated 250-500 spawning kokanee returning, dying and decaying in Trout Creek alone, this percentage translates into extensive loss of late season nutrients necessary for over-winter survival of age-0 fish.

Balancing tangible (fish, timber, grass etc.) and intangible (esthetic and intrinsic) resources while maintaining or increasing their total value has been a difficult task in the Kootenai River drainage, as well as many watershed drainages thoroughout the world. Research has shown that aquatic ecosystems are resilient and can restore themselves over time if properly protected and managed for biota (Meehan 1991). The sandy substrate in the lower section of Trout Creek is likely a natural occurrence for a flood plain stream (Rosgen 1985). However, proper particle sorting (provided by a natural pool, riffle, run matrix, in-stream woody debris structures and overhanging vegetation) would support a more even distribution and proportion of gravel, cobble and fines necessary to provide organism habitat. In addition, the riparian zone in the lower section of Trout Creek is lacking the lush and abundant vegetation necessary to stabilize the streambank, as well as provide cover for organisms, cooler water temperatures, and sufficient coarse organic material food for lower food chain organisms (Meehan 1991). The sparse presence of red-osier dogwood, willow seedlings and rushes suggest the desire of Trout Creek to begin healing itself; however, woody vegetation growth can be jump started and riparian area can be rested from grazing to boost recovery.

A flexible livestock management program coupled with revegetation efforts can be implemented along lower Trout Creek for relatively low cost and minimal effort. This type of program would likely remedy many of the deficiencies in the riparian and aquatic zone (Waters 1995). Exclusionary fencing is presently in place along the majority of the south fork but the north fork flows through a large single pasture where riparian and in-stream access by cattle is not limited. This pasture could be split and each section rested during alternate years. Temporary exclusion fencing could also be installed to keep cattle away from newly planted vegetation until it is well established. Available forage estimates will be calculated to determine maximum grazing pressure for the area. Provision of offsite watering, shade and improved forage up on the flood plain will also entice cattle away from the stream bottom and decrease impacts on the aquatic system. The flood plain area of Trout Creek contains excessive woody debris that could be placed in the stream bottom and allowed to sort itself out to provide natural habitat and a means of sediment retention.

Cottonwood pole and other native vegetation plantings can be used to begin re-establishment of live woody vegetation.

In addition to providing fish and macroinvertebrate habitat, re-vegetation of the flood plain portions of Trout Creek should also help to stabilize the stream banks, build the stream bed and reverse the effects of historic incising of Trout Creek. Implementation of this program would likely translate into a higher carrying capacity for and increased abundance of native fish species, cleaner water and substrate, and a better ecosystem balance that would, in turn, provide for human uses.

In order to assess impacts (positive or negative) of a rehabilitation program, it is necessary to continue monitoring the system at regular intervals. Therefore, an annual monitoring program which analyzes macroinvertebrate, periphyton and fish assemblages, physical habitat, water quality and vegetation will be implemented to track progress of the restoration project. Stream cross-sections will be surveyed and photo documentation recorded on a 5-year basis to clearly show results of the rehabilitation efforts.

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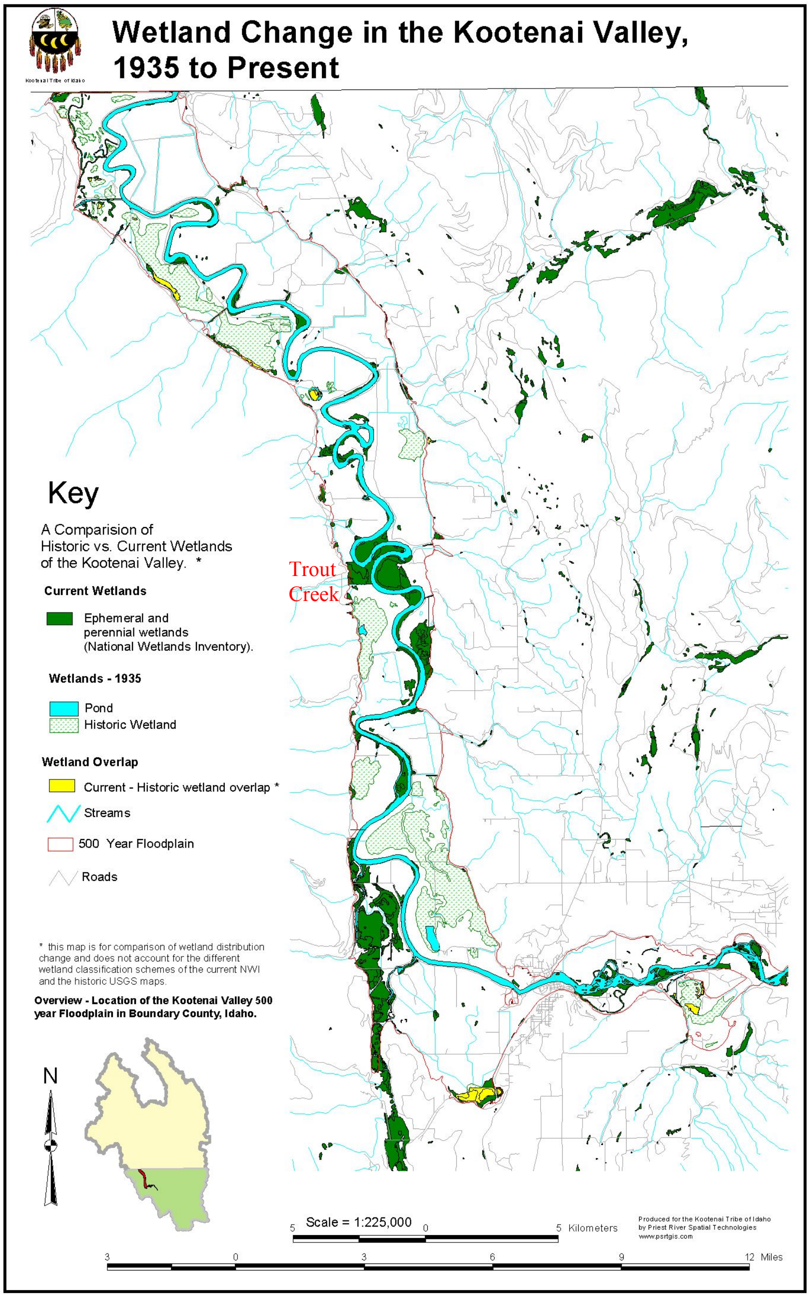
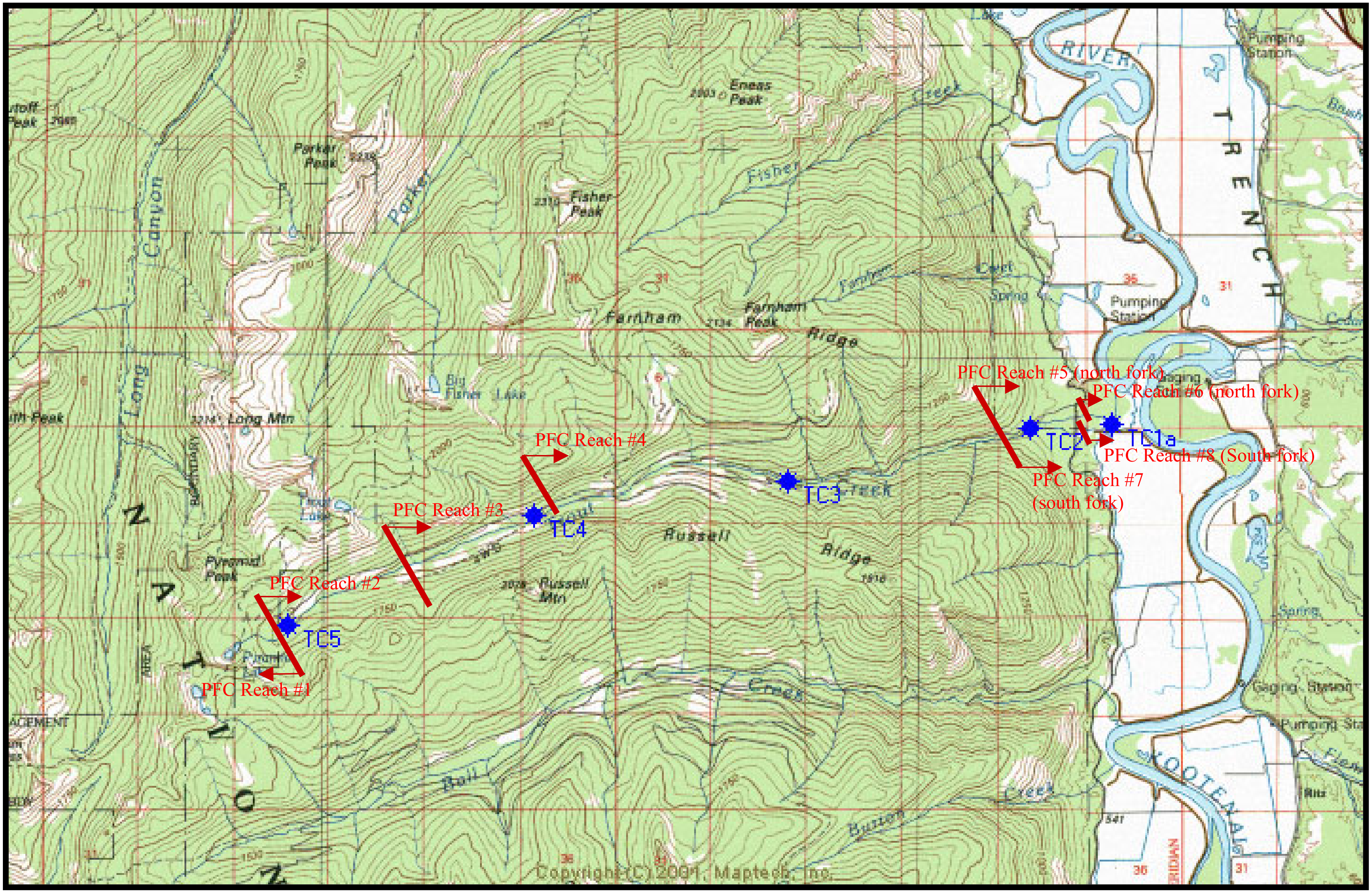
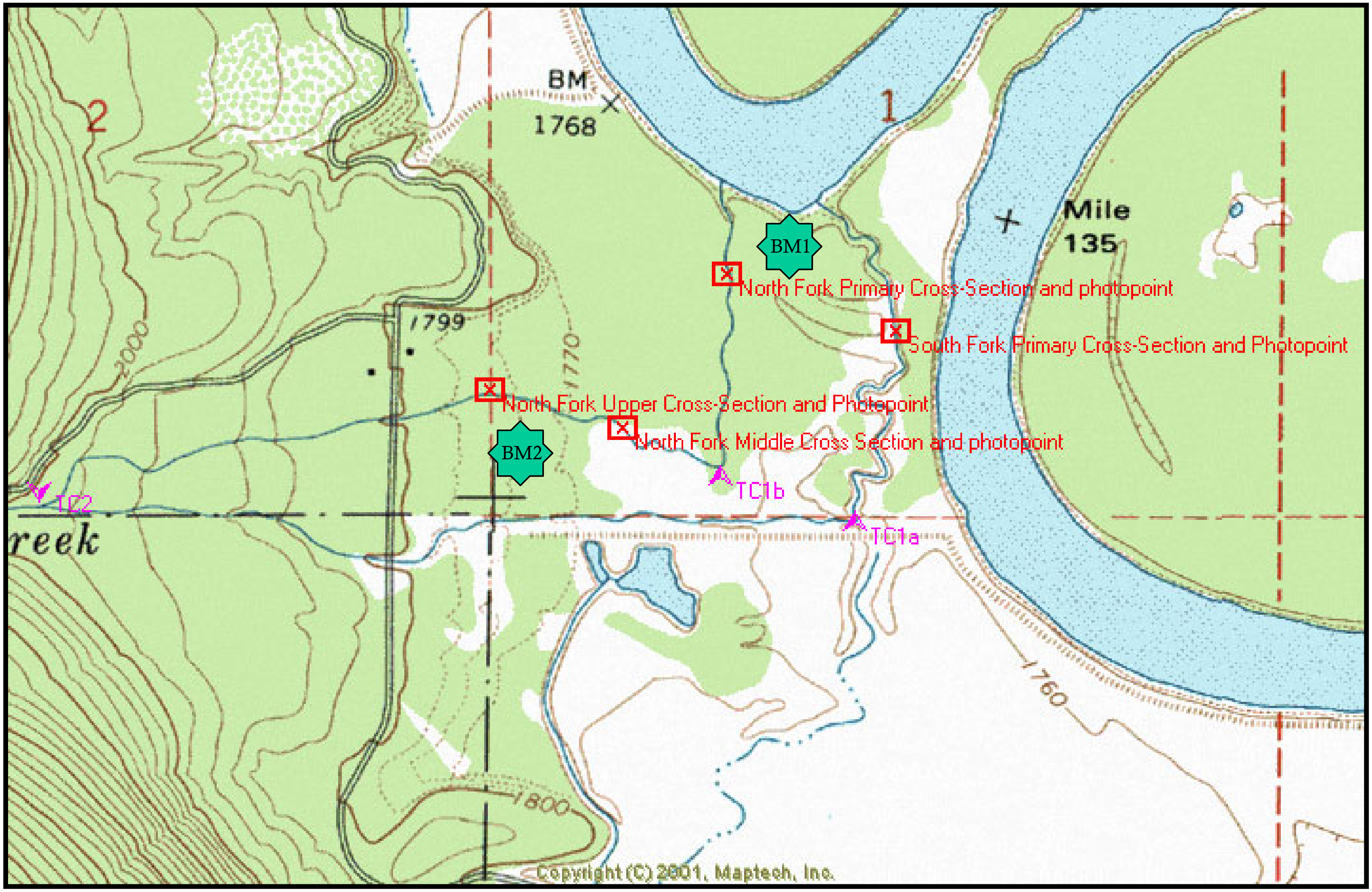


Appendix 1a. Map of wetland changes over time in the lower Kootenai River basin, Boundary County, Idaho.



Appendix 1b. Study site and PFC reach map of Trout Creek, Kootenai River watershed, Boundary County, Idaho.



Appendix 1c. Cross-section, photopoint and benchmark locations established during 2001 on the lower 2.1 km section of Trout Creek, Boundary County, Idaho.

Placing a block net at sample stie # TC1a

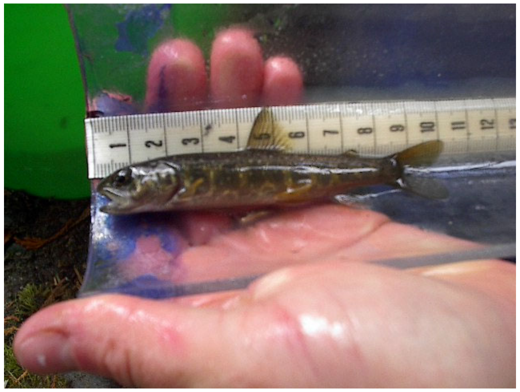
A block net in place at sample stie # TC1a

Backpack electroshcing for fish at sample site # TC1a

Working up fish at sample site # TC1a

Collecting a fin clip for genetic analysis of trout

Appendix 2. Biological assessment data collection along Trout Creek, Boundary County, Idaho



Bull trout captured at site
#TC2 in the transition zone

Potential brook/bull trout
hybrid - note the definite
spotting with slight worm-
like marks on back and head

Sculpin captured at site
#TC1a on the north fork

Westslope cutthroat trout
captured at site # TC5 in the
upland forested area

Appendix 2 continued. Biological assessment data collection along Trout Creek, Boundary County, Idaho

Site #TC3 in the upland
forested area

Using a Hess sampler to
collect macroinvertebrates at
site # TC1a

Using a Hess sampler to
collect macroinvertebrates at
site # TC1a

Appendix 2 continued. Biological assessment data collection along Trout Creek, Boundary County, Idaho

Appendix 3. SOP for chlorophyll determination methd

TITLE:	**DETERMINATION OF CHLOROPHYLL A AND B IN SLIDE SCRAPINGS USING THE BIOMATE 3 SPECTROPHOTOMETER**

Contributors: E. Marshall, L. O'Garro

Approved: ____________ ____________
Steve McGeehan, Ph.D. Chief Chemist Date

Approved: ____________ ____________
Gregory Möller, Ph.D. Technical Director Date

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Status: *This document is considered current standard procedure of the Analytical Sciences Laboratory when management approval is documented by signature above. This Standard Method is effective on the date of approval signature and supersedes all other versions until historically archived by the QAU as indicated below.*

Archived: ____________ ____________
Signature Title Date

Abstract:
This method is utilized to determine the absorption spectra of Chlorophylls a and b in 95% ethanol (EtOH) using known absorption coefficient to calculate the concentration of Chlorophylls a and b, total Chlorophyll and Ratio A/B of Chlorophyll in slide scraping samples mixed with water.

I. Equipment and Apparatus

- **A.** Separatory funnel 500 mL
- **B.** 1000 mL wide neck amber bottle
- **C.** 1000 mL narrow neck amber bottle
- **D.** 120 mL wide neck amber bottle
- **E.** Glass funnels
- **F.** Glass wool
- **G.** Turbo vap and turbo vap vials
- **H.** 15 mL conical vials
- **I.** Small beakers
- **J.** 5 mL and 1 mL Pipetman pipettors
- **K.** Biomate 3 Spectrophotometer
- **L.** Aluminum foil
- **M.** Cuvette - 3 mL

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II. Instrument Operation Parameters

A. Turbo Vap

1. Temp: Low
2. Nitrogen: 10
3. Dryness: No

B. Biomate 3 Test Setup Method Name WCLR

TEST SETUP	15:49 1Jan00
Absorbance Ratio	
Test Name	WCLR[Saved]
Wavelength 1	665nm
Wavelength 2	649nm
Ref. Wavelength Correction	Off
Sample Positioner	Auto 6
Number of Samples	2
ID# (0=OFF)	1
Low/High Limits	-9999/9999
Statistics	Off
Auto Print	On

III. Reagents

A. Diethyl ether
B. Ethanol (EtOH) 95%
C. Sodium sulfate (oven dried)

IV. Quality Control Standards

Chlorophyll a and Chlorophyll b standards were purchased from Sigma and diluted in 95% ethanol to a concentration of 100 µg/mL. Two QC samples are to be extracted with each analytical batch by spiking reagent grade water with both chlorophyll a and b in each sample at a concentration that is considered appropriate. Usually, 100 µL of each chlorophyll standard is spiked into each of the two QC samples so that the final concentration of total Chlorophyll is around 2 µg/mL in the 5 mL final volume of 95% EtOH.

V. Sample Preparation

A. For each sample (including reagent blank and QC samples), cover a 500 mL separatory funnel with aluminum foil, label with sample number.
B. Label wide neck and narrow neck 1L amber bottle with the sample number.
C. Quantitatively transfer the sample from the collection container into a 120 mL amber bottle by washing the sample out of the whirpak bag with water. After transferring the sample, make sure enough water has been used to cover the tip of the homogenizer (about 50 mL total).
D. Macerate the sample with the homogenizer for 20 seconds.

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E. Quantitatively transfer the sample into the separatory funnel with 200mL of 18 MΩ H2O. For the reagent blank and QC samples add 250 mL of 18 MΩ H2O. Spike the QC samples with 100µL of both of the 100µg/mL Chlorophyll a and b standards. Prepare a QC check sample at this time by spiking 100 µL of each Chlorophyll standard into 5 ml of 95% EtOH.

D. Add 100 mL of Diethyl ether and shake for 1 minute.

E. Allow layers to separate then drain off water layer into a 1 L narrow neck amber bottle. Drain ether layer through funnel containing sodium sulfate (plugged with glass wool) into a 1 L wide neck amber bottle. Pour the water layer back into separator funnel. In situations in which it becomes necessary to break up a bad emulsion, it is best to decant the ether layer into a 250 mL beaker which contains sodium sulfate in order to break up the emulsion. Then drain the ether into the 1L wide neck amber bottle (it may be necessary to reextract the salt in this beaker with 25 mL of ether to try to remove any residual chlorophyll).

F. Repeat the extraction twice using 75 mL of ether and collect the ether phase, each time draining the ether layer through the sodium sulfate. Replace the sodium sulfate if it becomes saturated with water.

G. Add about 5 grams of anhydrous sodium sulfate to the 1 L amber bottle that contains the ether extracts and store them in freezer overnight.

H. Decant the ether phase into a turbo vap flask (it may be necessary to pour the extract through anhydrous sodium sulfate if water is present). Rinse the 1 L amber bottle 3 times with about 10 mL ether and add the rinsings to the turbovap flask. Concentrate the samples to approx. 2 mL and perform a solvent exchange with 10 mL of 95% ethanol.

I. Concentrate the samples to approx. 3 mL, transfer the extracts to conical vials, and then adjust to a final volume of 5 mL . Cover the conical vials with aluminum foil.

VI. Sample Analysis

A. Turn on the main power control for the Biomate 3 Spectrophotometer and allow the machine to warm up for 10 minutes.

B. Check to determine if instrument operation parameters are as stated in Section II. Change the "Number of Samples" to match the number of samples in the analytical batch

C. Place 3 mL of 95% ethanol blank into a cuvette holder that is marked 'B'.

D. Place 3 mL of each 5 mL final volume sample into the other five cuvette holders within the six place cell rotor that are marked 1-5.

E. Close the lid of the cell compartment and press "run samples." After the instrument has read and printed the results for the first five samples, replace the cuvettes with next set of samples and press, "continue". Continue until you have read all of the samples.

F. Dilute sample if necessary (if absorbance >1). Note amount of dilution on benchsheet and start over from step B above.

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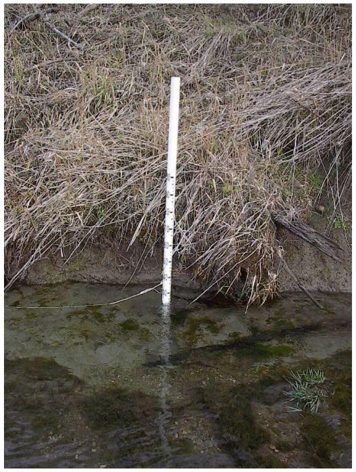


Staff gage at the north fork primary cross-section

Primary cross-section - right bank facing north (9/01)

Primary cross-section - left bank, facing south (9/01)

Primary cross-section - left bank facing south (9/01)

Primary cross-section - right bank facing east (9/01)

Appendix 4a. Northf fork of Trout Creek, primary cross-section, Boundary County, Idaho

Middle cross-section - right bank
facing west (9/01)

Middle cross-section - right bank
facing southeast (9/01)

Middle cross-section - right bank
facing east (9/01)

Middle cross-section - left bank
facing east (9/01)

Middle cross-section - right bank
facing northwest (9/01)

Middle cross-section - left bank
facing northwest (9/01)

Appendix 4a continued. North fork of Trout Creek, middle cross-section, Boundary County, Idaho.

Upper cross-section - right
back facing southwest
(9/01)

Upper cross-section - right
back facing west (9/01)

Upper cross-section - left
back facing east (9/01)

Upper cross-section - right
back facing east (9/01)

Upper cross-section - left
back facing north (9/01)

Upper cross-section - left
back facing northeast
(9/01)

Appendix 4a continued. North fork of Trout Creek, Upper cross-section, Boundary County, Idaho

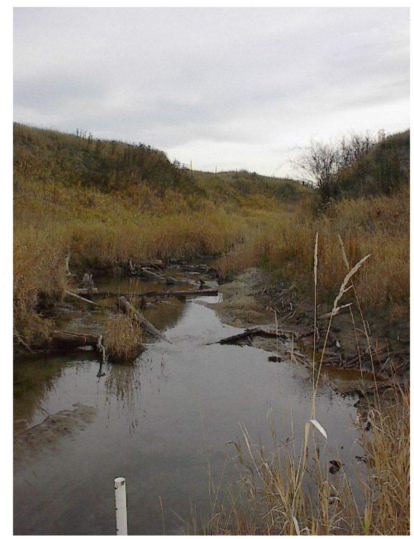
Staff gage at the south fork cross-section

East bank - facing north (10/01)

West bank - facing north (10/01)

West bank - facing east (10/01)

West bank - facing north 10/01)

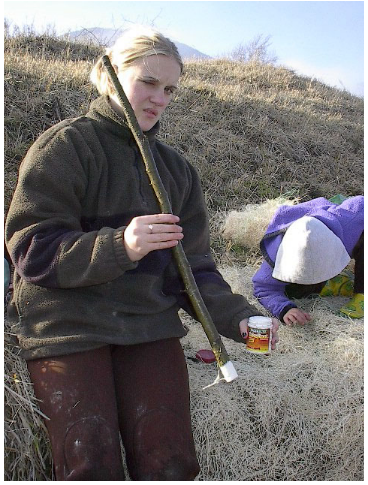


Channel bottom - facing south (10/01)

Appendix 4a continued. South fork of Trout Creek, primary cross-section, Boundary County, Idaho

Unstable bank prior to
placement of poplar matting

Unstable bank prior to
placement of poplar matting



Dipping a willow stick into
rooting hormore prior to
planting

Planting a willow stick

Planted area with poplar
matting

Appendix 4b. Bank stabilization and willow planting at the north fork of Trout Creek, primary cross-section, Boundary County, Idaho

Willow whip bundles, whips and sticks waiting to be planted

Unstable bank (downstream of primary cross-section) prior to placement of poplar matting

Bank with poplar matting in place

Appendix 4b continued. Bank stabilization and willow planting at the north fork of Trout Creek, primary cross-section, Boundary County, Idaho

Appendix 5. Fish taxa abbreviation key

Abbreviation	Common name	Scientific name
WCT	Westslope cutthroat trout	*Oncorhynchus clarki*
BLT	Bull trout	*Salvelinus confluentus*
RBT	Rainbow trout	*Oncorhynchus mykiss*
EBT	Eastern brook trout	*Salvelinus fontinalis*
SCU	Sculpin	*Cottus sp.*
LND	Longnose dace	*Rhinichthys cataractae*
SPD	Speckled dace	*Rhinichthys osculus*
MWF	Mountain whitefish	*Prosopium williamsoni*
RSS	Redside shiner	*Richardsonius balteatus*
BBH	Black bullhead	*Ictalurus melas*
KOK	Kokanee	*Oncorhynchus nerka*
LNS	Longnose sucker	*Catostomus catostomus*

Appendix 6. Data for individual fish captured by backpack electroshocking for a baseline biological assessment of Trout Creek, Boundary County, Idaho, 2001. See appendix 4 for fish taxa abbreviations.

Species	TL (mm)	Weight (g)	Age	Species	TL (mm)	Weight (g)	Age
BLT	112	15.2	2	RBT	45	1.2	
BLT	102	7.4	2	RBT	42	0.6	
BLT	110	9.6	2	RBT			
BLT	95	6.3	2	SCU	62	2.3	
BLT	(112)		3	SCU	60	1.6	
BLT	190	49.7	3	SCU	52	2	
BLT	(112)			SCU	80	3.8	
EBT	164	34.2	4	SCU	65	3.5	
EBT	226	111.1	4	SCU	96	9.2	
EBT	182	59.5	4	SCU	73	8.8	
EBT	148	32.9	4	SCU	72	4.2	
EBT	174	54.2	4	SCU	68	2.5	
EBT	135	25.4	3	SCU	56	1.8	
EBT	165	47	3	SCU	54	1.4	
EBT	220	116	4	SCU	90	9.8	
EBT	150	39.4		SCU	66	3.3	
EBT	87	7.1	2	SCU	64	3.6	
EBT	82	6	2	SCU	56	2	
EBT	74	4.1	2	SCU	60	1.6	
EBT	80	5.2	2	SCU	38	0.5	
EBT	72	3	2	SCU	42	1	
EBT	125	20	3	SCU	36	0.5	
EBT	127	20.7	3	SCU	43	0.9	
EBT	90	7.7	3	SCU	35	0.4	
EBT	75	4.3	3	SCU	39	0.6	
EBT	125	18.5	3	SCU	48	1.1	
EBT	47	1		SCU	60	2.3	
EBT	86	5.5		SCU	40	0.4	
EBT	108	11.4		SCU	44	0.6	
EBT	92	7.1		SCU	38	0.4	
LND	61	2.1		SCU	41	1	
LND	33	0.5		SCU	45	1.5	
LND	60	2.1		SCU	41	0.8	
LND	33	0.3		SCU	40	0.4	
LND	80	3.2		SCU			
LND	49	0.9		SCU			
LND	31	0.2		SCU			
LND	36	0.5		SCU			
LND	85	5.9		SCU	80	6.1	
LND	33	0.2		SCU	63	4.1	
LND	92	5.6		SCU	87	6.1	
LND	74	4		SCU	83	7	
LND	57	1.5		SCU	64	1.7	
LND	55	1.1		SCU	63	2.7	
LND	60	1.2		SCU	52	1.5	
LND	40	0.6		SCU	56	1.8	
LND	62	2.2		SCU	63	2	
LND	102	8.7		SCU	56	2	
LND	35	0.4		SCU	46	0.2	
LND	39	0.5		SCU	32	0.3	
LND	35	0.4		SCU	30	0.2	
LNS	70	4.1		SCU	45	0.9	
LNS	34	0.3		SCU	60	2.1	
LNS	35	0.2		SCU	66	3.4	
LNS	48	0.7		SCU	31	0.1	
LNS	39	0.6		SCU	55	0.9	
LNS	57	1.5		SCU	51	1.1	
LNS	62	2.2		SCU	47	1.3	

Appendix 6 continued . Data for individual fish captured by backpack electroshocking for a baseline biological assessment of Trout Creek, Boundary County, Idaho, 2001. See appendix 4 for fish taxa abbreviations.

Species	TL (mm)	Weight (g)	Age
LNS	49	1	
LNS	48	1.1	
LNS	53	1.3	
LNS	47	0.9	
LNS	49	1.1	
LNS	59	2	
LNS	40	0.6	
LNS	56	1.3	
LNS	57	1.7	
LNS	63	1.7	
LNS	43	0.8	
LNS	40	0.7	
LNS	38	0.5	
LNS	90	6	
LNS	39	0.5	
LNS	62	2.3	
LNS	80	5.1	
LNS	45	0.8	
LNS	28	0.3	
LNS	31	0.2	
LNS	43	0.7	
RBT	114	13.8	2
RBT	101	8.5	3
RBT	144	31.3	4
RBT	248	140	4
RBT	101	10.1	4
RBT	113	14.5	5
SCU	31	0.2	
SCU	55	1.7	
SCU	31	0.1	
SCU	39	0.6	
SCU	26	0.1	
SCU	63	2	
SCU	27	0.1	
SCU	30	0.2	
SCU	34	0.2	
SCU	50	1.2	
SCU	35	0.3	
SCU	52	1.1	
SCU	47	1.1	
SCU	30	0.1	
SCU	32	0.1	
SCU	50	1.2	
SCU	30	0.1	
SCU	30	0.1	
SCU	32	0.1	
SCU	28	0.1	
SCU	34	0.1	
SCU	30	0.1	
SCU	31	0.1	
SCU	32	0.1	
SCU	28	0.1	
SCU	32	0.1	
SCU	51	1.3	
SCU	65	2.7	
SCU	55	1.7	
SCU	65	2.3	
SCU	65	2.5	

Species	TL (mm)	Weight (g)	Age
SCU	48	1	
SCU	51	1.2	
SCU	61	2.3	
SCU	30	0.1	
SCU	52	1.1	
SCU	52	1.1	
SCU	52	1.5	
SCU	52	1.3	
SCU	27	0.1	
SCU	35	0.1	
SCU	32	0.1	
SCU	77	4.5	
SCU	83	6.7	
SCU	65	2.4	
SCU	71	3.2	
SCU	65	1.9	
SCU	70	3.1	
SCU	66	3	
SCU	62	1.9	
SCU	60	1.1	
SCU	60	2	
SCU	47	1.1	
SCU	45	0.9	
SCU	62	2.2	
SCU	60	2	
SCU	31	0.1	
SCU	32	0.1	
SCU	75	4.8	
SCU	62	2	
SCU	93	6.7	
SCU	72	3.3	
SCU	64	1.5	
SCU	74	3.5	
SCU	50	1.2	
SCU	32	0.4	
SCU	51	1.3	
SCU	82	5.7	
SCU	75	3.2	
SCU	28	0.2	
WCT	133	19	2
WCT	191	59.4	4
WCT	173	44.5	3
WCT	204	75.4	4
WCT	208	80.3	5
WCT	178	50.3	
WCT	210	85.7	4
WCT	180	54.1	5
WCT	172	47.5	4
WCT	194	71.5	4
WCT	150	32.8	4
WCT	135	24.2	3
WCT	139	27.1	3
WCT	243	114	
WCT	154	28.8	4
WCT	194	59.5	
WCT	151	29.1	3
WCT	137	22	2
WCT	186	57	4

Appendix 6 continued. Data for individual fish captured by backpack electroshocking for a baseline biological assessment of Trout Creek, Boundary County, Idaho, 2001. See appendix 4 for fish taxa abbreviations.

Species	TL (mm)	Weight (g)	Age	Species	TL (mm)	Weight (g)	Age
SCU	30	0.1		WCT	132	19.7	3
SCU	30	0.1		WCT	208	81	
SCU	26	0.1		WCT	134	21	
SCU	48	0.9		WCT	167	42	
SCU	65	2.4		WCT	153	33	4
SCU	50	1.2		WCT	197	72	
SCU	30	0.1		WCT	146	29	3
SCU	28	0.1		WCT	168	45	3
SCU	20	0.1		WCT	159	38.1	
SCU	31	0.1		WCT	136	24	3
SCU	44	0.7		WCT	132	22	2
SCU	53	1.1		WCT	148	31.6	
SCU	31	0.1		WCT	148	32	3
SCU	31	0.1		WCT	160	42	
SCU	23	0.1		WCT	205	91	
SCU	31	0.1		WCT	146	33	3
SCU	25	0.1		WCT	162	46	
SCU	26	0.1		WCT	136	27	
SCU	31	0.1		WCT	130	24	3
SCU	30	0.1		WCT	144	39	3
SCU	35	0.3		WCT	135	41	3
SCU	59	2		WCT	149	27.4	
SCU	57	1.5		WCT	195	63.3	
SCU	60	1.9		WCT	155	31.4	3
SCU	59	0.8		WCT	145	27	
SCU	55	1.3		WCT	146	28	3
SCU	65	2.5		WCT	168	44	3
SCU	63	2.2		WCT	133	21.5	4
SCU	63	2.1		WCT	139	25.3	3
SCU	29	0.3		WCT	138	27	
SCU	32	0.3		WCT	148	34	
SCU	55	1.6		WCT	172	55.5	
SCU	50	1.2		WCT	166	51	
SCU	75	4.3		WCT	160	46.5	
SCU	74	4		WCT	139	44	
SCU	69	2.8		WCT	150	27.6	4
SCU	49	0.9		WCT	145	26.6	4
SCU	52	1.1		WCT	188	60	3
SCU	60	1.9		WCT	153	36	5
SCU	63	2.3		WCT	130	22.2	2
SCU	51	1.3		WCT	188	70.4	4
SCU	27	0.3		WCT	146	33	4
SCU	70	2.8		WCT	148	35	3
SCU	70	3.1		WCT	179	65	4
SCU	30	0.2		WCT	48	1.1	1
SCU	38	0.5		WCT	60	1.7	1
SCU	60	2		WCT	67	2.8	1
SCU	35	0.7		WCT	59	2	1
SCU	52	1		WCT	60	2	1
SCU	52	0.8		WCT	91	9	2
SCU	43	0.5		WCT	125	17	2
SCU	31	0.1		WCT	116	15	2
SCU	30	0.2		WCT	108	12	2
SCU	85	7.9		WCT	100	10.3	2

Appendix 6 continued. Data for individual fish captured by backpack electroshocking for a baseline biological assessment of Trout Creek, Kootenai River drainage, Idaho, 2001. See appendix 4 for fish taxa abbreviations.

Species	TL (mm)	Weight (g)	Age
WCT	79	5.2	2
WCT	112	13.2	2
WCT	82	4.9	2
WCT	122	19.2	2
WCT	122	15.3	2
WCT	129	19.4	2
WCT	77	4	2
WCT	79	3.7	2
WCT	85	5.5	2
WCT	78	3.5	2
WCT	92	6.3	2
WCT	79	4.2	2
WCT	120	22	3
WCT	126	19	3
WCT	128	21.2	3
WCT	118	15.2	3
WCT	128	17	3
WCT	112	11.4	3
WCT	123	16.5	3
WCT	102	8.9	3
WCT	110	12	3
WCT	109	11	3
WCT	98	8.5	3
WCT	103	9	3
WCT	129	16.8	3
WCT	103	8.2	3
WCT	122	15.7	4
WCT	98	8.9	4
WCT	102	11.2	
WCT	74	4	
WCT	106	14	
WCT	45	0.5	
WCT	80	4	
WCT	55	1.9	
WCT	62	2.5	
WCT	57	1.8	
WCT	126	16.5	
WCT	97	7.4	
WCT	48	1.1	
WCT	48	1.1	
WCT	48	1.1	
WCT	48	1.1	
WCT	52	1.2	
WCT	65	2.3	
WCT	62	2.4	
MWF	255	134	4
MWF	237	108	4
MWF	251	124	7

Appendix 7. Family, Genus, species, functional group status and tolerance values of macroinvertebrates collected in Trout Creek, Boundary County, Idaho, June and October, 2001.

FAMILY/GENUS/SPECIES	FUNCTIONAL STATUS	TOLERANCE VALUE
Emphemeroptera (Mayflies)		
Ameletus	CG	0
Accentrella	CG	4
Baetidae	CG	4
Baetis	CG	5
Baetis alexandria	CG	5
Baetis bicaudatus	CG	2
Baetis tricaudatus	CG	5
Cinygma	SC	4
Cinygmula	SC	4
Drunella spp.	SC	0
Drunella doddsi	SC	0
Drunella grandis	SC	0
Drunella spinifera	PR	0
Epeorus spp.	SC	0
Epeorus grandis	SC	0
Epeorus longimanus	SC	0
Ephemerella infrenquens/inermis	SH	1
Ephemerellidae	CG	1
Heptageniidae	SC	4
Rhithrogena	SC	0
R. robusta	SC	0
Paraleptophlebia heteronea	CG	2
Seratella	CG	2
TAXA = 18		
Plecoptera (Stoneflies)		
Caliperla (specimen being verified)	PR	1
Capnidae	SH	1
Chloroperlidae	PR	1
Diura	SC	2
Doroneuria	PR	1
Isoperla	PR	2
Kogotus	PR	2
Leuctridae	SH	0
Megarcys	PR	2
Nemouridae	SH	2
Paraperla	PR	1
Paraleuctra	SH	0
Perlidae	PR	1
Perlinodes	PR	2
Perlodidae	PR	2
Plecoptera	PR	?
Skwala	PR	2
Setvena	PR	2
Sweltsa	PR	1
Visoka cataractae	SH	1
Yoraperla	SH	2
Zapada	SH	2
TAXA = 15		

Appendix 7. Family, Genus, species, functional group status and tolerance values of macroinvertebrates collected in Trout Creek, Boundary County, Idaho, June and October, 2001.

FAMILY/GENUS/SPECIES	FUNCTIONAL STATUS	TOLERANCE VALUE
Coleoptera (Aquatic beetles)		
Ampumixis	CG	4
Elmidae	CG	4
Harpalus	Semi-Aquatic	NA
Heterlimnius	CG	4
Heterlimnius corpulentus	CG	4
Lara	SH	4
Narpus	CG	4
TAXA = 5		
Trichoptera (Caddisflies)		
Arctophyche grandis	CF	2
Brachycentrus	CG	2
Dicosmoecus	SH	1
Ecclisomyia	CG	2
Glossosoma	SC	0
Hydropsyche	CF	4
Lepidostoma	SH	1
Limnephilidae	SH	4
Neothremma	SC	0
Ochrotrichia	CG	4
Oligophlebodes	SC	1
Onocosmoecus	SH	1
Orthotrichia	PR	6
Parapsyche	PR	1
Phyrganeidae	SH	NA
Polycentropus	PR	6
Psychoglypha spp.	CG	1
Rhyacophila spp.	PR	0
Rhyacophila (w/ gills)	PR	0
Rhyacophila (w/o gills)	PR	0
Trichoptera	unknown	NA
TAXA = 18		

Appendix 7 continued. Family, genus, species, functional group status and tolerance values of macroinvertebrates collected in Trout Creek, Boundary County, Idaho, June and October, 2001.

FAMILY/GENUS/SPECIES	FUNCTIONAL STATUS	TOLERANCE VALUE
Diptera (Aquatic Fly Larvae)		
Bezzia	CG	6
Ceratopogonidae	PR	6
Chironominae	CG	6
Chironomidae	CG	6
Chironomidae (pupa)	non-feeding	6
Diachlorus	PR	8
Diamesinae	CG	11
Dicranota	PR	3
Dolichopodidae	PR	NA
Empididae	PR	6
Forcipomyia	PR	6
Glutops	PR	3
Hemerodromia	PR	6
Hexatoma	PR	2
Oreogeton	PA	11
Orthocladius complex	CG	6
Prosimulium	CF	3
Simulium	CF	6
Tanypodinae	PR	6
Tabanidae	PR	8
Tipula	SH	4
Tipulidae	SH	3
Tipulidae (poss. genus Dicranota)	SH	3
TAXA = 20		
Non-insect Macroinvertebrates (Mollusks, Clams, worms, shrimp etc.)		
Cicadellidae (leafhopper-terrestrial insect)		NA
Gastropoda	SC	7
Hirudinea	PR	10
Nematoda	PA	5
Oligocheata	CG	5
Pelecypoda	CF	8
Planorbidae	SC	7
Sphaeridae	CF	8
Turbellaria	PR	4
TAXA = 8		

Appendix 8. Periphyton detected in samples collected from 6 sites along Trout Creek, Boundary County, Idaho, June and September 2001.

Taxon	TC1b	TC2	TC3	TC4	TC5	
	Jun	Jun	Sep	Jun	Jun	Sep
Cyanophyta (Blue-green algae)						
Anabaena wisconsinense	2					
Calothrix spp.					1	
Chaemaesiphon sp. (Entophysalis)			284			
Oscillatoria subrevis	8			14		
Phormidium tenue	75		2		2	3
Coccoid cyanophyta 3-6 um	1	31	575	5	1	14
Coccoid cyanophyta 6-10 um			2			8
***Chlorophyta** (Green algae)*						
Coccoid chlorophyta 3-6 um	2		15			
Coccoid chlorophyta 6-10 um	3		1	3		1
Chloroflagellate 3-10 um						1
Draparnaldia spp.	725					
Microspora spp.	3					
Mougeotia spp.	1	143	3			
Ulothrix spp.			466	3		
Euglenophyta (Flagellates)						
Euglena						4
Heteronema sp.						1
Chrysophyta (Flagellates)						
Coccoid Chrysophyta/Diatom Centric <10 um	15	3	3	8	8	8
Synura spaghnicola						68
Microflagellates 3-10 um	*1*					
Bacillariophyta *(Diatoms)*						
Achnanthes	6	86		*150*	*286*	*287*
Aulacosiera	2	2	1	7		9
Cocconeis	3					
Cymbella	1	3		2	11	29
Diatoma	30	31	56	7		1
Eunotia	2			13	3	5
Fragillaria		1		113	15	
Gomphonema	3	1		32	4	8
Hannaea	44	9	9	7	3	1
Melrosira	1		9			15
Meridion						4
Navicula	1	1	1			1
Navicula linearis						
Nitzschia	28	1	1	9	2	2
Pinnularia					1	2
Synedra	5	2	1	3		
Tabellaria		2				

Appendix 9. Phytoplankton detected in samples collected from 6 sites along Trout Creek, Boundary County, Idaho, September 2001. Samples were collected passively using a 68um plankton net placed in the channel thalweg.

Taxon	TC1b	TC1a	TC2	TC3	TC4	TC5
Cyanophyta (Blue green algae)						
Anabaena heterocyst-achenete		10				
Anabaena wisconsinense	14	19				
Oscillatoria amoena			24	110		
Chlorophyta (Green algae)						
Coccoid chlorophyta 3-6 um	4					
Coccoid chlorophyta 6-10 um						1
Closterium aciculare	1					
Clamydomonas spp.					1	
Chloroflagellate 3-10 um						1
Microspora spp.	172	349	39	10	67	8
Mougeotia spp.	118				16	
Spytogyra			15			
Stigeoclonium spp. (colony)	1		34			
Staurastrum alternans	1	16				
Euglenophyta (Flagellates)						
Euglena		2				4
Heteronema sp.						1
Coccoid picoplankton 2-3 um				1		
Chrysophyta (Flagellates)						
Coccoid Chrysophyta/Diatom Centric <10 um	1		1	3	3	4
Synura spaghnicola						68
Paraphysomonas sp.					1	
Microflagellates 3-10 um	5		2	2	6	
Bacillariophyta (Diatoms)						
Achnanthes suchlandtii				1		
Achnanthes lanceolata				1		
Achnanthes minutissima				9	1	42
Actinocyclus pfaffiana						2
Aulacosiera italica	21					
Cocconeis placentula				1		
Cymbella minuta						2
Cymbella cesatii						3
Diatoma mesodon			1	36		
Eunotia pectinalis						1
Fragillaria bacapitata		20				
Fragilaria capucina	15					
Fragilaria vaucherie	1			8	2	12
Frustulia vulgaris		1				
Gomphonema subclavatum	5	1	3	1		
Gomphonema parvulum						1
Hannea arcus				3		
Melrosira varians	22	99	73			53
Meridion						
Meridion circulare						3

Appendix 9 continued. Phytoplankton detected in samples collected from 6 sites along Trout Creek, Boundary County, Idaho, September 2001. Samples were collected passively using a 68um plankton net placed in the channel thalweg.

Navicula cryptocephala				5		
Navicula erfuga				1		
Nitzschia dissipata			1	4		1
Nitzschia gracilis	11					
Nitzschia linearis		1				
Nitzschia palea debilis	1					
Nitzschia peisonis						3
Surirella linearis var. constricta					1	2
Synedra ulna		3	6	10	2	5
Synedra rumpens						3
Tabellaria fenestrata	9					

Appendix 10. Water quality QA/QC check data for water samples collected during spring and fall bioassessments of Trout Creek, Boundary County, Idaho.

Parameter (mg/l)	Method detection limit	*July , 2001* Spike recovery (%)	QC check recovery (%)	Method Detection Limit	*October , 2001* Spike Recovery (%)	QC check recovery (%)
Nutrients						
Total phosphorous	0.0020	108.44	99.56	0.0020	108.21	104.78
Soluble reactive phosphorous	0.0010	101.65	100.21	0.0010	108.51	98.14
Ammonia	0.0050	105.13	104.81	0.0050	104.15	105.57
Nitrate+Nitrite	0.0100	95.16	94.99	0.0100	93.54	99.69
Total nitrogen	0.0500	102.33	101.46	0.0500	101.86	99.54
Metals						
Aluminum	0.0030	87.60	102.00	0.0030	107.60	109.60
Arsenic	0.0050	97.40	96.96	0.0050	98.40	97.20
Cadmium	0.0002	113.60	92.80	0.0002	91.20	97.20
Chromium	0.0020	95.60	101.60	0.0020	108.40	100.40
Cobalt	0.0200	104.00	100.30	0.0200	110.00	102.80
Copper	0.0010	90.16	88.92	0.0010	92.80	101.20
Iron	0.0100	104.10	98.78	0.0200	114.00	94.80
Lead	0.0010	108.80	94.80	0.0010	97.60	99.60
Manganese	0.0050	107.30	105.90	0.0050	112.60	101.00
Mercury	0.0001	106.00	104.80	0.0001	98.40	95.20
Nickel	0.0100	104.00	101.90	0.0100	111.70	102.30
Selenium	0.0030	95.92	91.20	0.0030	92.00	90.40
Zinc	0.0050	99.20	98.10	0.0050	112.25	102.70

Appendix 11. Trout Creek PFC Report