FISHERY MANAGEMENT INVESTIGATIONS

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PANHANDLE REGION
LITTLE NORTH FORK CLEARWATER RIVER
AND PRIEST RIVER
TRIBUTARY INVESTIGATIONS
2004

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LITTLE NORTH FORK CLEARWATER RIVER TRIBUTARY INVESTIGATIONS

ABSTRACT

Foehl, Larkins, Sawtooth, Canyon, and Buck creeks, tributaries of the Little North Fork Clearwater River, were surveyed during July 26-29, 2004 through snorkeling. We assessed the distribution of fishes and other fauna and defined habitat attributes that may influence their distribution. Two bull trout *Salvelinus confluentus*, 1,002 westslope cutthroat trout *Oncorhynchus clarkii lewisi*, 235 rainbow trout *O. mykiss*, 12 sculpin *Cottus sp*, and 38 tailed frog *Ascaphus truei* juveniles were counted from snorkeling 38 stream reaches covering 3,670 m in length and totaling 34,894 m^2 in area during this study. Complete fish barriers were identified in Sawtooth Creek (5,530 m upstream) and Larkins Creek (800 m upstream). One bull trout was observed in Foehl Creek and the other in Sawtooth Creek. The bull trout in Sawtooth Creek had a radio transmitter in it and was estimated to be about 500 mm in length, whereas the bull trout in Foehl Creek was estimated to be about 225 mm in length.

Cutthroat trout were observed in every stream reach we snorkeled except one and were the most abundant fish observed in every tributary. Cutthroat trout up to about 500 mm were observed in both lower Canyon and Foehl creeks. Rainbow trout were observed in every stream (31 of 38 reaches) we snorkeled, although only Canyon Creek supported densities >1.0 fish/100 m^2. Rainbow trout up to 400 mm were observed in Canyon Creek.

Correlations between densities of fishes and the analyzed habitat variables and principal component analysis indicate both cutthroat trout and rainbow trout select small, cold, high elevation streams. Cutthroat trout were also found to select for pools and against riffles whereas rainbow trout appeared to be indifferent to these variables. Density of cutthroat trout >300 mm were not significantly correlated to any habitat variables, but based on principal component analysis these larger fish were found more frequently in the larger streams, closer to the main river and where deeper water occurred. The larger rainbow trout (>255 mm) were similar to the larger cutthroat trout as they tended to be more abundant in the larger streams, closer to the main river, and where deeper water occurred.

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INTRODUCTION

Bull trout *Salvelinus confluentus* within the Klamath and Columbia River basins were listed as threatened in July 1998 under the Endangered Species Act. Considerable effort has been made to determine the distribution of bull trout and factors influencing their population strength since their listing (Batt 1996; Clearwater Basin Bull Trout Technical Advisory Team 1998). These efforts are instrumental in ensuring proper actions will be taken to recover bull trout.

Fish surveys and redd counts have documented bull trout in much of the Little North Fork Clearwater River basin (Watson and Hillman 1997; Fredericks et al. 2000; DuPont et al. In Press b); however, the distribution of bull trout was still unknown in many of its major tributaries (Clearwater Basin Bull Trout Technical Advisory Team 1998). These tributaries tend to be in remote locations and access is difficult. We cannot assume that these streams support bull trout despite their relatively pristine condition and close proximity to known bull trout populations. Bull trout distribution is often patchy, even in areas where populations are considered strong and habitat is in good condition (Rieman and McIntyre 1993, 1995). Often, overlooked habitat conditions determine whether bull trout will occur in a watershed (Rieman and McIntyre 1993; Watson and Hillman 1997; Colla and DuPont 2000).

During 2001, efforts were made by the Idaho Department of Fish and Game (IDFG) to assess the fishery in Butte, Canyon, Foehl, and Sawtooth creeks, remote tributaries of the Little North Fork Clearwater River, through electrofishing (DuPont et al. 2004). Difficult terrain restricted access into much of these tributaries as one had to carry the backpack electroshocker. In addition, poor electrofishing efficiency due to low conductivity and deep, swift water limited their ability to sample fish and was blamed for their inability to detect bull trout in these streams. Recommendations suggested that these tributaries be surveyed again utilizing a different technique such as snorkeling that could survey the low conductive swift waters and deep pools.

This study focused on reassessing the fishery in three of the previously sampled tributaries (Canyon, Sawtooth, and Foehl creeks) as well as Larkins and Buck creeks through snorkeling. We believed snorkeling would allow us to access more of these remote tributaries as well as allow us to assess the fishery in the deep, swift nonconductive waters that occurred in them.

OBJECTIVES

1. Determine the distribution and status of fishes and other fauna occurring in Buck, Canyon, Sawtooth, Larkins, and Foehl creeks, tributaries of the Little North Fork Clearwater River.

2. Assess the relationship between key habitat characteristics and the density of fishes and other fauna sampled in adequate numbers.

STUDY SITE

This study assessed the distribution and abundance of fishes in tributaries of the Little North Fork Clearwater River. The drainages selected for evaluation included Buck (4,000 hectares), Canyon (11,700 hectares), Sawtooth (7,200 hectares), Larkins (1,000 hectares), and Foehl (6,700 hectares) (Figure 1). Elevations range from 747 m at the mouth of Foehl Creek to 2,097 m at Crag Peak on the south side of the Sawtooth Creek watershed. Bedrock is mostly mica schist in the Foehl Creek watershed. The abundance of mica schist contributes to difficult soil conditions. These rocks tend to weather rapidly and deeply and form thick layers of silty and clayey soils. In addition, many of the mica flakes orient parallel to the slope creating slippery zones that greatly reduces the soil's stability. The Sawtooth, Canyon, and Larkins creeks watersheds are mostly belt series geology. The belt series geology is relatively stable and tends to break down into angular pieces that often resist erosion. These differences in geologies help explain why the Foehl Creek watershed experienced large mass failure events during the flood of 1996 whereas Sawtooth, Canyon, and Larkins creeks did not. These large mass failures caused debris torrents to wash down steep side slopes delivering large volumes of sediment and debris into and down Foehl Creek.

All the streams we surveyed occur in a canyon like environment with steep side slopes. Most display dendritic drainage patterns that erode and branch headward in somewhat random fashion, resulting in slopes with no predominate direction or orientation. Drainage densities and stream frequencies are fairly high, increasing towards the headwaters. The higher the drainage density, the closer the stream channels. This can result in a flashy system, as the headwater areas will tend to concentrate water faster due to shorter runoff distances, allowing less time and opportunity for evaporation and channel storage. Stream gradients typically are moderate to high (>3%), controlled by bedrock nickpoints and large woody debris. Steep gradients indicate naturally occurring high intensity or erosional processes operating on the slopes and in the channel.

Precipitation ranges from 140-165 cm annually, much occurring as snowfall accumulating through the winter months. The area does receive significant spring and fall rains, with the summers being relatively dry. However, high intensity, short duration summer rain events are common in the mountainous area. Elevations <1,300 m are prone to winter rain on snow events that can result in intense runoff coupled with mass failures. The average temperature ranges from 5.5-7.2°C below 1,500 m. Higher elevations can be much cooler.

The closest road to any of the streams we surveyed was about 1.5 air km away and one must hike a minimum of about 4 km of trail to get to any of these streams (Figure 1). All of these watersheds have had minimal land management occur on them in the past, and the land surrounding them is managed by the U.S. Forest Service (80%) or IDFG (20%).

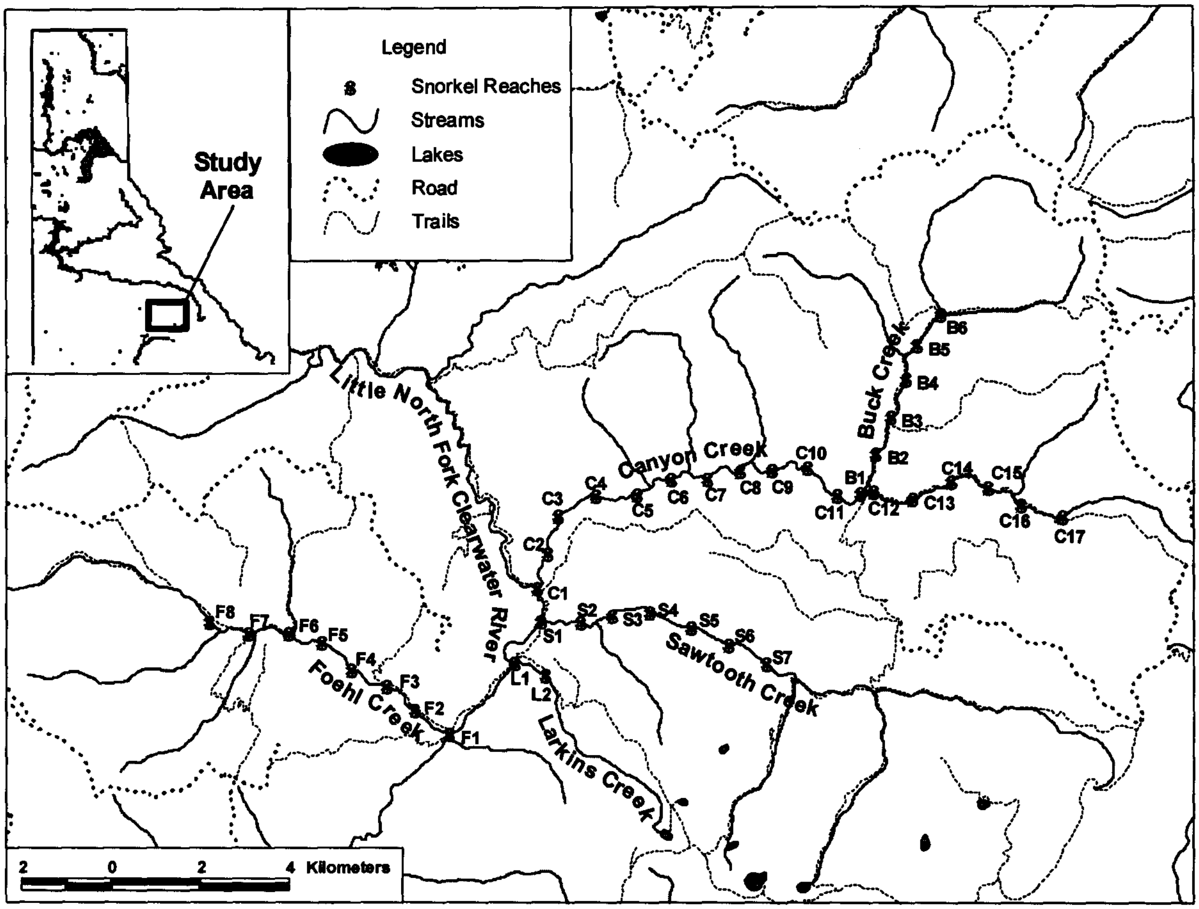

Figure 1. Stream reaches snorkeled during July 26-29, 2004 to evaluate the fisheries in Foehl, Larkins, Sawtooth, Canyon, and Buck creeks, tributaries of the Little North Fork Clearwater River, Idaho.

METHODS

Field Methods

To assess the fishery, fauna, and their habitat associations in Buck, Canyon, Sawtooth, Larkins, and Foehl creeks, 100 m stream reaches were snorkeled during daylight hours. The first snorkeling site occurred at the mouth of each stream, and each following site occurred 1 km upstream. Snorkeling continued until a complete fish barrier was encountered or until the stream became too small to snorkel effectively (Figure 1). In Foehl Creek, sampling ended after surveying eight sites (7 km upstream) due to time limitations. Reaches to be snorkeled were located using global positioning (GPS) units. When the GPS units could not communicate with enough satellites to document a location, USGS 1:24,000 maps were used to determine the location of sampling sites.

Two person teams were involved in surveying each sample site. At each site, one person snorkeled upstream attempting to count every fish and any other fauna encountered.

The other member measured the 100 m stream reach that would be snorkeled and collected habitat data. Estimates of fish abundance were limited to age 1+ salmonids (>75 mm), as summer counts for young of the year fishes are typically unreliable. Most YOY westslope cutthroat trout *Oncorhynchus clarkii lewisi* and rainbow trout *O. mykiss* will be smaller than 80 mm during surveys in July and occupy the shallow stream margins where snorkeling is less effective (Thurow 1994). All observed fish were recorded for each transect by species in 75 mm length groups. Prior to snorkeling each observer practiced on lengths of plastic pipes under water to ensure accurate estimates of fishes' lengths were made. Throughout the snorkel surveys, we periodically held these practice sessions to maintain our accuracy. Sculpin *Cottus sp* and other fauna were only counted during snorkel surveys.

The habitat variables measured at each site included wetted widths, stream gradient, stream temperature, maximum depth, large woody debris (LWD), and the percent of habitat represented by pool, run, riffle, and glide (Overton et al. 1997). Wetted widths were measured with a laser range finder, stream gradient was measured with a hand-held clinometer, and maximum depth was measured using a calibrated wading staff. Stream temperature was recorded with a hand-held thermometer at each site during the time of sampling. Two sizes of LWD were counted (>1 m in length and >10 cm in diameter and >1 m in length and >30 cm in diameter). Only that portion of the wood that occurred inside the wetted width was counted and evaluated for size. The two size classifications of LWD were determined by visual estimation.

Statistical Methods

The total number and the number of cutthroat trout >300 mm were summarized for each transect and stream reach we snorkeled. We used a 300 mm cutoff in our summary of cutthroat trout because we believed this is the size of fish that many fisherman desire to catch and also because this size class has been summarized in other snorkel surveys. Only five rainbow trout >300 mm in length were observed during our surveys so we chose to summarize rainbow trout by a smaller size class (>225 mm) than we did with cutthroat trout. This allowed us to do more statistical evaluations on the larger sizes of rainbow trout we observed. Densities were calculated for total numbers and the larger size category of cutthroat trout (>300 mm) and rainbow trout (>225 mm) we observed in each snorkel transect. This was accomplished by dividing the number of fish by the total surface area we snorkeled (average stream width times the stream length snorkel) at each transect.

The density estimates for the cutthroat trout and rainbow trout observed at each reach we surveyed were compared to their associated habitat conditions to evaluate which variables may be influencing their distribution. Comparisons between the measured habitat variables and the density of each species were evaluated using a linear regression analysis and by calculating the correlation coefficient between the variables (r). To determine if a significant relationship ($p < 0.10$) occurred between the sampled species densities and individual habitat variables, an analysis of variance was conducted on the regression. No correlations were calculated for sculpin or tailed frog *Ascaphus truei* tadpoles as snorkeling is ineffective at detecting fish or fauna that utilize the interstitial spaces in substrate.

Principal component analysis was utilized to depict the habitat conditions of the stream reaches snorkeled as well as the habitat use of the cutthroat trout and rainbow trout observed while snorkeling (Johnson and Wichern 1992). Two principal component scores (Factor 1 – x-axis and Factor 2 – y-axis) were calculated for each reach snorkeled based on maximum depth, stream width, gradient, large woody debris, elevation, distance from the Little North Fork

Clearwater River, and habitat composition (percent pool, riffle and run). We utilized a correlation matrix and a varimax rotation for this analysis. To depict habitat use of cutthroat trout and rainbow trout, we graphed the factor scores for only those reaches where cutthroat trout and rainbow trout of a particular size and/or density occurred.

RESULTS

Distribution and Abundance of Fishes and Tailed Frogs

Two bull trout, 1,002 cutthroat trout, 235 rainbow trout, 12 sculpin, and 38 tailed frog juveniles were counted from snorkeling 38 stream reaches covering 3,670 m in length and totaling 34,894 m^2 in area during this study (Table 1). Complete fish barriers were identified in Sawtooth and Larkins creeks and were located just upstream of where the last reach was snorkeled (Figure 1). One bull trout was observed in Foehl Creek and the other in Sawtooth Creek. The bull trout in Sawtooth Creek had a radio transmitter in it (tagged in Dworshak Reservoir by IDFG) and was estimated to be about 500 mm in length whereas the bull trout in Foehl Creek was estimated to be about 225 mm in length.

Cutthroat trout were observed in every stream reach we snorkeled except one reach in Foehl Creek. Average densities of cutthroat trout exceeded 4 fish/100 m^2 in every stream except Foehl Creek and lower Canyon Creek where their average densities were <1.5 fish/100 m^2 (Figure 2). Most (95%) of the cutthroat trout observed were <225 mm (Figure 3). Canyon and Foehl creeks were the only streams where cutthroat trout >300 mm were observed (Table 1 and Figure 3). Cutthroat trout estimated around 500 mm were observed in both lower Canyon and Foehl creeks (Figure 3). Casual snorkeling of deeper pools (>1.5 m) in Foehl Creek and lower Canyon Creek revealed they typically supported three or more cutthroat trout >375 mm in length.

Table 1. Fishes and fauna counted during snorkel surveys from July 26-29, 2004 on Foehl, Larkins, Sawtooth, Canyon and Buck creeks, tributaries of the Little North Fork Clearwater River.

Stream	Reach	Area (m^2)	Cutthroat trout counted		Rainbow trout counted		Bull trout counted	Sculpin counted	Tailed frogs counted
			Total	>300 mm	Total	>225 mm			
Buck Creek	B1	1,100	18	0	0	0	0	2	0
	B2	1,025	14	0	1	0	0	0	0
	B3	860	66	0	1	0	0	0	0
	B4	940	34	0	0	0	0	1	0
	B5	680	57	0	1	0	0	1	0
	B6	255	32	0	1	0	0		0
Total	6	4,860	221	0	4	0	0	4	0
lower Canyon Creek[a]	C1	1,150	10	0	9	2	0	3	0
	C2	1,300	1	0	14	2	0	0	1
	C3	1,125	5	2	20	7	0	0	0
	C6	1,100	18	2	14	1	0	0	0
	C7	1,060	7	1	11	3	0	0	4
	C8	1,160	30	1	7	0	0	2	0
	C9	1,060	22	0	8	0	0	0	0
Total	7	7,955	93	6	83	15	0	5	5
upper Canyon Creek	C10	900	40	1	10	0	0	1	14
	C11	960	30	0	11	0	0	0	10
	C12	800	21	0	0	0	0	0	0
	C13	825	14	0	1	0	0	0	0
	C14	440	33	1	2	0	0	0	0
	C15	400	42	1	10	0	0	0	0
	C16	350	22	0	5	0	0	0	0
	C17	300	2	0	13	2	0	0	0
Total	8	4,975	204	3	52	2	0	1	24
Foehl Creek	F1	1,360	1	0	3	0	0	0	0
	F2	1,000	0	0	14	3	0	0	0
	F3	1,220	9	2	7	0	1	0	1
	F4	1,060	23	5	8	1	0	0	0
	F5	1,260	25	2	3	0	0	0	4
	F6	980	17	0	0	0	0	0	3
	F7	624	11	0	0	0	0	0	0
	F8	270	8	0	0	0	0	0	0
Total	8	7,774	94	9	35	4	1	0	8
Sawtooth Creek	S1	1,260	14	0	11	0	1	1	0
	S2	1,320	26	0	9	0	0	1	1
	S3	1,200	6	0	1	0	0	0	0
	S4	1,040	49	0	9	3	0	0	0
	S5	1,360	76	0	1	1	0	0	0
	S6	1,300	64	0	6	2	0	0	0
	S7	1,000	112	0	22	0	0	0	0
Total	7	8,480	347	0	59	6	1	0	1
Larkins Creek	L1	425	18	0	2	0	0	0	0
	L2	425	25	0	0	0	0	0	0
Total	2	850	43	0	2	0	0	0	0
Grand total	38	34,894	1,002	18	235	27	2	12	38

[a] Sites C4 and C5 were not included in this dataset, as an inexperienced snorkeler was believed to have missed many fish based on paired comparisons with an experienced counter later on.

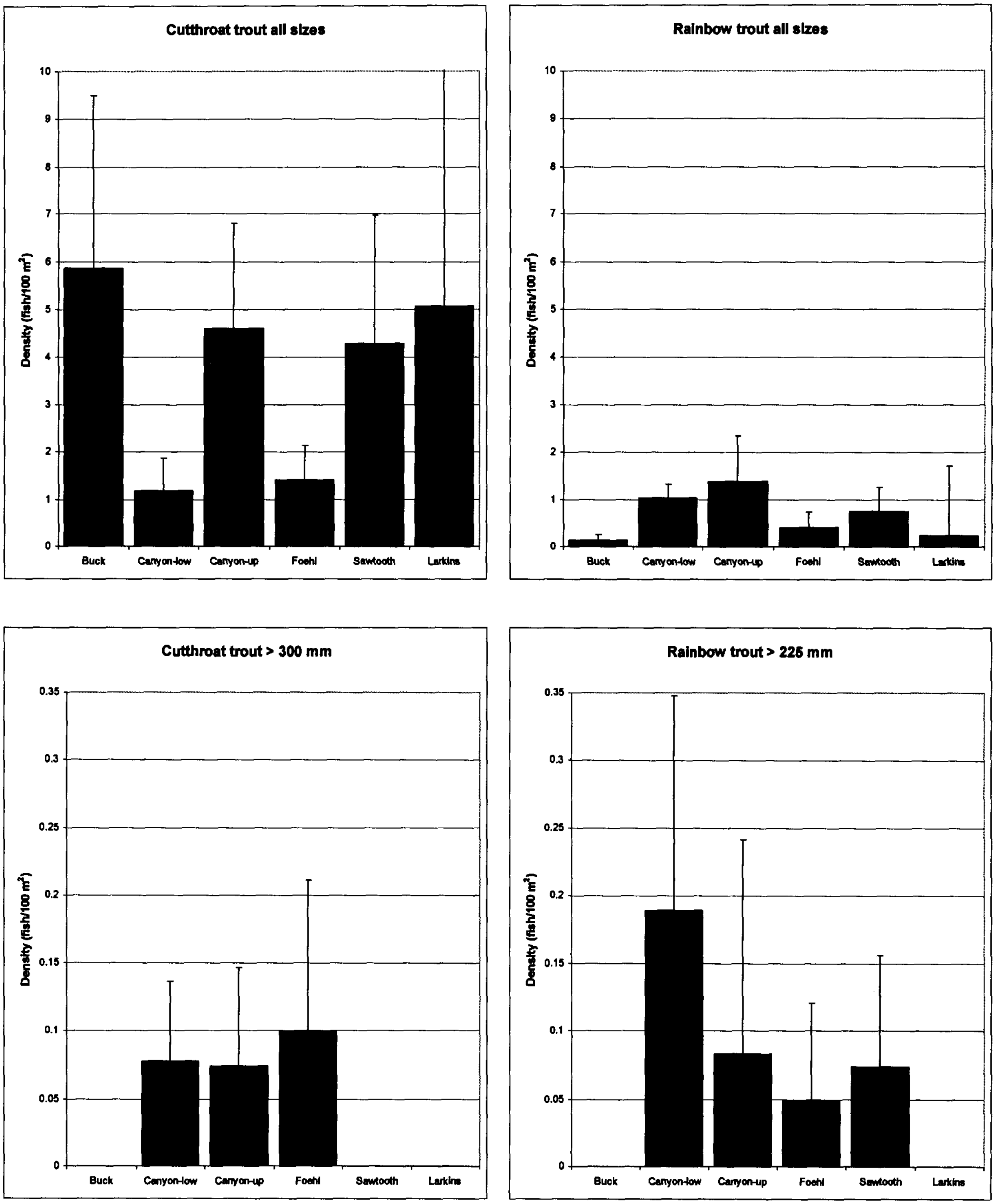

Figure 2. Average density of cutthroat trout and rainbow trout observed through snorkel surveys during July 26-29, 2004 in Buck, lower and upper Canyon, Foehl, Sawtooth, and Larkins creeks, tributaries of the Little North Fork Clearwater River, Idaho. Vertical lines indicate 90% confidence intervals.

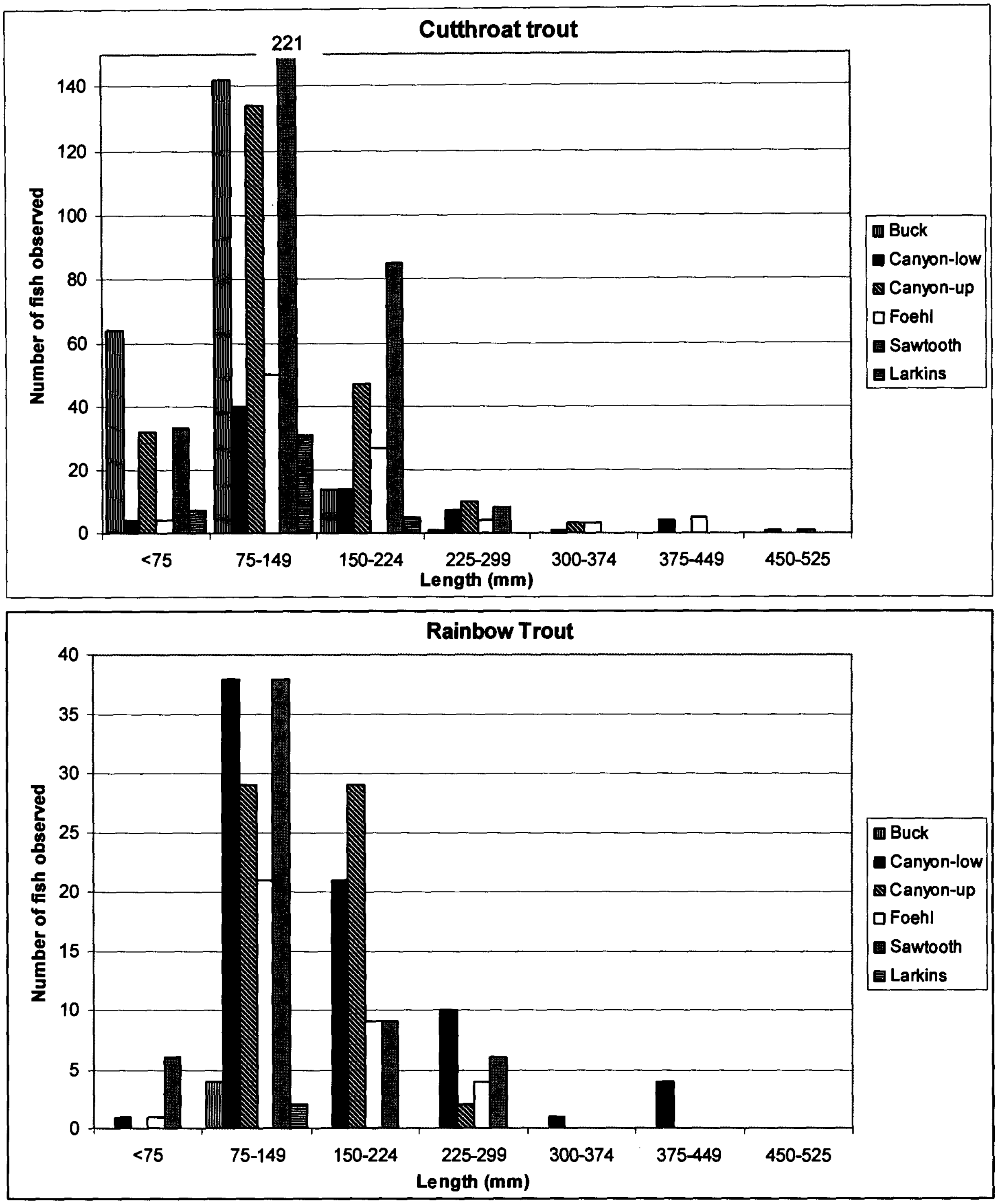

Figure 3. Length frequency histogram of cutthroat trout and rainbow trout sampled during July 26-29, 2004 from Buck, lower and upper Canyon, Foehl, Sawtooth, and Larkins creeks, tributaries of the Little North Fork Clearwater River, Idaho.

Rainbow trout were observed in every stream (31 of 38 reaches) snorkeled although only Canyon Creek supported densities >1.0 fish/100 m^2 (Table 1 and Figure 2). Five rainbow trout >300 mm were observed in all the reaches snorkeled, all of which occurred in lower Canyon Creek (Figure 3). The largest of these rainbow trout was estimated to be about 440 mm. Larkins and Buck creeks were the only streams where rainbow trout >225 mm were not observed (Table 1 and Figure 3). Through casual snorkeling of deeper pools (>2 m deep) in lower Canyon Creek, rainbow trout estimated around 500 mm were observed.

Sculpin and tailed frog tadpoles, which frequently live in the interstitial spaces of substrate, were not commonly observed while snorkeling (Table 1). No Idaho giant salamander *Dicamptodon aterrimus* were observed in any of the stream reaches snorkeled although some were observed while hiking along the streams.

Fish Habitat Associations

Ten variables were evaluated that may directly or indirectly influence the distribution of cutthroat trout and rainbow trout in the streams that we surveyed (Table 2). Because few bull trout, sculpin, and tailed frogs were observed, no evaluation between their densities and associated habitat were made.

Correlations between cutthroat trout densities and the analyzed habitat variables and principal component analysis indicate cutthroat trout select small, cold, high elevation streams (Table 3 and Figures 4-5). A positive significant relationship also occurred between cutthroat trout densities and their distance from the Little North Fork Clearwater River. All of these variables are highly correlated to each other making it difficult to determine which variables are responsible for controlling their distribution. Density of cutthroat trout >300 mm were not significantly correlated to any habitat variables but based on principal component analysis these larger fish were found more frequently in the larger streams, closer to the main river, and where deeper water occurred. The highest r-value (0.25) also suggests densities of larger cutthroat trout increase with depth.

Correlations between rainbow trout densities and the analyzed habitat variables and principal component analysis indicate they were more abundant in the steeper smaller streams that tend to occur at the higher elevations. The larger rainbow trout (>255 mm) were similar to the larger cutthroat trout as they tended to be more abundant in the larger streams, closer to the main river, and where deeper water occurred. Again, all of these variables are highly correlated to each other making it difficult to determine which variables are responsible for controlling cutthroat trout distribution.

Table 2. Habitat characteristics measured during July 26-29, 2004 from Buck, lower and upper Canyon, Foehl, Sawtooth, and Larkins creeks, tributaries of the Little North Fork Clearwater River (LNF).

Stream	Reach	Elevation (m)	Temp (°C)	Distance(m) from LNF	Habitat Composition Pool	Run	Riffle	Stream grade (%)	Max depth (m)	LWD count	Stream width (m)
Buck Creek	B1	3,415	11.0	10,606	25	0	75	2	0.5	7	11.00
	B2	3,475	11.5	11,606	20	10	70	2	0.8	5	10.25
	B3	3,535	12.0	12,606	0	30	70	2	0.8	25	8.60
	B4	3,590	12.0	13,606	20	20	60	2	1.0	29	9.40
	B5	3,655	10.0	14,606	8	7	85	1.5	1.2	22	6.80
	B6	3,740	10.0	15,356	20	20	60	3	0.7	4	4.25
Canyon Creek	C1	2,580	18.0	0	20	10	70	3	1.6	10	11.50
	C2	2,635	18.0	1,000	10	10	80	2	0.9	33	13.00
	C3	2,705	17.0	2,000	20	0	80	2	3.0	0	11.25
	C6	3,005	11.0	5,000	20	20	60	3	1.4	1	11.00
	C7	3,080	11.0	6,000	20	10	70	3	1.3	2	10.60
	C8	3,150	12.0	7,000	10	20	70	2	1.1	8	11.60
	C9	3,220	14.0	8,000	0	10	90	3	0.6	7	10.60
	C10	3,280	14.5	9,000	33	34	33	2	1.2	26	9.00
	C11	3,370	15.0	10,000	5	20	75	3	0.9	2	9.60
	C12	3,450	11.0	11,000	20	20	60	2	0.8	7	8.00
	C13	3,570	11.0	12,000	10	0	90	2	0.8	12	8.25
	C14	3,740	11.5	13,000	5	10	85	5	0.6	9	4.40
	C15	3,860	10.0	14,000	0	15	85	5	1.1	6	4.00
	C16	4,030	8.5	15,000	5	10	85	4	0.6	4	3.50
	C17	4,240	8.0	16,000	10	0	90	7	0.7	5	3.00
Foehl Creek	F1	2,460	12.0	0	0	20	80	3	0.7	4	13.60
	F2	2,550	13.0	1,000	0	15	85	3	0.9	1	10.00
	F3	2,670	13.0	2,000	0	15	85	3	0.9	1	12.20
	F4	2,765	14.0	3,000	10	5	85	3	1.5	10	10.60
	F5	2,870	15.0	4,000	15	0	85	3	1.0	4	12.60
	F6	3,000	14.5	5,000	30	30	40	5	0.9	19	9.80
	F7	3,145	15.0	6,000	10	0	90	5	0.7	9	7.80
	F8	3,320	14.0	7,000	5	0	95	7	1.0	2	9.00
Sawtooth Creek	S1	2,570	18.0	0	15	5	80	3	1.6	3	12.60
	S2	2,675	17.0	1,000	0	10	90	3	0.7	2	13.20
	S3	2,765	13.0	2,000	8	2	90	3	1.3	2	12.00
	S4	2,910	14.0	3,000	30	0	70	7	1.9	5	10.40
	S5	3,040	15.0	4,000	10	10	80	3.5	1.4	4	13.60
	S6	3,155	15.0	5,000	5	5	90	3.5	1.3	0	13.00
	S7	3,255	16.0	5,530	50	10	40	5	2.5	2	10.00
Larkins Creek	L1	2,515	12.0	0	40	0	60	4	0.5	10	4.25
	L2	2,960	12.0	800	50	0	50	7	1.5	15	4.25

Table 3. Correlations (r) between densities (number/100 m^2) of cutthroat trout and rainbow trout and the habitat variables collected during July 26-29, 2004 from Foehl, Larkins, Sawtooth, Canyon, and Buck creeks, tributaries of the Little North Fork Clearwater River, Idaho. Correlations shaded gray show where significant relationships occur ($p < 0.10$).

Habitat variable	Cutthroat trout total	Cutthroat trout >300 mm	Rainbow trout total	Rainbow trout >225 mm
Elevation	0.53	-0.07	0.26	-0.03
Temperature	-0.30	-0.04	-0.13	0.04
Distance from River	0.49	-0.04	0.16	-0.09
% Pool	0.20	-0.13	-0.02	0.00
% Riffle	-0.28	0.10	0.05	0.18
Gradient (%)	0.20	-0.05	0.30	0.19
Depth (m)	0.01	0.25	0.26	0.51
all LWD	0.11	-0.09	-0.22	-0.20
Stream width	-0.53	-0.01	-0.29	-0.02

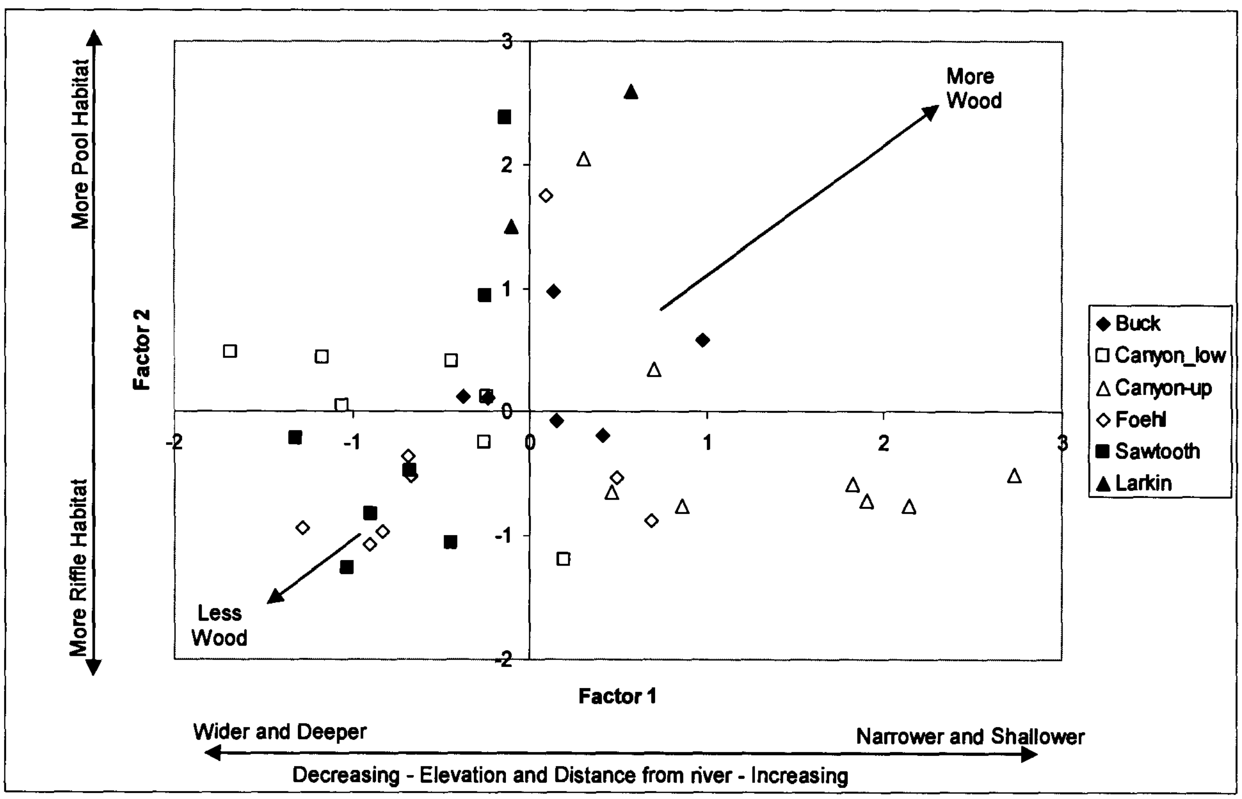

Figure 4. Principal component analysis depicting habitat conditions in the 38 stream reaches surveyed during July 26-29, 2004 in Foehl, Larkins, Sawtooth, Canyon, and Buck creeks, tributaries of the Little North Fork Clearwater River, Idaho.

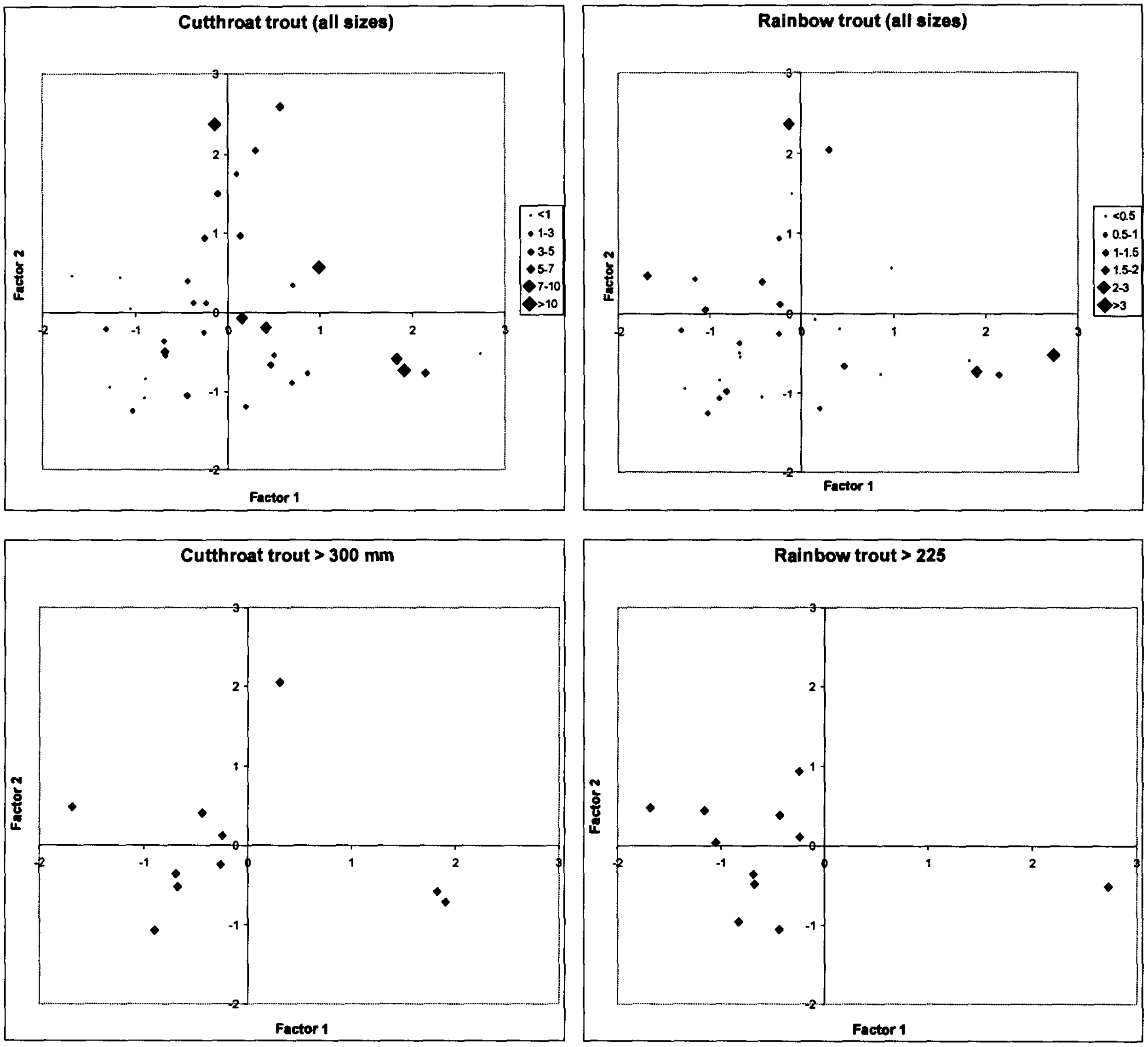

Figure 5. Principal component analysis depicting the habitat conditions of stream reaches where cutthroat trout and rainbow trout were observed through snorkel surveys during July 26-29, 2004 in Foehl, Larkins, Sawtooth, Canyon, and Buck creeks, tributaries of the Little North Fork Clearwater River, Idaho. Refer to Figure 4 for habitat conditions each factor represents. For the cutthroat trout (all sizes) and rainbow trout (all sizes), the legend refers to the density (fish/100 m^2) of fish observed at each reach.

DISCUSSION

Abundance and Distribution of Fishes and Fauna

Bull Trout

We observed two bull trout after snorkeling 38 different reaches in five different streams covering 34,894 m^2 of water suggesting that low and/or patchy densities of bull trout occur in these watersheds or none at all. Previous surveys in tributaries of the Little North Fork Clearwater River also found very low and patchy bull trout abundance (Fredericks et al. 2000; DuPont et al. 2004). Others have also found bull trout distribution to be patchy (Pratt 1985; Rieman and McIntyre 1995; Colla and DuPont 2000).

It is important to consider that not observing bull trout through snorkel surveys does not necessarily mean they do not exist in a particular reach of stream. Juvenile bull trout regularly use the interstitial spaces of substrate or woody debris for cover, which makes them difficult to locate during snorkel surveys (Pratt 1984; Shepard et al. 1984; Jakober et al. 2000; Thurow et al. In Review). Thurow et al. (In Review) found that during day snorkeling they were only able to observed 12.6% of the age 1 and older bull that were present in small streams with fish <200 mm being observed even less frequently. Others have reported much higher observability of bull trout through snorkeling with efficiencies exceeding 70% (Shepard and Graham 1983; Thurow and Schill 1996), although in both these examples it is believed they underestimated the true population abundance (Thurow et al. In Review). If bull trout populations occurred in the streams we snorkeled they likely have an adfluvial/fluvial life cycles based on telemetry work conducted by Schiff et al. (2005). Typically what we see for adfluvial/fluvial bull trout in the Little North Fork Clearwater watershed is that they rear 1-4 years before migrating downstream to larger water. This means most of these fish migrate from the tributaries before they reach 200 mm (Schiff et al. 2005). Consequently, the size of fish we were trying to identify during our snorkel surveys were the most difficult to locate. Combine that with the low densities that are believed to occur in this area and it is possible that these streams do have spawning and rearing bull trout populations.

By snorkeling 48 reaches in the main Little North Fork Clearwater River during 2002, observers were able to located 28 bull trout >300 mm in length out of an estimated population of 140 fish (DuPont et al. In Press a). These results suggest that day snorkel surveys can be effective at locating adult bull trout, whereas locating juvenile bull trout appears to be much more difficult as their use of interstitial spaces and other debris for cover makes them difficult to detect. Others have found similar findings where the ability to locate fish during snorkel surveys increases with their size (Hillman et al. 1992; Thurow et al. In Review). These findings suggest that snorkeling might not be the best technique to locate or quantify bull trout populations when low densities of juveniles are involved. However, Bonneau et al. (1995) found that snorkeling was more effective than electrofishing in low conductivity streams such as occurs in areas of the Little North Fork Clearwater River watershed and work conducted in 2001 (DuPont et al. 2004) found electrofishing ineffective in sampling these streams. These complexities add to the difficulty in locating juvenile rearing bull trout populations in the Little North Fork Clearwater River watershed. To overcome these difficulties, more intense surveys are required to say with certainty that bull trout are or are not present.

One of the bull trout we observed during this survey was in Foehl Creek. No bull trout were observed in Foehl Creek during electrofishing efforts in 2001 (DuPont et al. 2004). The size of bull trout observed was about 225 mm in length. This is about the size when bull trout migrate from juvenile rearing habitat to where they spend their adult life and wandering is quite common (Schiff et al. 2005). This bull trout was located about 2,000 m upstream from the mouth, a distance not difficult for this size of bull trout to negotiate. Consequently, the presence of this bull trout does not indicate with certainty that a spawning and rearing bull trout population occurs in Foehl Creek. However, we encountered no barrier that would restrict adult bull trout from reaching cool, high elevation streams in which to spawn. In addition, we did not snorkel any of the larger tributaries that are similar in size to tributaries in upper Little North Fork Clearwater River where bull trout are known to spawn (DuPont et al. In Press b). Most of these tributaries have a much higher gradient than other known bull trout spawning areas in the Little North Fork. The most likely bull trout spawning and rearing area would be in the upper 3 km of main Foehl Creek based on its gradient and elevation. We did not have enough time to make it to this section of Foehl Creek, so we do not know if there are any barriers that would prevent bull trout from reaching this area. Future surveys are needed to determine if a spawning and rearing bull trout population does occur in Foehl Creek. In four years of telemetry work conducted by Schiff et al. (In Prep), they tagged and tracked 138 different radio tagged bull trout that ascended the Little North Fork Clearwater River. Three of these fish (one in 2003 and two in 2004) migrated about 4 km up Foehl Creek (<900 m in elevation) and remained there through August. No follow-up surveys occurred to determine if they spawned or not, but it was believed these fish were ripe adults. Most known bull trout spawning sites in the Little North Fork Clearwater River occur at elevations >1,150 m (DuPont et al. In Press b), and consequently, we are unsure if these bull trout spawned at these locations, made quick migrations upstream to spawn, or moved into this section of stream to avoid warmer water temperatures that occurred in the main river.

The other bull trout we located was in Sawtooth Creek. This fish was located near the mouth of the stream, was estimated to be 500 mm in length, and had a radio transmitter in it. This fish was radio tagged in Dworshak Reservoir by the IDFG. A complete barrier (2.5 m falls) was identified on Sawtooth Creek about 5,530 m upstream from its mouth and at 992 m in elevation. This barrier blocks access to the higher elevation sections of this stream where lower gradients occur—areas we believe would provide good bull trout spawning habitat. Downstream of this barrier, temperatures (17°C) exceed those preferred by juvenile bull trout, spawning gravel is limited, and side tributaries are too steep and small to support bull trout. Temperatures over 15°C are often avoided by bull trout (Fraley and Shepard 1989; Rieman and McIntyre 1995; Saffel 1994). For these reasons, we believe it is unlikely that Sawtooth Creek supports a spawning and rearing bull trout population. The one bull trout we did observe in Sawtooth Creek was located within 100 m of the mouth and likely wandered there. This bull trout had a transmitter in it and based on tracking efforts it never migrated up Sawtooth Creek more than 100 m, suggesting it did not spawn in this stream (Schiff et al. In Prep). This was also the first radio tagged bull trout in the four years of telemetry work that entered Sawtooth Creek (Schiff et al. In Prep). These radio tagged bull trout have ascended every known spawning and rearing bull trout stream in the Little North Fork Clearwater River.

No bull trout were observed during our snorkel surveys in Canyon or Buck creeks. Interestingly, Canyon Creek was the only stream where bull trout were captured and observed during the 2001 survey (DuPont et al. 2004). In addition, telemetry work by Schiff et al. (2005) has shown that adult bull trout regularly ascend Canyon Creek and remain near Buck Creek through September, and bull trout redd surveys during 2003 found five bull trout redds in Buck Creek (DuPont et al. In Press b). These findings indicate that a spawning and rearing bull trout population does occur in Canyon and Buck creeks. However, our inability to locate a single bull trout in Canyon and Buck creeks after snorkeling 21 reaches that covered 17,790 m^2 of water suggests that bull trout densities must be low and their distribution patchy in these streams.

No bull trout were observed in Larkins Creek and a barrier (long steep cascade) was located about 800 m upstream from the mouth. We snorkeled 200 m of the 800 m of this stream that was available to migratory bull trout. Based on the large percentage of available stream we snorkeled (25%) without seeing a bull trout, the stream's low elevation, and potential for warmer water temperatures, we believe that a spawning and rearing bull trout population is unlikely in Larkins Creek.

Cutthroat Trout

Cutthroat trout were the most commonly observed fish in all of the streams we snorkeled and were located in every reach we snorkeled except one. Sizes of the cutthroat trout observed during our survey ranged from fry to large adults >450 mm in length. The large size of some of these cutthroat trout indicates that at least a portion of these cutthroat trout populations have a fluvial/adfluvial life cycle. It is unlikely that these larger cutthroat trout spend the winter in these streams as telemetry work conducted in the St. Joe River (Fredericks et al. 2002) and Coeur d'Alene River (DuPont et al. In Press c) found that during winter larger (>300 mm) cutthroat trout migrate downstream to where wide floodplains and slow velocity waters occur. This research suggests that the larger cutthroat trout we observed in the tributaries probably migrate downstream to Dworshak Reservoir to overwinter.

Our snorkel efforts in these tributaries occurred during the end of July, the time when we often see the warmest water temperatures in rivers and streams. It is possible that the larger fish we observed in Canyon and Foehl creeks moved there to avoid warmer water temperatures that occurred in the main river. Telemetry work in the Coeur d'Alene River found that some adult cutthroat trout did move from the main river into larger tributaries (similar in size to Sawtooth and Foehl creeks) during warmer times of the year (DuPont et al. In Press c). This telemetry work found that these tributaries were cooler than the main river especially at night and early morning. We did not measure water temperature in the Little North Fork Clearwater River, but based on discussions with anglers, fish were regularly caught throughout the day. This active behavior suggests water temperatures in the main river were not stressful to cutthroat trout and the presence of larger cutthroat trout in Foehl and Canyon creeks is most likely because they provide adequate food, habitat, and temperatures.

Densities of all sizes of cutthroat trout observed during our snorkel surveys were for the most part higher than what was observed in the Little North Fork Clearwater, St. Joe, and North Fork Coeur d'Alene rivers (Table 4). This is not surprising, as fluvial cutthroat trout are known to rear in smaller streams for one to four years before migrating to rivers or larger streams to spend their adult life (Pratt 1984; Shepard et al. 1984). In fact, the smallest streams we snorkeled (Buck, Larkins, and upper Canyon) had the highest densities of smaller cutthroat trout (<300 mm).

When we evaluated distribution of cutthroat trout >300 mm in length, we found that they were only observed in Foehl and Canyon creeks. No cutthroat trout >300 mm were observed in Sawtooth Creek, although it was the second largest stream we surveyed. We are unsure why larger cutthroat trout did not occur in Sawtooth Creek, although it may have been related to its vertical canyon walls that limit sunlight and productivity and potentially the necessary feed needed to support these larger fish. Densities of larger cutthroat trout were about five times lower in Foehl and Canyon creeks than we observed in the Little North Fork Clearwater, St. Joe, and North Fork Coeur d'Alene rivers (Table 4). However, about 67% of the habitat selected for snorkeling in the three rivers occurred in pools, whereas snorkeling occurred at random 100 m reaches in Foehl and Canyon creeks and only about 15% of the habitat we snorkeled were pools (4.5 times less pool habitat the rivers). This leads us to believe that densities of larger cutthroat trout (>300 mm) in Foehl and Canyon creeks were probably similar to what occurs in these three rivers. Through casual snorkeling of deeper pools (>1.5 m deep) in Canyon and Foehl creeks, we typically observed three or more cutthroat trout >375 mm with a few fish estimated to be around 500 mm in length. We believe fishing pressure is minimal in both these tributaries as access is difficult (limited or no trail access), no signs of human use were observed, and people just are not aware of the fishing potential of these streams. During our fieldwork, we observed eight different people fishing the Little North Fork Clearwater River and none on any of the tributaries. This work indicates that both Foehl and Canyon creeks could provide exceptional fishing opportunities as they both have large cutthroat trout and limited fishing pressure.

Table 4. Average density (fish/100 m^2) of cutthroat trout and rainbow trout observed while snorkeling Buck, Canyon, Foehl, Sawtooth, and Larkins creeks; Little North Fork Clearwater River (LNF CWR); St. Joe River; and North Fork Coeur d'Alene River (CDA River), Idaho during 2004.

Species	Buck	Lower Canyon	Upper Canyon	Foehl	Sawtooth	Larkins	LNF CWR[b]	St. Joe River[a]	CDA River[a]
Cutthroat	5.87	1.19	4.61	1.43	4.29	5.06	1.75	1.29	0.58
Cutthroat >300	0.00	0.08	0.07	0.10	0.00	0.00	0.46	0.52	0.15
Rainbow	0.13	1.04	1.39	0.40	0.75	0.24	0.81	0.00	0.25
Rainbow >225	0.00	0.19	0.08	0.05	0.07	0.00	0.18	0.00	0.10

[a] The St. Joe River and Coeur d'Alene River data was collected by DuPont et al. (In Press c).
[b] The Little North Fork Clearwater River was snorkeled during 2002 (DuPont et al. In Press a).

Cutthroat trout densities observed during our 2004 snorkel surveys were at least 3.5 times higher in all of the stream reaches that we also electrofished during 2001 (Table 5). This was especially true for the larger cutthroat trout as none >300 mm were sampled during 2001. In Foehl Creek, no cutthroat trout at all were surveyed in 2001 whereas in 2004 the highest density of large (>300 mm) cutthroat trout was observed there. Some of these differences could be explained by the ineffectiveness of electrofishing in swift, deep low conductive waters that occur in these streams. Electrofishing efficiency has been found to be inversely related to increasing flows (Reynolds 1996) and ineffective where low conductivities (<100 µS/cm), deep pools, and fast water occur (Fraley et al. 1982; Bonneau et al. 1995). Other reasons for the lower densities in 2001 could be attributed to the large flood events that occurred during 1996 and 1997. In both the Coeur d'Alene River and St. Joe River, we observed large declines in densities of cutthroat trout after these floods and it was not until 2004 that densities returned back to where they were preflood (DuPont et al. In Press c). In fact, the total absence of cutthroat trout observed in Foehl Creek during 2001 was believed to be the result of debris torrents that swept down the main channel during the 1996/1997 flood events (DuPont et al. 2004). These debris torrents left the stream with an abundance of loose cobble, few pools, little streamside vegetation and woody debris scattered throughout the floodplain. Since 2001, it appears that this stream had begun to recover as riparian vegetation was beginning to grow back and pools were starting to form around the woody debris. The worst conditions occur in the lower 1.5 km of Foehl Creek where the lowest densities of cutthroat trout were observed. The presence of large fluvial/adfluvial cutthroat trout in Foehl Creek helps explain how cutthroat trout could quickly recolonize this reach of stream. For example, stream reaches where bull trout were eradicated by intense fires in the Boise River basin were found to be repopulated several years later (Burton 2000). Large bull trout were observed in these streams following the fires, suggesting that repopulation was facilitated by migratory fish.

Table 5. The average densities (fish/100 m^2) of cutthroat trout and rainbow trout observed/sampled from lower Canyon, Foehl, and Sawtooth creeks, tributaries of the Little North Fork Clearwater River, Idaho during 2004 and 2001. Densities were determined through snorkeling during 2004 and through electrofishing during 2001.

	Lower Canyon Creek		Foehl Creek		Sawtooth Creek	
Species	**2004**	**2001**	**2004**	**2001**	**2004**	**2001**
Cutthroat	1.19	0.11	1.43	0.00	4.29	1.38
Cutthroat >300	0.08	0.00	0.10	0.00	0.00	0.00
Rainbow	1.04	1.00	0.40	1.00	0.75	0.45
Rainbow >225	0.19	0.06	0.05	0.00	0.07	0.00

Rainbow Trout

Rainbow trout were observed in every tributary we surveyed. It is believed these are native rainbow trout that are remnants from steelhead that once utilized the Little North Fork Clearwater watershed before the completion of Dworshak Dam in 1974, even though considerable stocking of rainbow trout has occurred into the North Fork Clearwater River watershed (Weigel et al. 2002). The highest densities of rainbow trout were observed in Canyon Creek and Sawtooth Creek—the largest two streams we surveyed. In Canyon Creek, these high densities of rainbow trout were observed from the mouth to the headwaters. Rainbow trout in Sawtooth Creek were also observed all the way to the barrier 5,530 m upstream from the mouth. In Foehl Creek, the most downstream reaches (1-4) supported high numbers of rainbow trout but were not observed once we moved upstream of reach 5 (4 km from the mouth).

Densities of rainbow trout in Canyon and Sawtooth creeks exceed what was observed in the St. Joe and North Fork Coeur d'Alene rivers during 2004, where rainbow trout were introduced through stocking programs (Table 4). Densities of rainbow trout in Canyon and Sawtooth creeks even exceeded or were similar to those observed in the Little North Fork Clearwater in 2001. This was somewhat surprising as rainbow trout densities have been shown to increase as the size of the river or stream increases (DuPont et al. 2004; DuPont et al. In Press b). In fact, more large rainbow trout appear to occur in lower Canyon Creek than the Little North Fork Clearwater River. Only two rainbow trout >300 mm were observed in the 48 reaches snorkeled in the Little North Fork Clearwater River during 2001 (DuPont et al. 2004). Five rainbow trout >300 mm were observed in lower Canyon Creek and individuals up to 500 mm in length were observed through casually snorkeling the deeper pools. It is not clear why Canyon Creek supports more and larger rainbow trout than the main river. Fishing pressure is higher in the Little North Fork Clearwater, but it is believed it is low enough (11% mortality) to have minimal impacts on the fishery (DuPont et al. In Press a). Based on this information, it appears that Canyon Creek is a unique stream as it is the only tributary that we are aware of in the Little North Fork Clearwater River watershed that could provide a rainbow trout fishery as well as fishery for larger cutthroat trout. The difficulties are that this stream does not have any trail access to its lower reaches and one must be in good physical condition to fish it.

When we compared our snorkel results to electrofishing findings in 2001 we found that densities of rainbow trout were higher in Canyon Creek and Sawtooth Creek during 2004 whereas densities of rainbow trout were higher in Foehl Creek during 2001 (Table 5). As we mentioned earlier, it is difficult to compare snorkel results with electrofishing findings as electrofishing did not appear to be effective in the low conductive, swift, deep waters that occur in these tributaries. The higher densities of rainbow trout that were observed in Foehl Creek during 2001 than 2004 are most likely because only the lower section of Foehl Creek (<3,450 m upstream) was electrofished during 2001, the same location where we saw the highest densities of rainbow trout during 2004.

Sculpin and Tailed Frogs

Both sculpin and tailed frogs were observed in eight of the 38 reaches snorkeled. Electrofishing efforts during 2001 in these same tributaries found that sculpin and tailed frogs were the most abundant animals (DuPont et al. 2004). Both sculpin and tailed frogs utilize the interstitial spaces of substrate revealing just how difficult it is to locate animals with these behaviors during daytime snorkel surveys (Nussbaum et al. 1983). Snorkeling should not be used if one wishes to evaluate either of these species.

Habitat Associations

Findings from this study indicate that cutthroat trout selected smaller, higher elevation stream reaches with cooler water, similar to what rainbow trout appeared to be selecting. These findings are contrary to what we observed during 2001 (DuPont et al. 2004) and in other research (Roper 1995; Dunnigan 1997; Muhlfeld 1999) where rainbow trout tended to utilize the lower, larger sections of streams where water temperatures tend to be warmer. This unusual finding is largely a result of the higher number of rainbow trout observed in the most upstream reaches of Canyon Creek, as in Buck Creek (high elevation stream) and upper Foehl Creek, rainbow trout were uncommon or absent altogether. We are not sure why rainbow trout utilized upper Canyon Creek. None of the habitat variables we collected suggested that upper Canyon Creek was considerably different from any of the other smaller streams we surveyed. Smaller rainbow trout and cutthroat trout are more difficult to differentiate from one another than larger fish and errors in identification can occur (DuPont et al. In Press c; Thurow et al. In Review). However, the people who snorkeled upper Canyon Creek were all very experienced in fish identification and snorkeling. Cutthroat trout did show a tendency to select those habitats with more pools and less riffle whereas rainbow trout were indifferent in the selection of these habitat variables, which is similar to other findings where cutthroat trout were found to prefer pools and rainbow trout riffles (McIntyre and Rieman 1995; Roper 1995; Rosenfeld et al. 2000).

The larger cutthroat trout and rainbow trout also appeared to select similar habitat as they were found more frequently in the larger streams, closer to the main river, and where deeper water occurred. These findings coincide with other research that has shown that larger fish tend to utilize larger sections of streams where more space and food is available (Behnke 1992). Only one significant correlation between densities of larger cutthroat trout or rainbow trout and the evaluated habitat variables were observed and that was with maximum depth. This absence of significant correlations between the density of larger fish and habitat variables is largely due to the low number of big fish that were observed in many of the stream reaches we surveyed.

The habitat associations found to occur with cutthroat trout and rainbow trout in this study make them vulnerable to direct impacts from logging activities. According to this study, these fish select for the small, cool, high elevation streams. Upper watersheds where these small streams occur are often targeted for timber management, and if the importance of these streams to cutthroat trout and rainbow trout is overlooked, impacts to the fishery could be significant. Future timber management in this area should be aware of the habitat preferences of cutthroat trout to ensure logging activities do not increase stream temperature or decrease LWD.

Significant correlations between the density of fishes and the amount of LWD were not detected during this study, although the work during 2001 (DuPont et al. 2004) as well as other research (Horan et al. 2000; Rosenfeld et al. 2000) has shown the density of cutthroat trout tend to increase with increasing density of LWD. This likely occurred because other variables such as pool depth, stream width, and elevation played more of a role where fish were located in these streams than wood. During 2001, one of the streams surveyed was Buck Creek, which was smaller in size and had much higher volumes of LWD. The small size of this stream made it easier to electrofish, and consequently, was largely why there was such a strong positive correlation between cutthroat trout density and LWD.

RECOMMENDATIONS

1. Future efforts to locate low density, bull trout rearing populations should utilize intensive efforts (maximize the number of sample sites) whether by electrofishing or snorkeling. Where access is not difficult, night snorkeling may be the best technique to evaluate juvenile bull trout.

2. Make land managers aware of the habitat requirements of cutthroat trout and rainbow trout and their vulnerability to disturbances around small, high elevation streams.

3. Snorkeling should not be utilized to evaluate sculpin or tailed frog populations.

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PRIEST RIVER TRIBUTARY ASSESSMENT

ABSTRACT

Between 2003 and 2004, 199 different sample sites were electrofished on 38 different streams to evaluate the fishery in tributaries around Priest Lake. Cutthroat trout *Oncorhynchus clarkii* were the most abundant species sampled and were collected in 36 of the 38 streams and 190 of the 199 sites surveyed. The highest densities of cutthroat trout on average were found in tributaries on the east side of Priest Lake (5.72 fish/100 m^2) whereas the lowest average density of cutthroat trout was found in tributaries on the west side of Priest Lake (4.48 fish/100 m^2). Brook trout *Salvelinus fontinalis* were the second most abundant salmonid sampled (1,642) and were collected from 26 of the 38 streams and 85 of the 199 sites that were surveyed. The highest average density of brook trout was found in tributaries on the west side of Priest Lake (7.48 fish/100 m^2) with the lowest average density being found in tributaries in the Upper Priest Lake basin (0.71 fish/100 m^2). Bull trout *S. confluentus* (192) were sampled from 12 of 38 streams and 41 of 199 sites. Average bull trout densities in the 12 streams where bull trout were found were all less than 1.2 fish/100 m^2 except in Uleda Creek (Priest River tributary) where the density was 5.13 fish/100 m^2. When compared to data collected since 1982, an overall declining trend in cutthroat trout and bull trout abundance was calculated in the Upper Priest Lake and Priest Lake basins. The largest declines in density of cutthroat trout and bull trout were documented in the Upper Priest Lake basin. Brook trout densities on the other hand have been increasing in this basin over the same period, whereas they have been declining in tributaries around Priest Lake. Based on this data, if lake trout *S. namaycush* abundance could be significantly reduced in Priest and Upper Priest lakes, adfluvial cutthroat trout and bull trout should increase substantially in numbers. Levels would never reach where they were historically due to the presence of brook trout in streams and significant stream alterations, but we believe they could be restored to levels where they could provide a fishery with limited harvest opportunities.

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INTRODUCTION

Historically, cutthroat trout *Oncorhynchus clarkii* fishing in Priest Lake basin was world renowned and limits of 15 fish from 14-16 inches in length were common (Bjornn 1957). As early as the late 1940s, people were complaining of how poor the cutthroat trout fishing had become (Bjornn 1957). In 1956, about 5,000 cutthroat trout were caught by anglers from Priest and Upper Priest lakes and by 1983, just over 100 cutthroat trout were caught (Mauser and Ellis 1985).

Historically, bull trout *Salvelinus confluentus* were also common in the Priest Lake basin and many of the major tributaries supported spawning runs of over 100 adfluvial fish (Bjornn 1957). Annual harvest of adult bull trout from streams exceeded 600 fish during the 1950s (Bjornn 1957). In the lakes, annual harvests between 1,000 and 2,000 bull trout were the norm during the 1950s, 60s, and 70s, and in 1978, the harvest of bull trout in Priest Lake peaked at over 2,300 fish (Bjornn 1957; Mauser et al. 1988). After 1978, the harvest of bull trout dropped significantly and by 1983, less than 100 fish were harvested (Mauser et al. 1988). By 1985, adfluvial bull trout runs into tributaries of Priest Lake were essentially gone, and the Upper Priest Lake basin supported the last relatively abundant bull trout population (Mauser 1986).

Between 1955 and 1989 numerous fishery surveys occurred in tributaries of Priest Lake, Upper Priest Lake, and Priest River to evaluate the distribution and abundance of fishes, whether factors in the tributaries could explain for the decline in cutthroat trout and bull trout, and whether stocking of cutthroat trout into the tributaries could improve the fishery (Bjornn 1957; Cowley 1987; Irving 1987; Horner et al. 1987; Horner et al. 1988; Strach and Bjornn 1991). These studies and others in the lakes (Bjornn 1957; Mauser 1986; Mauser et al. 1988) revealed that overharvest, habitat degradation, and competition/predation by exotic fishes were all contributing to declines in the cutthroat trout and bull trout fishery. The rapid expansion of the lake trout *S. namaycush* spurred by the introduction of mysis shrimp *Mysis relicta* is believed to be responsible for major declines of adfluvial bull trout and cutthroat trout through predation.

Since 1989, the cutthroat trout and bull trout fishery had continued to decline to the point that the bull trout population in Priest Lake was considered functionally extinct (PBBTTAT 1998) and bull trout redd counts in Upper Priest Lake in 2005 were less than 8% of what counted in 1985 (DuPont et al. In Press b). Cutthroat trout abundance also appeared to be a fraction of what it once was, as during a 2003 creel survey on Priest Lake and Upper Priest Lake only 12 anglers were found fishing for cutthroat trout (~1% of the effort) and they had caught and released 19 fish (DuPont et al. In Press a). To help protect bull trout and cutthroat trout, all waters upstream of and including Priest Lake are managed as catch-and-release for these species. The fishing regulations in Priest River and its tributaries are two cutthroat trout none between 8 and 16 inches in length, and all bull trout must be released.

Since 1989, surveys in tributaries within the Priest River and Priest Lake basin have been sporadic. Understanding the status of the fishery in these tributaries and potential threats (exotic fishes) to their abundance will help determine what direction future management could occur in to provide an acceptable fishery for this area. For this reason, we combined efforts with the Kalispel Tribe and the Idaho Department of Environmental Quality (IDEQ) to survey all major tributaries of the Priest Lake and Upper Priest Lake as well as several key tributaries of Priest River.

This study encompassed tributaries of Priest River, Priest Lake, and Upper Priest Lake, which is located in the northwest corner of the Idaho Panhandle (Figure 1). The Priest River basin is about 253,000 ha in size. Approximately 6,200 ha (2.5%) of the basin are in British

Columbia, where the headwaters of the Upper Priest River originate, and headwaters of major tributaries on the western side of the basin are located in Washington and cover about 50,000 ha (20% of Priest River watershed). Upper Priest Lake (542 ha; 31 m deep) is connected to Priest Lake (9,450 ha; 111 m deep) by a 4.4 km channel called the Thorofare. Water levels in the lakes and Thorofare are controlled by an outlet dam structure at the southwest corner of Priest Lake. This dam is believed to be a barrier to upstream fish migration. Priest River originates at the outlet of Priest Lake and flows a distance of 71 river km to its confluence with the Pend Oreille River at the city of Priest River. The average annual flow of Priest River (6.1 river km up from it confluence) has been 47 m^3/sec (1,661 ft^3/sec) since 1930.

The Priest River basin is surrounded by the Selkirk Mountain Range with elevations ranging from 632 m at the mouth of Priest River to 2,316 m at Twin Peaks located on the east side of Priest Lake in the headwaters of Indian Creek. The mountains on the east side of Priest River and the lakes tend to be dominated by granitics, are higher in elevation and steeper than what occurs on the west side. The mountains on the west side, a mixture of granitics (southern half of basin) and belt series geology (metamorphosed sedimentary rocks), have lower elevations and flatter gradients than on the east side. The higher elevations on the east side resulted in more recent and complete glaciation than on the west side. As a result much of the loose highly erosive rock, often associated with weathered granitics, has been scraped off the east side making it more stable and less erosive. Glaciation and its retreat left extensive unconsolidated surface deposits overlying bedrock in the Priest Lake basin and had great influence on soil development in the drainage. These deposits include mixes of boulders, gravels, sands, silts, and clays called glacial till. Extensive glacial till deposits exist in the lowlands surrounding Priest Lake, especially on the west side. Much of this material is coarse grained and deep, and supports unconfined aquifers. Within these outwash deposits are pockets of lacustrine fine grained silts and clays, and organic soils. These glacial till produced soils can be unstable, especially when coupled with groundwater. The combination of the flatter terrain, more erosive nature of the land, and abundance of glacial till that occurs on the west side of Priest River and the lakes helps explain why the streams on this side tend to have more fine sediments than streams on the east side.

Annual precipitation (rain and melted snow) averages 81 cm at Priest Lake and can reach 152 cm around the mountain peaks. At elevations above 1,460 m, snowfall accounts for more than 50% of total precipitation (Finklin 1983). The wettest months normally are November, December, and January. Local factors such as elevation, topography, vegetative cover, and the presence of a large water body influence the climatic conditions within the watershed.

Twenty different stream segments within the Priest River basin were listed as Clean Water Act Section 303(d) water quality limited segments (Table 1). Most of these streams were listed either because of sediment or temperature exceedences. Those water quality limited stream segments due to excess sediment were mostly tributaries located on the east side of Priest Lake or tributaries of Priest River.

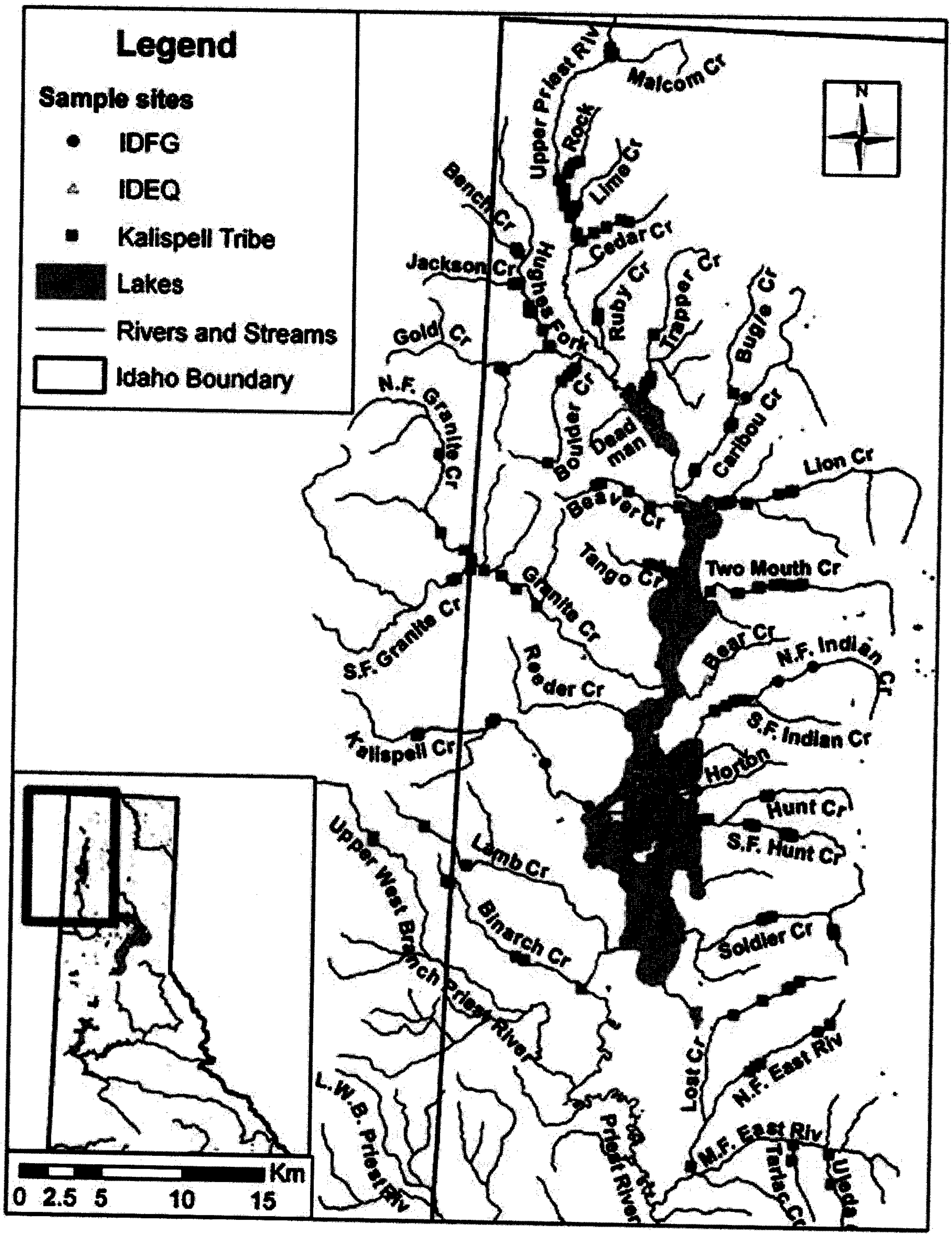

Figure 1. Sampling locations on streams surveyed during 2003 and 2004 by the Idaho Department of Fish and Game, Idaho Department of Environmental Quality and the Kalispell Tribe in the Priest River basin, Idaho.

Table 1. Stream segments in the Priest River basins that were listed as Clean Water Act Section 303(d) water quality limited segments and their pollutant of concern (EPA approved 2002 Idaho 303(d) list).

	Reason for TMDL Listing		
Stream	**Sediment**	**Temperature**	**Bacteria**
Priest River			
Priest River (Upper West Branch to mouth)	yes		
Lower West Branch Priest River	yes	yes	
East River	yes	yes	
Middle Fork East River		yes	
North Fork East River		yes	
Upper West Branch Priest River	yes	yes	
Binarch Creek	yes		
Priest Lake (West Side)			
Lamb Creek	yes	yes	
Kalispell Creek	yes	yes	
Reeder Creek	yes	yes	
Granite Creek		yes	
Beaver Creek	yes		
Priest Lake (East Side)			
Soldier Creek	yes	yes	
Indian Creek		yes	
Goose Creek			yes
Two Mouth Creek		yes	
Lion Creek		yes	
Upper Priest Lake			
Trapper Creek		yes	
Upper Priest River		yes	
Hughes Fork		yes	

The majority of the land on the west side of the basin is managed by the U.S. Forest Service. The northern boundary extends to, and includes, the Upper Priest River watershed to the Canadian border. The Upper Priest River headwater lands are administered by the British Columbia Ministry of Forests. Private property comprises approximately 10% of the west side land total. There are some blocks of commercial timberlands and a few large private holdings, in agricultural use, in the Nordman and Lamb Creek areas. More than 90% of the land on the east side of the basin is owned by the State of Idaho, with the northern boundary incorporating the Trapper Creek watershed. Most of this land is administered by Idaho Department of Lands under the State Endowment Trust. Some state land is managed by Idaho Parks and Recreation as the Priest Lake State Park. Around the 116 km of Priest Lake shoreline, approximately 26% of the property is privately owned (Bonner County 1989), and it is there that the most concentrated residential and business development has occurred. On the east side, blocks of private shoreline property exist at Coolin, Steamboat Bay east to Cavanaugh Bay, and from Bear Creek north to Canoe Point. On the west side, privately owned shoreline property is primarily around the Granite Creek area and Kalispell Bay. Within the federal and state owned lands, there has been considerable waterfront development through lease lot programs.

Native fish species that are known to occur in Priest and Upper Priest lakes and Priest River include cutthroat trout, bull trout, mountain whitefish *Prosopium williamsoni*, pygmy whitefish *P. coulterii*, slimy sculpin *Cottus cognatus*, torrent sculpin *C. rhotheus*, longnose dace

Rhinichthys cataractae, peamouth *Mylocheilus caurinus*, northern pikeminnow *Ptychocheilus oregonensis*, redside shiner *Richardsonius balteatus*, longnose sucker *Catostomus catostomus* and largescale sucker *C. macrocheilus*. Nonnative species found in these waters include kokanee *Oncorhynchus nerka*, lake trout, rainbow trout *O. mykiss*, brook trout *Salvelinus fontinalis*, brown trout *Salmo trutta*, largemouth bass *Micropterus salmoides*, smallmouth bass *M. dolomieui*, pumpkinseed *Lepomis gibbosus*, black crappie *Pomoxis nigromaculatus*, yellow perch *Perca flavescens*, northern pike *Esox lucius*, tench *Tinca tinca*, and brown bullhead *Ameiurus nebulosus*. The number of fish species that occur in the tributaries of this basin are much fewer in number and include cutthroat trout, bull trout, brook trout, slimy sculpin and torrent sculpin. In a few streams brown trout occur and near the mouth of some streams it is not unusual to find mountain whitefish, northern pikeminnow and longnose dace.

OBJECTIVES

1. Determine the distribution and density of fishes occurring in all major tributaries located upstream of and including the East River drainage in the Priest River drainage.

2. Compare the density of cutthroat trout, bull trout, and brook trout in select streams from 1957 to 2004 to assess trends in the fishery in streams within the Priest River drainage.

METHODS

Field Methods

To assess the fishery in tributaries within the Priest River basin upstream of and including the East River watershed, the Idaho Department of Fish and Game (IDFG) partnered up with the Idaho Department of Environmental Quality (IDEQ) and Kalispel Tribe to electrofish all the major tributaries in this area. Sampling sites were selected in each stream in areas we thought would help best portray the distribution of fishes and their status as well as allowing us to compare fish densities to past studies (Bjornn 1957; Cowley 1987; Irving 1987; Horner et al. 1987; Horner et al. 1988; Strach and Bjornn 1991). Site and reach lengths were measured using laser range finders.

At each sample site, fish were collected using a Smith-Root SR 15 backpack electrofisher and a three-person crew. The species and total length of each salmonid captured was recorded. Sculpin were not differentiated down to a species level. We used a multiple depletion method to acquire a population estimate for cutthroat trout, bull trout, and brook trout at all sites sampled by the IDFG and IDEQ (Zippin 1958; Lobon-Cervia and Utrilla 1993). Block nets were not used, although all sampling started and stopped in shallow areas that would help restrict movement of fish out of the sample area. MicroFish 3.0 (Van Deventer and Platts 1985) was utilized to calculate a population estimate at each of these sites where multiple electrofishing passes occurred. A correction factor (capture efficiency) was developed for cutthroat trout, bull trout, and brook trout by averaging the sampling efficiency from the 10 different sites where depletion sampling occurred. The average capture efficiency was used to estimate the total number of each species of fish that occurred at each of the sites where one pass occurred by dividing the number of specimens captured by their associated average capture efficiency. The estimated total number of fish that occurred at each site was divided by the area of stream sampled, resulting in an estimated density (number/100 m^2) for each sample site. An average density of cutthroat trout, bull trout, and brook trout were calculated for each stream surveyed by summing the population estimate from each site within a stream and dividing it by the total area electrofished. An average density of cutthroat trout, bull trout, and brook trout were also calculated for four different drainage areas (Table 2) within the study by equally weighting the average density estimate for each stream surveyed.

Table 2. Drainage areas used to summarize fisheries information collected during stream surveys in 2003 and 2004 in the Priest River watershed.

Drainage area	Description of drainage area
Upper Priest Lake Basin	All tributaries draining directly or indirectly into Upper Priest Lake.
Priest Lake – East Side	All tributaries on the east side of Priest Lake from the outlet dam upstream to and including the Caribou Creek watershed.
Priest Lake – West Side	All tributaries on the west side of Priest Lake from the outlet dam upstream to and including the Beaver Creek watershed.
Priest River	All tributaries downstream of Priest Lake draining into Priest River.

To help evaluate trends in salmonid abundance we compared the average density of cutthroat trout, bull trout, and brook trout that were observed (snorkeling) or sampled (electrofishing) between the 1982-1984 (Irving 1987), 1986-1989 (Cowley 1987; Horner et al. 1987; Strach and Bjornn 1991), 1994-1998 (IDEQ BURP data; Fredericks et al. 2002); and 2003-2004 time periods. The average density included all sample sites that occurred in each tributary during each time period. For every stream where density estimates were calculated for two or more time periods between 1957 and 2004 we conducted a linear regression (least squares) with the years the sampling occurred as the independent variable and the density of the fish as the dependent variable. The slope of the regression line was assumed to be the trend in fish abundance. Trends were calculated for different drainage areas by averaging the slope for all the streams in that area.

RESULTS

Density Estimates

Between 2003 and 2004, 199 different sample sites were electrofished on 38 different streams (Figure 1 and Appendix A) to evaluate the fishery in tributaries around Priest Lake. Cutthroat trout were the most abundant species sampled (Table 3) and were collected in 36 of the 38 streams and 190 of the 199 sites surveyed (Tables 4 and 5). The highest densities of cutthroat trout on average were found in tributaries on the east side of Priest Lake (5.72 fish/100 m^2) whereas the lowest average density of cutthroat trout were found in tributaries on the west side of Priest Lake (4.48 fish/100 m^2) (Table 5). Two out of seven (29%) streams on the west side had cutthroat trout densities >2.0 fish/100 m^2 whereas 75% of the east side tributaries, 83% of the Priest River tributaries, and 62% in the Upper Priest Lake tributaries had cutthroat trout densities >2.0 fish/100 m^2. The highest density of cutthroat trout (21.31 fish/100 m^2) was sampled from Tango Creek, a small tributary on the west side of Priest Lake (Table 5).

Table 3. The number of fishes the Kalispel Tribe, Idaho Department of Fish and Game (IDFG) and Idaho Department of Environmental Quality (IDEQ) sampled in tributaries of the Priest River basin, Idaho, during 2003 and 2004.

Collectors	Cutthroat trout	Bull trout	Brook trout	Brown trout	Sculpin	Longnose dace	Mountain whitefish	N. pike-minnow
Kalispel 2003	1,282	149	776	0	1,109	60	0	0
Kalispel 2004	687	22	369	6	297	19	1	1
IDFG	77	16	45	0	126	0	0	0
IDEQ	187	5	89	0	110	3	0	0
Total	2,233	192	1,279	6	1,642	82	1	1

Table 4. The number of streams and sites cutthroat trout, bull trout, and brook trout were sampled from in tributaries of the Priest River basin, Idaho, during 2003 and 2004.

		Number of Streams and (Sites) Each Species Were Sampled In		
Streams	Sites	Cutthroat trout	Bull trout	Brook trout
38	199	36 (190)	12 (41)	26 (85)

We sampled 192 bull trout from 12 of 38 streams and 41 of 199 sites during tributary surveys in 2003 and 2004 (Tables 3 and 4). Average bull trout densities in the 12 streams where bull trout were found were all less than 1.2 fish/100 m^2 except for Uleda Creek (Priest River tributary) where the density was 5.13 fish/100 m^2 (Table 5). The only other tributaries that had bull trout densities higher than 1.0 fish/100 m^2 were Indian and North Indian creeks, tributaries on the east side of Priest Lake (Table 5). The highest average density of bull trout was found in tributaries of Priest River (0.87 fish/100 m^2) and the lowest average density was found in tributaries on the west side of Priest Lake (0.01 fish/100 m^2) (Table 5). The highest average density in tributaries of Priest River was largely due to an abundance of bull trout collected in one tributary—Uleda Creek. Only one other bull trout was located outside of Uleda Creek in any of the other surveyed Priest River tributaries (Appendix A).

Brook trout were the second most abundant salmonid sampled in our stream surveys, with 1,279 in all (Table 3). Brook trout were sampled from 26 of the 38 streams and 85 of the 199 sites that were surveyed in 2003 and 2004 (Table 5). The highest average density of brook trout was found in tributaries on west side of Priest Lake (7.48 fish/100 m^2) with the lowest average density being found in tributaries in the Upper Priest Lake basin (0.71 fish/100 m^2) (Table 5). The only two streams where cutthroat trout were not found to occur (Bear Creek and Lamb Creek) had the highest brook trout densities, >22 fish/100 m^2 (Table 5). Average brook trout densities were at least 4.5 times higher than the average bull trout density in each of the four summary areas (Table 5). Brook trout densities in about 70% of the tributaries (17 out of 25) on the east side of Priest Lake and in the Upper Priest Lake basin were very low (<0.3 fish/100 m^2), whereas all but two (15%) of the tributaries surveyed on the west side of Priest Lake and Priest River had brook trout densities >1.0 fish/100 m^2 (Table 5). Brook trout were more abundant than cutthroat trout in eight of 13 tributaries (62%) on the west side of Priest Lake and Priest River whereas they were more abundant than cutthroat trout in 3 of 25 (12%) tributaries on the east side and the Upper Priest Lake basin.

Table 5. Population and density estimates (fish/100 m^2) of cutthroat trout, bull trout, and brook trout in stream reaches electrofished in the Priest River watershed, Idaho, during 2003 and 2004.

			Population Estimate			Density (Fish/100 m^2)		
Major Tributary	Stream surveyed	Area (m^2) sampled	Cutthroat trout	Bull trout	Brook trout	Cutthroat trout	Bull trout	Brook trout
Upper Priest Lake Basin								
	Malcolm Creek	2044	113.5	3.3	0.0	5.56	0.16	0.00
	Rock Creek	729	88.7	0.0	1.9	12.17	0.00	0.27
	Lime	1481	46.1	0.0	3.9	3.11	0.00	0.26
	Cedar	5381	101.1	0.0	0.0	1.88	0.00	0.00
	Ruby Creek	1275	117.1	0.0	60.1	9.19	0.00	4.71
	Hughes Fork	10407	88.7	4.9	54.3	0.85	0.05	0.52
	Bench	1260	115.3	0.0	33.0	9.15	0.00	2.62
	Jackson	1653	88.7	0.0	3.9	5.37	0.00	0.23
	Gold Creek	9407	95.8	82.3	1.9	1.02	0.87	0.02
	Boulder Creek	1457	88.7	0.0	7.8	6.09	0.00	0.53
	Upper Priest River	14600	95.8	28.0	0.0	0.66	0.19	0.00
	Deadman Creek	200	12.4	0.0	0.0	6.21	0.00	0.00
	Trapper Creek	7163	94.0	0.0	0.0	1.31	0.00	0.00
Priest Lake—East Side								
	Caribou Creek	9390	97.7	1.6	68.1	1.04	0.02	0.73
	Bugle Creek	800	52.0	0.0	53.0	6.50	0.00	6.63
	Lion Creek	10044	159.7	3.3	15.5	1.59	0.03	0.15
	Two Mouth Creek	5668	129.5	0.0	3.9	2.28	0.00	0.07
	Bear Creek	250	0.0	0.0	56.2	0.00	0.00	22.49
	Indian	1486	129.5	16.5	0.0	8.71	1.11	0.00
	North Indian Creek	1992	93.0	23.0	0.0	4.67	1.15	0.00
	South Indian Creek	500	88.0	0.0	0.0	17.60	0.00	0.00
	Horton Creek	231	12.0	0.0	0.0	5.19	0.00	0.00
	Hunt Creek	1284	99.4	0.0	0.0	7.74	0.00	0.00
	SF Hunt Creek	839	88.7	0.0	0.0	10.58	0.00	0.00
	Soldier	3639	99.4	0.0	286.9	2.73	0.00	7.88
Priest Lake—West Side								
	Beaver Creek	2039	115.3	0.0	54.3	5.66	0.00	2.66
	Tango	525	111.8	0.0	5.8	21.31	0.00	1.11
	Granite	13018	53.2	1.6	102.8	0.41	0.01	0.79
	NF Granite	12837	92.3	6.6	290.8	0.72	0.05	2.27
	SF Granite	7062	120.6	0.0	174.5	1.71	0.00	2.47
	Kalispell Creek	6581	100.7	0.0	232.1	1.53	0.00	3.53
	Lamb Creek	751	0.0	0.0	296.6	0.00	0.00	39.51
Priest River								
	Birnarch Creek	1454	86.9	1.6	102.8	5.98	0.11	7.07
	Upper West Branch	2595	92.3	0.0	122.1	3.56	0.00	4.71
	Lost Creek	1907	88.7	0.0	104.7	4.65	0.00	5.49
	NF East River	7101	186.3	0.0	162.9	2.62	0.00	2.29
	Uleda Creek	674	12.4	34.6	0.0	1.84	5.13	0.00
	Tarlac Creek	640	74.5	0.0	31.0	11.64	0.00	4.85
Summary by Drainage Area								
Upper Priest Lake Basin		57056	1146.1	118.5	166.7	4.81	0.10	0.71
Priest Lake—East Side		36124	1048.8	44.4	483.6	5.72	0.19	3.16
Priest Lake—West Side		42812	593.9	8.2	1156.8	4.48	0.01	7.48
Priest River		14371	541.1	36.2	523.5	5.05	0.87	4.07

When we examined the relative abundance (based on comparative densities) of salmonids in each of the four survey areas, Upper Priest Lake basin had the highest percentage of cutthroat trout and lowest percentage of brook trout (Table 6). The west side tributaries had the lowest percentage of cutthroat trout and highest percentage of brook trout (Table 6).

Table 6. Percent occurrence (by density) of cutthroat trout, bull trout, and brook trout sampled from each of the four drainage areas.

Drainage area	Cutthroat trout	Bull trout	Brook trout
Upper Priest Lake basin	85.7%	1.7%	12.6%
East Side Tributaries	63.0%	2.1%	34.8%
West Side Tributaries	37.4%	0.1%	62.5%
Priest River	50.5%	8.7%	40.7%

Trends in Abundance

The largest declines in density of cutthroat trout and bull trout since 1982 were documented in the Upper Priest Lake basin (Table 7 and Appendices B and C). Brook trout densities on the other hand have been increasing in this basin over the same period (Table 7 and Appendix D). The largest declines in bull trout density were documented in Bench and Jackson creeks (Upper Priest Lake basin). Bench and Jackson creeks also experienced the most recent invasion by brook trout, arriving there after 1998 (Appendix D).

Average densities of cutthroat trout, bull trout, and brook trout showed declining trends since 1982 in both the east and west side tributaries of Priest Lake (Table 7 and Appendices B, C and D). However, these trends for the most part were relatively flat (Table 7). Not one of the streams sampled from the east or west side of Priest Lake showed increasing trends in bull trout densities since 1982 (Table 7). Also, no tributaries on the west side showed increases in cutthroat trout densities since 1982, whereas five of the nine tributaries sampled on the east side showed increasing trends in cutthroat trout densities (Table 8). Three of five tributaries on the west side showed increasing trends in brook trout and two out of six tributaries on the east side showed increasing trends in brook trout (Table 8). Indian Creek and North Indian Creek (east side tributaries) showed relatively strong increases in cutthroat trout densities since 1982. Bull trout densities had declined in these streams over the same period and brook trout were not present in either stream during our 2003-2004 sampling. Despite the decline in bull trout density in Indian and North Indian creeks (~1/3 of what they were in 1982), they still had the second and third highest densities of bull trout in all the tributaries sampled (Appendix C).

The average density of cutthroat trout and brook trout showed increasing trends in tributaries of Priest River. Although the highest average density of bull trout was documented in Priest River tributaries during 2003-2004, the trend since 1982 was declining (Table 7).

Table 7. Trends (slope of linear regression line) in cutthroat trout, bull trout, and brook trout densities in tributaries of the Priest River watershed, Idaho, surveyed two or more times between 1982 and 2004.

Major drainage area	Stream surveyed	Slope of trend line		
		Cutthroat trout	Bull trout	Brook trout
Upper Priest Lake Basin				
	Malcom Creek	0.044	-0.010	0.000
	Rock Creek	-0.206	-0.041	0.200
	Lime Creek	-0.467	-0.033	0.004
	Cedar Creek	-0.139	-0.026	0.000
	Ruby Creek	-1.003	-0.016	0.111
	Hughes Fork	-0.218	-0.115	0.020
	Bench Creek	0.105	-1.703	0.036
	Jackson Creek	-0.226	-0.719	0.003
	Gold Creek	-0.043	0.049	-0.003
	Muskegon Creek	-0.800	-0.020	0.000
	Boulder Creek	-0.361	-0.089	0.006
	Upper Priest River	0.020	0.005	0.000
	Trapper Creek	-0.190	-0.057	0.001
Priest Lake—East Side				
	Caribou Creek	0.009	-0.002	0.011
	Lion Creek	-0.193	-0.021	0.008
	Two Mouth Creek	-0.146	-0.036	-0.005
	Bear Creek	0.000	0.000	-0.633
	Indian Creek	0.179	-0.085	-0.018
	North Indian Creek	0.241	-0.137	0.000
	South Indian Creek	—	—	0.000
	Horton Creek	-0.439	0.000	—
	Hunt Creek	0.087	0.000	0.000
	Soldier Creek	0.102	-0.002	-0.119
Priest Lake—West Side				
	Beaver Creek	-0.282	-0.005	-0.052
	Granite Creek	-0.002	-0.002	0.030
	N.F. Granite Creek	-0.009	-0.040	0.080
	S.F. Granite Creek	-0.037	-0.007	0.113
	Kalispell Creek	-0.055	-0.004	-0.361
	Lamb Creek	—	0.000	—
Priest River				
	Binarch Creek	0.362	0.007	—
	Upper West Branch	0.225	0.000	—
	Lost Creek	—	0.000	—
	North Fork East River	0.119	—	-0.125
	Uleda Creek	-0.163	-0.092	0.000
	Tarlac Creek	0.725	-0.275	0.172
Summary by Area				
	Upper Priest Lake basin	-0.268	-0.213	0.029
	Priest Lake - East Side	-0.018	-0.031	-0.084
	Priest Lake - West Side	-0.077	-0.010	-0.038
	Priest River	0.254	-0.072	0.016

Table 8. The number of tributaries in four different drainage areas of the Priest River watershed, Idaho, that experience increasing (>) trends, decreasing (<) trends or no change (=) in the density of cutthroat trout, bull trout and brook trout between 1982 and 2004.

	Trends in abundance								
	Cutthroat trout			Bull trout			Brook trout		
Drainage area	>	<	=	>	<	=	>	<	=
Upper Priest Lake basin	3	10	0	2	11	0	8	1	4
East Side Tributaries	5	3	1	0	6	3	2	4	3
West Side Tributaries	0	5	0	0	5	1	3	2	0
Priest River	4	1	0	1	2	2	1	1	1

DISCUSSION

Cutthroat trout were sampled from all but two of the streams we surveyed suggesting their distribution has not declined considerably from where they existed historically. Our data does suggest, however, that since 1982 cutthroat trout densities had been declining slowly in tributaries of the Priest Lake and Upper Priest Lake basins. This decline is the greatest in the Upper Priest Lake basin where lake trout and brook trout have been increasing in numbers and expanding their range since 1982. Lake trout and brook trout population growth has been minimal or declining (brook trout) since 1982 in the Priest Lake basin and helps explain why densities of cutthroat trout have declined at a lesser rate then what has occurred in the Upper Priest Lake basin. In fact, the trend for cutthroat trout in tributaries on the east side of Priest Lake has essentially been flat since 1982, as half the tributaries showed increasing trends and the other half decreasing trends.

One of the major changes with cutthroat trout in the Priest Lake and Upper Priest Lake basin is the loss of adfluvial cutthroat trout, which were the dominant life history form historically (Bjornn 1957). Based on creel surveys, adfluvial cutthroat trout represent a minor portion of the fishery in Priest and Upper Priest lakes (DuPont, In Press a). The dramatic decline of the adfluvial cutthroat trout in the 1940s was mostly believed to be caused by overfishing (Bjornn 1957) and the introduction of kokanee and lake trout (Behnke 1992). However, their continued suppression is largely believed to be caused by the expansion of lake trout (DuPont, In Press a). The decline of adfluvial cutthroat trout has also been documented in Yellowstone Lake after lake trout were illegally introduced (McMillion 2006). Bjornn (1957) documented that many of the tributaries in the Priest Lake basin where adfluvial cutthroat trout spawned also had resident fish and even observed them spawning together. Based on these findings, it is likely that cutthroat trout densities originally dropped in the tributaries when the adfluvial cutthroat trout population first declined and were later replaced by resident fish. Despite the downward trend in cutthroat trout abundance and the loss of adfluvial fish, the density of cutthroat trout in the tributaries we surveyed was very comparable to other cutthroat trout populations in tributaries of the Idaho Panhandle (Table 9).

Brook trout likely have displaced a portion of the cutthroat trout in many of the tributaries we surveyed, especially in the lower gradient stream reaches with higher amounts of fine sediment. For example, Bear Creek and Lamb Creek where cutthroat trout have been totally displaced by brook trout have very low gradients and high quantities of fine sediment.

Table 9. Densities (fish/100 m2) of salmonids surveyed from tributaries within the IDFG Panhandle Region, Idaho, between 2000 and 2004.

Tributary	Cutthroat trout	Bull trout	Brook trout	Rainbow trout	All salmonids
Priest River basin					
Upper Priest Lake Basin	4.81	0.10	0.71		5.62
East Side Priest Lake	5.72	0.19	3.16		9.07
West Side Priest Lake	4.48	0.01	7.48		11.97
Priest River tribs	5.05	0.87	4.07		9.99
LNFCWR tribs					
Buck Creek	5.87			0.13	6.00
Lower Canyon Creek	1.19			1.04	2.23
Upper Canyon Creek	4.61			1.39	6.00
Foehl Creek	1.43			0.4	1.83
Sawtooth Creek	4.29			0.75	5.04
Larkins Creek	5.06			0.24	5.30
Coeur d'Alene Lake tribs					
SF Mica Creek—lower	20.0		0.0		20.00
SF Mica Creek—upper	8.3		1.8		10.10
NF Mica Creek	1.5		0.0		1.50
St. Joe Tributaries					
Wisdom Creek	3.68	4.42			8.10
Medicine Creek	0.00	7.74			7.74
Upper St. Joe River	2.80	0.70			3.50

These findings are consistent with what other researchers have found (Shepard 2004; Dunham et al. 2002). Streams with lower gradients and higher quantities of fines were most abundant on the west side of Priest Lake and Priest River and this is where brook trout were most abundant. Brook trout were more abundant than cutthroat trout in about 71% of the streams we surveyed on the west side of Priest Lake and 50% of the tributaries of Priest River. About 62% of the salmonids surveyed on the west side of Priest Lake were brook trout and 41% in tributaries of Priest River. If brook trout replace cutthroat trout on a one to one basis, total production of cutthroat trout has been significantly reduced in these tributaries. Historically, tributaries on the west side of Priest Lake were considered the top producers of adfluvial cutthroat trout for Priest Lake (Bjornn 1957). Brook trout and habitat degradation has greatly reduced this potential.

In tributaries on the east side of Priest Lake, brook trout were more abundant than cutthroat trout in 20% of the streams we surveyed. Unfortunately, about half the tributaries on the east side of Priest Lake have barriers, typically within three miles of the lake, greatly reducing their potential for adfluvial cutthroat trout production. Tributaries in the Upper Priest Lake basin have the fewest brook trout, the best habitat, and most potential to produce adfluvial cutthroat trout. We are still uncertain how much brook trout will continue to expand and increase in abundance in this basin. Good habitat conditions in this basin may prevent brook trout from developing into high density populations.

Our data showed that between 1982 and 2004 brook trout continued to expand their range in only the Upper Priest Lake basin, whereas brook trout densities in tributaries on the east and west side of Priest Lake were trending downward. Lake trout have likely reached carrying capacity in Priest Lake and efforts are ongoing in Upper Priest Lake to prevent their continued growth. With brook trout and lake trout populations becoming more stable in the Priest Lake basin, it leads us to believe cutthroat trout populations should also become more stable. We also do not expect changes in habitat to cause densities of cutthroat trout to decline as timber and road building practices have been improving in recent years around Priest Lake.

Bull trout densities were low (<1.2 fish/100 m^2) or nonexistent in all the streams surveyed except Uleda Creek. These low densities are largely believed to be because of the proliferation of lake trout in both Priest Lake and Upper Priest Lake (Mauser 1986; Fredericks et al. 2002). This is not unusual as adfluvial bull trout have not been found to persist over the long term where strong lake trout populations exist (Donald and Alger 1993). Unfortunately, adfluvial bull trout have not been replaced by resident fish in the tributaries like we believe has occurred with cutthroat trout. If lake trout are not suppressed in Priest and Upper Priest Lakes, it is likely bull trout will disappear altogether. In tributaries of Upper Priest Lake, since 1982, we have seen bull trout disappear from eight different tributaries. This loss has not been as obvious in tributaries of Priest Lake as it is believed the major declines occurred in the late 1970s when the lake trout population exploded (Mauser 1986). It is not surprising that the stream with the highest bull trout density was found in Uleda Creek, as these fish migrate to Pend Oreille Lake where lake trout are not as abundant as in Priest Lake (DuPont et al. In Press c). Despite the high densities of Lake trout in Priest Lake since the mid 1970s, bull trout were located in six different tributaries, although, only the Indian Creek watershed supported appreciable densities of bull trout.

Brook trout do not appear to be expanding except in the upper Priest Lake basin. Cutthroat trout are distributed throughout most tributaries and remnant bull trout populations still occur in several streams. Based on these findings, if methods are found to significantly suppress lake trout, adfluvial cutthroat trout and bull trout should increase substantially in numbers. Levels would never reach where they were historically due to the presence of brook trout in streams and significant stream alterations, but we believe they could be restored to levels where they could provide a fishery with limited harvest opportunities.

If there are desires to restore bull trout in the Priest Lake basin, it should occur in the next 10 years. It is possible after this period that bull trout will no longer exist if significant efforts are not made to remove lake trout. Cutthroat trout on the other hand should continue to persist in the tributaries in a predominately resident form with a much reduced adfluvial component. We strongly believe a fishable cutthroat trout population (adfluvial fish) cannot exist with a flourishing lake trout population. Efforts to reduce lake trout numbers could include activities such as extensive gillnetting, trap netting, and angler incentive programs. These kinds of activities could cost upwards of $300,000 a year and there would be no guarantee that it would succeed. Lake trout were illegally introduced into Yellowstone Lake and efforts to remove them have been occurring since 1994 at a cost of about $300,000 a year. In the past 12 years, over 136,000 lake trout have been removed from Yellowstone Lake and the cutthroat trout population had declined by about 60% and it continues to drop (McMillion 2006). Establishment of a commercial fishery on lake trout could offset suppression costs, but currently there is no established market for lake trout and there could be some conflicts with the sport fishery. Unfortunately, there is no mitigation funding available for lake trout removal in Priest Lake.

Upper Priest Lake provides the last best chance to manage for native fish in this basin. Tributaries in the basin have the most potential to support large numbers of cutthroat trout and bull trout because they support the most miles of good steam habitat with the fewest number of brook trout. Due to the smaller size and shallower depths of Upper Priest Lake, lake trout removal efforts would cost significantly less than in Priest Lake and would have a higher chance of success if strategies are developed and implemented to block lake trout migration through the Thorofare.

RECOMMENDATIONS

1. Follow the commission approved management directions for Priest and Upper Priest lakes in the 2007-2012 Fish Management Plan.

2. Continue with lake trout removal on Upper Priest Lake and explore different techniques to block migration of lake trout through the Thorofare.

3. If removal efforts are successful in Upper Priest Lake, manage the lake for native species only. Currently, no lowland lakes in the Panhandle Region are managed for only native species.

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APPENDICES

Appendix A. Stream reaches surveyed, who sampled the stream (IDFG = Idaho Department of Fish and Game; IDEQ = Idaho Department of Environmental Quality; Kalispel = Kalispel Tribe), area sampled (m^2), and number of fish collected from each site through electrofishing in tributaries of the Priest River watershed, Idaho, during 2003 and 2004.

					Number of Fish Sampled							
Stream Surveyed	Sample site	Collector	Sample date	Area (m^2) sampled	Cutthroat trout	Bull trout	Brook trout	Brown trout	Sculpin	Dace	Mountain whitefish	N. Pike-minnow
Upper Priest River												
Malcolm Creek	1	Kalispel	2004	517	12							
Malcolm Creek	2	Kalispel	2004	207	13							
Malcolm Creek	3	Kalispel	2004	240	18	1						
Malcolm Creek	4	Kalispel	2004	1,080	21	1						
Rock Creek	1	Kalispel	2004	194	10		1		25			
Rock Creek	2	Kalispel	2004	56	10							
Rock Creek	3	Kalispel	2004	214	11							
Rock Creek	4	Kalispel	2004	93	11							
Rock Creek	5	Kalispel	2004	172	8							
Lime Creek	1	Kalispel	9/9/2003	816	11		2		12			
Lime Creek	2	Kalispel	9/9/2003	665	15				3			
Lime Creek	3	Kalispel	9/9/2003	—	10							
Lime Creek	4	Kalispel	9/9/2003	—	18							
Cedar Creek	1	Kalispel	6/23/2003	—	6							
Cedar Creek	2	Kalispel	6/23/2003	950	12				6			
Cedar Creek	3	Kalispel	6/23/2003	560	11				7			
Cedar Creek	4	Kalispel	6/24/2003	1,170	15				8			
Cedar Creek	5	Kalispel	6/24/2003	2,701	19				39			
Ruby Creek	1	Kalispel	2004	122	10		5		15			
Ruby Creek	2	Kalispel	2004	161	10		3		8			
Ruby Creek	3	Kalispel	2004	343	13		12		23			
Ruby Creek	4	Kalispel	2004	359	16		6		22			
Ruby Creek	5	Kalispel	2004	290	17		5		17			
Hughes Fork	1	Kalispel	7/1/2003	4,304	11	2	2		4			
Hughes Fork	2	Kalispel	7/1/2003	1,176	2	1						
Hughes Fork	3	Kalispel	7/2/2003	1,082	11		6		6			
Hughes Fork	4	Kalispel	7/2/2003	902	10		4		8			
Hughes Fork	5	Kalispel	7/2/2003	1,271	6		10		9			
Hughes Fork	6	Kalispel	7/2/2003	1,672	10		6		8			
Bench Creek	1	Kalispel	8/26/2003	224	17		16					
Bench Creek	2	Kalispel	8/26/2003	237	13		1					
Bench Creek	3	Kalispel	8/26/2003	459	17							
Bench Creek	4	Kalispel	8/26/2003	340	18							
Jackson Creek	1	Kalispel	8/25/2003	1,066	32		2					
Jackson Creek	2	Kalispel	8/25/2003	380	12							
Jackson Creek	3	Kalispel	8/25/2003	207	6				1			
Gold Creek	1	Kalispel	6/26/2003	768	7	8	1		3			
Gold Creek	2	Kalispel	6/26/2003	886	4	6						
Gold Creek	3	Kalispel	6/30/2003	1,218	2	3						
Gold Creek	4	Kalispel	6/30/2003	2,106	5	3						
Gold Creek	5	Kalispel	6/30/2003	1,956	3							
Gold Creek	6	Kalispel	7/1/2003	351	10	2						
Gold Creek	7	Kalispel	7/1/2003	288	14	1						
Gold Creek	8	Kalispel	7/1/2003	967	9	10						
Gold Creek	9	Kalispel	7/1/2003	615		12						
Gold Creek	10	Kalispel	7/1/2003	252		5						
Boulder Creek	1	Kalispel	2004	76	10							
Boulder Creek	2	Kalispel	2004	736	13		3					
Boulder Creek	3	Kalispel	2004	286	10							
Boulder Creek	4	Kalispel	2004	235	10		1					
Boulder Creek	5	Kalispel	2004	125	7							
Upper Priest Lake												
Upper Priest River	1	Kalispel	9/2/2003	—	1	14						
Upper Priest River	2	Kalispel	9/2/2003	—	8	8						
Upper Priest River	3	Kalispel	9/2/2003	—	8	2						

Appendix A. Continued.

Stream Surveyed	Sample site	Collector	Sample date	Area (m^2) sampled	Number of Fish Sampled: Cutthroat trout	Bull trout	Brook trout	Brown trout	Sculpin	Dace	Mountain whitefish	N. Pike-minnow
Upper Priest Lake, continued.												
Upper Priest River	4	Kalispel	9/2/2003	—	13	6						
Upper Priest River	5	Kalispel	9/2/2003	—	14	5						
Upper Priest River	6	Kalispel	9/2/2003	—	6	6						
Upper Priest River	7	Kalispel	9/2/2003	—		9						
Upper Priest River	1	Kalispel	2004	5,810	17	3						
Upper Priest River	2	Kalispel	2004	2,586	9	1						
Upper Priest River	3	Kalispel	2004	1,023	9	3						
Upper Priest River	4	Kalispel	2004	2,261	8	5						
Upper Priest River	5	Kalispel	2004	2,920	11	5						
Deadman Creek	1	IDEQ	8/10/2004	200	7							
Trapper Creek	1	Kalispel	8/5/2003	—	50							
Trapper Creek	1	IDFG	7/15/2004	1,222	6							
Trapper Creek	1	Kalispel	2004	5,166	9				60	10		1
Trapper Creek	2	Kalispel	2004	458	13							
Trapper Creek	3	Kalispel	2004	657	12							
Trapper Creek	4	Kalispel	2004	559	10							
Trapper Creek	5	Kalispel	2004	323	9							
Thorofare												
Caribou Creek	1	Kalispel	8/13/2003	2,640	4		3		65	17		
Caribou Creek	2	Kalispel	8/13/2003	1,205	10		3		64	5		
Caribou Creek	3	Kalispel	8/13/2003	837	6	1	7		25			
Caribou Creek	4	Kalispel	8/14/2003	2,017	14		11		86	16		
Caribou Creek	5	Kalispel	8/14/2003	328	11		2		26	8		
Caribou Creek	6	Kalispel	8/14/2003	1,464	5		5		42	10		
Caribou Creek	1	IDFG	7/15/2004	900	8		8		22			
Bugle Creek	1	IDEQ	8/16/2004	800	41		48		74			
Priest Lake - East Side												
Lion Creek	1	Kalispel	8/14/2003	1,504	11		2		34	4		
Lion Creek	2	Kalispel	8/18/2003	1,527	11				11			
Lion Creek	3	Kalispel	8/18/2003	1,435	13				14			
Lion Creek	4	Kalispel	8/18/2003	137	10				6			
Lion Creek	5	Kalispel	8/18/2003	390	5				8			
Lion Creek	1	Kalispel	2004	2,448	9		4		15			
Lion Creek	2	Kalispel	2004	834	10	1			10			
Lion Creek	3	Kalispel	2004	748	7	1			8			
Lion Creek	4	Kalispel	2004	1,020	14		2		6		1	
Lion Creek	5	Kalispel	2004	—	10							
Two Mouth Creek	1	Kalispel	7/23/2003	—	10							
Two Mouth Creek	2	Kalispel	7/23/2003	—	10							
Two Mouth Creek	3	Kalispel	7/23/2003	—	7							
Two Mouth Creek	4	Kalispel	7/28/2003	210	10							
Two Mouth Creek	5	Kalispel	7/29/2003	72	13							
Two Mouth Creek	1	Kalispel	2004	1,008	1		1		7			
Two Mouth Creek	2	Kalispel	2004	2,226	13				3			
Two Mouth Creek	3	Kalispel	2004	966	10				2			
Two Mouth Creek	4	Kalispel	2004	377	10		1					
Two Mouth Creek	5	Kalispel	2004	716	10							
Two Mouth Creek	6	Kalispel	2004	92	6							
Bear Creek	1	IDEQ	9/2/2004	250			29					
Indian Creek	1	Kalispel	7/28/2003	—	10	4	3					
Indian Creek	2	Kalispel	7/29/2003	—	10							
Indian Creek	3	Kalispel	7/29/2003	—	17							
Indian Creek	4	Kalispel	7/29/2003	—	12							
Indian Creek	5	Kalispel	7/29/2003	—		5						
Indian Creek	6	Kalispel	7/29/2003	1,008	46	6						
Indian Creek	7	Kalispel	7/31/2003	478	27	4						
North Indian Creek	1	IDEQ	8/16/2004	650	45	5						
North Indian Creek	1	IDFG	7/14/2004	700	21	16						
North Indian Creek	2	IDFG	7/14/2004	642	18							
South Indian Creek	1	IDEQ	8/16/2004	500	81							
Horton Creek	1	IDFG	7/14/2004	231	12							

Appendix A. Continued.

Stream Surveyed	Sample site	Collector	Sample date	Area (m²) sampled	Number of Fish Sampled: Cutthroat trout	Bull trout	Brook trout	Brown trout	Sculpin	Dace	Mountain whitefish	N. Pike-minnow
Priest Lake - East Side, continued.												
Hunt Creek	1	Kalispel	8/18/2003	397	13				2			
Hunt Creek	3	Kalispel	8/19/2003	85	11							
Hunt Creek	4	Kalispel	8/19/2003	84	9							
Hunt Creek	5	Kalispel	8/19/2003	42	13							
Hunt Creek	2	Kalispel	8/18/2003	676	10							
SF Hunt Creek	1	Kalispel	2004	102	11							
SF Hunt Creek	2	Kalispel	2004	244	11							
SF Hunt Creek	3	Kalispel	2004	140	10							
SF Hunt Creek	4	Kalispel	2004	180	10							
SF Hunt Creek	5	Kalispel	2004	174	8							
Soldier Creek	1	Kalispel	7/23/2003	1,004	4		33		4			
Soldier Creek	2	Kalispel	7/23/2003	1,545	4		104					
Soldier Creek	3	Kalispel	7/23/2003	794	2		11					
Soldier Creek	4	Kalispel	7/23/2003	34	10							
Soldier Creek	5	Kalispel	7/23/2003	107	10							
Soldier Creek	6	Kalispel	7/23/2003	98	14							
Soldier Creek	7	Kalispel	7/23/2003	59	12							
Priest Lake – West Side												
Beaver Creek	1	IDEQ	8/16/2004	300	13		12		36	3		
Beaver Creek	1	Kalispel	2004	1,318	11		9		13	4		
Beaver Creek	2	Kalispel	2004	240	10		6		26			
Beaver Creek	3	Kalispel	2004	59	10		1		1			
Beaver Creek	4	Kalispel	2004	54	13							
Beaver Creek	5	Kalispel	2004	68	8							
Tango Creek	1	Kalispel	7/28/2003	237	11		1					
Tango Creek	2	Kalispel	7/28/2003	92	11		1					
Tango Creek	3	Kalispel	7/28/2003	109	12		1					
Tango Creek	4	Kalispel	7/28/2003	43	15							
Tango Creek	5	Kalispel	7/28/2003	43	14							
Granite Creek	1	Kalispel	9/19/2003	3,513	3	1	16		20			
Granite Creek	2	Kalispel	9/19/2003	2,235	11		12		7			
Granite Creek	3	Kalispel	9/19/2003	3,617	6		7		12			
Granite Creek	4	Kalispel	9/19/2003	3,654	10		18		7			
Granite Creek	5	Kalispel	9/19/2003	—	2		18		8			
Granite Creek	6	Kalispel	9/19/2003	—	12		17		15			
NF Granite	1	Kalispel	9/20/2003	2,356	12		31		19			
NF Granite	2	Kalispel	9/20/2003	1,205	9	1	8		27			
NF Granite	3	Kalispel	9/20/2003	1,720	6		19		23			
NF Granite	4	Kalispel	9/20/2003	3,667	4		49		64			
NF Granite	5	Kalispel	9/20/2003	2,636	6	1	33		29			
NF Granite	6	Kalispel	9/20/2003	1,254	15	2	10		11			
SF Granite	1	Kalispel	9/20/2003	483	21							
SF Granite	2	Kalispel	9/20/2003	1,293	33							
SF Granite	3	Kalispel	9/20/2003	1,894	3		14		39			
SF Granite	4	Kalispel	9/20/2003	3,392	11		76		128			
Kalispell Creek	1	Kalispel	8/20/2003	2,807	9		21		39			
Kalispell Creek	2	Kalispel	8/20/2003	436	7		39		21			
Kalispell Creek	3	Kalispel	8/20/2003	1,534	19		9		31			
Kalispell Creek	4	Kalispel	8/20/2003	340	15		28		35			
Kalispell Creek	1	IDFG	7/13/2004	694	3		11		23			
Kalispell Creek	2	IDFG	7/13/2004	770	9		26		81			
Lamb Creek	1	Kalispel	2004	311			77					
Lamb Creek	2	Kalispel	2004	440			76					
Priest River												
Birnarch Creek	1	Kalispel	2004	988	2	1	53					
Birnarch Creek	2	Kalispel	2004	59	11							
Birnarch Creek	3	Kalispel	2004	82	2							
Birnarch Creek	4	Kalispel	2004	91	18							
Birnarch Creek	5	Kalispel	2004	18	3							
Birnarch Creek	6	Kalispel	2004	217	13							
Upper West Branch	1	Kalispel	2003	277	10		21		11			

Appendix A. Continued.

Stream Surveyed	Sample site	Collector	Sample date	Area (m^2) sampled	Number of Fish Sampled: Cutthroat trout	Bull trout	Brook trout	Brown trout	Sculpin	Dace	Mountain whitefish	N. Pike-minnow
Priest River, continued.												
Upper West Branch	2	Kalispel	2003	361	10		9		6			
Upper West Branch	3	Kalispel	2003	533	10		8					
Upper West Branch	4	Kalispel	2003	808	4		13		10			
Upper West Branch	5	Kalispel	2003	616	18		12		6			
East River												
Lost Creek	1	Kalispel	2004	141	10							
Lost Creek	2	Kalispel	2004	451	14							
Lost Creek	3	Kalispel	2004	202	12		1					
Lost Creek	4	Kalispel	2004	282			31					
Lost Creek	5	Kalispel	2004	831	14		22					
NF East River	1	Kalispel	7/21/2003	468	10		12		9			
NF East River	2	Kalispel	7/21/2003	673	14		9		4			
NF East River	3	Kalispel	7/21/2003	410	11		4		5			
NF East River	4	Kalispel	7/22/2003	440	12		5		8			
NF East River	5	Kalispel	7/22/2003	275	9		5		8			
NF East River	1	Kalispel	2004	620			13	5	13	5		
NF East River	2	Kalispel	2004	608	11		15	1	7			
NF East River	3	Kalispel	2004	1,246	10		21		16			
NF East River	4	Kalispel	2004	139	11							
NF East River	5	Kalispel	2004	532	10							
NF East River	6	Kalispel	2004	1,690	7							
Uleda Creek	1	Kalispel	7/8/2003	441	6	10			1			
Uleda Creek	2	Kalispel	7/8/2003	233	1	11						
Uleda Creek	3	Kalispel	7/8/2003	260	16							
Tarlac	1	Kalispel	7/9/2003	298	12		5		5			
Tarlac	2	Kalispel	7/9/2003	156	11		5					
Tarlac	3	Kalispel	7/9/2003	186	19		6					
Tarlac	4	Kalispel	7/9/2003	—	12							
SUMMARY												
Total Fish Sampled	199				2233	192	1279	6	1642	82	1	1
Number of Fish Collected Sites					190	41	85	2	80	10	1	1

Appendix B. Densities (fish/100 m^2) of cutthroat trout in tributaries of the Priest River watershed, Idaho, observed or sampled during 1982-1984[a], 1986-1989[b], 1994-1998[c], and 2003-2004. The number in superscript indicates the year the data was collected.

Major tributary	Stream surveyed	1982-4	1986-9	1994-8	2003-4
Upper Priest River					
	Malcom Creek	4.5^{4}	—	4.6^{8}	5.6^{4}
	Rock Creek	20.2^{4}	5.4^{6}	9.4^{8}	12.2^{4}
	Lime Creek	15.0^{4}	5.4^{6}	4.5^{8}	3.1^{3}
	Cedar Creek	7.1^{4}	6.8^{6}	10.0^{8}	1.9^{3}
	Ruby Creek	25.8^{4}	—	2.1^{8}	9.2^{4}
	Hughes Fork	7.6^{4}	1.6^{8}	3.3^{8}	0.9^{3}
Hughes Fork					
	Bench Creek	5.5^{4}	—	3.1^{8}	9.2^{3}
	Jackson Creek	10.2^{4}	—	7.5^{8}	5.4^{3}
	Gold Creek	2.0^{4}	1.6^{6}	1.4^{8}	1.0^{3}
	Muskegon	19.6^{4}	—	7.6^{8}	—
	Boulder Creek	18.0^{4}	3.4^{6}	7.3^{8}	6.1^{4}
Upper Priest Lake					
	Upper Priest River	0.3^{4}	0.1^{8}	0.3^{8}	0.7^{4}
	Deadman Creek				6.2^{4}
	Trapper Creek	6.8^{2}	2.4^{8}	3.3^{8}	1.3^{4}
Thorofare					
	Caribou Creek	0.8^{2}	0.0^{6}	0.0^{8}	$1.0^{3,4}$
	Bugle Creek	—	—	—	6.5^{4}
Priest Lake – East Side					
	Lion Creek	0.6^{2}	14.4^{8}	—	$1.6^{3,4}$
	S.F. Lion Creek	2.3^{2}	—	—	—
	Two Mouth Creek	1.4^{2}	12.3^{8}	Present^{4}	$2.3^{3,4}$
	Bear Creek	0.0^{2}	0.0^{6}	—	0.0^{4}
	Indian Creek	0.0^{2}	16.1^{8}	—	8.7^{3}
	North Indian Creek	0.0^{2}	0.6^{6}	—	7.5^{4}
	South Indian Creek	—	—	—	17.6^{4}
	Horton Creek	15.4^{2}	9.4^{6}	—	5.2^{4}
	Hunt Creek	8.1^{2}	2.0^{6}	—	7.7^{3}
	South Hunt Creek				10.6^{4}
	Soldier Creek	0.0^{2}	2.4^{8}	Present^{8}	2.7^{3}
Priest Lake – West Side					
	Beaver Creek	11.9^{4}	9.1^{8}	—	5.7^{4}
	Tango Creek				21.3^{3}
	Granite Creek	0.1^{4}	1.1^{8}	Present^{5}	0.4^{3}
	N.F. Granite Creek	1.3^{4}	0.0^{8}	—	0.7^{3}
	S.F. Granite Creek	2.7^{4}	1.8^{8}	Present^{8}	1.7^{3}
	Reeder Creek	—	—	0.0^{8}	—
	Kalispell Creek	3.8^{4}	0.0^{8}	—	$1.5^{3,4}$
	Lamb Creek	—	—	—	0.0^{4}
Priest River					
	Binarch Creek	—	0.2^{6}	—	6.0^{4}
	Upper West Branch	—	0.0^{6}	Present^{8}	3.6^{3}
East River					
	Lost Creek				4.7^{4}
	North Fork East River				$2.3^{3,4}$
	Middle Fork East River	—	8.1^{6}	Present^{5}	—
	Uleda Creek				
	Tarlac Creek	—	0.0^{6}	—	11.6^{3}
	Uleda Creek	—	4.4^{6}	—	1.8^{3}

[a] Irving 1987.
[b] Cowley 1987; Horner et al. 1987; Strach and Bjornn 1991
[c] IDEQ BURP data; Fredericks et al. 2002

Appendix C. Densities (fish/100 m^2) of bull trout in tributaries of the Priest River watershed, Idaho, observed or sampled during 1982-1984, 1986-1989, 1994-1998, and 2003-2004. The number in superscript indicates the year the data was collected.

Major tributary	Stream surveyed	1982-4	1986-9	1994-8	2003-4
Upper Priest River					
	Malcom Creek	1.5^{4}	—	4.2^{8}	0.2^{4}
	Rock Creek	1.1^{4}	0.0^{6}	$<0.01^{8}$	0.0^{4}
	Lime Creek	0.9^{4}	0.0^{6}	0.01^{8}	0.0^{3}
	Cedar Creek	0.8^{2}	0.0^{6}	0.2^{8}	0.0^{3}
	Ruby Creek	0.3^{2}	—	$<0.01^{8}$	0.0^{4}
	Hughes Fork	3.1^{4}	1.3^{8}	1.4^{8}	0.5^{3}
Hughes Fork					
	Bench Creek	31.8^{4}	—	0.6^{8}	0.0^{3}
	Jackson Creek	13.5^{4}	—	0.5^{8}	0.0^{3}
	Gold Creek	0.9^{4}	0.0^{6}	2.4^{8}	0.9^{3}
	Muskegon	0.3^{4}	—	0.0^{8}	—
	Boulder Creek	1.5^{4}	1.5^{6}	0.0^{8}	0.0
Upper Priest Lake					
	Upper Priest River	0.03^{4}	0.1^{8}	0.03^{8}	0.2^{4}
	Deadman Creek	—	—	—	0.0^{4}
	Trapper Creek	—	1.1^{8}	1.1^{8}	0.0^{4}
Thorofare					
	Caribou Creek	0.0^{2}	0.1^{6}	0.0^{8}	$0.02^{3,4}$
	Bugle Creek	—	—	—	0.0^{4}
Priest Lake – East Side					
	Lion Creek	0.5^{2}	0.3^{8}	—	$0.03^{3,4}$
	S.F. Lion Creek	2.3^{2}	—	—	—
	Two Mouth Creek	0.9^{2}	0.2^{8}	Present^{4}	$0.0^{3,4}$
	Bear Creek	0.0^{2}	0.0^{6}	—	0.0^{4}
	Indian Creek	3.9^{2}	0.3^{9}	—	1.1^{3}
	North Indian Creek	3.9^{2}	—	—	1.2^{4}
	South Indian Creek	—	—	—	0.0^{4}
	Horton Creek	0.0^{2}	0.0^{6}	—	0.0^{4}
	Hunt Creek	0.0^{2}	0.0^{6}	—	0.0^{3}
	South Hunt Creek	—	—	—	0.0^{4}
	Soldier Creek	0.0^{2}	0.1^{7}	0.0^{8}	0.0^{3}
Priest Lake – West Side					
	Beaver Creek	0.0^{4}	0.3^{9}	—	0.0^{4}
	Tango	—	—	—	0.0^{3}
	Granite Creek	0.0^{4}	0.1^{9}	0.0^{5}	0.01^{3}
	N.F. Granite Creek	1.2^{4}	0.0^{8}	—	0.05^{3}
	S.F. Granite Creek	0.1^{4}	0.2^{8}	Present^{8}	0.0^{3}
	Reeder Creek	—	—	0.0^{8}	—
	Kalispell Creek	0.1^{4}	0.0^{8}	—	$0.0^{3,4}$
	Lamb Creek	—	0.0^{6}	—	0.0^{4}
Priest River					
	Binarch Creek	—	0.0^{6}	—	0.1^{4}
	Upper West Branch	—	0.0^{6}	0.0^{8}	0.0^{3}
East River					
	Lost Creek	—	0.0^{6}	—	0.0^{4}
	North Fork East River	—	0.0^{6}	—	$0.0^{3,4}$
	Middle Fork East River	—	1.8^{6}	Present^{5}	
	Uleda Creek	—	6.6^{6}	—	5.1^{3}
	Tarlac Creek	—	4.4^{6}	—	0.0^{3}

a Irving 1987.
b Cowley 1987; Horner et al. 1987; Strach and Bjornn 1991
c IDEQ BURP data; Fredericks et al. 2002

Appendix D. Densities (fish/100 m^2) of brook trout in tributaries of the Priest River watershed, Idaho, observed or sampled during 1957, 1982-1984, 1986-1989, 1994-1998; and 2003-2004. The number in superscript indicates the year the data was collected.

Major Tributary	Stream Surveyed	1957	1982-4	1986-9	1994-8	2003-4
Upper Priest River						
	Malcom Creek	0.0	0.0^{4}	—	0.0^{8}	0.0^{4}
	Rock Creek	0.0	0.0^{4}	0.0^{6}	1.7^{8}	0.3^{4}
	Lime Creek	0.0	0.03^{4}	0.0^{6}	0.01^{8}	0.3^{3}
	Cedar Creek	0.0	0.0^{4}	0.0^{6}	0.0^{8}	0.0^{3}
	Ruby Creek	0.0	0.7^{4}	—	4.7^{8}	4.7^{4}
	Hughes Fork	0.0	0.01^{4}	0.9^{8}	1.2^{8}	0.5^{3}
Hughes Fork						
	Bench Creek	0.0	0.0^{4}	—	0.0^{8}	2.6^{3}
	Jackson Creek	0.0	0.0^{4}	—	0.0^{8}	0.2^{3}
	Gold Creek	0.0	1.6^{4}	0.0^{6}	0.0^{8}	0.02^{3}
	Muskegon	0.0	0.0^{4}	—	0.0^{8}	—
	Boulder Creek	0.0	0.5^{4}	0.0^{6}	0.0^{8}	0.5^{4}
Upper Priest Lake						
	Upper Priest River	0.0	0.0^{4}	0.0^{8}	0.02^{8}	Present^{4}
	Deadman Creek	—	—	—	—	0.0^{4}
	Trapper Creek	0.0	—	0.0^{8}	0.1^{8}	0.0^{4}
Thorofare						
	Caribou Creek	0.0	0.3^{4}	0.0^{6}	0.2^{8}	$0.7^{3,4}$
	Bugle Creek	—	—	—	—	6.6^{4}
Priest Lake – East Side						
	Lion Creek	Present	0.0^{2}	0.0^{8}	—	$0.2^{3,4}$
	S.F. Lion Creek	—	0.0^{2}	—	—	0.0^{4}
	Two Mouth Creek	Present	0.03^{2}	0.4^{8}	Present4	$0.1^{3,4}$
	Bear Creek	Present	32.0^{2}	38.9^{6}	—	22.5^{4}
	Indian Creek	Present	0.4^{3}	0.2^{8}	—	0.0^{3}
	North Indian Creek	0.0	0.0^{2}	0.0^{6}	—	0.0^{4}
	South Indian Creek	0.0	—	—	—	0.0^{4}
	Horton Creek	Present	0.0^{2}	0.0^{6}	—	0.0^{4}
	Hunt Creek	0.0	0.0^{2}	0.0^{6}	—	0.0^{3}
	South Hunt Creek	—	—	—	—	0.0^{4}
	Soldier Creek	Present	5.0^{2}	20.3^{8}	Present8	7.9^{3}
Priest Lake – West Side						
	Beaver Creek	Present	2.7^{4}	5.5^{8}	—	2.7^{3}
	Granite Creek	Present	0.0^{4}	0.7^{8}	Present5	0.8^{3}
	Tango Creek	—	—	—	—	1.1^{3}
	N.F. Granite Creek	Present	0.7^{4}	0.9^{8}	Present8	2.3^{3}
	S.F. Granite Creek	Present	0.4^{4}	0.3	—	2.5^{3}
	Reeder Creek	Present	—	—	Present8	—
	Kalispell Creek	Present	5.1^{4}	20.6^{8}	—	$3.5^{3'4}$
	Lamb Creek	—	—	—	—	39.5^{4}
Priest River						
	Binarch Creek	—	—	—	—	7.1^{4}
	Upper West Branch	—	—	—	Present8	4.7^{3}
East River						
	Lost Creek	—	—	—	—	5.5^{4}
	North Fork East River	—	—	4.3^{6}	—	$2.3^{3,4}$
	Middle Fork East River	—	—	1.7^{6}	Present8	—
	Uleda Creek	—	—	0.0^{6}	—	0.0^{3}
	Tarlac Creek	—	—	2.1^{6}	—	4.9^{3}

[a] Irving 1987.

[b] Cowley 1987; Horner et al. 1987; Strach and Bjornn 1991

[c] IDEQ BURP data; Fredericks et al. 2002

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