FISHERY MANAGEMENT INVESTIGATIONS

FEDERAL AID IN FISH RESTORATIONS
2001 JOB PERFORMANCE REPORT
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Steven M Huffaker, Director

REGIONAL FISHERIES MANAGEMENT INVESTIGATIONS
PANHANDLE REGION (Subprojects I-A, II-A, III-A, IV-A)

SUBPROJECT I.	**SURVEYS AND INVENTORIES**
Job a.	**Panhandle Region Mountain Lakes Investigations**
Job b.	**Panhandle Region Lowland Lakes Investigations**
Job c.	**Panhandle Region Rivers and Streams Investigations**
Job c^{2}.	**Little North Fork Clearwater Tributary Investigations**
Job c^{3}.	**Genetic Analysis of Westslope Cutthroat Trout and Bull Trout**
SUBPROJECT II.	**TECHNICAL GUIDANCE**
SUBPROJECT III.	**HABITAT MANAGEMENT**
SUBPROJECT IV.	**LAKE RESTORATION**

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2001 ANNUAL PERFORMANCE REPORT

State of:	Idaho	Program:	Fisheries Management F-71-R-26
Project:	I-Surveys and Inventories	Subproject:	I-A Panhandle Region
Job No.:	a	Title:	Mountain Lakes Investigations

Contract Period: July 1, 2000 to June 30, 2001

ABSTRACT

There were no mountain lake survey related activities in the Panhandle Region during this contract period.

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2001 ANNUAL PERFORMANCE REPORT

State of: Idaho Program: Fisheries Management F-71-R-26

Project: I-Surveys and Inventories Subproject: I-A Panhandle Region

Job No.: b Title: Lowland Lakes Investigations

Contract Period: July 1, 2000 to June 30, 2001

ABSTRACT

A midwater trawl was used in July to estimate the kokanee *Oncorhynchus nerka* population in Coeur d'Alene Lake. Trawl results indicated record low number of adult kokanee, with the total population of age-3 fish estimated at 25,300, or 3 fish/ha. We estimated 929,000 age-1 and 193,000 age-2 kokanee. The estimated population of age-0 kokanee was slightly over 7 million fish. The standing stock of kokanee was 3.86 kg/ha, compared to the 2000 estimate of 5.8 kg/ha. Kokanee fry collected in the trawl ranged from 30 to 70 mm TL, age-1 kokanee ranged from 80 to 160, age-2 ranged from 170 to 220 mm, and age-3 kokanee ranged from 250 mm to 290 mm. Hydroacoustic surveys confirm that the trawler underestimates the older age classes of kokanee but is accurate for age-0.

We counted 38 chinook salmon *O. tshawytscha* redds in the Coeur d'Alene River drainage and 36 in the St. Joe River. We estimated an additional four chinook salmon redds in Wolf Lodge Creek, based on fish captured and passed over the weir. All redds were left undisturbed to provide natural production. Due to lack of availability, no age-0 chinook salmon were stocked in Coeur d'Alene Lake in 2001.

An additional 195 lake trout *Salvelinus namaycush* were tagged by the Priest Lake volunteer angler. Fish ranged from 310 to 990 mm TL with a mean size of 440 mm. All of these fish were tagged near Bartoo Island. A total of 40 tagged lake trout were recaptured in 2001. All had been tagged in Priest Lake between 1986 and 2001. Lake trout were caught from 0 to 22.5 km from their original capture site, with an average distance of approximately 3 km from original capture site. Growth, as reported in tag returns, ranged from 0 to 15 cm/year with an average annual growth of 3.4 cm/year.

We used gill nets to capture lake trout from Upper Priest Lake in June, August and October. We netted and removed a total of 471 lake trout in the three netting efforts. Catches ranged from 78 lake trout in our June effort to 231 fish in October. Standardized catch ranged from 0.83 to 2.2 fish/hr/100m^2 with no apparent trend or evidence of depletion. Mean catch rate throughout the 2001 effort was 1.8 fish/hr/100m^2, compared to 0.95 fish/hr/100m^2 in 1999 and 1.1 fish/hr/100m^2 in 1998. Size of lake trout ranged from 265 to 930 mm TL, with a modal size of 510 mm. We incidentally netted seven bull trout *S. confluentus* during the lake trout netting efforts; no known bull trout mortality occurred. The ratio of lake trout to bull trout was 67:1, compared to 21:1 in 1999 and 10:1 in 1997.

We conducted kokanee spawner counts along the shoreline of Priest and Upper Priest lakes in November. A total of 1,765 kokanee spawners were counted in Priest Lake at five locations. Ten kokanee redds were observed along the shoreline of Upper Priest Lake. The numbers of redds observed at each of the five sites on Priest Lake were: Copper Bay 588, Huckleberry Bay 200, Cavanaugh Bay 523, Hunt Creek beach 232, and Indian Creek beach 222.

We tagged 95 black crappie *Pomoxis nigromaculatus* in Hayden Lake with reward tags to estimate annual black crappie exploitation in 2001. A total of 22 of these tags were returned within one year of initial capture for an uncorrected annual exploitation rate of 23 percent.

We conducted standard lake surveys on Freeman and Blue lakes using procedures outlined in the Idaho Department of Fish and Game (Department) Standard Lowland Lakes Survey Manual. Largemouth bass *Micropterus salmoides* were the most abundant species in the sample based on number and were the most abundant game species based on sample weight in both lakes. Game species comprised 100% of the sample in the Blue Lake survey with the catch consisting of largemouth bass, yellow perch *Perca flavescens,* black crappie, pumpkinseed *Lepomis gibbosus,* tiger muskie *Esox x E. masquinongy* and channel catfish *Ictalurus punctatus.* In Freeman Lake, game species comprised 92% of the sample based on number and 55% of the sample based on weight. Tench *Tinca tinca* were the only nongame species collected comprising 8% of the catch by number and 45% of the catch by weight.

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OBJECTIVES

1. Evaluate stock status of kokanee *Oncorhynchus nerka* in Coeur d'Alene Lake.

2. Count chinook salmon *O. tshawytscha* redds in the Coeur d'Alene and St. Joe rivers and estimate production of wild chinook salmon.

3. Conduct standard lake surveys of Freeman and Blue lakes; compare to previous studies.

4. Determine shoreline spawning areas used by kokanee; estimate number of redds in Priest and Upper Priest lakes.

5. Compare gill net catch rates of lake trout *Salvelinus namaycush* in 2001 with catch rates from 1998 and 1999 to provide additional information on the effectiveness of our lake trout suppression efforts.

6. Determine stock status of lake trout and bull trout *S. confluentus* in Upper Priest Lake.

7. Estimate exploitation of black crappie *Pomoxis nigromaculatus* in Hayden Lake.

METHODS

Coeur d'Alene Lake

Kokanee Population Estimate—We used a midwater trawl, as described by Bowler et al. (1979), Rieman and Myers (1990), and Reiman (1992), to estimate the kokanee population in Coeur d'Alene Lake. Twenty transects were trawled during the dark phase of the moon July 17-18, 2001. Trawl transects were selected using a stratified random sample design and were in identical locations (as near as possible) to those used in previous years (Figure 1). We typically trawl 22 sites, however mechanical problems prevented trawling two transects in 2001. Kokanee were measured and weighed, and scale and otoliths were collected from representative length groups for age analysis.

We used an experimental sinking gill net to estimate mean length of male and female kokanee spawners. The net was set at depths of 3-5 m near Higgins Point for two hours on November 27, 2001. Potential egg deposition (PED) was estimated as the number of female kokanee spawners (half the mature population based on midwater trawling) multiplied by the average number of eggs produced per female. Average number of eggs produced per female kokanee was calculated using the following length to fecundity regression (Rieman 1992):

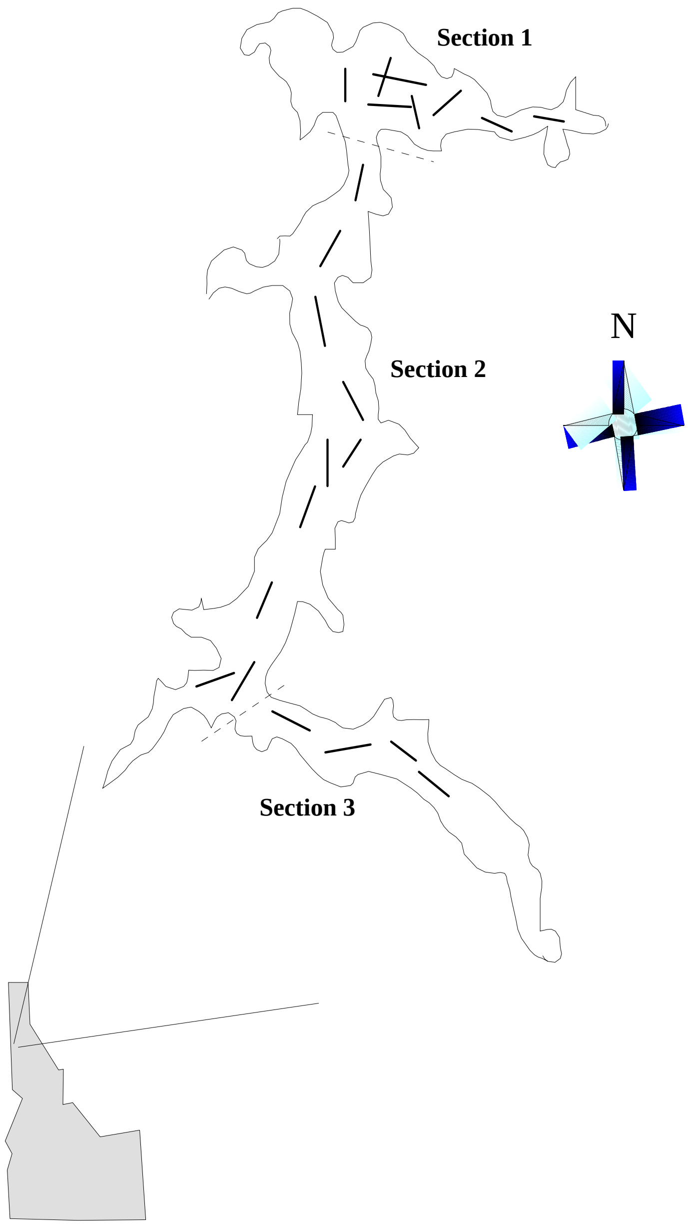

Figure 1. Location of the midwater trawling transects in three sections of Coeur d'Alene Lake, Idaho, used to estimate the kokanee population.

$$Y = 3.98x - 544$$

Where: x=mean length of female kokanee spawners (mm)
Y=mean number of eggs per female

Chinook Salmon Abundance—Department personnel used a helicopter to conduct chinook salmon redd surveys in the Coeur d'Alene, North Fork Coeur d'Alene, South Fork Coeur d'Alene, Little North Fork Coeur d'Alene and St. Joe rivers on October 9, 2001. We estimated the natural production using these redd counts, an estimate of 4,000 eggs per redd, and a mean egg-to-smolt survival of 10%. Due to the anticipated low number of returning adult chinook salmon, we installed a fish weir on Wolf Lodge Creek to collect eggs from migrating adult chinook salmon. The weir was installed beneath the Interstate 90 bridge on August 22 and removed September 26.

Spirit Lake

Kokanee population and relative year-class abundance are typically evaluated each year, however due to low lake levels in 2001 we were unable to launch our 9.5 m trawling boat at Spirit Lake.

Priest Lake

2001 Tagging and Tag Returns—Lake trout were tagged as part of an ongoing effort to quantify angler exploitation and help define the population dynamics of lake trout in Priest Lake. All fish were caught and tagged by Randy Phelps, a volunteer angler. Spaghetti tags were placed in the dorsal musculature beneath the dorsal fin. Catch location, date, fish length and weight, and any comments regarding the health or release of the fish were recorded at the time of tagging along with the tag number. Fish were released back to the same water from where they were captured.

In addition, we continued to collect information on lake trout reported by anglers in 2001 with tags from previous years. As in past years, we summarized total and annual growth and distance from original capture.

Kokanee Spawner Counts—Lakeshore areas were surveyed to determine the location of kokanee spawning and to quantify the number of spawners. Kokanee spawner counts were conducted in five historic spawning areas on Priest Lake and the entire shoreline of Upper Priest Lake. Surveys were conducted on November 7 on Priest Lake and November 16, 2001 on Upper Priest Lake. Surveys were conducted using a boat with two observers standing on the bow while a third person drove the boat contouring the shoreline at a depth of about 3 m. Each observer counted spawners, and an average of the two counts was used as the estimate for each of the five sites. Our efforts were concentrated on the area between the Granite Creek delta and Copper Bay, Indian Creek campground and marina, Cavanaugh Bay Marina, Hunt Creek delta and Huckleberry Bay (Figure 2).

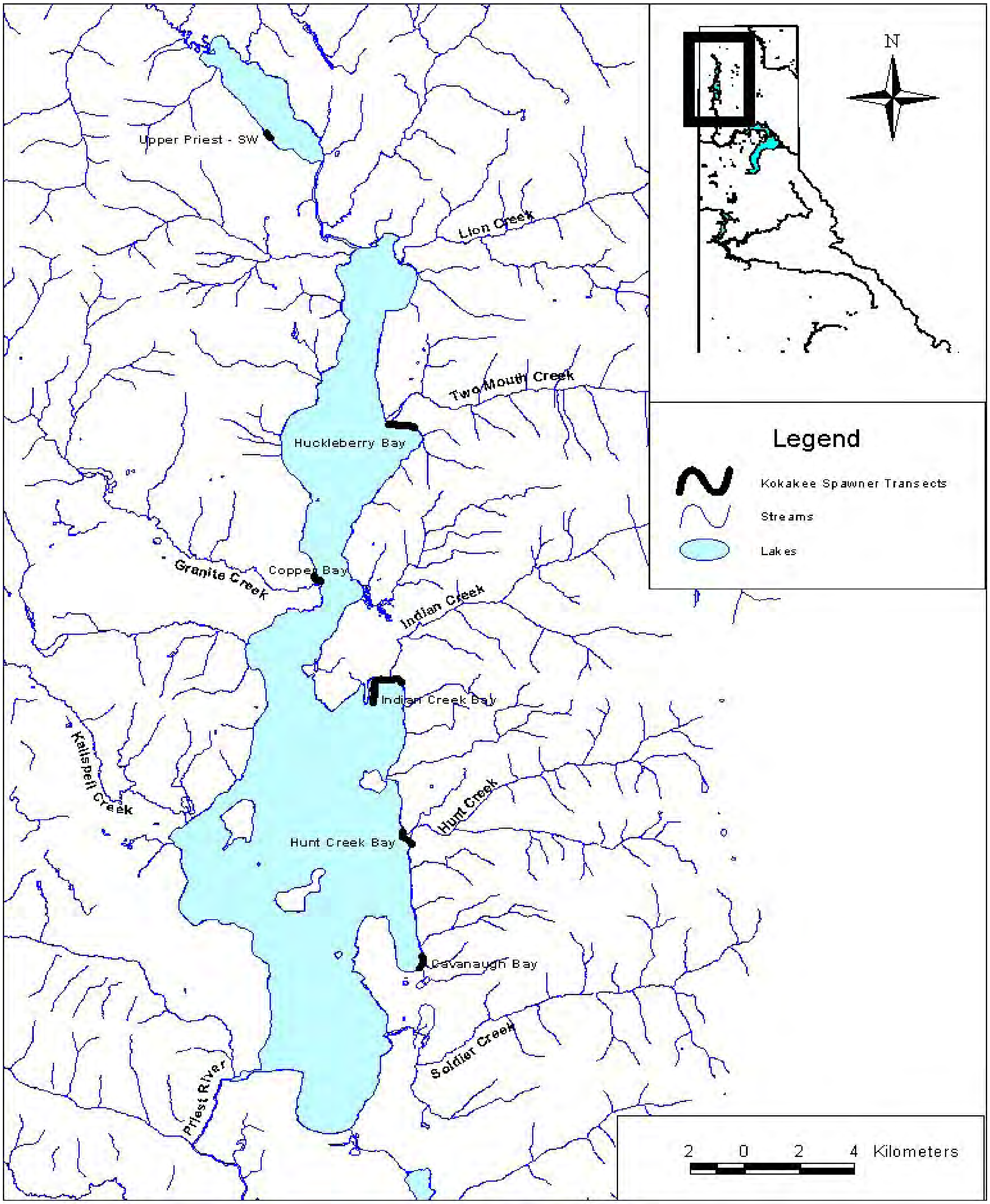

Figure 2. Location of 2001 kokanee spawner counts on Priest Lake and Upper Priest Lake, Idaho.

Upper Priest Lake

Lake Trout Netting—Lake trout were sampled from Upper Priest Lake using four 91.4 x 2.4 m experimental, monofilament, sinking gill nets with three panels of 2.5, 3.8 and 5.1 cm mesh.

Sampling occurred on June 12-13, August 8-9 and October 25-26, 2001. A concerted effort was made to avoid incidental bull trout captures. Gill nets were set perpendicular to shore at depths ranging from 20 to 33 mm. Nets were set during daylight hours only and were pulled every 45-50 minutes. We standardized catch to a unit of sampling effort (fish/hr/100m^2 of gill net) for comparison with 1998 and 1999 efforts. Netted lake trout were measured, examined for tags and filleted. All processed lake trout were given to the Post Falls, Idaho food bank for distribution to the indigent.

Standard Lowland Lake Surveys

We conducted standard lowland lake surveys on Blue and Freeman lakes using procedures outlined in the Idaho Department of Fish and Game (Department) Standard Lowland Lakes Survey Manual. We used two trap nets, two floating and two sinking gill nets, and one hour of electrofishing effort on each lake. Freeman Lake was gillnetted on the night of June 21, 2001 and electrofishing was conducted on the night of August 20. Blue Lake was gillnetted June 27 and electrofishing was conducted on July 3. We then standardized our catch to a single unit of effort (one trap net, one pair of gill nets, and one hour of electrofishing time).

Hayden Lake

Crappie Exploitation – Black crappie *Pomoxis nigromaculatus* were sampled through electrofishing and tagged with Floy T-bar anchor reward tags to estimate annual exploitation in 2001. Tagging occurred on May 9 and 17, 2001.

RESULTS

Fish Population Characteristics

Coeur d'Alene Lake

Kokanee Abundance—Trawl results indicated a record low number of adult kokanee, with the total population of age-3 fish estimated at 25,300, or 3 fish/ha, far below the 22-year mean of nearly one million age-3 kokanee (Table 1). We estimated 929,000 age-1 and 193,000 age-2 kokanee. Both of these year classes were below the 1979-2001 mean, but were slightly higher than the 2000 estimates (Table 1). The estimated population of age-0 kokanee was the highest ever recorded and twice that of the 23-year mean of 3.4 million fish. The standing stock of kokanee in Coeur d'Alene Lake was 3.86 kg/ha. This is about half of the 2000 estimate of 8 kg/ha and far below the 22 year mean of 84 kg/ha. Consistent with previous years, the highest age-0 kokanee densities were in the northern section of the lake (Table 2). Based on the 2000 potential egg deposition (PED) estimate and the 2001 age-0 estimate, egg to fry survival was 22%, which is identical to the 2000 estimate and much higher than previous years (Table 3).

Table 1. Estimated abundance of kokanee made by midwater trawl in Coeur d'Alene Lake, Idaho, from 1979-2001. To follow a particular year class of kokanee, read up one row and right one column.

Sampling year	Age class Age 0+	Age 1+	Age 2+	Age 3/4+	Total	Age 3+/ha
2001	7,098,700	929,900	193,100	25,300	8,247,000	3
2000	4,184,800	783,700	168,700	75,300	5,212,600	8
1999	4,091,500	973,700	269,800	55,100	5,390,100	6
1998	3,625,000	355,000	87,000	78,000	4,145,000	8
1997	3,001,100	342,500	97,000	242,300	3,682,000	25
1996	4,019,600	30,300	342,400	1,414,100	5,806,400	147
1995	2,000,000	620,000	2,900,000	2,850,000	8,370,000	296
1994	5,950,000	5,400,000	4,900,000	500,000	12,600,000	52
1993	5,570,000	5,230,000	1,420,000	480,000	12,700,000	50
1992	3,020,000	810,000	510,000	980,000	5,320,000	102
1991	4,860,000	540,000	1,820,000	1,280,000	8,500,000	133
1990	3,000,000	590,000	2,480,000	1,320,000	7,390,000	137
1989	3,040,000	750,000	3,950,000	940,000	8,680,000	98
1988	3,420,000	3,060,000	2,810,000	610,000	10,900,000	63
1987	6,880,000	2,380,000	2,920,000	890,000	13,070,000	93
1986	2,170,000	2,590,000	1,830,000	720,000	7,310,000	75
1985	4,130,000	860,000	1,860,000	2,530,000	9,370,000	263
1984	700,000	1,170,000	1,890,000	800,000	4,560,000	83
1983	1,510,000	1,910,000	2,250,000	810,000	6,480,000	84
1982	4,530,000	2,360,000	1,380,000	930,000	9,200,000	97
1981	2,430,000	1,750,000	1,710,000	1,060,000	6,940,000	110
1980	1,860,000	1,680,000	1,950,000	1,060,000	6,500,000	110
1979	1,500,000	2,290,000	1,790,000	450,000	6,040,000	46
Previous x	3,241,200	1,622,300	1,780,300	909,100	7,407,000	94

Table 2. Kokanee population estimates and standing crop (kg/ha) in each section of Coeur d'Alene Lake, Idaho, July 17-18, 2001

Section	Age 0	Age 1	Age 2	Age 3	Kg/ha
1	6,676,362	325,733	8,919	3,554	4.39
2	414,627	365,677	127,647	17,915	3.27
3	7,689	238,459	56,549	3,845	5.18
Whole Lake	7,098,678	929,868	193,115	25,314	
(90% CI)	3,748,493	275,667	104,672	18,267	3.86

Table 3. Estimates of female kokanee spawning escapement, potential egg disposition, fall abundance of kokanee fry, and their subsequent survival rates in Coeur d'Alene Lake, Idaho, 1979-2001.

Year	Estimated female escapement	Estimated potential number of eggs ($x10^6$)	Fry estimate the following year ($x10^6$)	Percent egg to fry survival
2001	12,650	10		
2000	37,700	32	7.10	22.00
1999	28,000	19	4.18	22.62
1998	39,000	26	4.09	15.73
1997	90,900	54	3.60	6.67
1996	707,000	358	3.00	0.84
1995	1,425,000	446	4.02	0.90
1994	250,000	64	2.00	0.31
1993	240,000	92	5.95	6.46
1992	488,438	198	5.57	2.81
1991	631,500	167	3.03	1.81
1990	657,777	204	4.86	1.96
1989	516,845	155	3.00	1.94
1988	362,000	119	3.04	2.55
1987	377,746	126	3.42	2.71
1986	368,633	103	6.89	6.68
1985	530,631	167	2.17	1.29
1984	316,829	106	4.13	3.90
1983	441,376	99	0.70	0.71
1982	358,200	120	1.51	1.25
1981	550,000	184	4.54	2.46
1980	501,492	168	2.43	1.45
1979	257,716	86	1.86	2.20

Kokanee fry collected in the trawl ranged from 30 to 70 mm TL. Age-1 kokanee ranged from 80 to 160 mm, with a modal length of around 140 mm. Age-2 fish ranged from 170 to 240 mm, with a modal length of around 200 mm. Size of the age-3 kokanee at the time of trawling ranged from 250 to 300 mm, with a modal length of 255 mm (Figure 3). Typical of kokanee in Coeur d'Alene Lake, maturity was primarily at age-3. Seven of eight age-2 kokanee captured were mature were females, and no mature age-2 kokanee were found. All of the age-3 kokanee captured were mature.

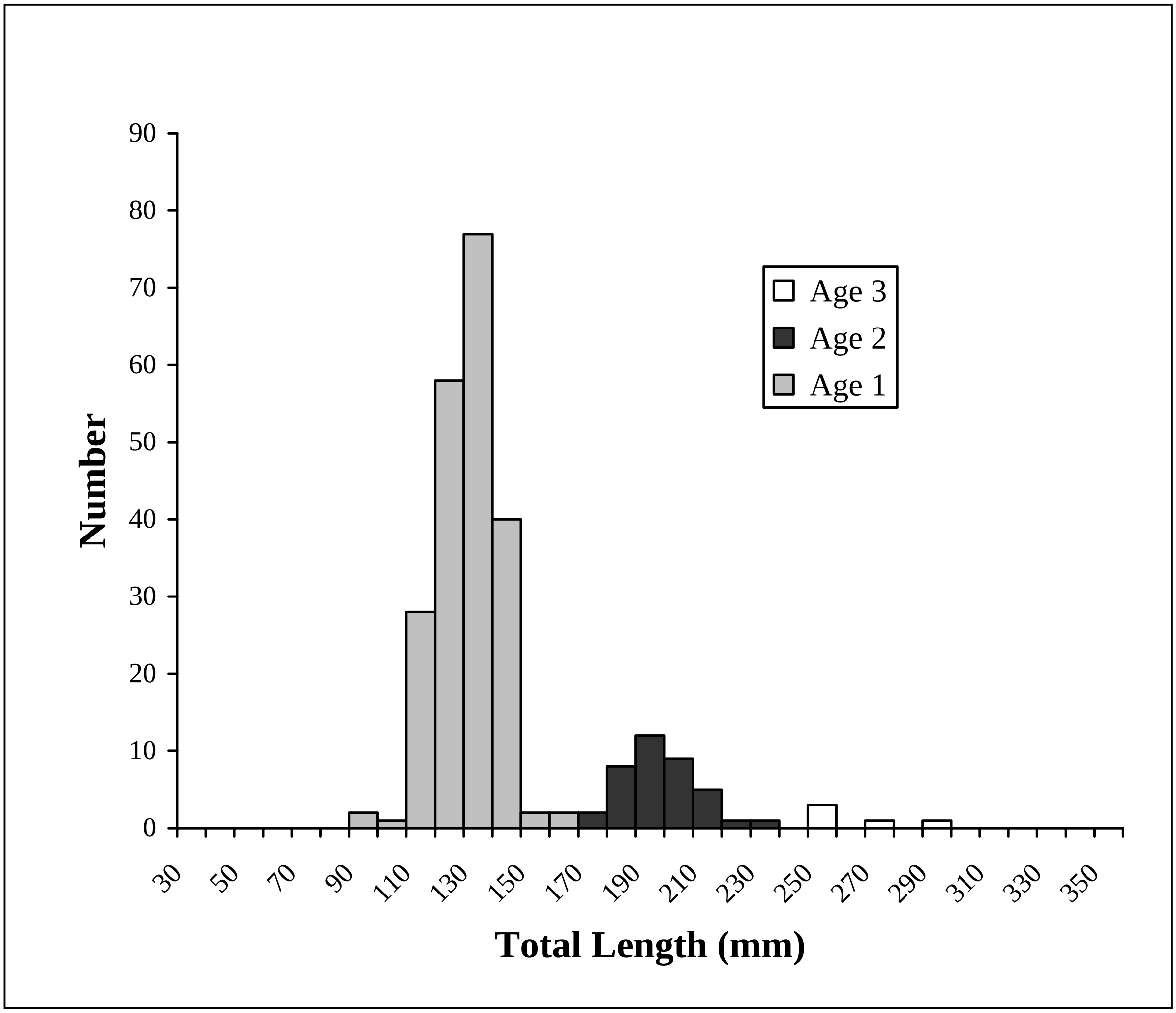

Figure 3. Length frequency and age of kokanee collected by midwater trawling in Coeur d'Alene Lake, Idaho, July 2001.

In two one-hour gill net sets, we collected 242 kokanee spawners near Higgins Point in Wolf Lodge Bay. Males far outnumbered females, with only around 7% of the sample being females. Female mean length was 344 mm TL, (n=18, SD=22.3). Male mean and modal lengths were 356 and 342 mm, respectively (n=127, SD=29.6). Mean length of spawners was comparable to that of 2000. Spawner length during the past two years was the largest it has been since 1960 (Figure 4). Mean fecundity was estimated at 825 eggs per female based on a mean female spawner length of 344 mm, and potential egg deposition was approximately 10.4 million eggs (Table 3). This represents the lowest PED estimate to date and is well below the average for the past 22 years (140 million).

Chinook Salmon Abundance—Eight adult chinook salmon, four males and four females, were captured in the Wolf Lodge Creek weir from September 20 to September 26, 2001. Of these, one was of hatchery origin. Male and female mean lengths were 647 and 730 mm TL, respectively. The decision was made to release all eight chinook salmon above the weir to spawn naturally due to the availability of 40,000 hatchery fish from other systems in 2001. The weir was disassembled and removed on September 26.

We counted 38 chinook salmon redds in the Coeur d'Alene River drainage and 36 in the St. Joe River. We estimated an additional four chinook salmon redds in Wolf Lodge Creek based on fish captured and passed above the weir. Therefore, we estimated the total number of chinook salmon redds in the drainage at 78 (Table 4). All redds were left undisturbed to provide natural production. Conditions for counting were relatively favorable (clear skies and clear water), and we were easily able to see most redds. We estimated the natural production using these redd counts at 4,000 eggs per redd and a mean egg-to-smolt survival of 10%. Based on these figures, we estimated smolt production from wild chinook salmon to be 31,200 fish.

In previous years, we utilized a combination of hatchery reared and naturally produced juvenile chinook salmon to maintain the chinook salmon population in Coeur d'Alene Lake. However, in 2000 no hatchery chinook salmon were available for release as smolts in 2001. Over the past 20 years, we have stocked an average of 30,000 age-0 chinook salmon in Wolf Lodge Bay (Table 5).

Priest Lake

2001 Tagging and Tag Returns—An additional 195 lake trout were tagged by the Priest Lake volunteer angler. Fish ranged from 310 to 990 mm TL with a mean size of 440 mm. All of these fish were tagged near Bartoo Island.

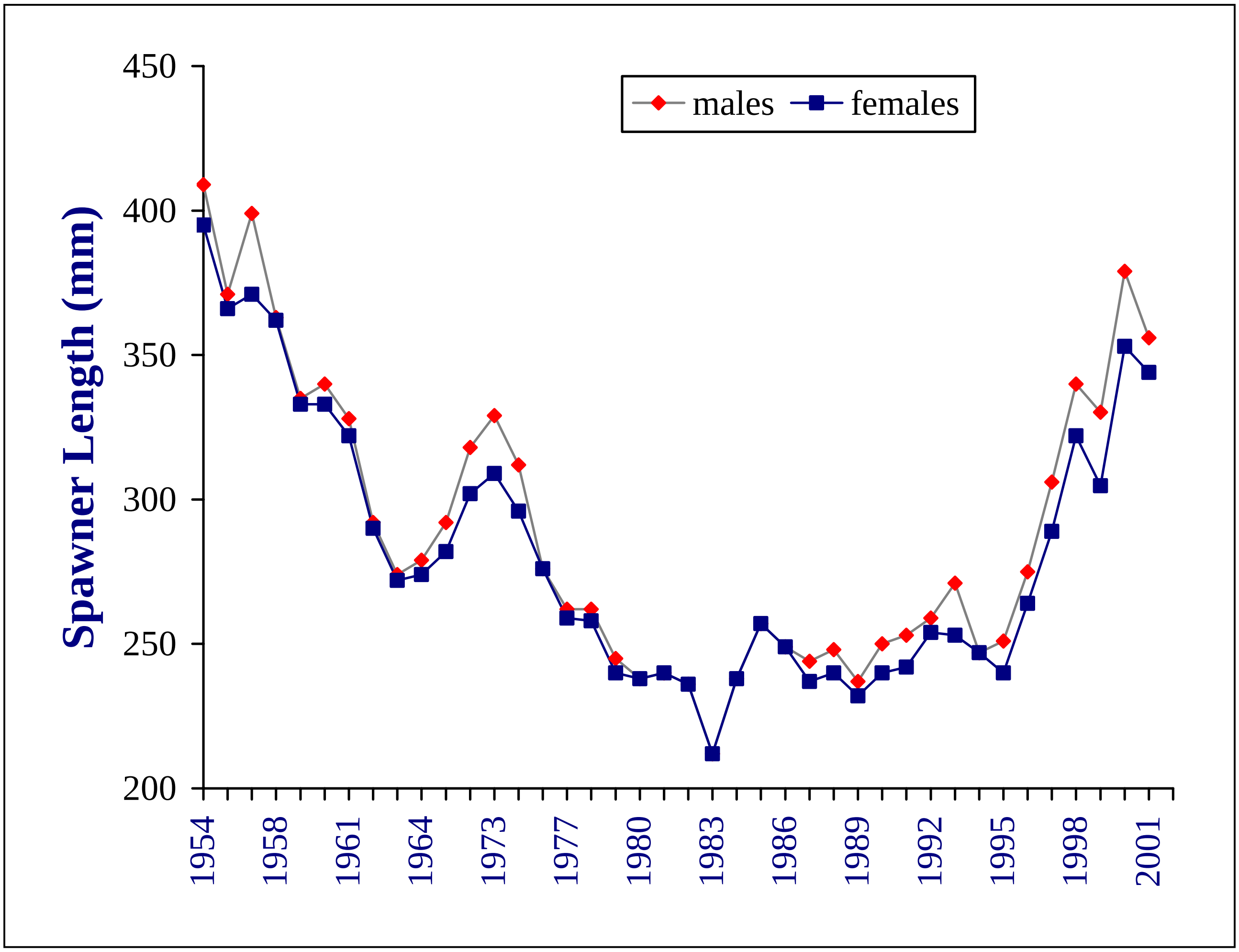

Figure 4. Mean total length of male and female kokanee spawners in Coeur d'Alene Lake, Idaho from 1954 to 2001. Years where mean lengths were identical between sexes are a result of averaging male and female lengths.

Table 4. Chinook salmon redd counts in the Coeur d'Alene River drainage, St. Joe River, and Wolf Lodge Creek, Idaho, 1990-2001

Location	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Coeur d'Alene												
Cataldo Mission to S.F. Cd'A River	41	11	29	80	82	45	54	18	11	7	16	18
S.F. Cd'A River to L.N.F. Cd'A River	10	0	5	11	14	14	13	5	3	5	20	13
L.N.F. Cd'A River to Steamboat Creek	--	2	3	6	1	1	13	6	1	0	3	2
Steamboat Creek to steel bridge	--	--	1	0	0	1	13	6	1	0	3	2
Steel bridge to Beaver Creek	--	--	--	--	0	0	0	1	0	0	0	0
S.F. Cd'A River	--	--	--	--	0	0	0	0	1	0	0	0
L.N.F. Cd'A River	--	--	--	--	13	--	4	0	0	0	5	4
Coeur d'Alene River Subtotal	**51**	**13**	**38**	**97**	**110**	**64**	**84**	**33**	**15**	**12**	**45**	**38**
St. Joe River												
St. Joe City to Calder	4	0	18	20	6	1	59	20	3	0	5	21
Calder to Huckleberry C.G.	3	1	1	4	0	0	5	2	1	0	0	15
Huckleberry C.G. to Marble Creek	3	0	2	0	1	0	7	2	0	0	0	--
Marble Creek to Avery	0	0	0	0	1	0	0	0	2	0	0	--
St. Joe River Subtotal	**10**	**1**	**21**	**24**	**8**	**1**	**71**	**24**	**6**	**0**	**5**	**36**
Wolf Lodge Creek									4	5	3	4
TOTAL	**66**	**14**	**63**	**121**	**118**	**65**	**155**	**57**	**25**	**17**	**53**	**78**

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Table 5. Number of chinook salmon stocked and estimated number of naturally produced chinook salmon entering Coeur d'Alene Lake, Idaho, 1982-2001.

	Hatchery produced				Naturally produced		
Year	Number	Stock	Rearing hatchery	Fin clip	Redds	Estimated smolts	Total
1982	34,400	Bonneville	Hagerman	--	--	--	34,400
1983	60,100	Bonneville	Mackay	--	--	--	60,100
1984	10,500	L. Michigan	Mackay	--	--	--	10,500
1985	18,500	L. Michigan	Mackay	Left Ventral	--	--	18,500
1986	29,500	L. Michigan	Mackay	Right Ventral	--	--	29,500
1987	59,400	L. Michigan	Mackay	Adipose	--	--	59,400
1988	44,600	Coeur d'Alene	Mackay	Left Ventral	--	--	44,600
1989	35,400	Coeur d'Alene	Mackay	Right Ventral	--	--	35,400
1990	36,350	Coeur d'Alene	Mackay	Adipose	52	23,400	59,100
1991	42,650	Coeur d'Alene	Mackay	Left Ventral	70	31,500	73,100
1992	10,000	Coeur d'Alene	Mackay	Right Ventral	14	6,300	16,300
1993	0	--	--	--	63	28,350	28.350
1994	17,269	Coeur d'Alene	Nampa	Adipose	100	40,000	57,269
1995	30,200	Coeur d'Alene	Nampa	Left Ventral	100	40,000	70,200
1996	39,700	Coeur d'Alene	Nampa	Right Ventral	65	26,000	65,700
1997	12,100	Coeur d'Alene	Nampa	Adipose	84	33,600	45,700
1998	55,200	Priest Rapids	Cabinet G.	Left Ventral	37	14,800	70,000
1999	25,000	Big Springs	Cabinet G.	Right Ventral	25	10,000	35,000
2000	28,200	Big Springs	Nampa	Adipose	17	6,800	35,000
2001	0	--	--	--	78	31,200	31,200

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A total of 40 tagged lake trout were recaptured in 2001. All had been tagged in Priest Lake between 1986 and 2001 (Table 6). Lake trout were caught from 0.0 to 22.5 km from their original capture site, with an average distance of approximately 3 km from original capture site.

Growth, as reported in tag returns, ranged from 0 to 15 cm/year, with an average annual growth of 3.4 cm/year. This compares to a reported mean annual growth of 4 cm/year in 2000 and 1.3 cm/year in 1999.

Kokanee Spawner Counts—A total of 1,765 kokanee spawners were counted at five shoreline sites on Priest Lake (Figure 2). Ten kokanee spawners were counted on Upper Priest Lake, however high winds and rain made visual observation difficult on Upper Priest Lake. Very few dead kokanee were observed at the time of our surveys. Mean lengths of two male and two female kokanee were 431 and 393 mm TL, respectively. The majority of the kokanee spawned in water 0.5 m and deeper with redds seen as deep as 6 m; however, kokanee were observed spawning in water as shallow as 15 cm. Very shallow redds were noted in Cavanaugh and Copper bays. Redds were dug in combinations of substrate material ranging from sand to stones 7.6 cm in diameter. Numbers of redds observed at each of the five sites on Priest Lake were: Copper Bay 588, Huckleberry Bay 200, Cavanaugh Bay 523, Hunt Creek beach 232, and Indian Creek beach 222.

Upper Priest Lake

Lake Trout Netting—We netted and removed 471 lake trout in the three netting efforts. Catches ranged from 78 lake trout in our June effort to 231 fish in October. Standardized catch ranged from 0.83 to 2.2 fish/hr/100 m^2, with no apparent trend or evidence of depletion. Mean catch rate throughout the 2001 effort was 1.8 fish/hr/100 m^2 of gill net, compared to 0.95 fish/hr/100 m^2 in 1999 and 1.1 fish/hr/100 m^2 in 1998 (Figure 5). Size of lake trout ranged from 265 to 930 mm TL, with a modal size of 510 mm (Figure 6).

We incidentally netted seven bull trout during the lake trout netting efforts, and no known bull trout mortality occurred. The ratio of bull trout to lake trout was 1:67, compared to 1:21 in 1999 and 1:10 in 1997 (Figure 7).

Table 6. Size, growth, and locations of tagged lake trout reported by anglers from Priest Lake, Idaho, 2001

		Recapture			Mark			Growth (mm)		
Tag #	Color	Date	Length (mm)	Location	Date	Length (mm)	Location	Total	Annual	Distance (km)
R1-316	Blue	1/3	437	Cavanaugh	Aug-99	350	NE Bartoo	87	58	3.5
R1-017	Blue	3/7	531	Bartoo	Sept-95	475	NE Bartoo	56	11	0
R1-298	Green	3/22	500	Pinto Pt.	Jun-00	482	SE Bartoo	18	14	3
R1-382	Green	3/22	400	Cavanaugh	Jul-00	385	NE Bartoo	15	11	2
2545	Orange	4/28	775	Grandview	Oct-00	662	Thorofare	113	75	--
A000260	White	5/29	550	South End	May-90	437	Pinto Pt.	113	10	--
R1-306	Blue	6/18	575	Bartoo	Aug-99	500	NE Bartoo	75	37	--
R1-678	Green	6/17	375	Bartoo	Jun-00	400	NE Bartoo	25	25	--
R1-726	Green	6/17	350	Bartoo	Sept-00	355	NE Bartoo	5	5	--
R1-28	Green	6/30	500	SE Bartoo	Aug-98	400	SE Bartoo	100	33	0
R1-499	Green	7/3	450	NFW Bartoo	Jul-00	400	SE Bartoo	50	50	<1
R1-305	Green	7/7	550	Kaniksu	Aug-99	450	NE Bartoo	100	50	--
02549	Orange	7/22	637	8 mile Isl.	Jul-01	545	--	--	--	--
00142	Yellow	7/24	650	E. Twin	Jun-86	540	Huck Bay	100	110	7
R1-873	Green	8/5	450	NE Bartoo	Jul-01	450	NE Bartoo	Not enough time at large		
R1-268	Green	8/8	550	NE Bartoo	Jun-00	450	NE Bartoo	0	0	0

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Table 6. Continued

		Recapture			Mark			Growth (mm)		
Tag #	Color	Date	Length (mm)	Location	Date	Length (mm)	Location	Total	Annual	Distance (km)
R1-0324	Blue	8/12	487	4 mile Isl.	Aug-99	407	NE Bartoo	80		
R1-140	Blue	8/14	456	8 mile *sl.	Oct-95	--	NE Bartoo	--	--	--
R1-0024	Green	11/7	525	Cavanaugh	Aug-98	442	SE Bartoo	83	36	3.2
R1-20660	Green	10/6	525	Papoose Isl.	Aug-00	525	NE Bartoo	0	0	1.6
02435	Orange	8/8	637	Kalispell Isl.	May-00	675	U P Lake	0	0	21.7
R1-00493	Green	9/25	337	Bartoo	Jul-00	35	NE Bartoo	2	2	0
02589	Orange	8/28	737	Cavanaugh	Nov-00	737	Thorofare	0	0	22.5
R1-00360	Green	8/19	487	Bartoo	Jun-00	437	NE Bartoo	50	41	0
R100494	Green	7/3	375	Bartoo	Jul-00	440	NE Bartoo	0	0	0
R1-00085	Green	9/9/00	575	Bartoo	Jul-99	437	NE Bartoo	138	115	0
R1-00321	Green	10/27	525	Pinto Pt.	Jun-00	457	NE Bartoo	68	48	4.8
R1-00315	Yellow	11/18	525	Pinto Pt.	May-96	450	NE Bartoo	75	15	4.8
R1-00703	Green	11/4	550	Cavanaugh	Aug-00	462	SE Bartoo	88	67	3.2
R1-00746	Green	11/27	550	Cavanaugh	Sep-00	467	NE Bartoo	83	69	1.6
R1-0068	Blue	11/24	650	Reeder Pt.	Jun-99	417	NE Bartoo	233	93	8
R1-00484	Green	11/25	500	Bartoo	Jul-00	447	NE Bartoo	53	40	0

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Table 6.   Continued

		Recapture			Mark			Growth (mm)		
Tag #	Color	Date	Length (mm)	Location	Date	Length (mm)	Location	Total	Annual	Distance (km)
R1-00741	Green	11/18	500	Pinto Pt.	Sep-99	452	NE Bartoo	48	40	4.8
R1-00224	Green	11/8	450	Bartoo	Sep-99	407	NE Bartoo	43	20	0
R1-00136	Green	11/12	506	Cavenaugh	Jul-99	437	NE Bartoo	69	30	1.6
R1-0451	Green	12/15	500	Cavanaugh	Jul-00	450	NE Bartoo	50	34	3.2
R1-0251	Blue	12/30	--	4 mile Isl.	May-97	475	NE Bartoo	--	--	3.2
R1-00222	Green	9/17	--	Bartoo	Sep-99	417	NE Bartoo	Larger fish ate tagged fish		
R1-00405	Green	7/29	--	Reeder Bay	Jul-00	437	NE Bartoo	Larger fish ate tagged fish		
R1-00117	Green	7/21	--	--	Jul-00	412	NE Bartoo	Larger fish ate tagged fish		

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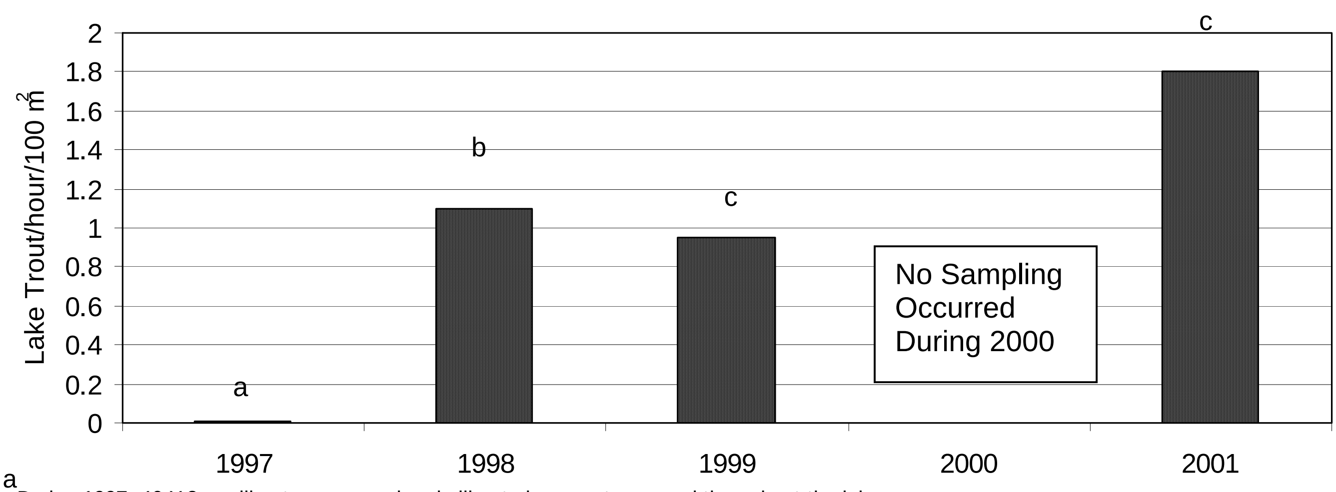

[a] During 1997, 46 X 2 m gill nets were used and gill net placement occurred throughout the lake.

[b] During 1998, 46 X 2 m gill nets were used for approximately 25% of the effort and remaining effort used 92 X 2.5 m nets. Net placement occurred throughtout the lake.

[c] During 1999 and 2001, all gill nets were 92 m x 2.5 m and gill net placement was standardized in areas higher catch

Figure 5. Standardized catch rates (fish/hr/100 m^2 of gill net) of lake trout from Upper Priest Lake, Idaho, 1997-2001

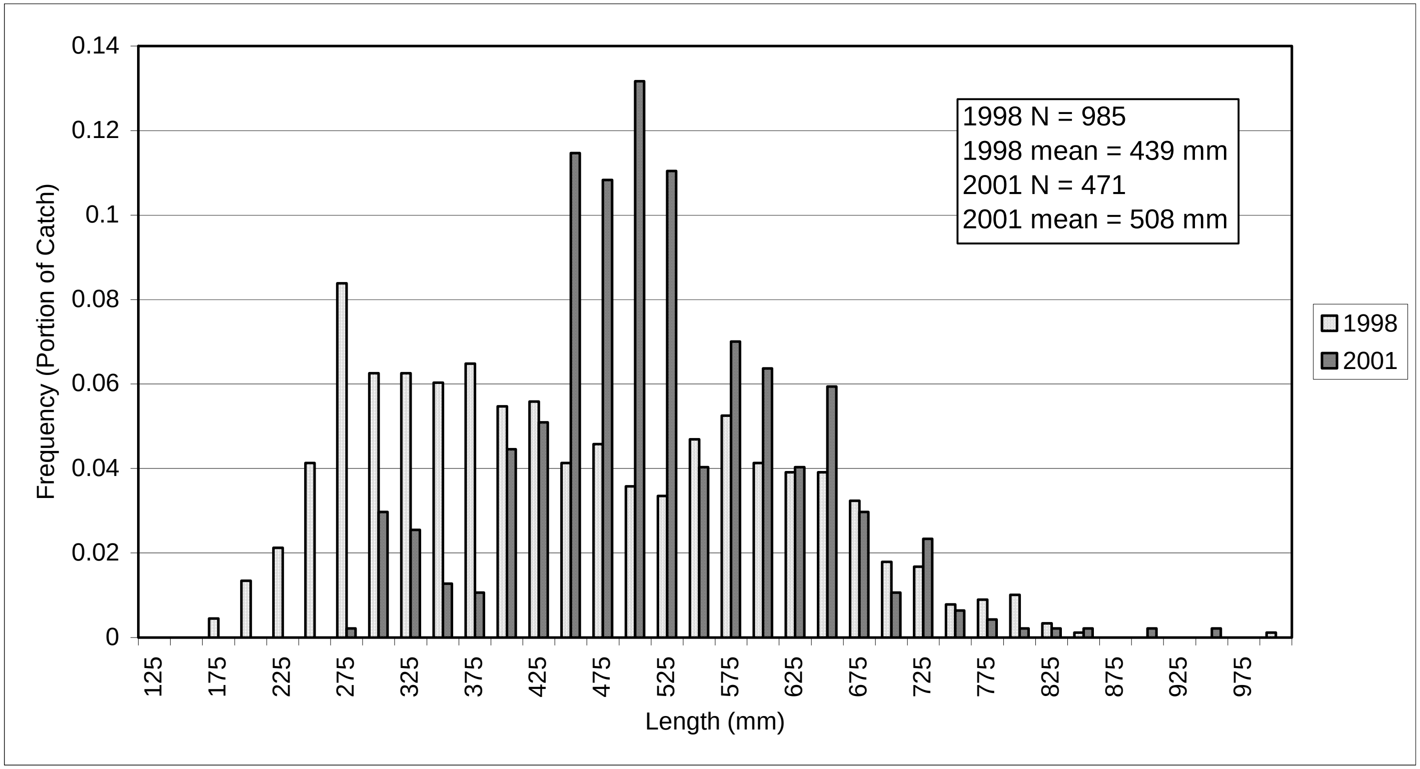

Figure 6. Length frequency of lake trout collected in gill nets in 1998 and 2001 from Upper Priest Lake, Idaho

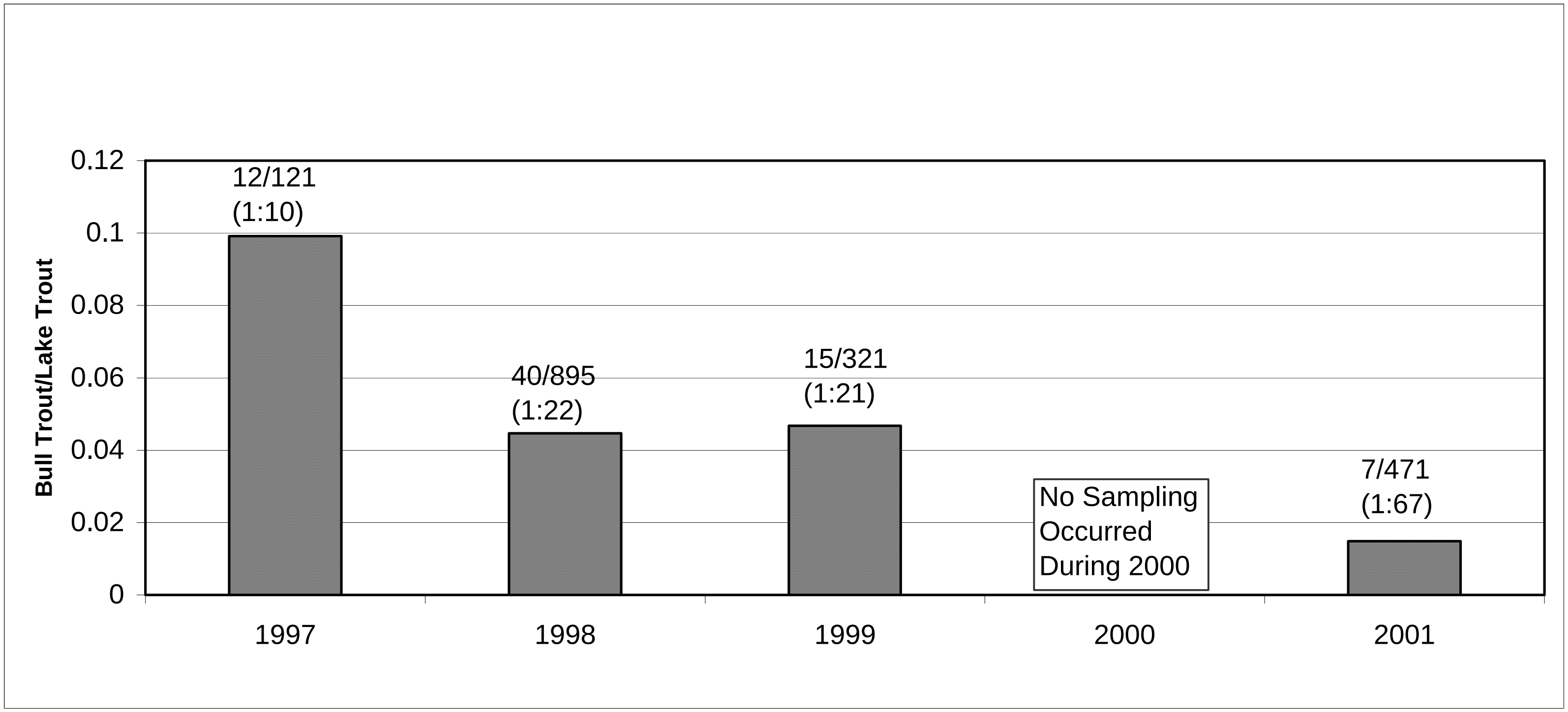

Figure 7. Bull trout to lake trout ratio collected in gill nets in 1997-2001 from Upper Priest Lake, Idaho.

Standard Lowland Lake Surveys

Freeman Lake

Lake Characteristics and Management—Freeman Lake is a 16 ha natural lake located in Bonner County, Idaho on the Idaho/Washington border (Figure 8). The lake is relatively shallow, with a mean depth of 1.8 m and a maximum depth of 5.2 m. The shallow nature of Freeman Lake is very conducive to rooted aquatic vegetation, and there is a distinct vegetation line around the lake at about 3 m depth. Public access to Freeman Lake is limited to a single boat launch on the southwest side where the Idaho Fish & Game Department (Department) owns approximately 540 m of shoreline. Freeman Lake is a two-story fishery supporting both warm and cold water species. Management of the fishery is under general statewide regulations, with the exception of an electric motors only provision. The rainbow trout *Oncorhynchus mykiss* fishery in Freeman is supported by an annual stocking of 5,000 catchable rainbow trout. Tiger muskie *Esox lucius x E. masquinongy* were first introduced into Freeman Lake in 1989 with an initial stocking of 100 fish. Since that time, another 139 tiger muskie have been stocked in the lake (35 in 1991, 50 in 1993 and 54 in 1997). The intent was to utilize the abundant forage base (mainly pumpkinseed *Lepomis gibbosus* and yellow perch *Perca flavescens*) to produce a limited trophy fishery for tiger muskies. Angler reports from Freeman Lake indicate legal size muskie (76.2 cm and greater in length in 2001) are being taken annually. Channel catfish *Ictalurus punctatus* were introduced to Freeman Lake in 1997 with an initial stocking of 1,500 fish. Since then, catfish have been stocked in 1999 (2,600 fish) and 2000 (450 fish).

Fishery Characteristics—The 2001 fishery survey of Freeman yielded catches of largemouth bass *Micropterus salmoides,* yellow perch, black crappie *Pomoxis nigromaculatus,* pumpkinseed, rainbow trout, brown bullhead *Ameiurus nebulosus,* and tench *Tinca tinca* (Table 7). We collected 261 fish weighing approximately 70.8 kg per unit of combined gear sampling effort (one hour of electrofishing, one floating and one sinking gill net, and one trap net). Game species comprised 92% of the sample based on number and 55% of the sample based on weight. Tench *Tinca tinca* were the only nongame species collected comprising 8% of the catch by number and 45% of the catch by weight. Of fish sampled, largemouth bass were the most abundant species based on number and the most abundant game species based on sample weight. Length, weight, catch per unit of effort for individual fish species and sampling locations of each gear are detailed in Appendix A.

We collected 126 largemouth bass (48% of the total sample) per combined unit of sampling effort, ranging from 150 to 460 mm in length. Sample weight was 19 kg, or 27% of the total sample weight. Proportional stock density (PSD; Anderson 1980) was 6.6 and RSD-400 was 1, suggesting high exploitation of legal size (305 mm) largemouth bass. Relative weight was 82-108, indicating slightly below average weight of the Freeman Lake population.

We collected eight black crappie per unit of effort, ranging in length from 200 to 260 mm. Black crappie comprised 3% of the sample by number and 2% of the sample by weight. Size structure of black crappie was heavily weighted toward quality-size fish (200 mm) with a PSD of 100 and an RSD-250 of 25.

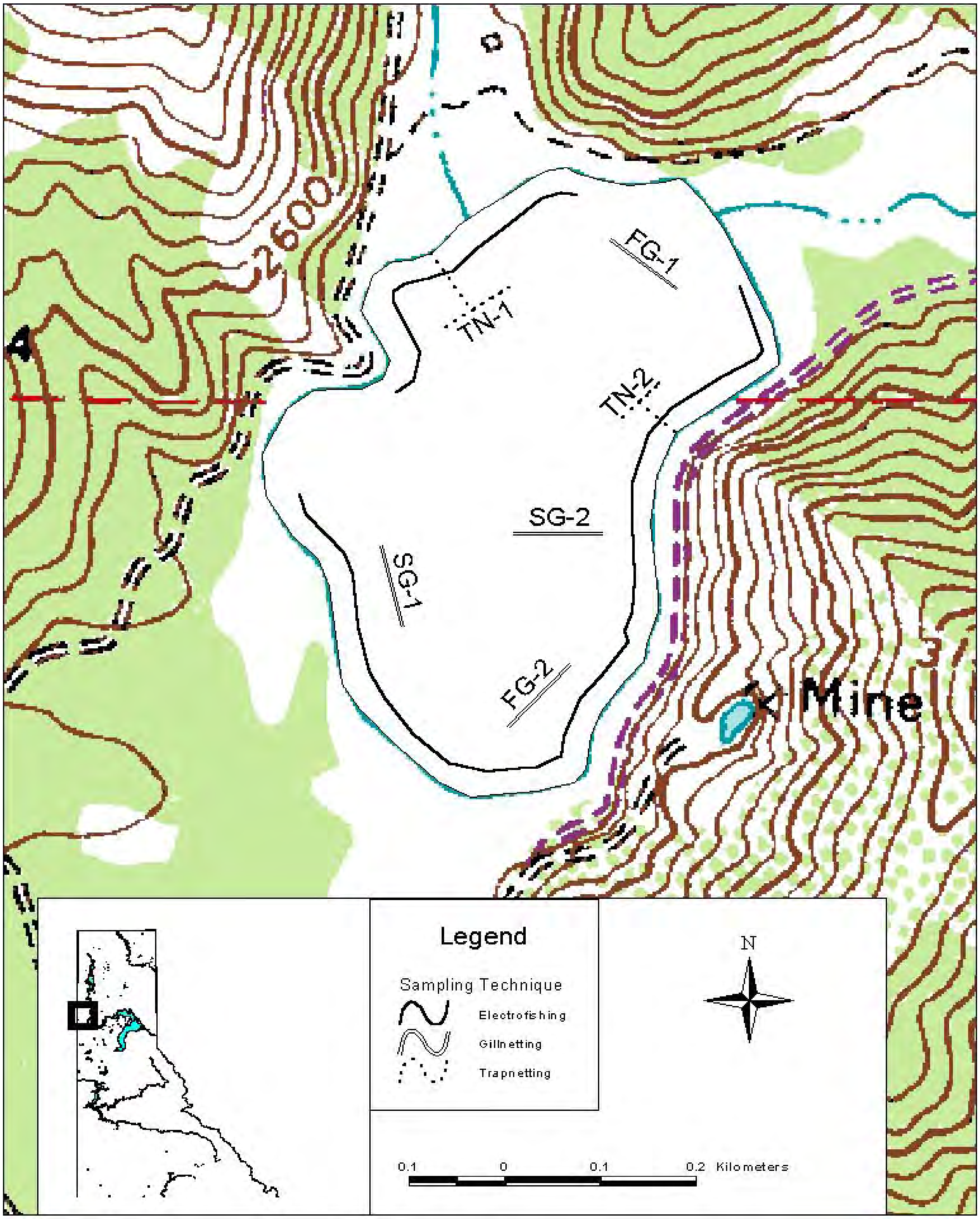

Figure 8. Map of Freeman Lake, Idaho, showing 2001 gill net and trap net locations and electrofishing transects.

Table 7. Fishery characteristics for game species based on standard lake surveys of Freeman and Blue lakes, Idaho, 2001.

Species	Parameter	Freeman Lake	Blue Lake
Largemouth bass	Number Captured	126	122
	Range (TL)	150-460 mm	70-500 mm
	Modal Size	220 mm	190 mm
	PSD	6.6	21
	Relative Weight	84-103	64-105
Yellow perch	Number Captured	44	167
	Range (TL)	140-280 mm	110-210 mm
	Modal Size	220 mm	180 mm
	PSD	86	9
	Relative Weight	86-105	86-127
Black crappie	Number Captured	9	35
	Range (TL)	200-260 mm	90-300 mm
	Modal Size	210 mm	180 mm
	PSD	100	30
	Relative Weight	109-139	100-137
Rainbow trout	Number Captured	45	None stocked
	Range (TL)	220-280 mm	
	Modal Size	240 mm	
	PSD	0	
	Relative Weight	--	
Brown bullhead	Number Captured	6	0
	Range (TL)	290-350 mm	
	Modal Size	--	
	PSD	--	
	Relative Weight	--	
Pumpkinseed	Number Captured	66	34
	Range (TL)	90-190 mm	90-170 mm
	Modal Size	170 mm	140 mm
	PSD	73	33
	Relative Weight	--	--
Channel catfish	Number Captured	0	4
	Range (TL)		520-630 mm
	Modal Size		--
	PSD		--
	Relative Weight		--
Tiger muskie	Number Captured	0	2
	Range (TL)		530-560
	Modal Size		--
	PSD		--
	Relative Weight		--

We collected 44 yellow perch ranging from 140 to 280 mm. Yellow perch comprised almost 9% of the sample by number and about 5% of the sample by weight. Size structure of yellow perch was heavily weighted toward quality-size fish (200 mm) with a PSD of 86 and an RSD-250 of 20. Relative weight was 86-105, indicating average condition of the population (Table 7).

Comparison with 1995 Survey—In 1995, no tench were collected in a similar sampling effort. In 2001 tench comprised 8% of the catch by number and 45% of the catch by weight. Numerically, largemouth bass comprised around 8% of the sample in 1995 compared to 48% in 2001.

Rainbow trout were the only species to show a marked decrease in relative abundance since 1995. In 2001 rainbow trout comprised 9% of the sample by number and 6% by weight compared to 82% and 98%, respectively in 1995. This discrepancy is probably a function of when the lake was stocked, as the rainbow trout fishery is a put-and-take fishery. Length, weight, and catch per unit of effort for individual fish species and sampling locations of each gear type are detailed in Table 7 and Appendix A.

Blue Lake

Lake Characteristics and Management—Blue Lake is a 36 ha natural lake located in Bonner County, Idaho, approximately 11.3 km north of the town of Priest River (Figure 9). This shallow bog lake has a mean depth of less than 3.5 m. Aquatic vegetation consumes most of Blue Lake by the end of the summer months. Blue Creek is the only inlet or outlet of Blue Lake. This stream flows approximately 2.4 km west to Priest River. This sometimes ephemeral stream provides no upstream fish passage from Priest River to the lake due to a reported waterfall of 4.5 m in height.

The shoreline surrounding Blue Lake is privately owned except for a country road right-of-way at the northwest end of the lake. This access provides an unimproved boat launch site for smaller boats. Bonner County purchased this access site, circa 1954 from a local landowner specifically for sportsmen’s access to Blue Lake.

Blue Lake was rotenoned in 1954 to remove unwanted populations of various nongame species. The lake was recommended for renovation again in 1989, but the project was canceled after local fishermen objected (Maiolie and Davis 1995). Instead of rotenoning the lake, tiger muskie were introduced in 1989 along with continued stocking of channel catfish to provide a unique fishery in north Idaho. An initial stocking of 350 tiger muskie was followed up with another 295 tiger muskie (150 in 1993 and 145 in 1997). Channel catfish have been stocked in Blue Lake three times (1987, 1990, and 1993) with 2,044, 250, and 3,000 fish, respectively. A 1994 survey of Blue Lake showed the fish community consisted mainly of yellow perch, pumpkinseed and largemouth bass. Channel catfish stocking was discontinued in Blue Lake after the 1994 survey due to limited shoreline access for anglers and extensive weed growth.

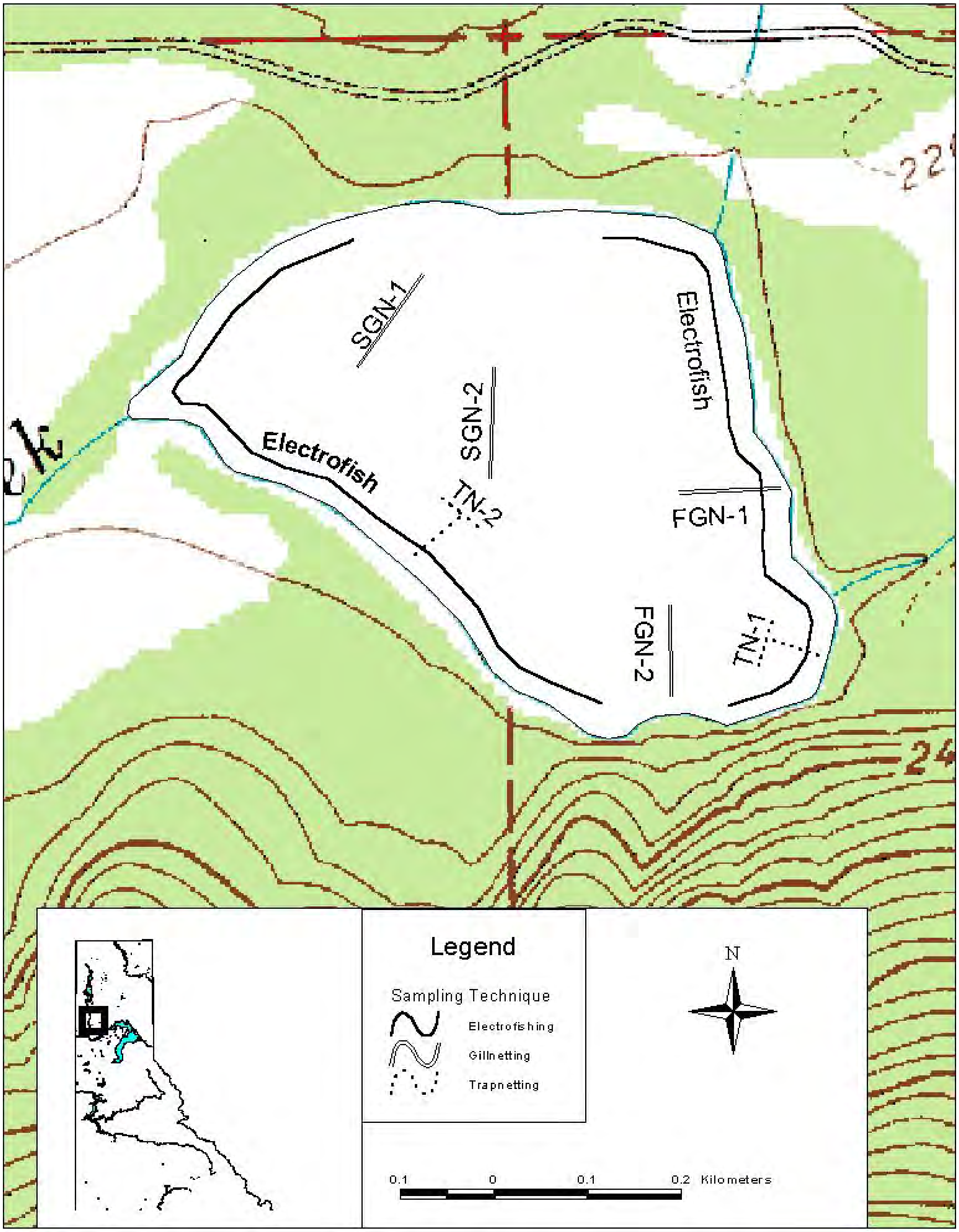

Figure 9. Map of Blue Lake, Bonner County, Idaho, showing 2001 gill net and trap net locations and electrofishing transects.

Fishery Characteristics—The 2001 fishery survey of Blue Lake yielded catches of largemouth bass, yellow perch, black crappie, pumpkinseed, tiger muskie and channel catfish (Table 7). We collected 315 fish weighing approximately 43 kg per unit of combined gear sampling effort (one hour of electrofishing, one floating and one sinking gill net, and one trap net). Game species comprised 100% of the sample. Length, weight, catch per unit of effort for individual fish species and sampling locations of each gear type are detailed in Figure 9 and Appendix A.

Largemouth bass were the most abundant species in the sample based on number and sample weight. We collected 122 largemouth bass (39% of the total sample) ranging from 70 to 500 mm in length per combined unit of sampling effort. Sample weight was 22 kg, or 51% of the total weight. Proportional stock density (Anderson 1980) was 21 and RSD-400 was 5, suggesting high exploitation of legal size (305 mm) largemouth bass. Relative weight was 64-105, indicating below average weight of the Blue Lake population. Length, weight, and catch per unit of effort for individual fish species and sampling locations of each gear type are detailed in Table 7 and Appendix A.

We collected 35 black crappie per unit of effort, ranging from 90 to 300 mm. Black crappie comprised 11% of the sample by number and 9% of the sample by weight. Proportional stock density (Anderson 1980) was 30 and relative weight was 100-137 (Table 7).

We collected 119 yellow perch per unit of effort, ranging from 110 to 210 mm. Yellow perch comprised almost 38% of the sample by number and about 18% of the sample by weight. Proportional stock density was 10. Relative weight was 86-127, indicating average condition of the population.

Comparison with 1994 Survey—The relative abundance of black crappie, yellow perch, pumpkinseed and channel catfish remained about the same when comparing the 2001 and 1994 surveys. Largemouth bass showed the only marked change in relative abundance between the two surveys. Largemouth bass comprised 38% of the catch by number in 2001 compared to 18% in 1994. Unfortunately no weights were collected in the 1994 sample.

Hayden Lake

Black Crappie Exploitation—We implanted 95 $10 reward Floy T-bar tags in black crappie in Hayden Lake during May to estimate annual exploitation in 2001. A total of 22 of these tags were returned within one year of initial capture for an uncorrected annual exploitation rate of 23%. We assumed minimal tag loss and a non-reporting rate of around 25%. Therefore, total exploitation was likely around 30%.

DISCUSSIONS AND RECOMMENDATIONS

Coeur d'Alene Lake Kokanee and Chinook Salmon

Based on midwater trawl estimates, the kokanee population is continuing to show a gradual recovery from the impacts of the high runoff events of 1996 and 1997. Although the numbers of age-3 and age-2 kokanee are still well below the 23-year average, the age-0 kokanee year class is at a record high and twice the average. The spawning escapement in 2001 was the weakest since trawling began, and the PED was only around 10 million eggs. Because of the size of mature kokanee (260-300 mm) in the 2000 and 2001 trawl efforts and the decreased capture efficiency with increasing size (Rieman 1992); we most likely underestimated the population of spawners. This suggests escapement of 2000 and 2001 spawners was greater than trawl-based estimates indicate and may partially account for the exceptionally high PED to fry survival rates in 2000 and 2001.

No hatchery juvenile chinook salmon were available for release Coeur d'Alene Lake in 2001. The relatively small size of chinook salmon released in 1998 and 1999 compared to all previous years appears to have influenced their survival or out migration behavior. These two release groups were reared at Cabinet Gorge Hatchery as opposed to Nampa or Mackay hatcheries where they have been reared in previous years and in 2002. The colder water temperatures of Cabinet Gorge Hatchery hindered growth and resulted in an average size of only 91 and 100 mm in the 1999 and 1998 release groups, respectively. The large size of the 2002 hatchery fish is expected to have a positive influence on their survival (estimated to be 6.3-6.5 mm in mid-June [Rick Alsager, Department Nampa Hatchery Manager, personal communication]). We counted 78 chinook salmon redds in 2001 that should yield an estimated 31,000 wild smolts in 2002. We plan to supplement the Coeur d'Alene Lake chinook salmon population with approximately 40,000 fall chinook salmon smolts in June 2002 to provide a total stocking of around 70,000 chinook salmon.

Considering the estimated population of age-0 kokanee was the highest ever recorded and twice that of the 23-year mean of 3.4 million fish, chinook salmon should have a solid forage base on which to rebuild.

Recommendations

1. Stock 40,000 age-0 chinook salmon in 2002 to supplement the estimated 30,000 naturally produced fish, for a combined total of 70,000 age-0.

2. Continue to monitor the recovery of the kokanee population and adjust age-0 chinook salmon supplementation accordingly.

3. Continue to encourage catch-and-keep chinook salmon fishing.

Upper Priest Lake

Lake Trout Netting—Our 2001 gillnetting efforts confirm the presence of an expanding lake trout population in Upper Priest Lake. Comparing 1957, 1998, and 2001, the ratio of lake trout to bull trout indicates a progressive increase in the relative abundance of lake trout and a decreasing relative abundance of bull trout. The ratio of lake trout to bull trout was 67:1 in 2001 compared to 21:1 in 1999 and 10:1 in 1997 (Figure 7). We collected seven bull trout in 2001. Bull trout ranged in size from 650 to 740 mm. No juvenile bull trout were collected, and comparison with gill net data from 1956 indicates this portion of the population is absent (Figure 10).

It could be argued that the low abundance of bull trout in the lake is because these fish enter the tributaries to spawn in the fall. Estimating the lake trout to bull trout ratio excluding the August netting effort had no effect on the ratio. This expanding lake trout population is the greatest threat to the existence of bull trout in Upper Priest Lake.

The increasing lake trout population in Upper Priest Lake and evidence that lake trout contribute to the decline of bull trout and cutthroat populations in other systems (Donald and Alger 1993) strongly suggest some means of controlling the lake trout population will be necessary to insure the persistence of bull trout. However, the lake cannot be treated as a closed system; in order for lake trout reduction in Upper Priest Lake to be successful immigration from Priest Lake must be controlled. A fish barrier is necessary to minimize immigration of lake trout into Upper Priest Lake. Immigration of lake trout from Priest Lake has been well documented (Fredericks etal. 2000). We explored the use of an electric weir in the Thorofare as a means of controlling movement of lake trout into Upper Priest Lake from the lower lake. During August 2001 we conducted a site visit with Dave Smith, owner of Smith-Root, Inc. to assess the possibility of installing an electric fish barrier in the Thorofare. However, due to cost restraints (estimated at $500,000-$750,000) and concerns about public safety considering the amount of summer boat traffic using the Thorofare, this option was not feasible.

We are currently seeking funding to test the use of strobe lights as a technique to repel lake trout from upstream migration in the Thorofare. The success of strobe lights as an effective tool to produce an avoidance response by a variety of fish species is well documented (Maiolie et al. 2001, Johnson et al. 2001, Taft et al. 2001).

From June through November 1998, the Department removed nearly 1,000 lake trout from Upper Priest Lake by gillnetting. During this time the ratio of lake trout to bull trout improved from 80:1 to 6:1 (Fredericks et al. 1999). This project demonstrated that the lake trout population in Upper Priest Lake could be significantly reduced by gillnetting, thereby reducing the predation threat to bull trout and cutthroat trout. A combination of lake trout removal from Upper Priest Lake through extensive gillnetting and prevention of lake trout immigration from Priest Lake through the Thorofare will be necessary to restore bull trout in Upper Priest Lake.

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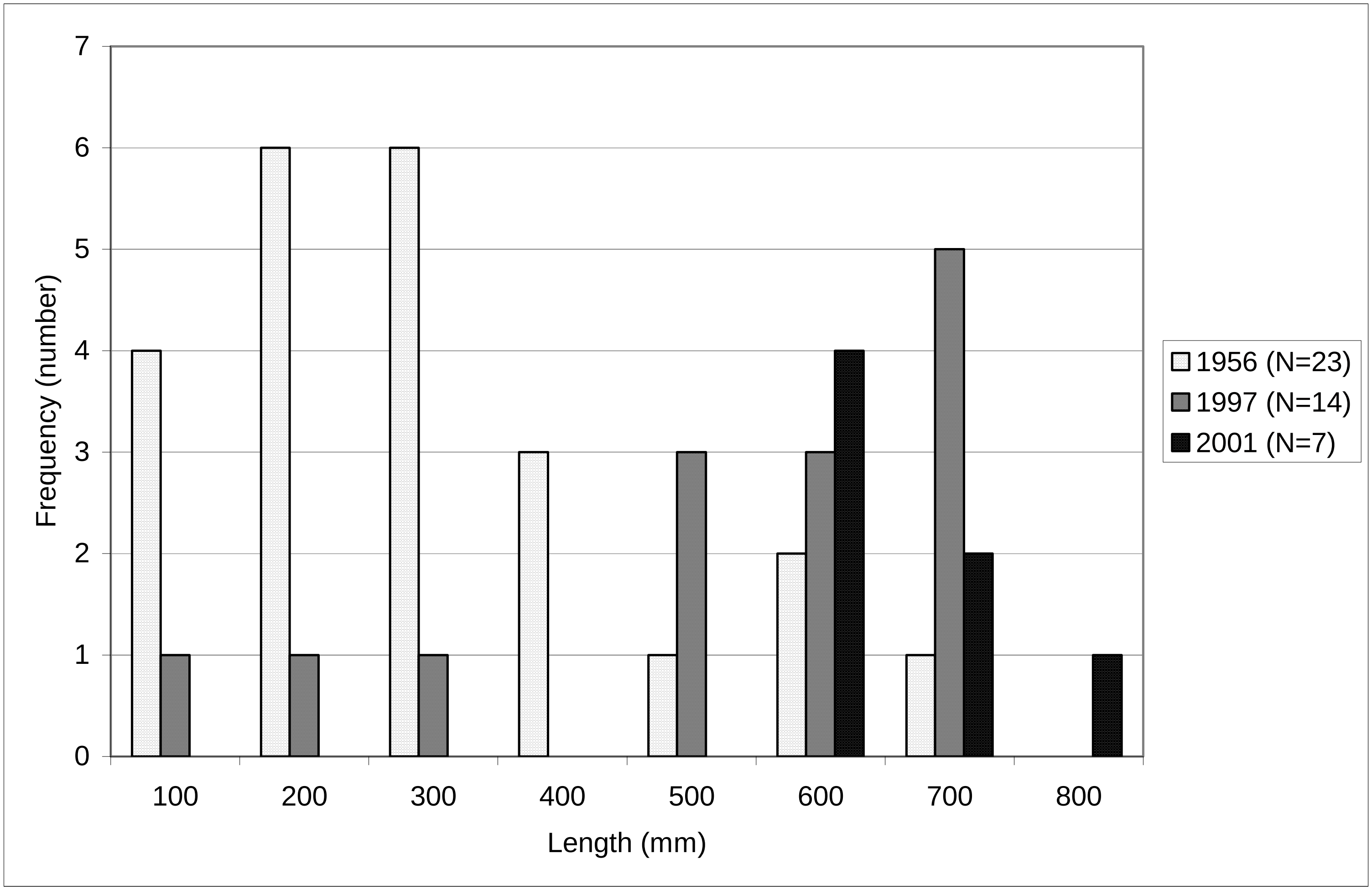

Figure 10. Length frequency of bull trout collected in gill nets in 1956, 1997 and 2001 from Upper Priest Lake, Idaho.

Priest Lake and Upper Priest Lake Kokanee Spawner Counts

We counted 1,765 kokanee spawners at five sites on Priest Lake. Observations by local residents indicate more kokanee spawning along the shoreline of Priest Lake in 2001 than have been seen in many years. Leusink (1966) reported concentrations of kokanee spawners in excess of 45,000 during November 1965 along the beaches and in the tributaries of Priest Lake. Between 1973 and 1975, Priest Lake kokanee spawner counts in mid-November ranged from 1,750 to 5,500. Kokanee numbers plunged the following year with 17 and 57 spawners counted mid-November during 1976 and 1977, respectively. Areas counted in that time frame were not consistent from year to year nor were transect boundaries identified. Between 4 and 11 shoreline areas and 4 to 6 tributaries were counted in a given year.

Mean lengths of two male and two female kokanee in 2001 were 431 and 393 mm, respectively. Interestingly, in 1967 the mean lengths of males and females were 310 and 297 mm, respectively (Leusink 1968); and in 1973, Irizarry (1975) stated:

> "In November 1973, we measured 300 kokanee spawners from Priest Lake which averaged 11.4 inches in total length. Eight trophy-size kokanee (17 inches or longer) were observed in water deeper than 8 feet. The largest kokanee measured was a 22-inch male. Although numerous kokanee have attained trophy-size as a result of Mysis shrimp introductions, the average size of spawners has changed slightly since 1955."

The large size of adult kokanee in Priest Lake in 2001 is likely the result of low density. Historical records indicate kokanee spawning activity at Priest Lake occurs between October 29 and December 29 with the peak between November 13 and November 23 (Irizarry 1974, 1975). We conducted our Priest Lake survey on November 7, 2001. In 2002, we will conduct our Priest Lake and Upper Priest Lake surveys a week later. In 1966, based on intuitive estimates, Leusink (1966) estimated that 80 percent of the spawners used shoreline areas of Priest Lake. The remaining 20 percent of spawning occurred in the first mile of tributary streams with the largest concentrations occurring in Indian and Kalispell creeks (Leusink 1966). In 2002 we will survey the lower sections of several Priest Lake and Upper Priest Lake tributaries to determine if kokanee spawning occurs.

It appears a considerable number of beach-spawned kokanee eggs are lost each year at Priest Lake because of winter drawdown. It is our observation that the major kokanee spawning areas have a gradually sloping shoreline and early drawdown and stabilization of lake levels at a low level prior to kokanee spawning may enhance egg to fry survival. Early drawdowns carry economical impacts with them; i.e., resort and marina owners may incur losses as low levels may make their docks and existing boat ramps inaccessible to boaters. The lack of boat access to Priest Lake during low water level has been an issue for 30 years. These issues need to be addressed, along with assessing the potential for restoring the kokanee fishery. The addition of a well-maintained, deep water, public boat ramp needs to be aggressively pursued. We did not measure water depth over redds in 2001, but it is our observation that at least a third of the kokanee redds were in water less than 15 cm deep. These redds were no doubt lost as the drawdown is typically complete on November 30 (Gary Stockinger, Avista Utilities, personal communication). A loss of even 20% of redds may not seem significant, but when coupled with high predation rates it may severely impact a particular year class. A drawdown initiated after Labor Day, and more importantly completed prior to November 1, may be a workable plan. November 1 would be a moving target, as fall precipitation will have a significant impact on the rate and completion of drawdown.

RECOMMENDATIONS:

1. Continue to monitor kokanee spawner numbers on Priest and Upper Priest lakes and expand surveys to include lower sections of historical spawning tributaries.

2. Pursue the addition of a well maintained, deep water, public boat ramp on Priest Lake.

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APPENDIX

Appendix A. Lowland lakes and reservoirs standard data base, fish community characteristics, Freeman Lake and Blue Lake, 2001.

FISH COMMUNITY CHARACTERISTICS

LAKE/RESERVOIR NAME: FREEMAN LAKE REGION: 1 DATE: 6/8/2001

Catch Per Unit* of Combined Gear Sampling Effort

SPECIES	LENGTH RANGE$^{(mm)}$	No.	%	Wt. $^{(kg)}$	%
LMB	150-460	126	48	19.07	27%
Yellow Perch	140-280	26	9	3.48	5%
Black Crappie	200-260	8	3	1.43	2%
Pumpkinseed	90-190	52	21	7.53	11%
Rainbow Trout	220-280	23	9	3.9	6%
Brown Bullhead	290-350	6	2	2.9	4%
GAME FISH SUBTOTAL:		241	92	38.31	55%
Tench	420-520	20	8	32.53	45%
NON-GAME FISH SUBTOTAL:		20	8	32.53	48%
ALL SPECIES TOTAL:		261	100%	70.84	100%

*one hour electrofishing, one trap net night, and one combined floating and sinking gill net night.

Appendix A. Continued

FISH COMMUNITY CHARACTERISTICS

LAKE/RESERVOIR NAME: BLUE LAKE REGION: 1 DATE: 7/-/2001

Catch Per Unit* of Combined Gear Sampling Effort

SPECIES	LENGTH RANGE (mm)	No.	%	Wt. (kg)	%
LMB	70-500	122	38.7	22.127	51.5
Yellow Perch	110-210	119	37.8	7.676	17.9
Black Crappie	90-300	35	11.1	3.967	9.2
Pumpkinseed	90-170	34	10.8	2.051	4.8
Tiger Muskie	530-560	1	0.6	1.650	3.8
Channel Catfish	520-630	3	1.0	5.435	12.8
GAME FISH SUBTOTAL:		315	100%	42.91	100%
NON-GAME FISH SUBTOTAL:		-0-		-0-	
ALL SPECIES TOTAL:		315	100%	42.91	100%

*one hour electrofishing, one trap net night, and one combined floating and sinking gill net night.

2001 ANNUAL PERFORMANCE REPORT

State of: Idaho Program: Fisheries Management F-71-R-26

Project: I-Surveys and Inventories Subproject: I-A Panhandle Region

Job No.: c-1 Title: Rivers and Streams Investigations

Contract Period: July 1, 2000 to June 30, 2001

ABSTRACT

In July 2001, a total of 65 transects in the St. Joe and Coeur d'Alene rivers were snorkeled to estimate trout *Oncorhynchus spp.* and mountain whitefish *Prosopium williamsoni* abundance and approximate size distribution. Mean densities of age-1 and older cutthroat trout *O. clarki* and mountain whitefish in the St. Joe River transects were 0.80 and 0.92 fish/100m^2, respectively. Densities in the North Fork Coeur d'Alene River were 0.73 cutthroat trout and 3.26 mountain whitefish/100m^2. Densities in the Little North Fork Coeur d'Alene River were 0.25 cutthroat trout and 0.03 mountain whitefish/100m^2. Both rivers show increasing trends in abundance of cutthroat trout and mountain whitefish following the declines observed after the 1996 flood event.

We used a backpack electrofisher to sample five tributaries on the east side of Priest River/Lake to evaluate the status of the bull trout *Salvelinus confluentus* population. Findings suggest that bull trout abundance and distribution is declining in the Middle Fork East River and Indian Creek. High densities of bull trout (10.4 fish/100m^2) remain in Uleda Creek, a tributary of the Middle Fork East River. Adult bull trout up to 700 mm in length were sampled from Uleda Creek indicating they have a fluvial or adfluvial life cycle.

We conducted bull trout redd counts in tributaries of Priest River, Pend Oreille Lake, St. Joe River, and Little North Fork Clearwater River in September and October to add to the long-term trend data set. We counted 41 redds in the Upper Priest Lake drainage, 699 bull trout redds in the Pend Oreille Lake drainage, 40 redds in the St. Joe River drainage, and 18 redds in the Little North Fork Clearwater River drainage. Clearwater Region personnel also conducted bull trout redd counts in the Little North Fork Clearwater River at different locations and counted 39 redds. Improving trends in bull trout redd abundance was not apparent for any of the basins evaluated in 2001. The number of redds counted in the Priest, Pend Oreille and Little North Fork Clearwater drainages was above the index stream means, whereas counts in the St. Joe River drainage were about average.

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INTRODUCTION

This report documents efforts by Panhandle Region fisheries management personnel to evaluate the status of stream fisheries and their response to changes in management, fishing pressure, habitat alterations, and climatic conditions. These findings are instrumental in ensuring proper actions will be taken to protect, preserve, perpetuate and manage the fishes of Idaho.

STUDY SITES

St. Joe and Coeur d'Alene River Snorkel Surveys

Transect locations in the St. Joe River were originally established in 1969 (Rankel 1971); however, due to changes in stream habitat four of the original transects were either eliminated or combined in 2000. Modified transect boundaries were selected based on fish holding capabilities, access, and permanence for future study. Six new transects were added downstream of Avery in 2001 as changes in regulations made this the only area where cutthroat trout *Oncorhynchus clarki* could be kept. This brings the total number of transects to be snorkeled on the St. Joe River to 30 (Figure 1).

Transects in the Coeur d'Alene River system were initially established in 1973 (Bowler 1974). These transect locations have changed somewhat over the years as the river has shifted positions and pools have filled in. Modified transect boundaries were selected based on fish holding capabilities, access, and permanence for future study. Twenty-five transects occur in the North Fork Coeur d'Alene River and 10 occur in the Little North Fork Coeur d'Alene River (Figure 2).

Middle Fork East River and Indian Creek Fishery Assessment

Four stream reaches were surveyed in the Middle Fork East River (Figure 3) and two in Indian Creek to assess their fish populations (Figure 4). Sample sites were selected based on previous surveys (Horner et al. 1987; Irving 1987). By duplicating the same sample sites, changes in the fishery could be more accurately evaluated.

Bull Trout Spawning Surveys

Bull trout *Salvelinus confluentus* redds were counted in selected index tributaries of the Priest, Pend Oreille, St. Joe, and Little North Fork Clearwater river drainages based on previous surveys (Figures 5. 6, 7, 8). Actual streams surveyed were dependent on available time and findings from previous surveys. Streams where no redds had been found over several consecutive years were often not surveyed to save time and/or allow more time to investigate new streams.

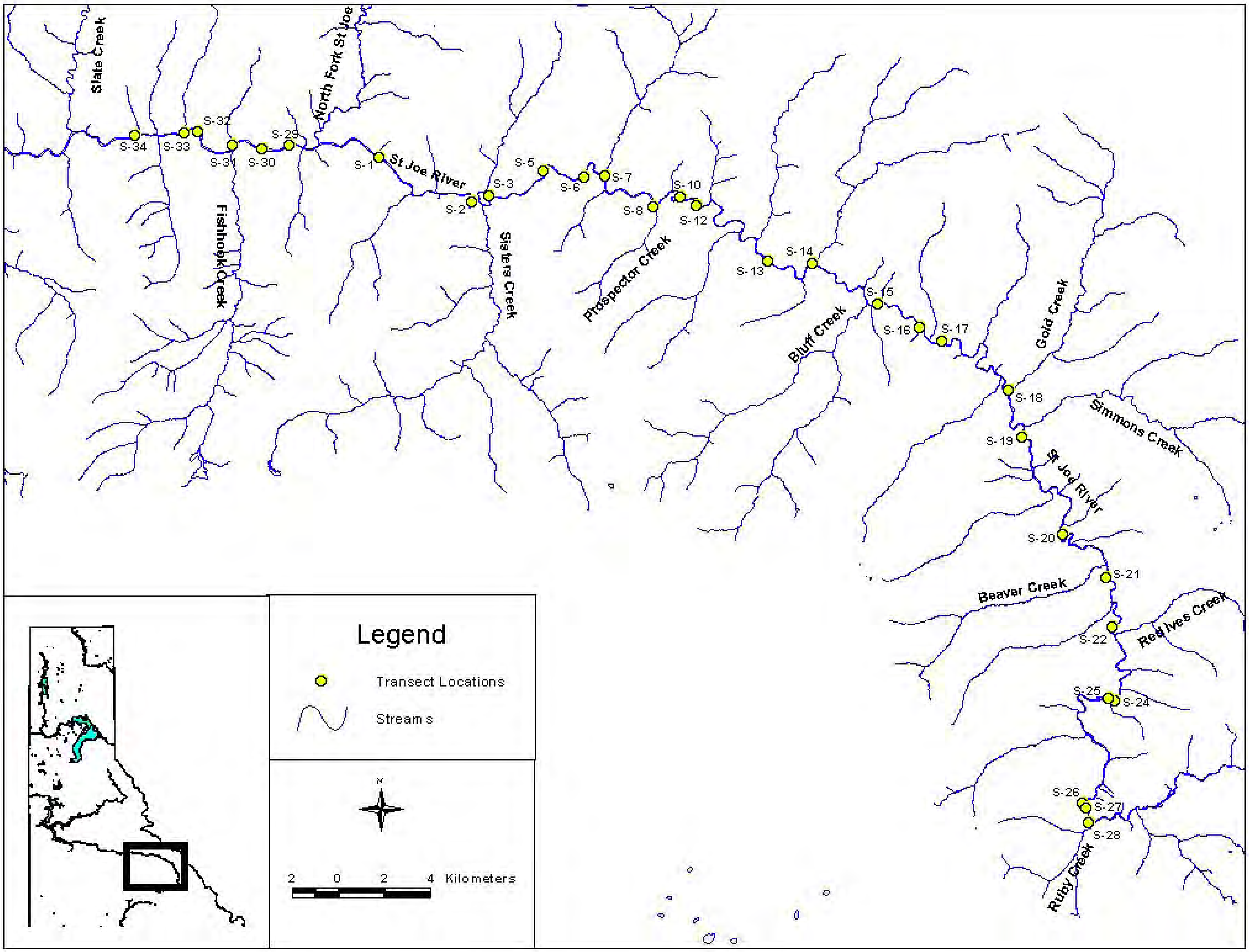

Figure 1. Location of snorkel transects on the St. Joe River, Idaho, 2001

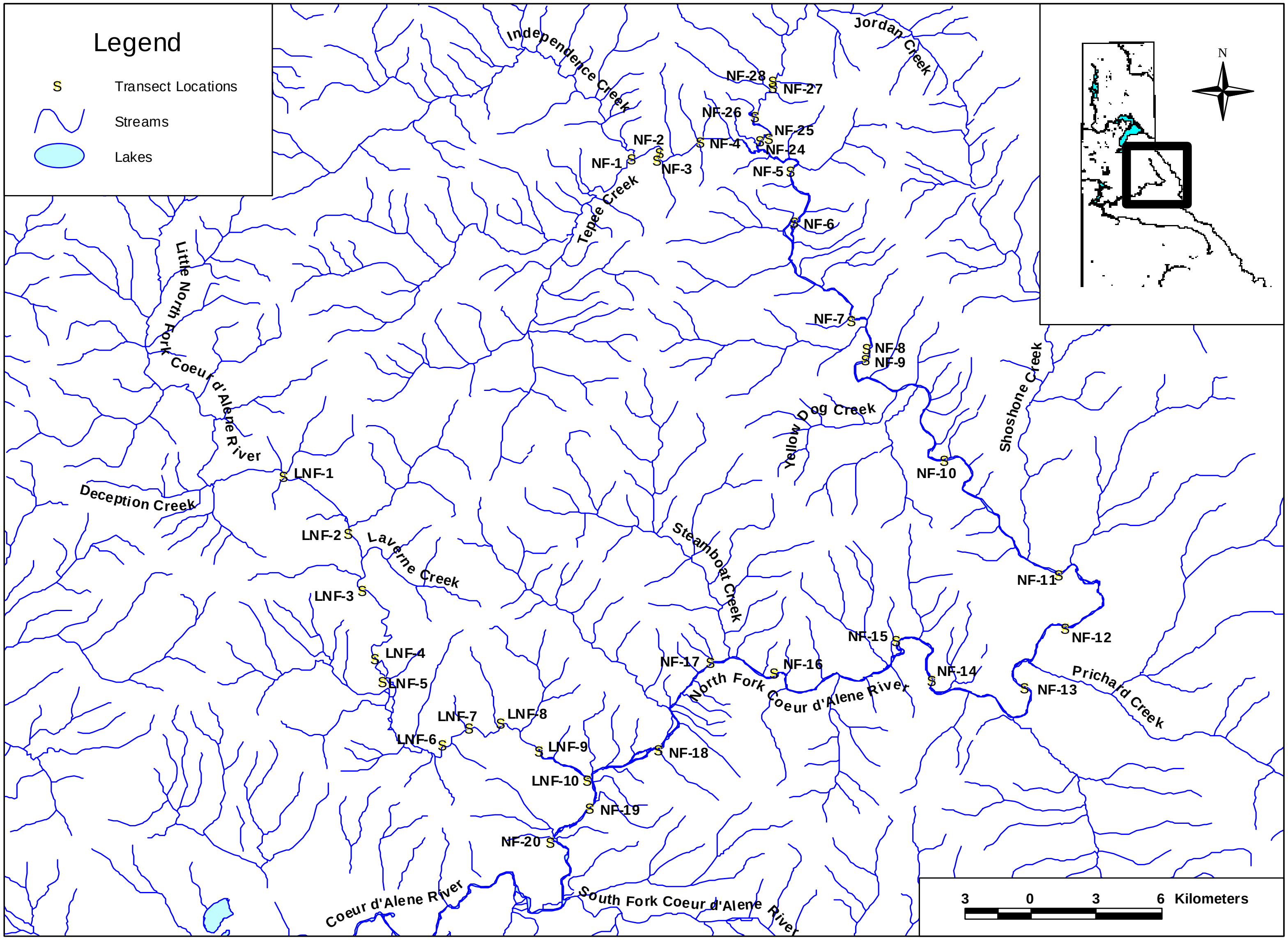

Figure 2. Location of snorkel transects on the Coeur d'Alene River, Idaho, 2001.

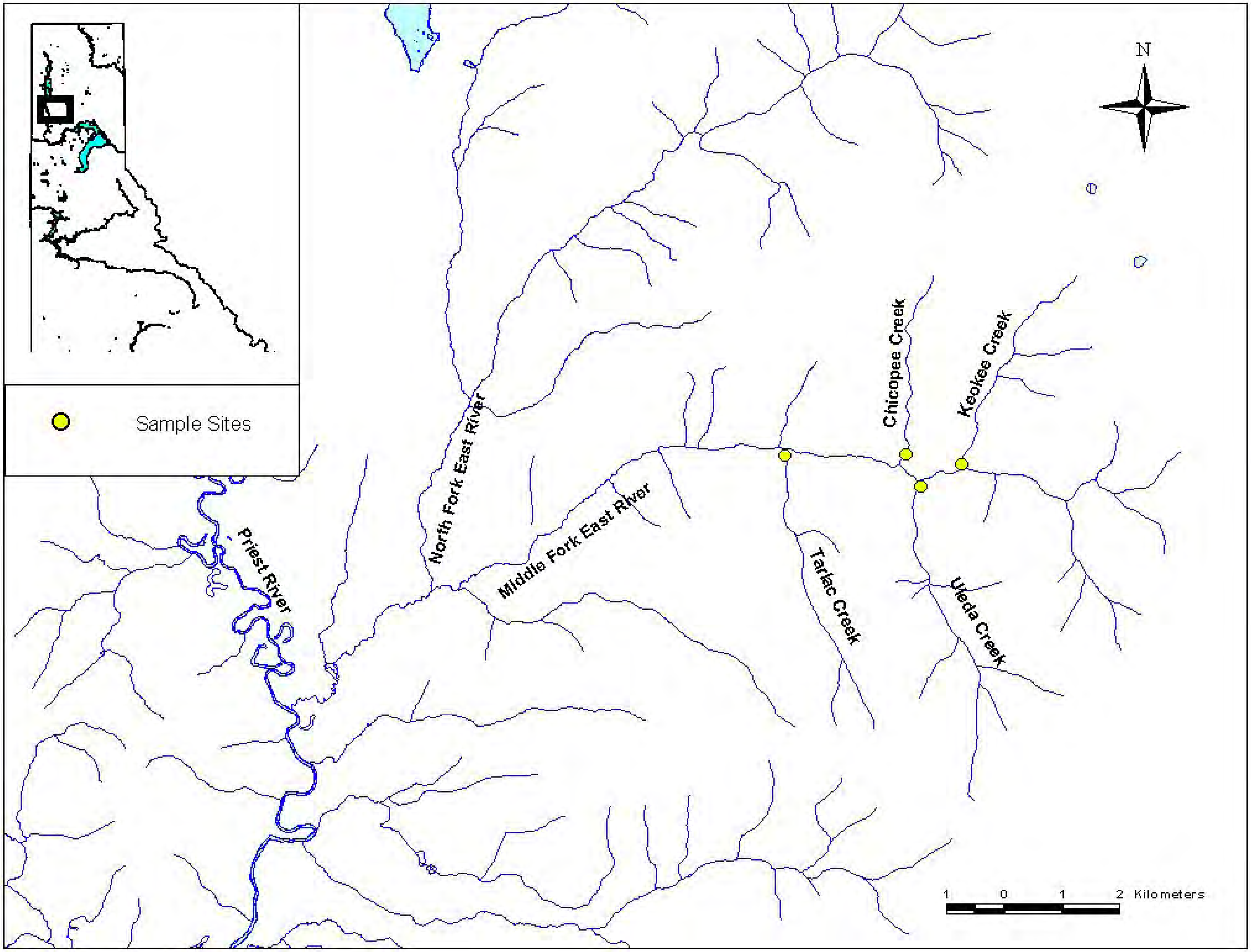

Figure 3. Locations where sampling occurred during 2001 on tributaries of the Middle Fork East River, Idaho.

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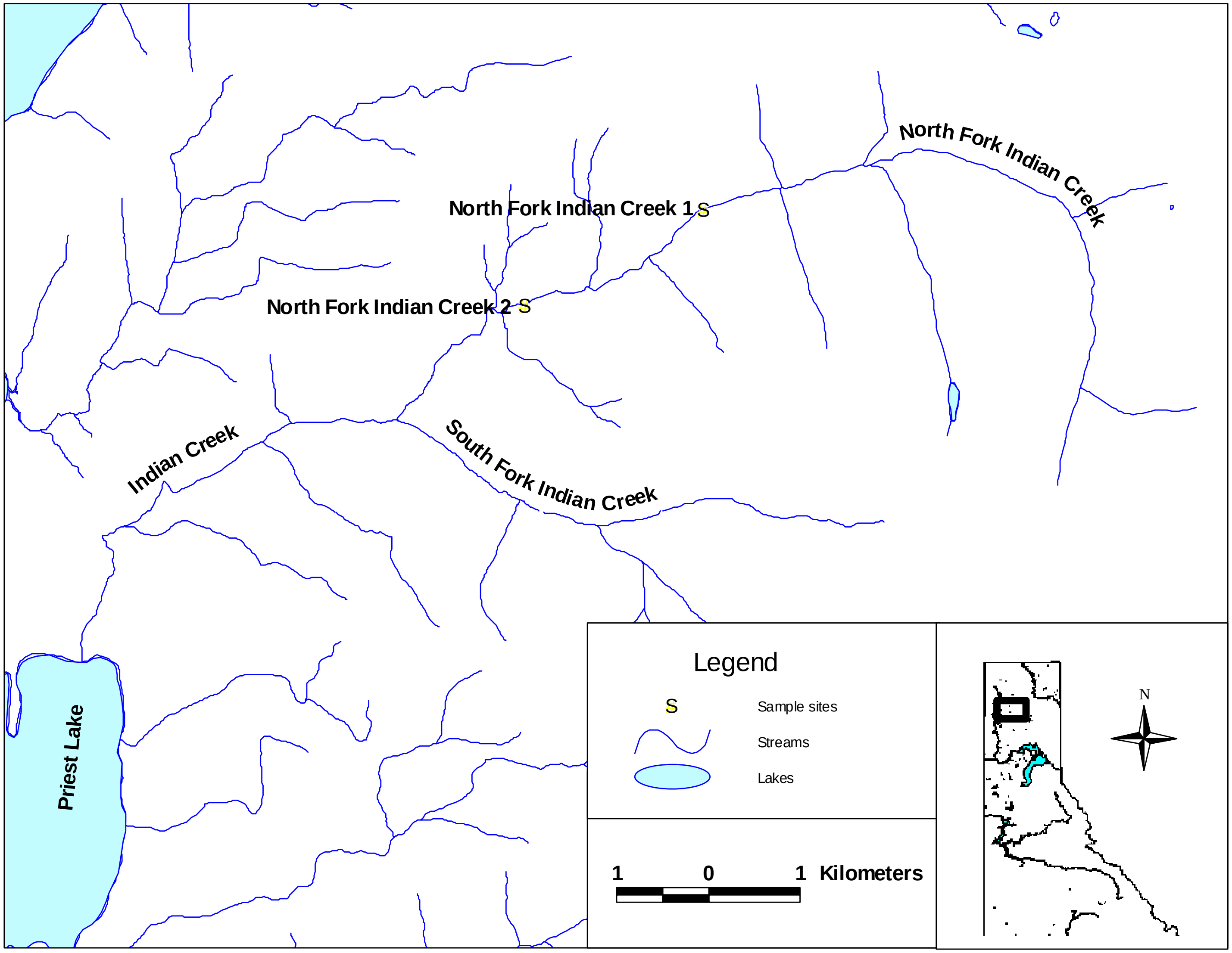

Figure 4. Locations where sampling occurred during 2001 on the North Fork of Indian Creek, Idaho.

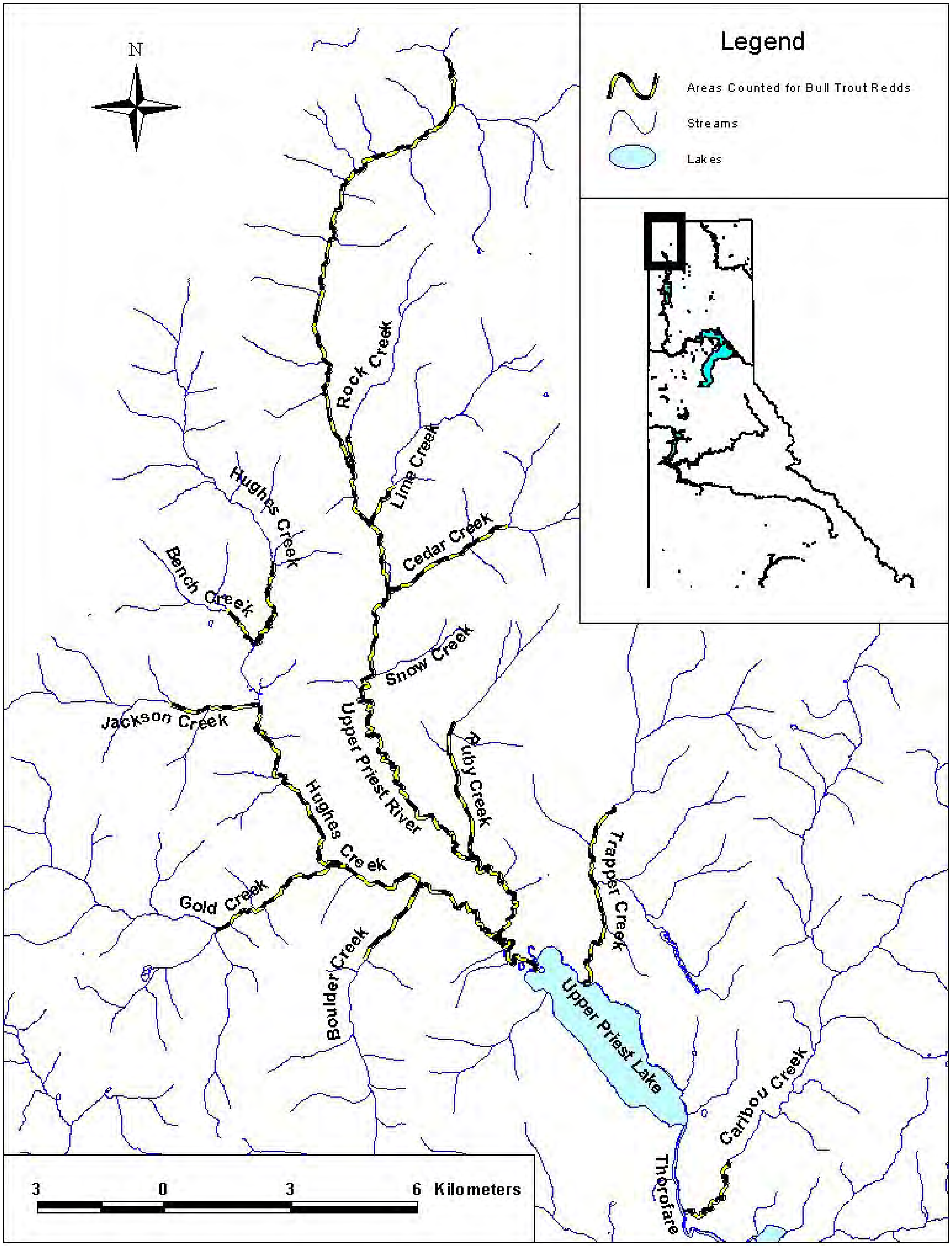

Figure 5. Stream reaches in the Upper Priest Lake basin, Idaho, where bull trout redd counts were conducted in 2001.

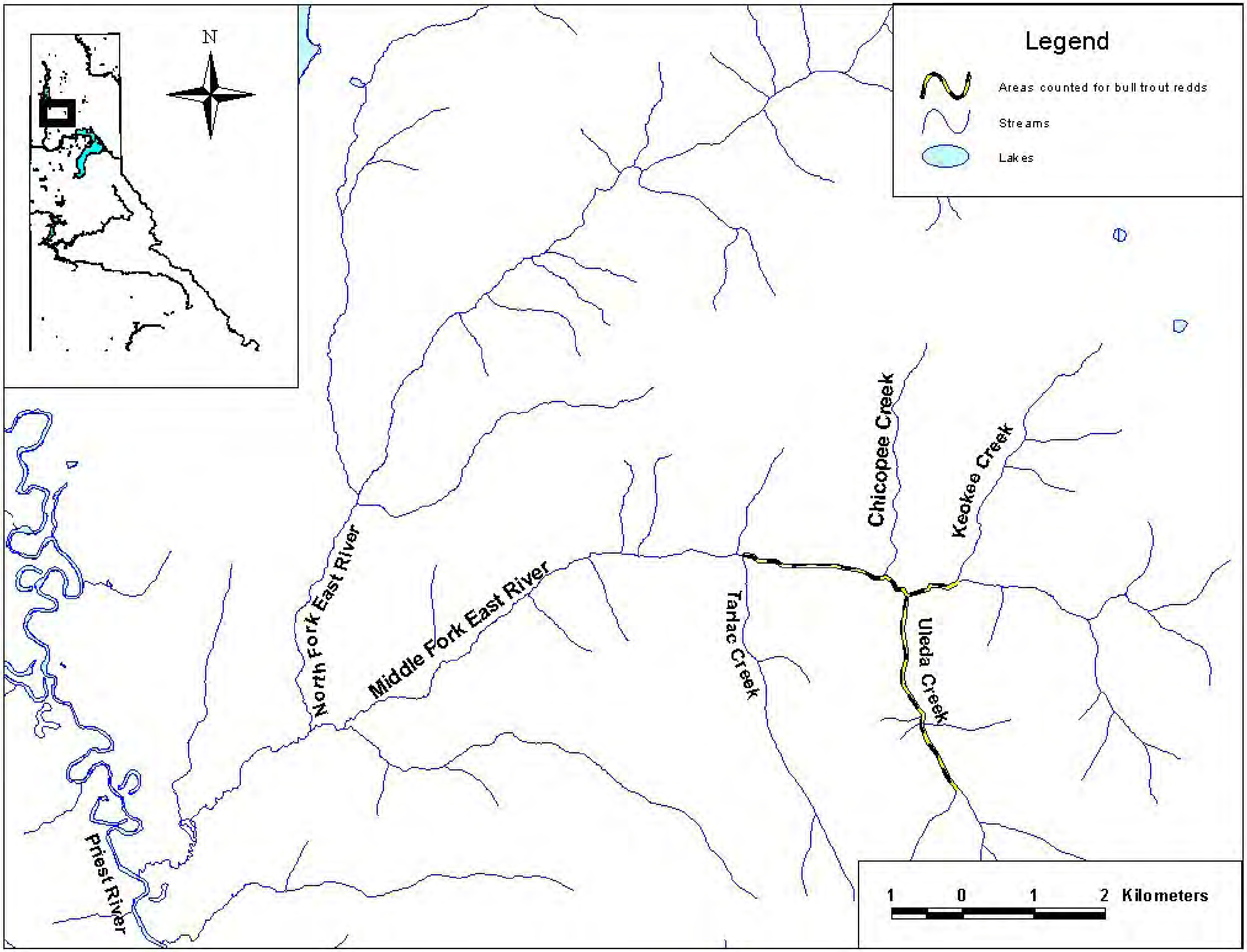

Figure 6. Stream reaches in Middle Fork East River, Idaho, where bull trout redd counts were conducted in 2001.

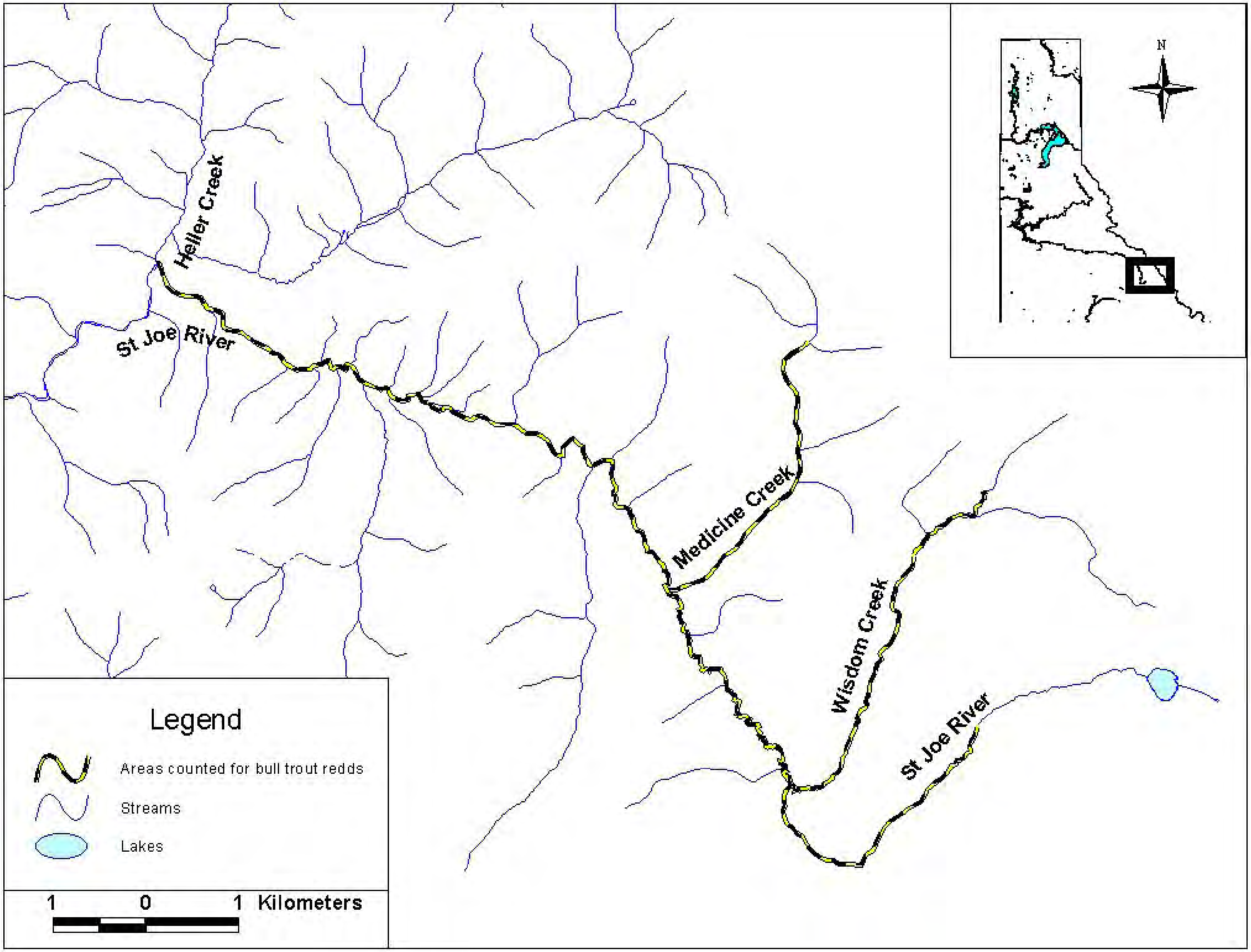

Figure 7. Stream reaches in the upper St. Joe watershed, Idaho, where bull trout redd counts were conducted in 2001.

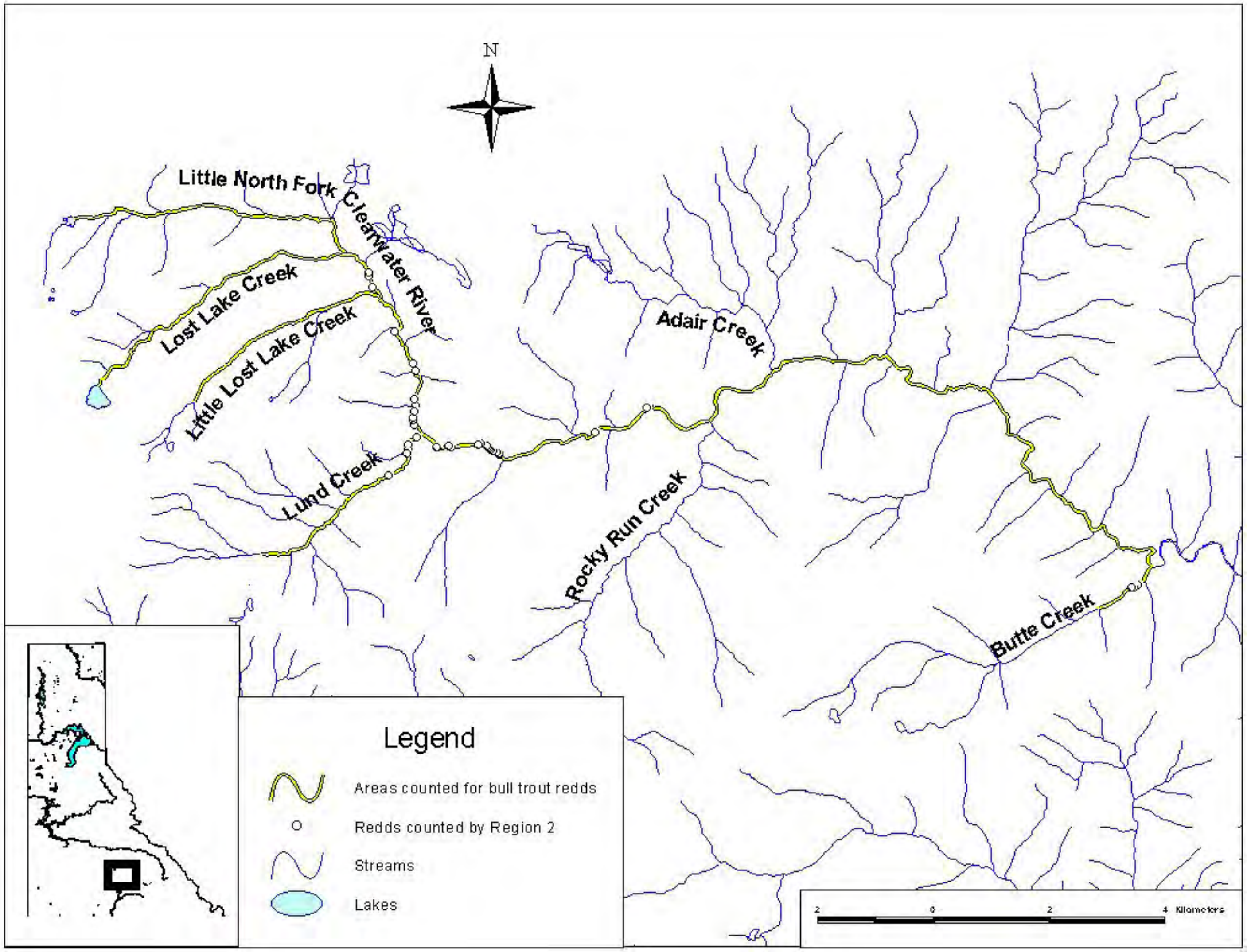

Figure 8. Stream reaches in the upper Little North Fork Clearwater River basin, Idaho, that were surveyed for redds in 2001. Panhandle Region conducted its survey on all stream segments upstream of and including Lund Creek. Clearwater Region surveyed downstream of Lost Lake Creek.

OBJECTIVES

1. Estimate salmonid and density trends in abundance in snorkeling transects in the St. Joe and Coeur d'Alene rivers.

2. Assess game fish species composition, size structure, and abundance in Middle Fork East River and Indian Creek, tributaries of the Priest River basin.

3. Conduct bull trout redd counts and estimate spawning escapement in Pend Oreille Lake, Upper Priest Lake, St. Joe River and Little North Fork Clearwater River drainages.

METHODS

St. Joe and Coeur d'Alene River Snorkel Surveys

We used snorkel surveys to evaluate trends in fish abundance in the St. Joe and Coeur d'Alene rivers. The methodology used for each transect was based on sightability and transect width. Our intent was to be reasonably certain that all fish in the transect were visible to the divers and few or no fish were overlooked. In the wider transects, where one diver could not easily see fish across the river, two divers were used, one on each side of the river. In narrower stream reaches, only one diver was used. We periodically duplicated counts using different divers to check accuracy of counts. Divers began at the upstream of the transect and snorkeled downstream, as the size of the rivers precluded upstream counts.

Estimates of salmonid abundance were limited to age-1+ fish, as summer counts for young of the year (YOY) cutthroat trout are typically unreliable. Most YOY cutthroat trout 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.

After completing fish counts, we measured length and width of each transect with a Tasco 800 Lasersite Rangefinder to determine the surface area (m^2) surveyed. Fish counts were converted to density (fish/100m^2) to standardize the data and make it possible to compare counts to other watersheds. In an effort to accurately locate and duplicate snorkel surveys in the future, transect locations were saved and recorded as waypoints using a Magellan 315 Global Positioning System (GPS) (Appendix A). In addition, photographs were taken of each site including permanent landmarks and starting and ending points of each transect.

Middle Fork East River and Indian Creek Fishery Assessment

Fish populations in tributaries of Middle Fork East River and Indian Creek were sampled by multiple pass electrofishing using a Smith Root SR-15 backpack electrofishing unit. Crews worked upstream, with each consecutive pass made immediately after and with equal effort to the previous one, until we achieved a 50% reduction in fish numbers. Captured fish were measured, placed in holding containers and monitored for recovery until all passes were complete. Once electrofishing was complete, we returned fish to the general area from which they were captured. Capture efficiency estimates were calculated for all sites using MicroFish 3.0, a maximum likelihood estimator (Van De Venter and Platts 1985). Because of the difficulties in capturing smaller fish, we did not use fish less than 60 mm in the population estimates. Transects were selected to include typical pool and riffle habitat representative of the stream. Transect length and widths were determined using a laser rangefinder, and the estimated total number of fish per site was converted to fish/100m^2. Population estimates were based on total surface area of sites sampled.

Bull Trout Spawning Surveys

Bull trout redds were counted in selected index tributaries of the Priest, Pend Oreille, St. Joe, and Little North Fork Clearwater rivers. Counts occurred at similar times as had occurred in the past. Survey techniques and identification of bull trout redds followed methodology described by Pratt (1984). Research has demonstrated the level of observer training and experience may influence the accuracy of redd counts (Bonneau and LaBar 1997; Dunham et al. 2001); consequently, only experienced biologists were utilized for bull trout redd counts in the established index streams. We estimated the range of adult bull trout spawners entering each drainage by applying a low estimate of 2.2 fish/redd (Bonar et al. 1997) and an upper estimate of 3.2 fish/redd (Fraley and Shepherd 1998) to the total number of redds observed.

RESULTS

St. Joe and Coeur d'Alene River Snorkel Surveys

St. Joe River

Thirty transects were snorkeled in the St. Joe River July 17-19, 2001. A total of 658 cutthroat trout, 52 rainbow trout *O. mykiss,* two bull trout and 753 mountain whitefish *Prosopium williamsoni* were counted (Table 1). Cutthroat trout were observed in all 30 St. Joe River snorkel sites. Densities (all size classes) ranged from 0.5 to 5.58 fish/100 m^2 with an overall average of 0.80/100m^2 (Table 1). The highest cutthroat densities (1.41 fish/100 m^2) were counted in the reach from Prospector Creek to Spruce Tree Campground (Table 2). Overall densities of cutthroat trout were higher in 2001 than those observed in 1998 and 2000 but are still below the 1995 and 1997 estimates (Table 2). Fourteen percent of the cutthroat trout observed were estimated to be over 300 mm TL. Densities of larger cutthroat trout are higher than those observed during 1997, 1998 and 2000 but are half those recorded between 1993 and 1996 (Table 3).

Mountain whitefish were counted in all but two transects in the section of river surveyed during 2001 (Table 1). Mean density for mountain whitefish was slightly higher than cutthroat trout at 0.92 fish/100 m^2. The highest density of mountain whitefish (1.25 fish/100 m^2) was counted in the most downstream reach (Calder to North Fork St. Joe) where the lowest density of cutthroat trout was counted (Table 4). Mountain whitefish densities appear to have increased since 2000 and are the highest counted since 1996 (Table 4). Rainbow trout were only counted downstream of the North Fork St. Joe River where this species is annually stocked.

Table 1. Number and density of fish observed while snorkeling transects in the St. Joe River, Idaho, in 2001. Calder to N.F. St. Joe River is the only area outside of the catch-and-release regulation as of 2000.

Reach	Transect Number	Length (m)	Width (m)	Area (m^2)	Cutthroat trout: Number counted ≤300mm	Cutthroat trout: Number counted >300mm	Cutthroat trout: Density (#/100 m^2)	Rainbow trout counted	Bull trout counted	Mountain whitefish: Number counted	Mountain whitefish: Density (#/100 m^2)
Calder to N.F. St Joe	S-29	80	39.33	3,147	0	1	0.03	0	0	50	1.59
	S-30	120	40.50	4,860	35	0	0.72	0	0	4	0.08
	S-31	87	39.50	3,437	3	0	0.09	0	0	84	2.44
	S-32	120	37.25	4,470	6	1	0.16	37	0	78	1.74
	S-33	104	25.75	2,678	2	0	0.07	14	0	65	2.43
	S-34	89	43.50	3,872	0	2	0.05	1	0	0	0.00
N.F. St Joe to Prospector Creek	S-1	64	40.00	2,560	7	0	0.27	0	0	0	0.00
	S-2	112	23.00	2,576	16	1	0.66	0	0	22	0.85
	S-3	55	15.00	825	21	0	2.55	0	0	13	1.58
	S-5	200	30.00	6,000	44	5	0.82	0	0	22	0.37
	S-6	220	34.50	7,590	16	2	0.24	0	0	17	0.22
	S-7	127	33.67	4,276	11	2	0.30	0	0	4	0.09
	S-8	118	18.00	2,124	15	7	1.04	0	0	38	1.79
Prospector Creek to Red Ives	S-10	250	22.00	5,500	20	6	0.47	0	0	46	0.84
	S-12	126	28.00	3,528	30	3	0.94	0	0	41	1.16
	S-13	136	27.67	3,763	40	10	1.33	0	0	40	1.06
	S-14	112	20.00	2,240	26	2	1.25	0	1	80	3.57
	S-15	95	16.00	1,520	17	3	1.32	0	0	20	1.32
	S-16	163	14.25	2,323	18	0	0.77	0	0	3	0.13
	S-17	158	17.50	2,765	52	0	1.88	0	0	4	0.14
	S-18	59	15.25	900	29	2	3.45	0	0	24	2.67
	S-19	46	16.33	751	18	2	2.66	0	0	0	0.00
	S-20	86	19.25	1,656	16	4	1.21	0	0	4	0.24
	S-21	39	19.75	770	35	8	5.58	0	0	19	2.47
	S-22	65	24.75	1,609	32	11	2.67	0	0	39	2.42
Red Ives to Ruby Cr.	S-24	65	17.25	1,121	18	2	1.78	0	0	4	0.36
	S-25	75	19.25	1,444	21	1	1.52	0	1	10	0.69
	S-26	57	23.50	1,340	1	1	0.15	0	0	4	0.30
	S-27	69	25.75	1,777	16	3	1.07	0	0	11	0.62
	S-28	59	13.25	782	14	0	1.79	0	0	7	0.90
Total	All 30 Transects	3,156	--	82,200	579	79	0.80	52	2	753	0.92

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Table 2. Average density (number/100 m^2) of all sizes of cutthroat trout counted by reach during snorkel evaluations from 1993 to 2001 in the St. Joe River, Idaho. Transects snorkeled from the Calder to the North Fork St. Joe River reach differed in 2001 from those snorkeled between 1993 and 2001.

Reach	1993	1994	1995	1996	1997	1998	2000	2001
Calder to N.F. St. Joe River	0.07	0.23	0.16	0.14	0.15	0.09	--	0.22
N.F. St. Joe to Prospector Creek	0.86	0.49	1.04	0.47	0.34	0.22	0.49	0.57
Prospector Creek to Spruce Tree C.G.	1.98	1.84	2.76	2.80	3.31	1.19	1.14	1.41
Spruce Tree C.G. to Ruby Creek	1.32	1.39	2.58	2.57	1.13	1.44	1.06	1.19
All transects – Calder to Ruby Creek	0.80	0.76	1.19	1.06	1.09	0.50	--	0.80

Table 3. Average density (number/100 m^2) of cutthroat trout >300 mm counted by reach during snorkel evaluations from 1993 to 2001 in the St. Joe River, Idaho. Transects snorkeled from Calder to the North Fork St. Joe River reach differed in 2001 from those snorkeled between 1993 and 2001.

Reach	1993	1994	1995	1996	1997	1998	2000	2001
Calder to N.F. St. Joe River	0.02	0.05	0.02	0.03	0.00	0.01	--	0.02
N.F. St. Joe to Prospector Creek	0.22	0.10	0.10	0.08	0.02	0.01	0.12	0.07
Prospector Creek to Spruce Tree C.G.	0.64	0.49	0.43	0.67	0.18	0.10	0.24	0.19
Spruce Tree C.G. to Ruby Creek	0.81	0.47	0.70	0.76	0.13	0.26	0.18	0.11
All transects – Calder to Ruby Creek	0.26	0.20	0.19	0.25	0.06	0.50	--	0.10

Table 4. Average density (number/100 m^2) of mountain whitefish counted by reach during snorkel evaluations from 1993 to 2001 in the St. Joe River, Idaho. Transects snorkeled from the Calder to the North Fork St. Joe River reach differed in 2001 from what was snorkeled between 1993 and 2001.

Reach	1993	1994	1995	1996	1997	1998	2000	2001
Calder to N.F. St. Joe River	0.60	0.18	0.34	0.88	0.44	0.10	--	1.25
N.F. St. Joe to Prospector Creek	0.88	1.77	1.28	0.98	0.27	1.32	0.59	0.45
Prospector Creek to Spruce Tree C.G.	1.85	0.64	1.78	1.07	0.53	0.71	0.49	1.17
Spruce Tree C.G. to Ruby Creek	0.74	1.03	1.73	1.60	0.35	0.38	0.47	0.56
All transects – Calder to Ruby Creek	0.97	0.75	1.03	1.01	0.41	0.60	--	0.92

Coeur d'Alene River

Thirty-five transects were snorkeled in the Coeur d'Alene River July 18-30, 2001. A total of 518 cutthroat trout, 330 rainbow trout, 3 brook trout *Salvelinus fontinalis* and 2,099 mountain whitefish were counted (Table 5). Cutthroat trout were most abundant in the North Fork Coeur d'Alene River in the catch-and-release area upstream of Yellow Dog Creek (Figure 9, Table 6), although not significantly more than the restricted harvest area (t=test, P=0.7). The average cutthroat trout density (all size classes) for the entire North Fork Coeur d'Alene River during 2001 was 0.73 fish/100 m^2, the highest ever recorded. A strong upward trend in cutthroat trout density is apparent on the North Fork Coeur d'Alene River (Figure 10). However, if only cutthroat trout greater than 300 mm are evaluated, no apparent increase in density has occurred over time and the 2001 density of 0.045 fish/100 m^2 is about average (Figure 11; Table 7). About 6% of the cutthroat trout observed during 2001 were over 300 mm in length.

Cutthroat trout densities in the Little North Fork Coeur d'Alene River (0.25 fish/100 m^2) are lower than those observed in the North Fork in the Coeur d'Alene River. No apparent trend in abundance is evident over time (Figure 10, Table 6). No cutthroat trout greater than 300 mm were observed during 2001 in the Little North Fork Coeur d'Alene River, and a downward trend is evident if densities are evaluated over time (Figure 11; Table 7). Lower densities of cutthroat trout were observed upstream of Laverne Creek in the catch-and-release area, although not significantly less (t=test, P=037).

Rainbow trout were observed in 14 snorkel transects. About 96% of the rainbow trout were observed in the most downstream reaches where harvest is allowed (Table 5). These are the same stream reaches where rainbow trout have been stocked in the past. Densities of rainbow trout observed ranged from 0.00 to 2.06 fish/100 m^2, with a mean density of 0.39 fish/100 m^2. Of the 330 rainbow trout observed, eight (2.4%) were estimated to be over 300 mm in length.

Mountain whitefish were observed in 17 snorkel transects in the Coeur d'Alene River and densities ranged from 0.00 to 10.3 fish/100 m^2 with a mean density of 2.5 fish/100 m^2. Highest densities of mountain whitefish were in the lower reach of the river, with few mountain whitefish observed upstream of Teepee Creek or in the Little North Fork Coeur d'Alene River (Table 5). The average mountain whitefish density observed in the North Fork Coeur d'Alene River was the second highest ever recorded, and an increasing trend in abundance is evident over time (Figure 2).

Middle Fork East River and Indian Creek Fishery Assessment

Middle Fork East River

Tarlac, Uleda, Keokee and Chicopee creeks were electrofished on August 7, 2001 to evaluate their fish populations. Cutthroat trout were sampled from each of these tributaries and were the most abundant fish in Keokee and Chicopee creeks (Table 8). Uleda Creek was the only stream found to support bull trout and had an estimated density of 10.4 fish/100 m^2. Nine juvenile bull trout ranging in size from 42 to 174 mm were sampled from Uleda Creek and another three adult fish were sampled that ranged in size from 490 to 630 mm. Spot sampling upstream found

Table 5 Number and density of fish observed while snorkeling transects in the Coeur d'Alene River, Idaho, during 2001.

	Transect number	Length (m)	Width (m)	Area (m^2)	Cutthroat trout counted ≤300mm	Cutthroat trout counted >300mm	Cutthroat trout density (#/100 m^2)	Rainbow trout counted	Brook trout counted	Mountain whitefish counted	M. whitefish density (#/100 m^2)
	NF-1	36	21.00	756	7	0	0.93	0	0	47	6.22
	NF-2	35	14.50	508	1	1	0.39	0	0	0	0.00
	NF-3	94	15.25	1,434	1	1	0.14	0	0	2	0.14
	NF-4	106	17.00	1,802	0	0	0.00	0	0	0	0.00
N.F. CdA - Yellow Dog to Tepee (C & R)	NF-5	91	19.25	1,752	35	3	2.17	0	0	145	8.28
	NF-6	63	14.50	914	8	0	0.88	0	0	0	0.00
	NF-7	93	18.00	1,674	27	0	1.61	1	0	0	0.00
	NF-8	113	25.00	2,825	76	4	2.83	9	0	186	6.58
	NF-9	130	21.25	2,763	20	0	0.72	4	0	66	2.39
N.F. Coeur d'Alene River – Confluence of S.F. Cd'A River to Yellow Dog Creek (Limited Harvest Allowed)	NF-10	--	--	--	--	--	--	--	--	--	--
	NF-11	50	24.75	1,238	0	0	0.00	0	0	0	0.00
	NF-12	185	41.00	7,585	40	5	0.59	10	0	18	0.24
	NF-13	100	36.00	3,600	8	1	0.25	0	0	128	3.56
	NF-14	147	34.75	5,108	93	2	1.86	105	0	527	10.32
	NF-15	107	31.00	3,317	37	1	1.15	25	0	188	5.67
	NF-16	230	21.00	4,830	17	1	0.37	37	0	98	2.03
	NF-17	160	39.00	6,240	4	0	0.06	25	0	166	2.66
	NF-18	138	32.25	4,451	0	0	0.00	46	0	177	3.98
	NF-19	103	40.50	4,172	15	3	0.43	14	0	125	3.00
	NF-20	171	27.00	4,617	7	3	0.22	23	0	176	3.81
N.F. Cd'A - Tepee Cr. to Jordan Cr. (C & R)	NF-24	30	11.75	353	3	0	0.85	0	0	0	0.00
	NF-25	39	8.75	341	1	0	0.29	0	0	0	0.00
	NF-26	72	19.50	1,404	22	2	1.71	0	0	14	1.00
	NF-27	67	21.75	1,457	16	2	1.24	0	0	30	2.06
	NF-28	71	13.75	976	0	0	0.00	0	0	0	0.00
Little N.F.Cd'A Riv. (LNF 1 and 2 are C & R; LNF 3-10 are limited harvest)	LNF-1	91	14.75	1,342	4	0	0.30	0	0	0	0.00
	LNF-2	111	17.75	1,970	0	0	0.00	0	0	0	0.00
	LNF-3	75	24.00	1,800	11	0	0.61	0	0	0	0.00
	LNF-4	139	15.75	2,189	0	0	0.00	0	0	0	0.00
	LNF-5	154	19.25	2,965	29	0	0.98	0	1	0	0.00
	LNF-6	81	11.25	911	0	0	0.00	0	0	0	0.00
	LNF-7	70	13.75	963	0	0	0.00	0	0	0	0.00
	LNF-8	173	24.50	4,239	1	0	0.02	12	0	2	0.05
	LNF-9	120	18.25	2,190	3	0	0.14	8	0	0	0.00
	LNF-10	100	16.25	1,625	3	0	0.18	11	2	4	0.25
Total	35 sites	3,545	--	84,307	489	29	0.61	330	3	2,099	2.49

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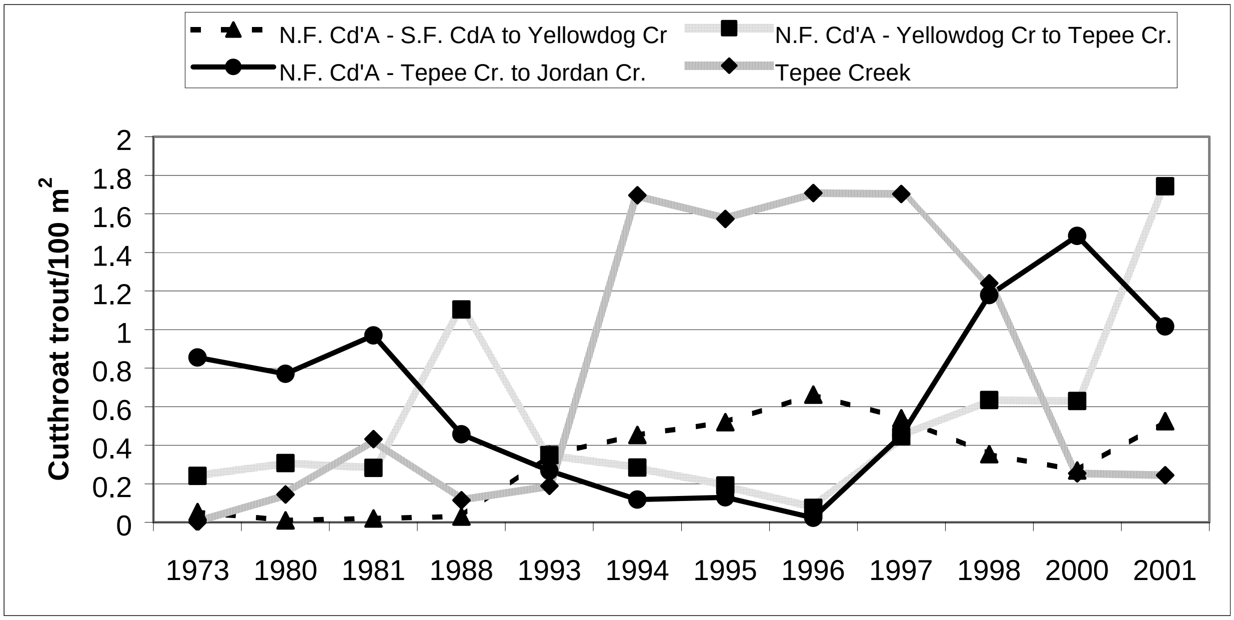

Figure 9. The average density of cutthroat trout observed while snorkeling reaches of the North Fork Coeur d'Alene River, Idaho, between 1973 and 2001.

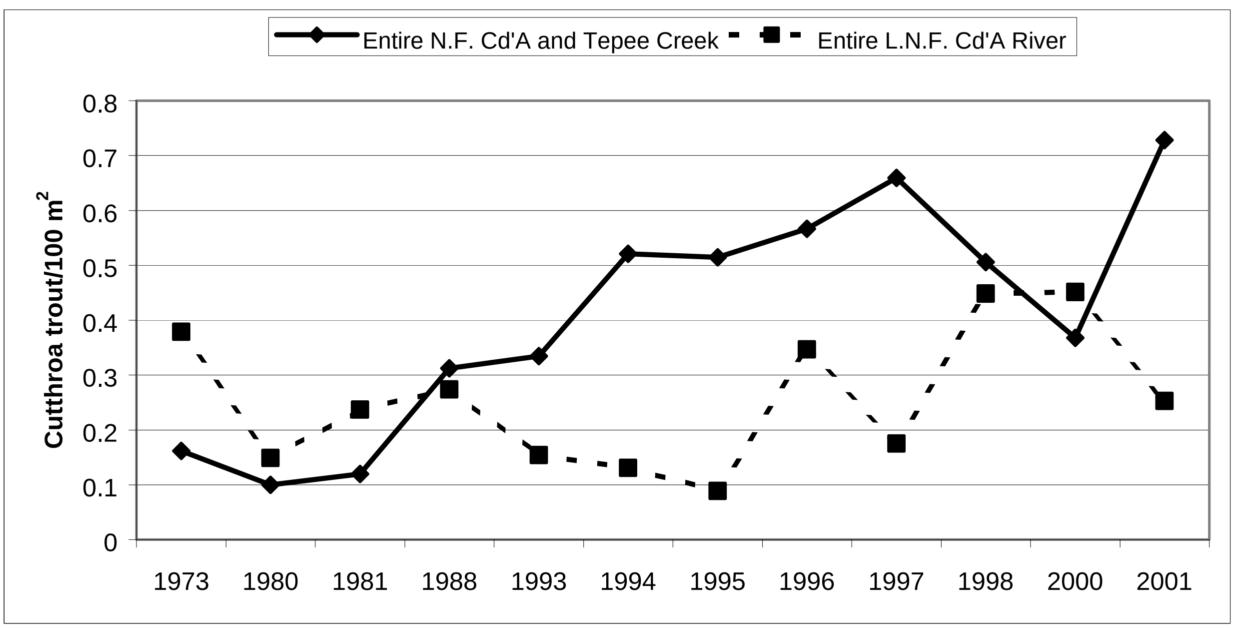

Figure 10. The average density of cutthroat trout observed while snorkeling the North Fork Coeur d'Alene River (N.F. Cd'A) and Little North Fork Coeur d'Alene River (L.N.F. Cd'A), Idaho, between 1973 and 2001.

Table 6. Average density (number/100 m^2) of cutthroat trout counted in reaches of the North Fork Coeur d'Alene River (N.F. Cd'A) and Little North Fork Coeur d'Alene River (L.N.F. Cd'A), Idaho, during snorkel evaluations from 1973 to 2001.

River Section	1973	1980	1981	1988	1993	1994	1995	1996	1997	1998	2000	2001
N.F. Cd'A – S.F. Cd'A River to Prichard Cr.	0.06	0.02	0.02	0.05	0.56	0.64	0.63	0.96	0.47	0.33	0.41	0.53
N.F. Cd'A – Prichard Cr to Yellow Dog Cr.	0.05	0.00	0.03	0.02	0.08	0.32	0.44	0.36	0.62	0.41	0.13	0.51
N.F. Cd'A – Yellow Dog Cr. to Tepee Cr.	0.24	0.31	0.28	1.10	0.35	0.28	0.19	0.07	0.44	0.63	0.63	1.74
N.F. Cd'A – Tepee Cr. to Jordan Cr.	0.86	0.77	0.97	0.46	0.27	0.12	0.13	0.02	0.45	1.18	1.49	1.02
Tepee Creek	0.00	0.14	0.43	0.12	0.19	1.70	1.57	1.71	1.70	1.24	0.26	0.24
L.N.F. C'dA – Mouth to Laverne Cr.	0.33	0.04	0.02	0.10	0.18	0.03	0.04	0.12	0.23	0.39	0.36	0.28
L.N.F. C'dA – Laverne Cr. To Burnt Cabin Cr.	0.79	1.04	1.95	0.90	0.03	0.47	0.22	0.90	0.00	0.66	0.79	0.12
Entire N.F. Cd'A River and Tepee Creek	0.16	0.10	0.12	0.31	0.33	0.52	0.52	0.57	0.66	0.51	0.37	0.73
Entire L.N.F. Cd'A River	0.38	0.15	0.24	0.27	0.15	0.13	0.09	0.35	0.18	0.45	0.45	0.25
All Transects	0.20	0.11	0.14	0.31	0.31	0.44	0.44	0.53	0.57	0.49	0.38	0.61

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Table 7. Average density (number/100 m^2) of cutthroat trout greater than 300 mm counted in reaches of the North Fork Coeur d'Alene River (N.F. Cd'A) and Little North Fork Coeur d'Alene River (L.N.F. Cd'A), Idaho, during snorkel evaluations from 1973 to 2001.

River Section	1973	1980	1981	1988	1993	1994	1995	1996	1997	1998	2000	2001
N.F. Cd'A – S.F. Cd'A River to Prichard Cr.	0.00	0.02	0.01	0.01	0.08	0.11	0.08	0.18	0.05	0.00	0.01	0.0
N.F. Cd'A – Prichard Cr to Yellow Dog Cr.	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.03	0.01	0.06
N.F. Cd'A – Yellow Dog Cr. to Tepee Cr.	0.02	0.12	0.04	0.08	0.04	0.04	0.01	0.01	0.01	0.02	0.07	0.07
N.F. Cd'A – Tepee Cr. to Jordan Cr.	0.06	0.43	0.26	0.23	0.28	0.09	0.09	0.00	0.08	0.18	0.38	0.09
Tepee Creek	0.00	0.03	0.43	0.06	0.08	0.31	0.07	0.14	0.11	0.08	0.05	0.04
L.N.F. C'dA – Mouth to Laverne Cr.	0.02	0.02	0.00	0.05	0.06	0.00	0.00	0.01	0.00	0.00	0.04	0.00
L.N.F. C'dA – Laverne Cr. To Burnt Cabin Cr.	0.18	0.37	0.18	0.09	0.03	0.00	0.00	0.05	0.00	0.00	0.06	0.00
Entire N.F. Cd'A River and Tepee Creek	0.01	0.05	0.04	0.04	0.06	0.08	0.04	0.07	0.04	0.03	0.04	0.05
Entire L.N.F. Cd'A River	0.03	0.05	0.02	0.06	0.06	0.00	0.00	0.02	0.00	0.00	0.04	0.00
All Transects	0.01	0.05	0.04	0.05	0.06	0.07	0.03	0.06	0.03	0.02	0.04	0.03

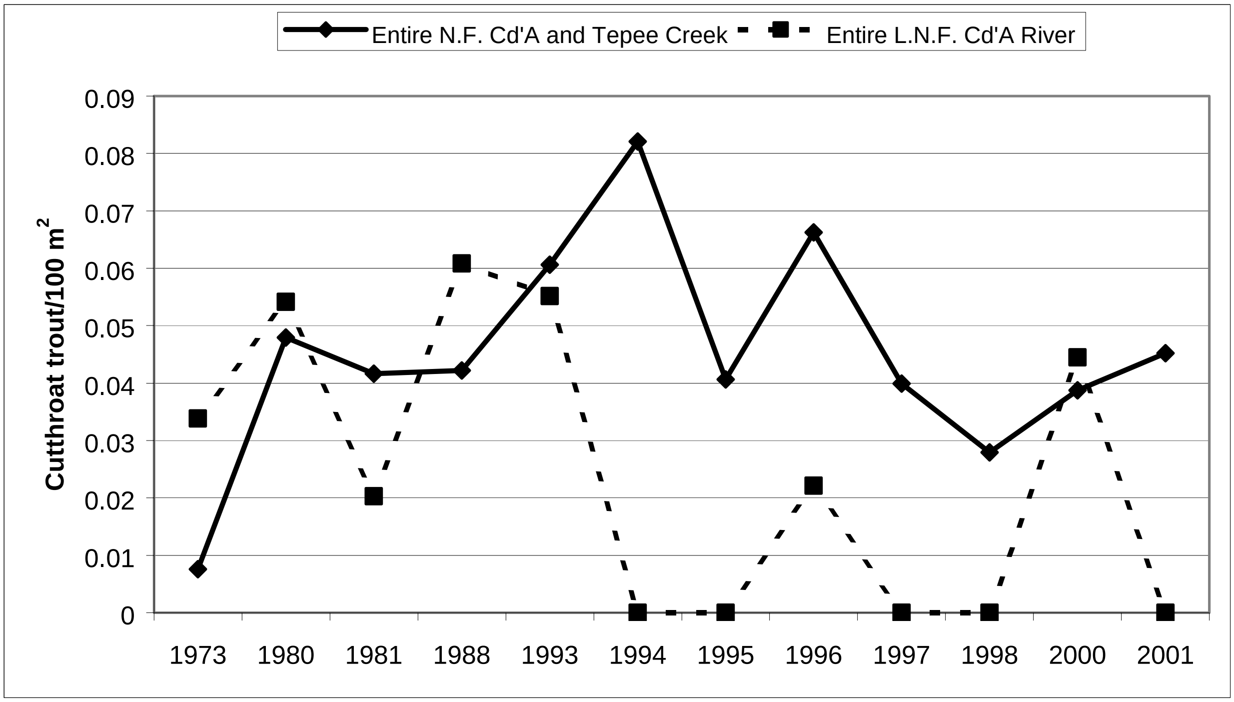

Figure 11. The average density of cutthroat trout > 300 mm observed while snorkeling the North Fork Coeur d'Alene River (N.F. Cd'A) and Little North Fork Coeur d'Alene River (L.N.F. Cd'A), Idaho, between 1973 and 2001.

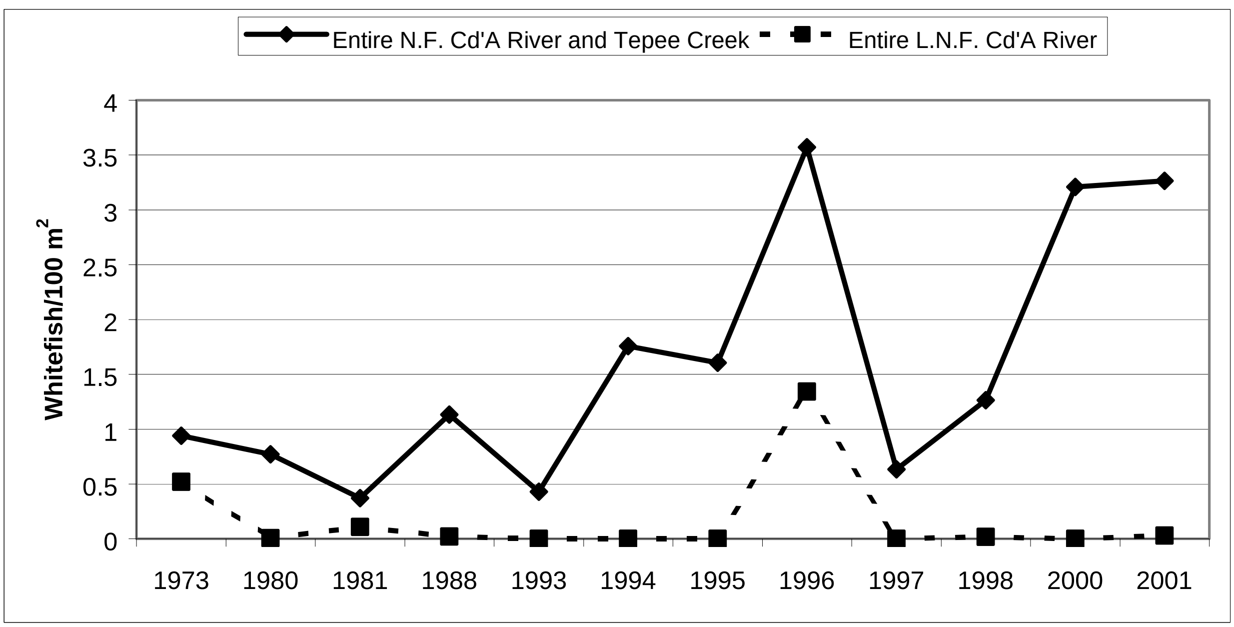

Figure 12. The average density of mountain whitefish observed while snorkeling the North Fork Coeur d'Alene River (N.F. Cd'A) and Little North Fork Coeur d'Alene River (L.N.F. Cd'A), Idaho, between 1973 and 2001

Table 8. Density of fishes (number/100 m^2) determined from electrofishing surveys (1986 and 2001) and snorkel surveys (1983) in selected tributaries of the Priest River basin, Idaho. Tarlac and Uleda creeks were previously surveyed in 1986 (Horner et al. 1987) and North Fork Indian Creek was previously surveyed during 1983 (Irving 1987).

	Cutthroat trout		Brook trout		Bull trout	
Streams	1983-1986	2001	1983-1986	2001	1983-1986	2001
Tarlac	0	2.8	2.1	7.4	4.4	0.0
Uleda	4.4	1.7	0.0	0.0	6.6	10.4
Keokee	-	14.0	0	4.0	-	0.0
Chicopee	-	20.3	-	0.0	-	0.0
N.F. Indian Creek 1	10.91	25.0	0.3	0.0	0.2	0.0
N.F. Indian Creek 2	0	0.0	0.0	0.0	3.9	0.5

another four bull trout ranging in size from 490 to 700 mm. Bull trout were not sampled from Tarlac Creek, where they were the most abundant fish in 1986. Surveys during 2001 found brook trout as the most abundant species in Tarlac Creek. Brook trout were also sampled from Keokee Creek.

Indian Creek

Two sites on North Fork Indian Creek were electrofished to evaluate for the presence of bull trout. Bull trout were sampled only from the downstream site (N.F. Indian 2), with the estimated density being 0.5 fish/100 m^2 (Table 8). At this site 150 m of stream was electrofished and three bull trout ranging in size from 155 to 180 mm were sampled. During 1983 bull trout densities were found to be 3.9 fish/100 m^2 at the same site. The size of bull trout sampled during 2001 ranged from 155 to 180 mm. No other fish were sampled from this site. Cutthroat trout and sculpin *Cottus spp.* were the only fish sampled from the upper site (N.F. Indian 1). Cutthroat densities were estimated to be 25.0 fish/100 m^2, considerably higher than those documented in 1983 (Table 8). The size of cutthroat trout sampled during 2001 ranged from 50 to 195 mm. During 1983, brook trout and bull trout were also documented to occur at this site.

Bull Trout Spawning Surveys

Priest River Basin

Bull trout redd counts from October 3 to 9, 2001 in the Upper Priest River basin identified 34 redds (Table 9). Most redds in the Upper Priest basin were counted in Upper Priest River (22 of 34), whereas few redds were counted in any of the smaller streams. The number of redds is higher than last year; however, when compared to the redd counts documented during 1985, it appears the adfluvial bull trout population in the Upper Priest Lake basin is a fraction of what it once was. An additional seven redds were counted in the East River (Middle Fork East River and Uleda Creek), which was surveyed for the first time in 2001. Members from the US Fish and Wildlife Service counted the East River on October 12. Expanding the number of redds observed by 2.2 and 3.2 fish/redd, an estimated range of 75-112 bull trout entered streams from the Upper Priest Lake basin and 15 to 23 bull trout entered the East River to spawn in 2001.

Pend Oreille Lake Basin

A total of 699 redds were counted in the Pend Oreille Lake drainage, 562 (80%) of which were in the six index streams (Trestle, East Fork Lightning, Gold, North Gold, Johnson, and Grouse creeks). All redds were counted between October 11 and October 26. As is typical, around half of the total redds counted were in Trestle Creek (331), followed by Gold Creek (127) (Table 10). Redd counts in 2001 were interesting in that an unusually high number of redds was counted in several streams (Rattle Creek, Johnson Creek and Pack River). In fact, the number of redds counted in Rattle Creek (67) was the highest ever counted in this stream. Other tributaries such as Granite Creek, Sullivan Springs, Grouse Creek and Twin Creek had unexpectedly low numbers of redds. If the number of redds counted in the six index streams is evaluated from 1983 to 2001, a flat trend is observed. However, if only the last ten years are evaluated, an increasing trend is evident. Expanding the number of redds observed by 2.2 and 3.2 fish/redd, an estimated range of 1,538 to 2,307 bull trout entered the Pend Oreille Lake tributaries to spawn in 2001.

Table 9. Description of bull trout transect locations, distance surveyed and number of redds counted in the Priest River drainage, Idaho, from 1985 to 2001.

Stream	Transect description	Length (km)	1985	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Upper Priest River	Falls to Rock Cr.	12.5	--	--	--	--	--	15	4	15	33	7	7
	Rock Cr. to Lime Cr.	1.6	--	--	2	1	1	2	0	3	7	0	2
	Lime Cr. to Snow Cr.	4.2	12[a]	--	3	4	2	8	1	10	9	9	5
	Snow Cr. to Hughes Cr.	11.0	--	--	0	0	--	0	3	7	4	2	8
	Hughes Cr. to Priest Lake	2.3	--	--	0	0	--	0	--	--	0	0	--
Rock Cr.	Mouth to F.S. trail 308	0.8	--	0	0	--	--	2	1	0	--	0	0
Lime Cr.	Mouth upstream 1.2 km	1.2	4[b]	0	0	--	--	0	2	0	1	0	0
Cedar Cr.	Mouth upstream, 3.4 km	3.4	--	--	0	2	1	0	1	0	0	0	0
Ruby Cr.	Mouth to waterfall	3.4	--	0	0	--	--	--	0	0	--	--	--
Hughes Cr.	Hughes Meadow to trail 312	2.5	--	7	3	2	0	1	4	0	1	0	0
	Trail 311 to F.S. road 322	4.0	--	2	0	7	1	2	0	0	0	0	0
	F.S. road 622 to mouth	7.1	40[c]	--	1	--	--	2	3	1	0	2	6
Bench Cr.	Mouth upstream 0.8 km	1.1	--	0	2	2	0	1	0	0	0	0	0
Jackson Cr.	Mouth to FS trail 311	2.2	--	4	0	0	0	0	0	0	--	--	--
Gold Cr.	Mouth to F.S. road 1013	3.7	24	5	2	6	5	3	0	1	1	9	5
Boulder Cr.	Mouth to waterfall	2.3	--	0	0	0	--	0	0	0	--	0	1
Trapper Cr.	Mouth to waterfall	5.0	--	--	4	4	2	5	3	8	2	0	1
Caribou Cr.	Mouth to old road crossing	2.6	--	--	1	0	0	0	0	0	--	--	--
MF East River	Tarlac Cr. to Keokee Cr.	3.3	--	--	--	--	--	--	--	--	--	--	3
Uleda Creek	Mouth upstream 3.0 km	3.0	--	--	--	--	--	--	--	--	--	--	4
	TOTALS		80[d]	18	18	28	12	41	22	45	58	29	41

[a]Redds were counted from Lime Creek to Cedar Creek, which is about half the distance that is currently counted.
[b]Redds were counted from the mouth to F.S. road 1013, which is about ¼ of the distance that is currently counted.
[c]Redds were counted from F.S. road 622 to F.S. road 1013, which is about 1/3 of the distance that is currently counted.
[d]Redds were counted in about 10% of the stream reaches where they are currently counted.

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Table 10. Number of bull trout redds counted per stream in the Pend Oreille Lake basin, Idaho, from 1983 to 2001.

Stream	1983	1984	1985	1986	1987	1988	1989	1990	1991[a]	1992	1993	1994	1995[b]	1996	1997	1998	1999	2000	2001
CLARK FORK R.	--	--	--	--	--	--	--	--	--	2	8	17	18	3	7	8	5	5	6
Lightning Cr.	28	9	46	14	4	--	--	--	--	11	2	5	0	6	0	3	16	4	7
East Fork Lightning [c]	110	24	132	8	59	79	100	29	--	32	27	28	3	49	22	64	44	54	36
Savage Cr.	36	12	29	--	0	--	--	--	--	1	6	6	0	0	0	0	4	2	4
Char Cr.	18	9	11	0	2	--	--	--	--	9	37	13	2	14	1	16	17	11	2
Porcupine Cr.	37	52	32	1	9	--	--	--	--	4	6	1	2	0	0	0	4	4	0
Wellington Cr.	21	18	15	7	2	--	--	--	--	9	4	9	1	5	2	1	22	8	7
Rattle Cr.	51	32	21	10	35	--	--	--	--	10	8	0	1	10	2	15	13	12	67
Johnson Cr. [c]	13	33	23	36	10	4	17	33	25	16	23	3	4	5	27	17	31	4	34
Twin Cr.	7	25	5	28	0	--	--	--	--	3	4	0	5	16	6	10	19	10	1
Morris Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0
NORTH SHORE																			
Trestle Cr. [c]	298	272	298	147	230	236	217	274	220	134	304	276	140	243	221	330	253	301	331
Pack River	34	37	49	25	14	--	--	--	--	65	21	22	0	6	4	17	0	8	28
Grouse Cr. [c]	2	108	55	13	56	24	50	48	33	17	23	18	0	50	8	44	50	77	18
EAST SHORE																			
Granite Cr.	3	81	37	37	30	--	--	--	--	0	7	11	9	47	90	49	41	25	7
Sullivan Springs	9	8	14	--	6	--	--	--	--	0	24	31	9	15	42	10	22	19	8
North Gold Cr. [c]	16	37	52	8	36	24	37	35	41	41	32	27	31	39	19	22	16	19	16
Gold Cr. [c]	131	124	11	78	62	111	122	84	104	93	120	164	95	100	76	120	147	168	127
Total of 6 index streams [c]	570	598	571	290	453	478	543	503	423	333	529	516	273	486	373	597	541	623	562
Total of all streams	814	881	830	412	555	478	543	503	423	447	656	631	320	608	527	726	705	732	699

[a] Represents partial counts due to early snow fall.

[b] Observation conditions impaired by high runoff

[c] Index streams include Trestle, East Fork Lightning, Gold, North Gold, Johnson, and Grouse Creeks

St. Joe River

We counted 40 redds in the three index streams (Medicine Creek, Wisdom Creek, and upper St. Joe River) of the St. Joe River drainage on September 24, 2001 (Table 11). This was the second straight year of declining redd numbers after the highest number was recorded in 1999. However, the number of redds counted during 2001 is about equal to the 10-year average of 40.5 redds. The number of redds counted in Medicine Creek was substantially lower than observed the previous two years, whereas the redds counted in Wisdom Creek and the upper St. Joe River were higher than those counted in the previous four years. In fact, the number of redds counted in Wisdom Creek was the highest ever recorded. Expanding the number of redds observed by 2.2 and 3.2 fish/redd, an estimated range of 88 to 128 bull trout entered the St. Joe River drainage index stream reaches to spawn in 2001.

Little North Fork Clearwater River

Bull trout redd surveys were conducted on September 25, 2001 in the upper Little North Fork Clearwater River drainage. During this survey 18 redds were counted, which matches the count in 2000, the highest total on record (Table 12). However, there are inconsistencies in stream reaches counted throughout the years. Clearwater Region personnel also conducted bull trout redd surveys in the Little North Fork Clearwater River basin on September 22 and 23, 2001 and counted 39 redds (Table 12, Figure 8). This more than doubled our 2001 total. Clearwater Region personnel counted some stream reaches that we have not counted in the past. These new stream reaches accounted for 22 of the 39 redds they counted. The number of redds documented in the stream reaches that both Clearwater Region and Panhandle Region personnel counted varied considerably by who counted them; we counted 13 redds in Lund Creek, an all time high, whereas Clearwater Region counted 5 redds. In the Little North Fork Clearwater River between Lund Creek and Lost Lake Creek, we counted 3 redds and Clearwater Region counted 12 redds. Expanding the number of redds (Panhandle Region counts) observed by 2.2 and 3.2 fish/redd, an estimated range of 40 to 58 bull trout entered the upper Little North Fork Clearwater River to spawn in 2001. Using Clearwater Region counts; an estimated range of 86 to 186 bull trout entered the upper Little North Fork Clearwater to spawn.

DISCUSSION

<u>St. Joe and Coeur d’Alene River Snorkel Surveys</u>

Cutthroat Trout

Overall cutthroat trout densities appear to be increasing in the St. Joe River since the large decline that was observed in 1998. In all likelihood, the decrease in cutthroat trout density in 1998 was a delayed response to the large flood event that occurred during February 1996 and not a factor of changes in fishing pressure or a change in fishing regulations. Floods have been found to impact fish populations through increases in bedload movement, changes in channel morphology, silting of spawning gravel and scouring or filling of pools and riffles (Swanston 1991; Pearson et al. 1992; Abbott 2000). Although cutthroat trout densities appear to be increasing in the St. Joe River, they are still significantly lower (t=test, P <0,05) than those documented in 1995 and 1996. The decline in cutthroat trout abundance following the flow was even more pronounced for fish greater than 300 mm as densities were three to four times higher prior to the flood than they are now. The abundance of fish greater than 300 mm appears to be increasing but is significantly lower than what occurred in 1993-1996, prior to the flood (t=test, P <0.05). If favorable conditions occur, we should continue to see increases in the abundance in the St. Joe River cutthroat population.

Table 11. Number of bull trout redds counted per stream in the St. Joe River Basin, Idaho, from 1992 to 2001.

Stream	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
St. Joe.-Heller Cr. to Lake*	10	14	3	20	14	6	0	10	2	11
Beaver Cr. and Bad Bear Cr.	2	2	0	0	0	0	1	--	--	--
Fly Cr.	--	--	--	0	0	--	2	--	--	--
Heller Cr.	0	0	--	0	--	1	0	--	0	--
Medicine Cr.*	11	33	48	26	23	13	11	48	43	16
Mosquito Cr.	--	--	--	0	4	--	2	--	--	--
Red Ives Cr.	--	0	--	1	0	1	0	--	0	--
Sherlock Cr.	0	3	--	2	1	1	0	--	0	--
Simmons Cr.	--	7	5	0	--	0	1	--	--	--
Wisdom Cr.*	1	1	4	5	1	0	4	11	3	13
Total (index streams)	22	48	55	51	38	19	15	69	48	40
Total (all streams)	24	60	60	54	43	22	21	69	48	40

*Bull trout index streams

Table 12. Number of bull trout redds counted per stream in the Little North Fork Clearwater River basin, Idaho, from 1994 to 2001. During 2001, Clearwater Region fisheries personnel also surveyed some of the same stream reaches as Panhandle Region personnel. Redd counts numbers from Clearwater Region are in parentheses.

Stream	1994	1996	1997	1998	1999	2000	2001
Butte Creek	--	--	--	--	--	--	(5)
Lund Creek	0	7	2	2	1	1	13 (5)
Little Lost Lake Creek	0	1	1	1	7	3	1
Lost Lake Creek	0	0	0	0	--	1	--
Little North Fork Clearwater River							
Rocky Run Cr. to Lund Cr.	--	--	--	--	--	--	(17)
Lund Cr. to Lost Lake Cr.	--	--	-	1	9	8	3 (12)
Lost Lake Cr. to headwaters	0	2	0	0	--	5	1
Total	0	10	6	4	17	18	18 (39)

Changes in the St. Joe River fishing regulations in 2000 increased the catch-and-release zone by about 20 km so that it now extends from the confluence of the North Fork St. Joe River to the headwaters. The remainder of the river now has a slot limit (release all cutthroat trout between 203 and 406 mm where previously fish over 350 mm could be harvested. These more restrictive changes should speed up the recovery of the cutthroat trout following the flood.

A strong increasing trend in cutthroat trout density is apparent in the Coeur d'Alene River despite the decline following the 1996 flood event. In fact, the overall density of cutthroat trout in the Coeur d'Alene River in 2001 was the highest ever recorded. The overall density of cutthroat trout in the North Fork Coeur d'Alene River (0.73/fish/100m^2) is now approaching what currently occurs in the St. Joe River (0.80/fish/100m^2). However, if only cutthroat trout greater than 300 mm are evaluated in the Coeur d'Alene River, no apparent increase in density has occurred over time. The density of cutthroat trout greater than 300 mm in the Coeur d'Alene River (0.03/fish/100m^2) is significantly lower (t-test, $P<0.05$) than what was observed in the St. Joe River (0.10/fish/100m^2) in 2001.

The low densities of cutthroat trout greater than 300 mm observed in the Coeur d'Alene River is perplexing, as the abundance of fish less than 300 mm has been increasing over the years. There are a number of possible theories why this condition occurs: 1) habitat for juvenile trout (tributary habitat) is improving whereas habitat important for larger cutthroat trout (deep, slow velocity pools) is not; 2) improving habitat conditions in the system could account for the increase in abundance of juvenile fish (<300 mm), whereas high incidental mortality and/or poaching is cropping off the larger fish; 3) as cutthroat trout in the Coeur d'Alene River increase in size, they move downstream or upstream to areas where snorkel transects are not located; 4) a large proportion of this cutthroat trout population is made up of adfluvial fish; the larger fish would therefore have migrated down to the lake by the time the snorkeling was conducted; and 5) some combination of above.

Angling pressure has increased on the Coeur d'Alene River, thus it is worth assessing whether incidental hooking mortality is cropping off the larger cutthroat trout. However, if this were the case you would expect to see the same response in the St. Joe River where fishing pressure has also increased. Increase in fishing pressure can have positive aspects, as it often results in heightened compliance with fishing regulations through self-policing. Lewynsky (1986) believed noncompliance helped explain why cutthroat trout densities did not increase in the Coeur d'Alene River after more restrictive fishing regulations were applied in 1975.

Research by Hunt and Bjornn (1992) in the St. Joe River found that during winter, large cutthroat trout moved downstream to deep, low velocity pools. Some of these pools were found to contain several hundred cutthroat trout. It was speculated that the loss of several of the most critical pools could result in large declines in cutthroat trout abundance throughout the St. Joe River. It is believed that cutthroat trout in the Coeur d'Alene River also have similar overwinter habitat requirements and could be equally well influenced by loss of this pool habitat. Bedload movement has been reported as a problem on the Coeur d'Alene River (DEQ 2001). Excessive bedload movement could fill or reduce the volume of deep pools that are important to over-winter survival of cutthroat trout. There is evidence of pool filling, as several of the snorkel transects were changed in recent years because the river had shifted or filled in the pool where a transect was once located.

During 1999 (Fredericks et al. 2002) and 2000 (Liter et al. In press) fisheries population estimates were made on a 5.1 km reach of the Coeur d'Alene River downstream of the snorkel transect locations. Findings from these studies estimated the number of cutthroat trout greater than 100 mm in this reach of river to be 2,685 fish and 2,265 fish in 1999 and 2000, respectively. About half of these fish were over 250 mm. These studies were conducted from late May to early June; however, recaptured fish from this study indicate they remain within 6 km of the capture site throughout the summer. These findings indicate that larger cutthroat trout are utilizing reaches of the Coeur d'Alene River that currently are not evaluated in the annual snorkel surveys.

Adfluvial cutthroat trout definitely spawn in the Coeur d'Alene River drainage, as fish tagged in the Coeur d'Alene River have been recaptured in Coeur d'Alene Lake (Fredericks et al. In press). It is unknown what percent of the fish in the Coeur d'Alene River have an adfluvial life cycle. Water quality from the South Fork Coeur d'Alene River has improved and no longer creates a migration barrier to adfluvial fish trying to ascend the North Fork Coeur d'Alene River as it once did (Ellis 1932; Schreiber 1990). These conditions should allow the adfluvial cutthroat trout population to increase in abundance.

In the past few years, reports from anglers indicate fishing is improving in the Coeur d'Alene River, especially for fish longer than 300 mm. These reports are contrary to the findings produced from the snorkeling. Additional snorkel transects or additional studies may be required to better evaluate the abundance of cutthroat trout that occur in the Coeur d'Alene River.

Mountain Whitefish

Mountain whitefish populations appear to be increasing in density in both the Coeur d'Alene and St. Joe rivers after significant declines were observed following the 1996 flood event. Densities of mountain whitefish in the Coeur d'Alene River show an increasing trend since 1973 when evaluation of these transects first began. Reasons for this improvement are unknown.

Mountain whitefish were more abundant in the Coeur d'Alene River than in the St. Joe River. However, comparison between the two systems may not be entirely valid because much of the lower St. Joe River was not snorkeled. Most mountain whitefish in the North Fork Coeur d'Alene River were observed in the large, deep pools and runs in the lower section of river, similar to the habitat occurring in the lower St. Joe River.

Rainbow Trout

Rainbow trout were observed almost exclusively in both the St. Joe and Coeur d'Alene rivers in those snorkel transects where put-and-take stocking occurs. Over 93% of the rainbow trout observed were between 150 and 300 mm, the same size range at which these fish are stocked. These findings suggest that little natural reproduction is occurring and over-winter survival is low for hatchery reared rainbow trout.

Rainbow trout were far more abundant in the Coeur d'Alene River system than in the St. Joe River. However, more transects in the Coeur d'Alene River occurred in stream reaches where rainbow trout stocking occurs.

Middle Fork East River and Indian Creek Fishery Assessment

Middle Fork East River

Electrofishing tributaries of the Middle Fork East River during 2001 indicated that bull trout distribution may be decreasing, but strongholds still exist. In 1986, bull trout were essentially sampled at every site electrofished in the Middle Fork East River watershed (Horner et al. 1987), whereas in 2001 bull trout were found to occur only in Uleda Creek. However, sampling during 2001 did not occur in the mainstem where recent surveys have found bull trout to remain (IDL, unpublished data; DEQ, BURP data). In 2001, no bull trout were sampled from Tarlac Creek, whereas in 1986 they were the most abundant fish to occur there. Now the most abundant fish in Tarlac Creek is brook trout. Brook trout have been found to displace bull trout from watersheds through hybridization and competition (Dambacher et al. 1992; Mullan et al. 1992; Leary et al. 1993). It is believed that the competitive advantage that brook trout have over bull trout increases as habitat becomes degraded or stream temperature is elevated. Habitat conditions were not evaluated in this study; however, intensive timber management has occurred in this watershed and could have influenced stream substrate, large woody debris and/or stream temperature.

Sampling during 2001 found high densities (10.4 fish/100m^2) of bull trout in Uleda Creek, which is higher than that observed in 1986. No brook trout were sampled from Uleda Creek although they occur in the mainstem directly downstream (IDL, unpublished data). This occurrence has been documented before and is believed to result from habitat conditions that favor bull trout over brook trout (Rieman and McIntyre 1993). Research and surveys suggest that where stream temperatures remain below 10-12ºC bull trout have a competitive advantage over brook trout (Dambacher et al. 1992; Riehl 1993; McMahon et al. 1999). The stream temperature measured in Uleda Creek was 9ºC at about 9:00 AM on August 7.

The bull trout sampled from Uleda Creek ranged from 42 to 700 mm in length. Seven adults ranged in size from 490 to 700 mm. Insufficient food or space is available in the East River for these bull trout to reach this size. Consequently, these fish must have a fluvial or adfluvial life cycle and spend much of their life in the Priest River, Pend Oreille Lake or Priest Lake. Bull trout reportedly have been caught from the Priest River in the spring; however, these fish could have been migrating to the East River from one of the lakes. Most likely these fish do not migrate to Priest Lake as the bull trout population using this lake collapsed in the late 1970s. If these bull trout come from Pend Oreille Lake they must swim down the Pend Oreille River about 35 km then turn up Priest River for about 40 km before they will enter the East River. This type of migration is unusual but not unheard of. Additional studies will be required to determine the life cycle of these bull trout. Understanding their life cycle is important in ensuring adequate protection is provided to promote recovery of this species.

Indian Creek

The electrofishing surveys conducted on North Fork Indian Creek during 2001 suggest this bull trout population is decreasing in abundance. In North Fork Indian Creek, bull trout were not located at one sample site (N.F. Indian 1) where they had been identified in 1983 (Irving 1987). At the other sample site (N.F. Indian 2) the density of bull trout was about eight times lower than what was observed in 1983. Degraded habitat conditions do not appear to be responsible for this decline in bull trout abundance, although this watershed is heavily managed for timber. Historically, a flume was constructed along this stream to transport timber to Priest Lake. This flume still exists in places along Indian Creek, and as it has collapsed it has provided large quantities of large woody debris to the stream. In all likelihood, habitat conditions are improving in Indian Creek.

A significant decline in butt trout abundance in all tributaries of Priest Lake was documented in the late 1970s and early 1980s. In fact, by 1990, many considered the bull trout population associated with Priest Lake functionally extinct. The loss of this bull trout population was initially blamed on over-fishing. However, when bull trout harvest was closed in 1984 and the population did not respond, it became evident other problems existed. Continued research found that lake trout in Priest Lake were likely competing with and/or preying upon bull trout and largely contributed to their disappearance (Mauser 1986). Mauser (1986) documented what appeared to be the last of the adfluvial runs of bull trout in Indian Creek as redd counts dropped from nine in 1983 to zero in 1985. Although significantly fewer bull trout occur in Indian Creek now than were documented in 1983, it is encouraging to know they still exist. It is not known if these bull trout are largely represented by a resident life cycle or if some adfluvial fish still manage to survive in Priest Lake. In 1999, two adfluvial fish were observed spawning in North Fork Indian Creek (Joe DuPont, personal observation), indicating at least some of these bull trout have an adfluvial life cycle.

Despite the decline in bull trout abundance in North Fork Indian Creek, it appears the cutthroat trout population is doing well, as the estimated density in 2001 (25 fish/100m^2) was more than double that observed in 1983. It is possible that decline in bull trout abundance reduced predation and competition on cutthroat trout, allowing them to increase in abundance. Removal of brook trout has been shown to result in increases in cutthroat trout abundance where they existed sympatrically (Strach and Bjornn 1990).

Bull Trout Spawning Surveys

Priest River Basin

A cursory look at bull trout redd counts from 1992 to 2001 suggests the bull trout population in the upper Priest Lake basin is relatively stable and possibly increasing in abundance. However, it is important to note new sites were added to the surveys in 1996 and again in 2001. After adding the redd counts conducted by Mauser (1986) in 1985 it becomes evident that the number of spawning bull trout in the upper Priest Lake basin is a fraction of what it once was. This information supports work conducted on Upper Priest Lake where bull trout numbers appear to be dropping significantly and only larger bull trout remain. It seems evident that the expanding population of lake trout in Upper Priest Lake poses an increasing threat to the adfluvial bull trout population (Fredericks et al. 2001, Donald and Alger 1993). If this is true, a dramatic drop in the number of bull trout redds may be observed in the near future. Bull trout redd counts by Mauser (1986) documented this very circumstance on Priest Lake tributaries where the number of redds observed in those tributaries declined from double digits to zero from 1983 to 1985. This decline in redds occurred several years after a crash in the bull trout population was noticed in the lake. These findings add to the urgency for correcting the lake trout problem in Upper Priest Lake. Delays in correcting this problem could result in losses to this bull trout population.

Pend Oreille Lake Basin

Redds counted in the Pend Oreille Lake basin indicate this system has the most abundant and stable bull trout population in northern Idaho and possibly the state. Evaluation of the six index streams since 1983 shows the trend in bull trout redds counted is fairly flat, and the total of 699 redds far exceeds what is counted elsewhere in the state. Redd counts in Trestle Creek and Gold Creek consistently produce the highest counts and have remained relatively stable over time. Widely fluctuating numbers of redds have been counted in other streams such as Rattle Creek, Grouse Creek, Johnson Creek and the Pack River. Those streams having high variability in their redd counts are typically those streams with unstable habitat conditions. However, periodic increases in the number of redds counted indicate these streams have the potential to support strong bull trout populations once improvements occur. Those streams where consistently low redd counts have occurred in recent years (Lightning, Salvage, Morris and Porcupine creeks) may require considerable time and money to recover the population, and/or these streams have little potential to support high numbers of butt trout. However, Lightning, Salvage and Porcupine creeks historically supported substantial spawning activity. Morris Creek bull trout appear to be a recently refounded population.

Redd counts in 2001 were interesting in that several streams (Rattle Creek, Johnson Creek and Pack River) had an unusually high number of redds counted. In fact, the number of redds counted in Rattle Creek (67) was the highest ever counted in this stream. Other tributaries such as Granite Creek, Sullivan Springs, Grouse Creek and Twin Creek had unexpectedly low numbers of redds counted. These unexpected counts could be a result of the drought condition that occurred in Pend Oreille basin during 2001. The mouths of many streams dried up early in the year and if bull trout did not access them early, they would be forced to go elsewhere. Unexpected increases in bull trout redd counts could also be a delayed response to the changes in fishing regulations that occurred in 1995 (one fish) and 1996 (catch-and-release).

St. Joe River

The number of redds counted (40) in the three index streams (Medicine Creek, Wisdom Creek, and upper St. Joe River) of St. Joe River during 2001 was about equal to the 10-year average, although it was lower than counts during the past two years. Evaluation of the bull trout redds counted in the three index streams since 1992 shows a relatively flat trend.

The number of redds counted in Medicine Creek was lower than that observed the last two years and is a concern since more redds are counted in this stream than any other in the entire Spokane River drainage. It is believed that Medicine Creek is critical to the persistence of bull trout in the Spokane River drainage. Ironically, Medicine Creek is not an unaltered habitat. Much of the stream was channelized in the early 1990s and is not suitable spawning or rearing habitat. The potential for habitat restoration in Medicine Creek should be investigated with the US Forest Service. Additionally, the concentrated reproduction in Medicine Creek represents a risk to the population, and the potential to increase production in other tributaries, particularly Wisdom Creek, should also be evaluated.

The number of bull trout redds counted in Wisdom Creek was the highest since counts began in 1992. Redd counts in the upper St. Joe River were also higher than those observed in the past four years. These higher counts are intriguing as they contrast with the large decline observed in Medicine Creek. The higher counts in Wisdom Creek can partially be explained because the counter surveyed more of the stream than in the past. Typically, redd counts stopped at a steep cascade about 2.5 km upstream from the mouth. This counter continued another 2 km upstream past the cascade and counted another five redds. Future redd counts should include this area above the cascade.

The three reference streams where bull trout redds are annually counted are believed to be the only streams in the entire Spokane River drainage that support relatively strong bull trout populations. This is an alarming fact as in the 1930s most of the major tributaries in the St. Joe River and some in the St. Maries River were documented to have bull trout populations (IDFG 1933). Studies should be designed to evaluate bull trout survival so that proper limiting factors can be identified and corrected.

Little North Fork Clearwater River

Bull trout redds counted in the Little North Fork Clearwater River drainage have been low and highly variable since counts began in 1994. The 18 redds counted in the upper Little North Fork Clearwater River drainage in 2001 matched the highest number to date. Unfortunately, the trend data is somewhat complicated by inconsistency in streams counted. Nevertheless, the high count in 2001 is encouraging and potentially reflects much higher escapement than was estimated in 1994-1998.

Clearwater Region Department personnel also conducted bull trout redd surveys in the Little North Fork Clearwater River on approximately the same date we did. Their counts duplicated some of the areas we counted and included some areas we have not counted in the past. Those areas that were counted by both Clearwater Region and Panhandle Region were very inconsistent, raising questions about the reliability of the data. For example, in one stream reach we counted 5 redds, and Clearwater Region personnel counted 12 redds. In the other stream reach where counts were duplicated, we counted 13 redds and Clearwater Region counted 5 redds. The absence of periphyton and algae on the rocks in these streams certainly added to the difficulty in correctly determining redds. Dunham et al. (2001) and Bonneau and LaBar (1997) found that high observer variability is common when counting redds. Both suggested thorough training as the best strategy to reduce variability among observers. This was the first that one of our observers had counted redds and could explain some of this variability. For several of the Clearwater Region personnel this was their first time counting bull trout redds (Danielle Schiff, Department, personal communication). However, these individuals walked these same stream reaches twice over a three-week period. Using this technique they were able to observe the addition of new redds over time, which may have improved their accuracy in determining redds.

Redd counts by Clearwater Region on the stream reaches we had not surveyed in the past were quite promising. A total of 22 redds were counted. These stream reaches alone account for more redds than we have ever counted in a single year on the Little North Fork Clearwater River. Further, these findings suggest the number of bull trout spawners utilizing the upper Little North Fork Clearwater River is considerably higher than we had originally believed. These new stream reaches should be added in future redd counts to more accurately evaluate and track the strength of this bull trout population.

RECOMMENDATIONS

1. Continued to monitor cutthroat trout abundance in the St. Joe and Coeur d'Alene rivers through snorkel surveys.

2. Investigate whether new snorkel transects should be added in the Coeur d'Alene River upstream or downstream of the current transect locations, which would better allow us to track abundance of cutthroat trout longer than 300 mm.

3. Conduct a study to evaluate movement and habitat use of adult cutthroat trout in the Coeur d'Alene River.

4. Continue to monitor bull trout spawning escapement through redd counts in the Pend Oreille, St. Joe, Upper Priest, and Little North Fork Clearwater drainages.

5. Develop maps for personnel conducting redd counts to ensure consistency in the length of streams being surveyed, and record GPS locations of redds counted.

6. Provide training to all personnel who will be conducting redd counts in the Panhandle Region.

7. Add to the Little North Fork Clearwater River redd survey the new stream reaches where Clearwater Region personnel found bull trout redds.

8. Discuss with the US Forest Service the feasibility of habitat restoration in Medicine Creek and/or Wisdom Creek.

9. Conduct a survival study on bull trout in the St. Joe River basin to better evaluate the major limiting factors.

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APPENDIX

Appendix A. Global Position System coordinates for St. Joe River, Idaho, snorkel sites.

Transect Number	Latitude Coordinate	Longitude Coordinate
S-1	47^{o} 14.74 N	115^{o} 45.76 W
S-2	47^{o} 13.68 N	115^{o} 42.63 W
S-3	47^{o} 13.83 N	115^{o} 42.04 W
S-5	47^{o} 14.35 N	115^{o} 40.19 W
S-6	47^{o} 14.35 N	115^{o} 40.19 W
S-7	47^{o} 14.16 N	115^{o} 38.20 W
S-8	47^{o} 13.49 N	115^{o} 36.43 W
S-10	47^{o} 13.72 N	115^{o} 35.52 W
S-12	47^{o} 13.51 N	115^{o} 34.96 W
S-13	47^{o} 12.18 N	115^{o} 32.58 W
S-14	47^{o} 12.10 N	115^{o} 31.07 W
S-15	47^{o} 11.14 N	115^{o} 28.89 W
S-16	47^{o} 10.57 N	115^{o} 27.47 W
S-17	47^{o} 10.26 N	115^{o} 26.74 W
S-18	47^{o} 09.08 N	115^{o} 24.48 W
S-19	47^{o} 07.99 N	115^{o} 24.06 W
S-20	47^{o} 05.71 N	115^{o} 22.74 W
S-21	47^{o} 04.69 N	115^{o} 21.32 W
S-22	47^{o} 03.53 N	115^{o} 21.15 W
S-24	47^{o} 01.83 N	115^{o} 21.12 W
S-25	47^{o} 01.87 N	115^{o} 21.33 W
S-26	46^{o} 59.46 N	115^{o} 22.26 W
S-27	46^{o} 59.35 N	115^{o} 22.14 W
S-28	46^{o} 59.00 N	115^{o} 22.09 W
S-29	47^{o} 15.06 N	115^{o} 48.81 W
S-30	47^{o} 14.98 N	115^{o} 49.71 W
S-31	47^{o} 15.09 N	115^{o} 50.74 W
S-32	47^{o} 15.41 N	115^{o} 51.88 W
S-33	47^{o} 15.38 N	115^{o} 52.38 W
S-34	47^{o} 15.35 N	115^{o} 54.05 W

Appendix B. Global Position System coordinates for North Fork (NF) and Little North Fork (LNF) Coeur d'Alene River, Idaho, snorkel sites.

Transect Number	Latitude Coordinate	Longitude Coordinate
NF-1	47^{o} 52.66 N	116^{o} 12.58 W
NF-2	47^{o} 52.82 N	116^{o} 11.56 W
NF-3	47^{o} 52.64 N	116^{o} 11.62 W
NF-4	47^{o} 53.16 N	116^{o} 10.06 W
NF-5	47^{o} 52.32 N	116^{o} 06.72 W
NF-6	47^{o} 51.00 N	116^{o} 06.63 W
NF-7	47^{o} 48.42 N	116^{o} 04.54 W
NF-8	47^{o} 47.70 N	116^{o} 04.02 W
NF-9	47^{o} 47.41 N	116^{o} 04.08 W
NF-10	47^{o} 44.77 N	116^{o} 01.21 W
NF-11	47^{o} 41.80 N	115^{o} 57.06 W
NF-12	47^{o} 40.39 N	115^{o} 56.86 W
NF-13	47^{o} 38.87 N	115^{o} 58.38 W
NF-14	47^{o} 39.10 N	116^{o} 01.81 W
NF-15	47^{o} 40.13 N	116^{o} 03.06 W
NF-16	47^{o} 39.32 N	116^{o} 07.54 W
NF-17	47^{o} 39.62 N	116^{o} 09.90 W
NF-18	47^{o} 37.38 N	116^{o} 11.83 W
NF-19	47^{o} 35.89 N	116^{o} 14.35 W
NF-20	47^{o} 35.02 N	116^{o} 15.83 W
NF-24	47^{o} 53.10 N	116^{o} 07.86 W
NF-25	47^{o} 53.18 N	116^{o} 07.51 W
NF-26	47^{o} 53.74 N	116^{o} 08.04 W
NF-27	47^{o} 54.50 N	116^{o} 07.33 W
NF-28	47^{o} 54.65 N	116^{o} 07.37 W
LNF-1	47^{o} 44.54 N	116^{o} 25.48 W
LNF-2	47^{o} 43.06 N	116^{o} 23.11 W
LNF-3	47^{o} 41.57 N	116^{o} 22.63 W
LNF-4	47^{o} 39.84 N	116^{o} 22.18 W
LNF-5	47^{o} 39.19 N	116^{o} 21.92 W
LNF-6	47^{o} 37.56 N	116^{o} 19.72 W
LNF-7	47^{o} 37.98 N	116^{o} 18.77 W
LNF-8	47^{o} 38.10 N	116^{o} 17.59 W
LNF-9	47^{o} 37.39 N	116^{o} 16.21 W
LNF-10	47^{o} 36.62 N	116^{o} 14.43 W

2001 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-26

Project: I-Surveys and Inventories

Subproject: I-A Panhandle Region

Job No.: c-2

Title: Little North Fork Clearwater River Tributary Investigations

Contract Period: July 1, 2000 to June 30, 2001

ABSTRACT

Butte, Canyon, Foehl and Sawtooth creeks, tributaries of the Little North Fork Clearwater River, were surveyed to assess the distribution of fishes and other fauna and habitat attributes that may influence their distribution. One bull trout *Salvelinus confluentus,* 118 westslope cutthroat trout *Oncorhynchus clarki lewisi,* 34 rainbow trout *O. mykiss,* 6 rainbow/cutthroat trout hybrids *P. clarki x O. mykiss,* 564 sculpins *Cottus species,* 167 tailed frog juveniles *Ascaphus truei,* and 17 Idaho giant salamanders *Dicamptodon aterrimus* were sampled during this study. Based on these findings, it did not appear bull trout populations resided in Butte, Canyon, Foehl or Sawtooth creeks. However, in an ongoing telemetry study, bull trout were found to ascend and spawn in Butte and Canyon creeks. Poor electrofishing efficiency due to low conductivity and deep swift water probably account for the inability to detect bull trout in these streams. Low densities of salmonids were sampled in all streams except Butte Creek. Low densities appear to be a factor of unproductive waters and poor sampling efficiency.

Cutthroat trout were found to be strongly associated with cold, small streams that had high amounts of large woody debris (LWD), whereas rainbow trout selected larger steam reaches with less LWD, closer to the main river. This niche separation helps explain why westslope cutthroat trout and rainbow trout have been able to coexist for thousands of years with minimal hybridization. The habitat attributes associated with cutthroat trout make them susceptible to land management activities such as logging and road building that often takes place in the upper portions of watersheds.

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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; Davis et al. 2000); however, the distribution of bull trout still remains 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).

This study focused on evaluating whether bull trout populations occur in tributaries of the Little North Fork where there current status is unknown. It also gathered baseline information on the fisheries, other fauna and habitat variables that may be responsible for their population strength and distribution. This type of information is important in developing recovery strategies for bull trout and assisting with future fisheries and land management decisions.

STUDY SITE

This study assessed the distribution and abundance of bull trout and other associated fishes in tributaries of the Little North Fork Clearwater River. The tributaries selected for evaluation included Butte, Canyon, Sawtooth, and Foehl creeks (Figure 1). These tributaries were selected for sampling because they are major tributaries of the Little North Fork Clearwater, limited information is available on their fisheries and the habitat appears suitable to support bull trout. All of these watersheds have had minimal land management occur on them in the past and are managed by the U.S. Forest Service or Idaho Department of Fish and Game.

OBJECTIVES

1. Determine the distribution and status fishes and other fauna occurring in Butte, Canyon, Sawtooth, 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.

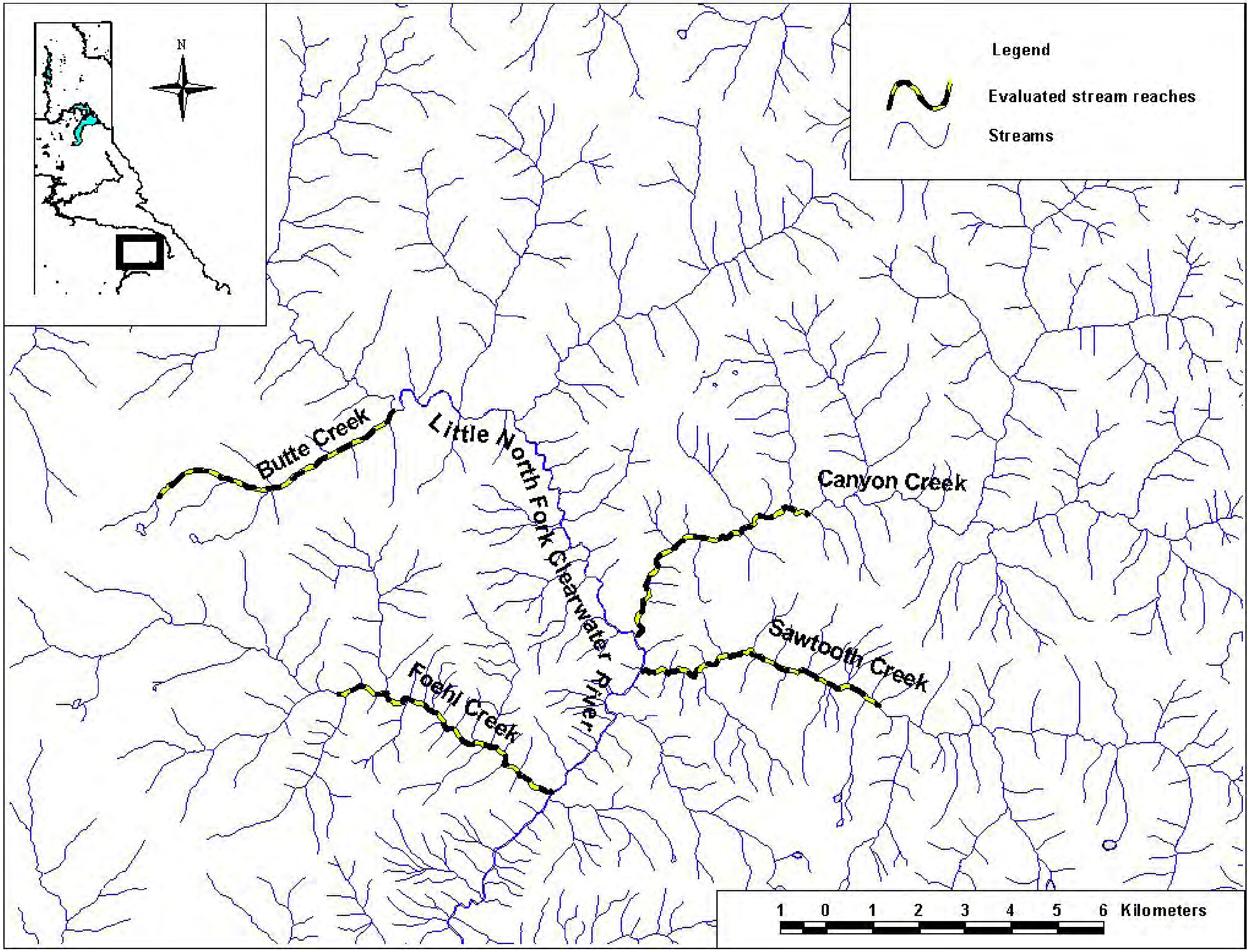

Figure 1. Stream reaches where sampling occurred during July 2001 on Butte, Canyon, Foehl, and Sawtooth creeks, tributaries of the Little North Fork Clearwater River, Idaho.

METHODS

Field Methods

To assess the fishery, fauna and their habitat associations in Butte, Canyon, Sawtooth and Foehl creeks, nine 50 m sites within the lower 6 km of each stream were selected for sampling. These nine sites were selected using a random stratified technique where three sites were selected within a 2 km upper, middle and lower reach. Site and reach lengths were measured using 7.5 minute US Geological topographic maps. The actual number of sites sampled in each stream was a factor of time. Sampling proceeded upstream until it was time to turn back (i.e. waning daylight). For example, only four sites were sampled on Foehl Creek when time ran out. To ensure more sites were sampled, the length of each site was shortened from 50 m to 30 m in all but Canyon Creek.

At each site, the fish and fauna were sampled using a Smith-Root SR 15 backpack electrofisher and a three-person crew. The species and total length of each salmonid captured was recorded, whereas only total number of sculpin *Cottus sp.* and other fauna sampled were recorded. Sculpin were not differentiated down to a species level. We used a multiple depletion method to acquire a population estimate for one randomly chosen site per stream (Zippin 1958; Lobon-Cervia and Utrilla 1993). Block nets were not used to separate sample sites.

The habitat variables measured at each site included wetted widths, stream gradient, stream temperature, large woody debris (LWD) and the percent of habitat represented by pool, run, riffle and glide. Wetted widths were measured with a laser range finder and stream gradient was measured with a hand-held clinometer. Stream temperature was recorded with a hand-held thermometer at each site during the time of sampling, except in Foehl Creek when a thermometer was not available. A single observer estimated the proportion each sample site was represented by pool, run, riffles, and glide habitat (Overton et al. 1997). The same observer made counts of LWD within the wetted width of the site. Large woody debris was defined as any piece of wood within the wetted area of the stream greater than or equal to 1 m in length and 30 cm in diameter. This size classification was determined by visual estimation when counting pieces of LWD.

Statistical Methods

Capture efficiency was determined for fishes and fauna captured in adequate abundance at each of the four sites where multiple passes were conducted using MicroFish 3.0 (Van Deventer and Platts 1985). Average capture efficiency was calculated using the four sites where multiple passes occurred to account for variability among sites. The average capture efficiency was used to estimate the total number of each species of fish and other fauna that occurred at each of the sites where one pass occurred by dividing the number of specimens captured by their associated average capture efficiency. Not enough westslope cutthroat trout *Oncorhynchus clarki lewisi*, rainbow trout *O. mykiss* and rainbow/cutthroat trout hybrids were sampled at the multiple pass sites to estimate capture efficiency rates for each. Consequently, the number of salmonids (excluding bull trout) sampled at each of the multiple pass sites were pooled to determine capture efficiency for all salmonids combined. This value was then used to estimate the total number of each salmonid species that occurred at each site where one pass occurred. The estimated total number of fish and fauna that occurred at each site was divided by the area of stream sampled, resulting in an estimated density (number/100m^2) for each sample site.

The density estimates for the fishes and other fauna sampled in adequate numbers 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 ($p < 0.05$) occurred between the sampled species densities and individual habitat variables, an analysis of variance was conducted on the regression.

RESULTS

Distribution and Abundance of Fishes and Tailed Frogs

One bull trout, 118 cutthroat trout, 34 rainbow trout, 6 rainbow/cutthroat trout hybrids, 564 sculpin, 167 tailed frog *Ascaphus truei* juveniles and 17 Idaho giant salamander *Dicamptodon aterrimus* were sampled during this study (Table 1). The single bull trout was captured 500 m upstream from the mouth of Canyon Creek. Another bull trout was observed near the mouth of Canyon Creek during casual snorkeling. Most (85%) cutthroat trout were sampled in Butte Creek, and none were sampled from Foehl Creek. Rainbow trout and rainbow/cutthroat trout hybrid densities were low in all streams sampled. Sculpin were relatively abundant throughout the study area, except in Butte Creek, where they were captured only in the lower reaches of the stream. Tailed frogs were captured throughout the study area and Idaho giant salamanders were sampled from all but Foehl Creek.

The one bull trout sampled was 305 mm long and was the longest fish sampled during the survey. Lengths of cutthroat trout sampled were between 53 mm and 260 mm with the average size being 128 mm (Figure 2). Rainbow trout sampled were between 70 mm and 230 mm in length with the average length being 119 mm (Figure 3).

Fish Habitat Associations

Ten variables were evaluated that may directly or indirectly influence the distribution of the fishes and fauna that occur in the streams that were evaluated (Table 2). Because few bull trout and rainbow/cutthroat trout hybrids and Idaho giant salamanders were sampled, no evaluation between their densities and associated habitat were made.

Table 1. Electrofishing findings on Foehl, Sawtooth, Canyon and Butte creeks, tributaries of the Little North Fork Clearwater River, Idaho.

Stream	Species	Number of Sites	Number Sampled	Mean Density (number/100 m^2)	Range of Densities
Foehl Creek (7/11/01)	BLT	4	0	0.0	None Sampled
	WSC	4	0	0.0	None Sampled
	RBT	4	11	1.0	0.3 to 2.7
	HYB	4	1	<0.1	0.0 to 0.2
	Scul	4	83	6.0	4.6 to 9.6
	T. Frogs	4	104	7.8	0.7 to 16.0
	Salamander	4	0	<0.1	None Sampled
Sawtooth Creek (7/12/01)	BLT	6	0	0.0	None Sampled
	WSC	6	16	1.4	0.0 to 2.7
	RBT	6	4	0.5	0.0 to 0.5
	HYB	6	2	0.2	0.0 to 0.5
	Scul	6	237	22.0	16.0 to 38.0
	T. Frogs	6	31	2.6	0.0 to 6.5
	Salamander	6	6	0.6	0.0 to 1.1
Canyon Creek (7/10/01)	BLT	6	1	<0.1	0.0 to 0.1
	WSC	6	2	0.1	0.0 to 0.4
	RBT	6	18	1.0	0.0 to 2.9
	HYB	6	0	0.0	None Sampled
	Scul	6	214	11.0	6.2 to 18.0
	T. Frogs	6	3	0.1	0.0 to 0.5
	Salamander	6	10	0.4	0.0 to 0.6
Butte Creek (7/24/01)	BLT	8[a]	0	0.0	None Sampled
	WSC	8[a]	100	13.0	1.6 to 25.0
	RBT[b]	8[a]	1	0.1	0.0 to 1.1
	HYB[c]	8[a]	3	0.5	0.0 to 2.0
	Scul[b]	8[a]	30	5.7	0.0 to 17.3
	T. Frogs	8[a]	29	5.0	2.2 to 12.6
	Salamander	8[a]	1	0.1	0.0 to 1.0
All Streams	BLT	24	1	<0.1	0.0 to <0.1
	WSC	24	118	3.6	0.0 to 25.0
	RBT[b]	24	34	0.7	0.0 to 2.9
	HYB[c]	24	6	0.2	0.0 to 2.0
	Scul[b]	24	564	11.2	2.2 to 38.0
	T. Frogs	24	167	3.9	0.0 to 16.0
	Salamander	24	17	0.3	0.0 to 1.1

Species sampled were: BLT = bull trout, WSC = westslope cutthroat trout, RBT = rainbow trout, HYB = rainbow/cutthroat trout hybrid, Scul = sculpin species, T. Frogs = tailed frog juveniles, and Salamander = Idaho giant salamander.

[a] Nine sites were sampled in Butte Creek, but wetted widths were not recorded for site 7, and data for this site was not used.
[b] No RBT were sampled above site 1 and no sculpins were sampled above site 4.
[c] Fish identified as hybrids could have been cutthroat.

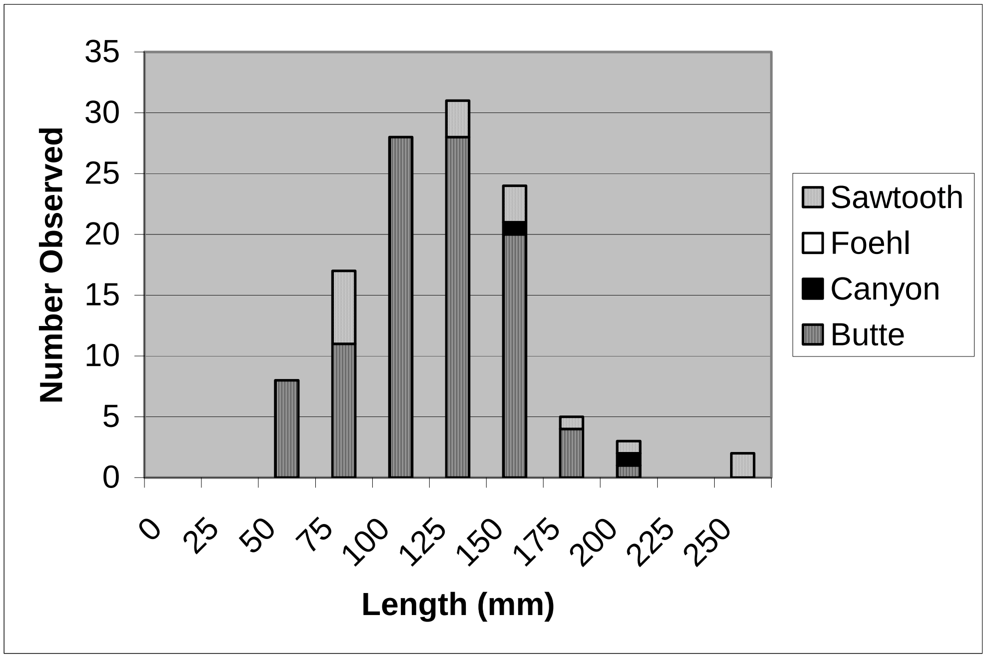

Figure 2. Length frequency histogram of westslope cutthroat trout sampled during July 2001 from tributaries of the Little North Fork Clearwater River, Idaho.

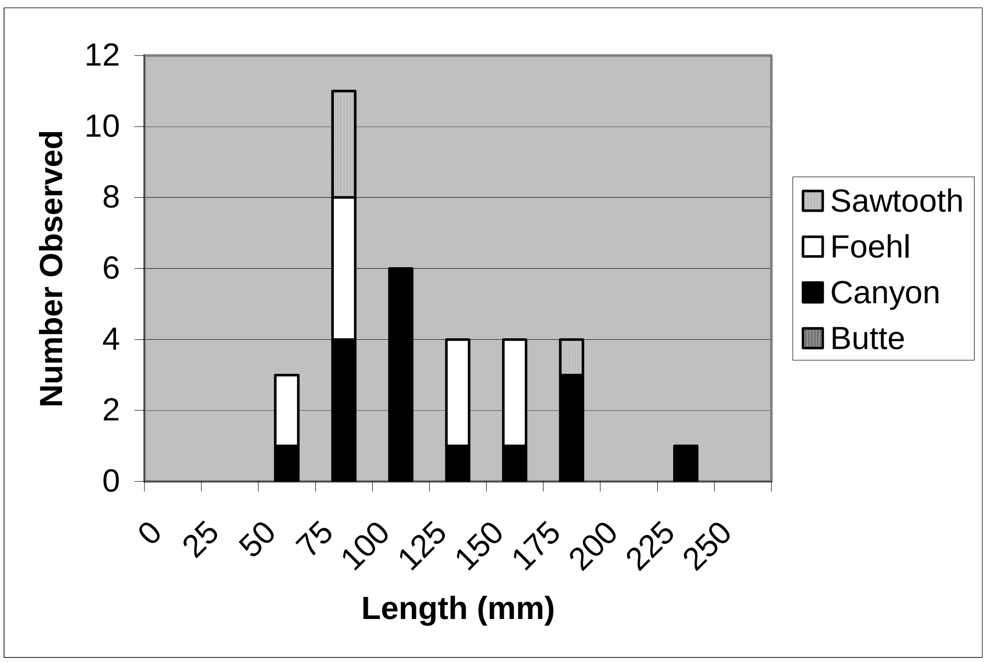

Figure 3. Length frequency histogram of rainbow trout sampled during July 2001 from tributaries of the Little North Fork Clearwater River, Idaho.

Table 2. Habitat characteristics measured during July 2001 on Foehl, Sawtooth, Canyon and Butte creeks, tributaries of the Little North Fork Clearwater River, Idaho.

Stream	Transect	m upstream from mouth	Stream width (m)	LWD count	Elevation (m)	Ave. stream temp. (°C)	Habitat Composition Pool	Riffle	Run	Glide	Stream gradient
Foehl Creek	1	1050	11.0	0	768	-	15%	65%	0%	20%	5.0%
	3	1400	16.3	0	786	-	25%	50%	0%	25%	4.5%
	4	2550	13.0	0	826	-	10%	40%	40%	10%	3.5%
	5	3450	15.0	1	856	-	5%	70%	25%	0%	6.0%
Sawtooth Creek	1	0	13.3	2	859	16	5%	60%	35%	0%	3.0%
	2	750	9.5	2	871	16	10%	40%	40%	10%	4.0%
	3	1200	7.5	0	876	16	30%	10%	30%	30%	3.5%
	4	2050	11.3	1	925	16	25%	25%	25%	25%	4.0%
	6	3350	15.0	0	1009	16	15%	40%	25%	20%	3.5%
	7	4600	11.0	1	1051	16	35%	35%	0%	30%	7.0%
Canyon Creek	1	500	15.0	0	792	15	0%	85%	15%	0%	-
	2	600	16.7	0	796	15	0%	95%	5%	0%	2.0%
	3	1150	15.7	2	805	15	5%	40%	55%	0%	3.0%
	4	3150	10.0	0	853	15	35%	25%	24%	0%	2.5%
	5	3400	17	2	860	15	30%	50%	0%	20%	2.5%
	6	3750	15.7	1	878	15	5%	95%	0%	0%	3.5%
Butte Creek	1	500	6.3	4	1075	11	20%	40%	20%	20%	4.0%
	2	830	3.3	3	1106	11	15%	60%	10%	15%	5.0%
	3	1300	3.5	6	1152	11	10%	10%	80%	0%	4.0%
	4	1850	8.0	5	1186	11	25%	50%	0%	25%	8.0%
	5	2650	3.3	4	1222	11	30%	20%	30%	20%	4.0%
	6	3300	3.4	5	1300	11	20%	30%	50%	0%	2.0%
	7	4050	--	7	1389	11	15%	70%	0%	15%	7.0%
	8	4700	6.0	9	1503	11	15%	70%	0%	15%	7.0%
	9	5550	5.0	8	1605	11	15%	70%	15%	0%	14.0%

Correlations between cutthroat trout densities and the analyzed habitat variables indicate cutthroat trout select small, cold streams, with an abundance of LWD (Table 3). This analysis also showed cutthroat trout density had a positive significant relationship with elevation and the distance from the mouth of the stream. All of these variables are highly correlated to each other making it difficult to determine which variables are responsible for controlling their distribution.

Correlations between rainbow trout densities and the analyzed habitat variables indicate they select larger, low elevation streams with low quantities of LWD (Table 3). This analysis also showed rainbow trout density decreased with increasing distance from the mouth of the stream. 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 3. Correlations (r) between densities (number/m^2) of fishes and tailed frogs and the habitat variables collected during 2001 from tributaries of the Little North Fork Clearwater River, Idaho. Correlations shaded gray show where significant relationships occur ($p < 0.05$). Species evaluated were: WSC = westslope cutthroat trout, RBT = rainbow trout, Scul = sculpin species, and T. Frogs = tailed frog juveniles.

Habitat Variable	WSC Density	RBT Density	Scul Density	T. Frog Density
LWD	0.905	-0.440	-0.381	0.263
Elevation	0.858	-0.518	-0.405	0.207
Distance from Mouth	0.424	-0.506	-0.349	0.241
Stream Width	-0.742	0.495	0.157	-0.319
Temperature	-0.737	0.359	0.635	-0.524
% Pool	0.095	-0.243	-0.055	0.021
% Run	-0.139	0.337	-0.205	-0.137
% Riffle	0.208	-0.241	0.234	0.158
% Glide	-0.145	-0.023	0.011	0.028
Gradient	0.305	-0.293	-0.293	0.267

Correlations between sculpin densities and the analyzed habitat variables indicate higher densities occurred at lower elevations, closer to the mouth of streams and where higher temperatures occurred. The only habitat variable tailed frog densities were significantly correlated to was temperature, which showed tailed frog density tended to increase as stream temperature decreased (Table 3).

DISCUSSION

Abundance and Distribution of Fishes and Fauna

Based on the electrofishing findings it did not appear bull trout populations resided in Butte, Canyon, Foehl, or Sawtooth creeks. However, in an ongoing telemetry study, Schriever and Schiff (In Press) found four adult bull trout migrated about 10 km up Canyon Creek to just below its confluence with Buck Creek. These fish stayed in this area into September suggesting they spawned there. Canyon Creek was the only stream where we observed bull trout. Several other bull trout with transmitters were found congregating near the mouth of Butte Creek. Follow-up redd count surveys by Schriever and Schiff (In Press) found five bull trout redds in Butte Creek about 0.5 km upstream from the mouth. This information indicates bull trout populations do occur in at least Canyon and Butte creeks and suggests that the sampling techniques used in this study were not effective in capturing and/or locating bull trout. The low conductivity, deep pools and swift water encountered in these streams made electrofishing difficult and often ineffective. After electrofishing several deep pools where only a few salmonids were sampled, an observer snorkeled the same reach and counted many more fish remaining in the pool. According to Reynolds (1996), extremely low conductivities, as is believed to occur in the streams sampled, exceeds most power sources and reduces efficiency. Electrofishing has shown to be ineffective in sampling bull trout where low conductivities (<100 µS/cm), deep pools and fast water occurs (Fraley et al. 1982; Bonneau et al. 1995). In these situations, day or night snorkeling is the suggested technique in assessing bull trout abundance.

Bull trout distribution can be patchy and is often associated with cold water (<15°C) especially where springflow or upwelling occurs (Heimer 1965; Pratt 1985; Rieman and McIntyre 1995; Colla and DuPont 2000). Sampling sites selected for this study may have skipped over or did not extend far enough upstream where preferred habitat conditions and bull trout occurred. Stream temperatures in Sawtooth and Canyon creeks where sampling occurred peaked near 18°C. Temperatures over 15°C are often avoided by bull trout (Fraley and Shepard 1989; Rieman and McIntyre 1995; Saffle 1994) and may help explain why only one bull trout was captured in the these streams.

Besides the one bull trout, other salmonids sampled during this study included cutthroat trout, rainbow trout and rainbow/cutthroat tout hybrids. Cutthroat trout were the dominant salmonid (75%) capture during this study, although 85% of these fish came from Butte Creek. The density of salmonids sampled during this survey was relatively low (except Butte Creek) when compared to other assessments of northern Idaho streams with low conductivities and steeper gradients (Table 4). Lund, Lost Lake and Gold Creeks were assessed by Davis et al. (2000) and Medicine and North Fork Indian Creeks were assessed by Liter et al. (In Press).

Table 4. The average densities (fish/100 m^2) of salmonid species sampled from northern Idaho streams with low conductivities and high gradients. Streams shaded in gray are the findings from this study.

	Little North Fork Clearwater River Tributaries						Pend Oreille	St. Joe	Priest Basin	
Species	Butte	Canyon	Foehl	Sawtooth	Lund	Lost Lake	Trestle	Medicine	Gold	NF Indian
Cutthroat trout	13.0	0.1	0.0	1.4	--	--	4.6	0	1.0	5.2
Rainbow trout	0.1	1.0	1.0	0.5	--	--	--	0	0	0.0
Bull trout	0.0	0.1	0.0	0.0	--	--	4.2	8.6	2.0	0.4
All salmonids	13.6	1.2	1.0	2.1	4.2	5.6	11.8	8.6	3.0	5.6

Davis et al. (2000) suggested low fish densities in the upper Little North Fork Clearwater watershed could be the result of low stream productivity, and McIntyre and Rieman (1995) reported streams with low productivity are often related to low densities of cutthroat trout. No direct measurements were taken during this study to evaluate productivity, although the absence of periphyton on rocks and the geology these watersheds occur in (granite and meta-sedimentary) suggest productivity was low. Skille (1991) attributed the low densities of fishes in the Little North Fork Clearwater River drainage to overexploitation. The remoteness of the study area, restrictive bag limits, and observations by Idaho Department of Fish and Game personnel indicate overexploitation is not having a noticeable effect on the Little North Fork Clearwater River fishery (Davis et al. 2000). No evidence of extensive fishing pressure was observed during this study.

Butte Creek has several attributes that can help explain why a higher density of salmonids was sampled from it than Canyon, Foehl, and Sawtooth creeks. Butte Creek was about two to three times narrower, the stream temperature was 2°C to 7°C cooler and substantially more LWD occurred in it than the other surveyed streams. Electrofishing efficiency has been found to be inversely related to increasing flows (Reynolds 1996). Larger streams such as Canyon, Foehl, and Sawtooth Creeks have deeper and swifter waters making fish more difficult to shock and capture. Increasing amounts of LWD have been shown to be positively correlated with increasing densities in cutthroat trout and bull trout (Rieman and McIntyre 1995; Horan et al. 2000; Rosenfeld et al. 2000), and bull trout and cutthroat trout have been found to avoid stream temperatures > 17°C (Saffel 1994; Rieman and McIntyre 1995; Dunnigan 1997), as occurred in or are believed have to occurred in the sample areas of Canyon, Foehl and Sawtooth Creeks.

Foehl Creek is the only stream where cutthroat trout and Idaho giant salamander were not sampled. Rainbow trout were also very low in abundance. Foehl Creek appeared to be an unstable system as loose cobble occurred throughout the floodplain and little streamside vegetation existed. It is likely that debris torrents swept down the main channel during the 1997 flood event. These conditions likely contribute to the absence or low abundance of salmonids and Idaho giant salamanders found in Foehl Creek. No attempt was made to determine the reason this system appeared so unstable; however, it is believed that natural causes are responsible, as minimal land management activities have occurred in this watershed.

It is difficult to determine if the salmonids sampled during this survey have a migratory or resident life history. The majority (98%) of salmonids sampled during this survey were less than 225 mm. This could mean that these fish rear for two to three years before migrating downstream into the Little North Fork Clearwater River, or that the low productivity believed to occur in these streams limits growth to the point where adult resident fish do not exceed 225 mm. A couple of steep cascades and drops were located on Butte and Sawtooth creeks that could present passage problem. Upstream of these points resident fish may be more abundant. We believe that at least a portion of the salmonids sampled have a migratory life history based on the larger (> 300 mm) adult cutthroat trout and rainbow trout that occur in the Little North Fork Clearwater River (Davis et al. 2000).

Habitat Associations

Findings from this study indicate that cutthroat trout selected smaller, higher elevation stream reaches with cooler water and higher quantities of LWD whereas rainbow trout selected larger stream reaches with less LWD, closer to the main river. These findings are similar to other publications (Roper 1995; Dunnigan 1997; Muhlfeld 1999). The niche separation observed between westslope cutthroat trout and rainbow trout helps explain why they have been able to coexist for thousands of years with minimal hybridization.

The habitat associations found to occur with cutthroat trout in this study makes them vulnerable to direct impacts from logging activities. According to this study cutthroat trout 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 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.

A significant relationship between the density of fishes and the proportions of pools, runs, riffles, and glides were not detected during this study. These findings are contrary to other studies where cutthroat trout were found to select pool habitat and rainbow trout selected riffle habitat (McIntyre and Rieman 1995; Roper 1995). The inability to sample pool habitat efficiently during this study may help explain this discrepancy. While sampling pools it was common to see fish darting past the influence of the electric current or out of reach of the netters.

Tailed frogs can be good indicators of stream health and have been shown to disappear from streams where poor logging practices have occurred (Nussbaum et al. 1983). Based on the findings from this study, a significant negative relationship occurred between the density of tailed frog juveniles and stream temperature. Nussbaum et al. (1983) also reported cold or cool water temperatures seemed to be necessary for tailed frogs, and water temperatures where these fish were located average about 12°C during summer. Tailed frogs are often abundant and easy to located and may be useful in determining if streams have water temperatures suitable to support cutthroat trout.

Knowledge of sculpin abundance in a given drainage can indicate certain habitat conditions such as high oxygen levels and cold temperatures (Simpson and Wallace 1982). The ability to discern between sculpin sp., which this study did not do, is necessary to determine these details as different sculpin have different habitat preferences. Four or five different sculpin species are known to occur in the North Fork Clearwater River basin (Simpson and Wallace 1982). This study found sculpin density increased as water temperature increased and the elevation and distance from the mouth decreased. These findings may be related to the sculpins inability to negotiate steep stream segments or cascades. On Butte Creek, no sculpin were found upstream of where several steep drops occurred.

RECOMMENDATIONS

1. Develop a sampling protocol that can be used to evaluate bull trout presence/absence and density in larger, low conductivity streams in remote locations, and re-evaluate these streams for bull trout.

2. Develop trend sites so recovery of bull trout can be monitored over time. Trend sites should be monitored at least every three to five years.

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

4. Learn to differentiate between sculpin species and report species differences.

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2001 ANNUAL PERFORMANCE REPORT

State of:	Idaho	Program:	Fisheries Management F-71-R-26
Project:	I-Surveys and Inventories	Subproject:	I-A Panhandle Region
Job No.:	c-3	Title:	Genetic Analysis of Westslope Cutthroat Trout and Bull Trout

Contract Period: July 1, 2000 to June 30, 2001

ABSTRACT

Genetic analysis was completed on 55 westslope cutthroat trout *Oncorhynchus clarki lewisi* samples from the St. Joe River and 36 westslope cutthroat trout samples from Upper Priest Lake. In addition, genetic analysis was completed on 136 bull trout *Salvelinus confluentus* samples collected from the St. Joe River and nine locations in the Upper Priest Lake basin.

Of the 55 cutthroat trout samples analyzed from the St. Joe River, all exhibited both mtDNA and nDNA banding patterns of Westslope cutthroat trout. No introgressive hybridization with rainbow trout *O. mykiss* or Yellowstone cutthroat trout *O. Clarki bouvieri* was observed. Of the 36 samples from Upper Priest Lake, all except one exhibited banding patterns indicative of Westslope cutthroat trout. We believe this sample was mislabeled, as it appeared to be from some fish other than a westslope cutthroat trout.

Of the 136 bull trout samples analyzed from the St. Joe River and Upper Priest Lake basin, all 136 exhibited both mtDNA and nDNA banding patterns of bull trout. No introgressive hybridization with brook trout *S. fontinalis* was observed.

Bull trout from the St. Joe River and Priest River drainages showed significant differences in the frequencies of their mitochondrial haplotypes between locations but did not show significant differences at the single nuclear locus examined. Significant allele frequency differences at the HSC 71 locus were not observed among bull trout populations within the Upper Priest Lake basin itself. Larger sample sizes are required before a determination of their genetic distinctiveness or lack thereof can be made with statistical power.

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INTRODUCTION

Hybridization of bull trout *Salvelinus confluentus* and westslope cutthroat trout *Oncorhynchus clarki lewisi* with introduced species such as brook trout *S. fontinalis,* rainbow trout *O. mykiss* and Yellowstone cutthroat trout *O. clarki bouvieri* can threaten their genetic integrity, reduce survival, and possibly lead to local extinctions (Mullan et al. 1992; Leary et al. 1993; Rieman and McIntyre 1993). Genetic analysis of these fish often can provide information that will indicate if hybridization is an issue and how serious it is. Where hybridization is detected, managers can develop solutions to solve the problem before it becomes serious.

Westslope cutthroat trout were petitioned in 1997 to be listed as threatened under the Endangered Species Act. A status review by the US Fish and Wildlife Service eventually found that they were not warranted for listing; however, petitioners claimed they would re-file as they did not believe hybridization was considered in the decision. The petitioners argued that hybridization of westslope cutthroat trout with other species had altered their genetics, and consequently pure or true westslope cutthroat trout had been lost in many more watersheds than the US Fish and Wildlife Service ad originally believed (Montana Trout Unlimited, personal communication). Genetic evaluations of westslope cutthroat trout in Idaho streams will indicate whether there is any merit to this argument.

The bull trout population in the Priest Lake basin is declining at an alarming rate, and if they continue to decline, we will begin to see these fish perish from many of their spawning tributaries. As these fish disappear, their unique genetics developed from thousands of years of natural selection will also be lost. Presumably, the genetic makeup of these fish has evolved to maximize survival in the local environment in which they must endure (Spruell et al. 1999).

Once limiting factors are corrected in the basin, efforts to repopulate bull trout into their historic spawning tributaries can occur. Reintroduction of bull trout may be the quickest and possibly most practical way to restore bull trout into some of the tributaries (Spruell et al. 1999). To increase the likelihood of successful reintroduction it would be best to use fish with similar genetics as the fish that evolved there. Determining the genetic makeup of these fish can be useful in concluding which bull trout stocks have the best chance for survival if introductions become necessary.

The St. Joe River and Upper Priest River basin are watersheds that support bull trout and westslope cutthroat trout. However, limited information is available on the genetic makeup of these populations. Genetic analysis of these fish will provide a more accurate characterization of these species' population structure, improving management and conservation (Durham et al. 1999).

STUDY SITE

This study took place in the St. Joe River and Upper Priest Lake watershed (Figure 1). Bull trout were collected from eight tributaries of the Upper Priest Lake basin, Upper Priest Lake and the St. Joe River (Figure 1). Cutthroat trout genetic samples came from the St. Joe River and Upper Priest Lake. These watersheds are located in northern Idaho and drain large expanses of land managed by the US Forest Service.

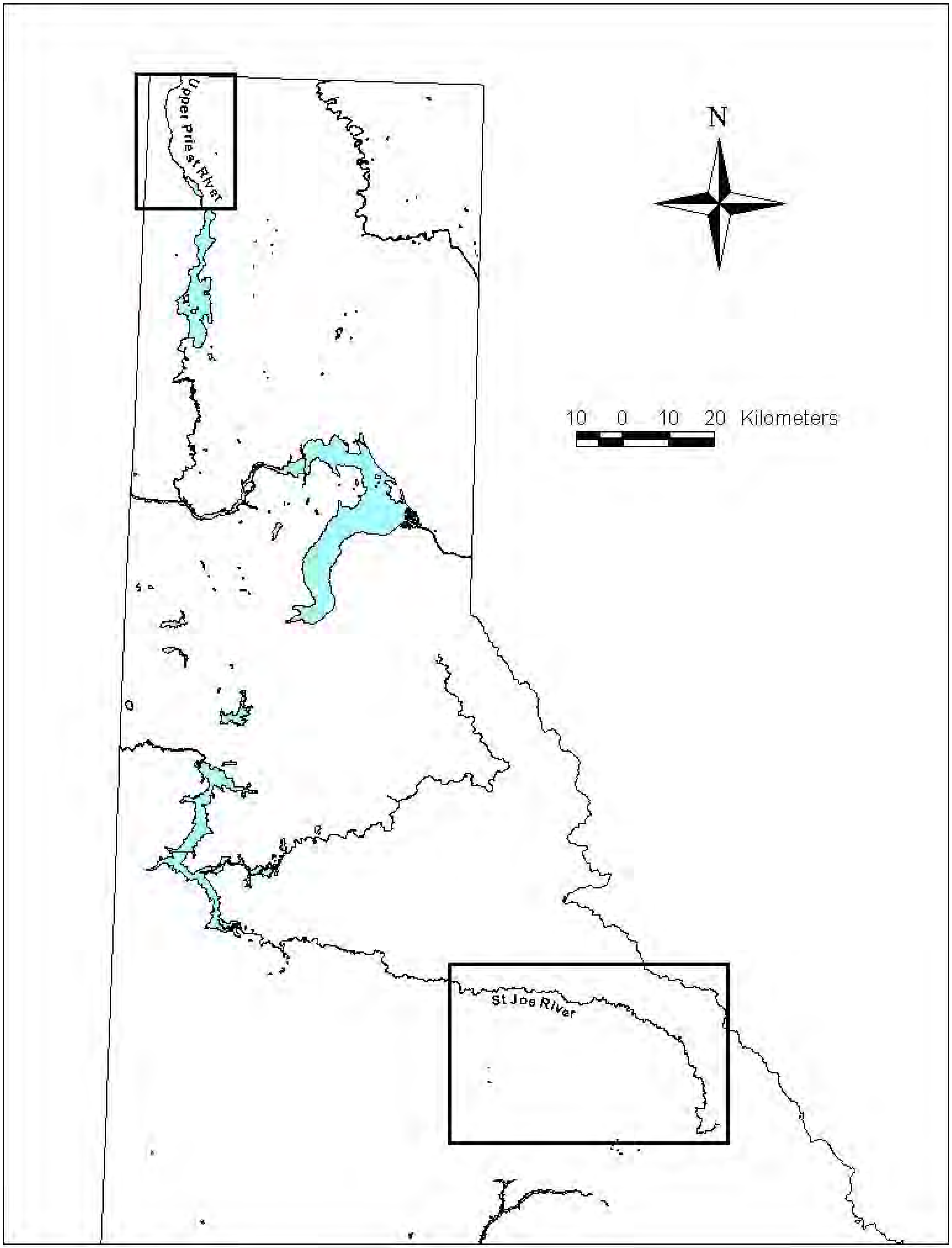


Figure 1. Locations of the St. Joe River and Upper Priest River basins in northern Idaho where bull trout and westslope cutthroat trout were sampled for genetic analysis.

Table 1. Locations in northern Idaho where tissue samples of bull trout and westslope cutthroat trout were sampled for genetic analysis.

Species	Drainage	Tributary	Number of Samples
Bull Trout	St. Joe River	Mainstem	18
	Upper Priest basin	Bench Creek	3
		Hughes Fork	3
		Mainstem	3
		Ruby Creek	4
		Malcom Creek	13
		Lime Creek	16
		Rock Creek	7
		Trapper Creek	30
		Upper Priest Lake	39
Bull trout total			136
Cutthroat trout samples			91
Total tissue samples			227

OBJECTIVES

1. Evaluated whether bull trout from the Upper Priest Lake basin and St. Joe River are hybridizing with brook trout.

2. Determine the genetic uniqueness of the various tributary stocks of bull trout where sampling occurred.

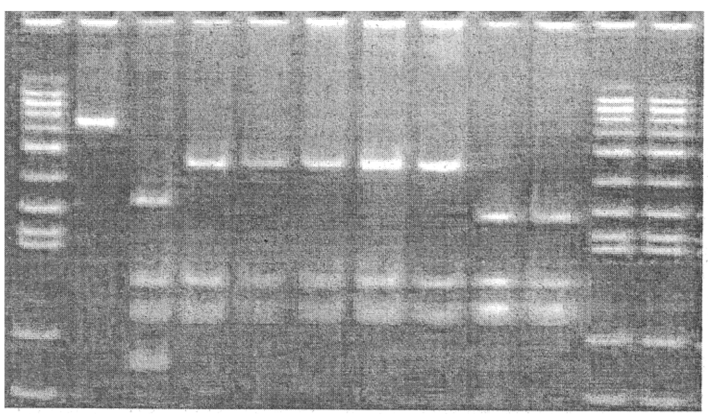
3. Evaluate whether westslope cutthroat trout from the Upper Priest Lake basin and St. Joe River are hybridizing with rainbow trout or Yellowstone cutthroat trout.

METHODS

During assessments of bull trout and cutthroat trout populations in the St. Joe River and Upper Priest Lake basin, tissue samples were collected from many of the fish handled between 1997 and 1999. Small sections of fins (the size of an eraser head) were collected from fish for genetic analysis. Fin clips were placed in scale envelopes (dry) or in vials with lysis butter or alcohol. All fin clips were labeled with their species, sampling date and sampling location. Samples were stored until genetic analysis occurred in 2001.

We used a mitochondrial (mtDNA) Restriction Fragment Length Polymorphism (RFLP) marker and a nuclear DNA (nDNA) RFLP marker to assess the extent of westslope cutthroat trout, Yellowstone cutthroat trout and rainbow trout genes in the assumed cutthroat trout samples and the same loci to examine population differences and possible hybridization (with brook trout) within the bull trout samples.

Mitochondrial DNA and nDNA were extracted from all samples using methods described by Paragamian et al. 1999, adapted from protocols by Sambrook et al. (1989) and Dowling et al. (1990). Extracted DNA was amplified using the polymerase chain reaction (PCR) and primers specific for the mitochondrial Cytochrome b (cyt b) gene and primers specific for the nuclear, Heat-shock cognate 71 (HSC 71) gene (intron, non-coding region). The regions were amplified in a 40ul reaction consisting of 0.5-3.0 ul DNA extract (approx. 2.5ng/ul); 4.0 ul 1OX buffer supplied by the manufacturer (Perkin Elmer), 4.0 ul $MgCl_2$, 3.2 ul BSA, 1.0 ul DMSO, 4.0 ul of each primer, 3.2 ul 10.0 mM dNTPs (10mM each of dATP, dCTP, dGTP, and dTTP), 0.15 ul AmpliTaq Gold polymerase (Perkin Elmer), and 13.45-15.95 ul dH_20. Amplified products from the cyt b gene region were digested with both the *Hinf-I* and *Rsa-I* restriction endonucleases. Both methods yield diagnostic banding patterns between westslope cutthroat trout, Yellowstone cutthroat trout and rainbow trout (Figure 2).



A = YSC
B = WSC
C = RBT

Figure 2. Acrylamide gel demonstrating diagnostic banding patterns between Yellowstone cutthroat trout (YSC), westslope cutthroat trout (WSC), and rainbow trout (RBT) developed from digesting the mitochondrial Cytochrome b gene with *Hinf-I* restriction endonucleases.

Amplified products from the HSC 71 gene region were digested with the Taq-I restriction nuclease, which reveals diagnostic banding patterns (alleles) between westslope cutthroat trout, Yellowstone cutthroat trout, and rainbow trout. Digests were electrophoresed on 3% agarose gels with tris acetate-EDTA buffer or 6% acrylamide gels with tris-borate-EDTA and visualized as band patterns (fragments) when stained with ethidium bromide and fluoresced under UV-light. Fragment size in base pairs was estimated by comparison to a size standard, an Xba I digested pUC-19 marker (Bio-Synthesis). Each unique band pattern generated by a specific restriction enzyme was assigned a letter and designated a haplotype.

In order to estimate relationships of mtDNA haplotypes between samples, composite haplotypes were analyzed using the software package REAP (Restriction Enzyme Analysis Package; McElroy et al. 1991). This generated estimates of genetic divergence among haplotypes and the software package PHYLIP (Phylogenetic Inference Package; Felsenstein 1993, which was used to construct an unrooted least squares network using "d" values from REAP (Fitch and Margoliash 1967). Haplotype frequencies between tributaries were analyzed for significant differences using a Monte Carlo chi-square simulation, 1000 iterations ($P \leq .05$) (Rolf and Bentzen 1989).

RESULTS

We completed genetic analysis on 55 "westslope cutthroat trout" samples from the St. Joe River and 36 "westslope cutthroat trout" samples from the Upper Priest Lake. Additionally, we examined 136 fin clips from bull trout collected from the St. Joe River and nine locations in the Priest Lake basin (Table 1).

Of the 55 cutthroat trout samples analyzed from the St. Joe River, all 55 exhibited both mtDNA and nDNA banding patterns of westslope cutthroat trout (Figure 2). No introgressive hybridization with rainbow trout or Yellowstone cutthroat trout was observed. Of the 36 samples from Upper Priest Lake all except one, Sample #14, exhibited banding patterns indicative of westslope cutthroat trout. This individual's banding pattern was strikingly different than any we have observed in the past. The amplification products from the nuclear and mitochondrial loci are of vastly different sizes. Moreover, the restriction sites are different for every restriction enzyme digestion. Based on this, we believe this sample to be from some fish other than a westslope cutthroat trout. The differences are so great, particularly the amplicon size, that we speculate this sample is from a species other than an *Oncorhynchus.*

The two cutthroat trout populations examined did not show significant differences in the distribution of haplotypes frequencies when tested using chi-square analysis (X^2=2.2358, 0.1<P<0.05). Moreover, the distribution of allele frequencies at the single nuclear locus (HSC 71) was also insignificant. Thus, the cutthroat trout populations examined do not appear to differ significantly with regard to these two genetic markers. The level of nucleotide divergence among cutthroat trout haplotypes ranged from 0.003 to 0.014.

Of the 136 bull trout samples analyzed from the St. Joe River and Upper Priest Lake basin, all 136 exhibited both mtDNA and nDNA banding patterns of bull trout. No introgressive hybridization with brook trout was observed.

The analyzed bull trout samples showed significant differences (X^2=4.5112, 0.05<P<0.025) in haplotypes frequencies between St. Joe River bull trout and samples collected from the entire Upper Priest Lake basin (Table 2). However, sample sizes from 5 of 10 locations were too small to infer genetic differentiation with the Upper Priest Lake basin itself (except for Upper Priest Lake, Trapper Creek, Lime Creek and Malcom Creek). Significant allele frequency differences at the HSC 71 locus were not observed among bull trout populations within the Upper Priest Lake basin itself or between the entire Upper Priest River basin and the St. Joe River. Larger sample sizes from the Upper Priest River, Ruby Creek, Rock Creek, Bench Creek, Hughes Fork, and Malcom Creek will require analysis before a determination of their genetic distinctiveness or lack thereof can be made with statistical power.

However, Malcom Creek samples (n=13) were tested for significance in our analysis. Tests of significant frequency differences between locations within Upper Priest Lake and Trapper Creek were also insignificant ((X^2=1.9857, 0.5<P<0.1).

Table 2. Results of Monte Carlo X^2 analysis of haplotypes frequency distributions in bull trout sample locations from the Upper Priest basin and St. Joe River, Idaho. Significant differences are in bold.

	Overall	UPL	TrC	UPR	BeC	RoC	RuC	HuF	LiC	MaC
UPL	2.534	--								
TrC	1.899	1.986	--							
UPR	US	US	US	--						
BeC	US	US	US	US	--					
RoC	US	US	US	US	US	--				
RuC	US	US	US	US	US	US	--			
HuF	US	US	US	US	US	US	US	--		
LiC	0.234	2.335	2.365	US	US	US	US	US	--	
MaC	1.874	0.003	1.762	US	US	US	US	US	0.900	--
SJR	**4.511**	3.795	3.564	US	US	US	US	US	2.112	1.348

Legend: UPL=Upper Priest Lake, TrC=Trapper Creek, UPR=Upper Priest River, BeC= Bench Creek, RoC=Rock Creek, RuC=Ruby Creek, HuF=Hughes Fork, LiC=Lime Creek, MaC= Malcom Creek, SJR=St. Joe River, Overall=all Upper Priest Lake Locations, US=insufficient samples.

DISCUSSION

Analysis of the “westslope cutthroat trout” genetics indicates that they are pure westslope cutthroat trout as no introgressive hybridization with rainbow trout or Yellowstone cutthroat trout was observed. Rainbow trout have been introduced into the St. Joe River on a regular basis as early as the 1930s (IDFG 1933), although stocking has been greatly reduced and fall spawning rainbow trout were used in recent history. It wasn’t until 2000 that only sterile rainbow trout were stocked into the St. Joe River (IDFG stocking records). Introductions of rainbow trout on top of cutthroat trout populations have resulted in significant hybridization in many locations in Idaho, and are considered a threat to the persistence of pure cutthroat trout populations (Rieman and Apperson 1989, Colorado Division of Wildlife et al. 2000). Rainbow trout were believed to have displaced cutthroat from many historical areas when rainbow trout invaded the Columbia River basin 30,000 years ago (Behnke 1992). Rainbow trout do not appear to be hybridizing with westslope cutthroat trout in the St. Joe River based on our information. All future stocking of rainbow trout into the St. Joe River system will be only with sterile fish. Long-term plans are to phase out stocking of rainbow trout directly into the river, and stocking will only occur into catch out ponds located along the St. Joe River. Actions of these types will help ensure interactions between westslope cutthroat trout and rainbow trout are kept to a minimum.

Yellowstone cutthroat trout were introduced into the Priest Lake basin during the 1950s and 1960s in an effort to reverse the declining fishery (IDFG stocking records). Impacts resulting from introducing Yellowstone cutthroat trout on top of westslope cutthroat trout are not clear. However, some have speculated that interbreeding between nonnative and native fish can produce offspring with a genetic makeup less suited for survival in the environment they must endure (Rieman and Apperson 1989; Colorado Division of Wildlife et al. 2000). Fortunately, our findings indicate that hybridization between westslope cutthroat trout and Yellowstone cutthroat trout did not occur in the Upper Priest Lake basin. Future introductions of cutthroat trout into the Upper Priest Lake basin will only occur in the high mountain lakes. Westslope cutthroat trout have been used for stocking the last 30 years, and plans are to only stock sterile cutthroat trout in the future.

The cutthroat trout populations examined (St. Joe River and Upper Priest Lake) do not appear to differ significantly with regard to the two genetic markers evaluated. The level of nucleotide divergence among cutthroat haplotypes ranged from 0.003 to 0.014. This is indicative of the level of divergence observed among non-admixed salmonid populations (Williams and Jaworski 1995; Williams et al. 1996).

Analysis of the bull trout genetics found that no introgressive hybridization with brook trout had occurred. This was surprising, as two of the genetic samples were believed by individuals with considerable expertise to be bull trout x brook trout hybrids. The analysis used to evaluate whether hybridization had occurred is not full proof, and additional testing would be required to say with 100% certainty that none of the bull trout that were evaluated were bull trout x brook trout hybrids (Matt Powell, geneticist, personal communication). Hybridization of bull trout with brook trout is considered a threat to the long-term persistence of bull trout (Dambacher et al. 992; Leary et al. 1993). Understanding the degree of threat that brook trout are having on the St. Joe River and Upper Priest Lake basin bull trout populations is important in developing butt trout recovery plans. Additional analysis may be necessary to accurately evaluate to what degree brook trout hybridization is threatening these bull trout populations.

Bull trout from the St. Joe River and Priest River drainage revealed significant differences in the frequencies of their mitochondrial haplotypes between locations but did not show significant differences at the single nuclear locus examined. The mitochondrial differences we observed may be the result of founding effects or drift or previous bottlenecks within the sample locations studied, whereas non-significant differences at the nuclear locus may reflect different levels of gene flow or rates of divergence at that particular locus.

Significant allele frequency differences at the HSC 71 locus were not observed among bull trout populations within the Upper Priest Lake basin. Larger sample sizes from the Upper Priest River, Ruby Creek, Rock Creek, Bench Creek, Hughes fork, and Malcom Creek will require analysis before a determination of their genetic distinctiveness or lack thereof can be made with statistical power. Previous studies in the Pend Oreille Lake basin found that significant differences in genetic makeup did occur between bull trout inhabiting different streams even when they were separated by less than 10 kilometers (Spruell et al. 1999). To accurately judge whether significant differences occur between bull trout inhabiting different streams, genetic analysis on at least 30 and preferably 50 fish per stream are often required (Matt Powell, personal communication). Trapper Creek was the only stream for this evaluation where at least 30 samples were collected. More genetic samples will be required if this type of analysis is desired.

RECOMMENDATIONS

1. Continue to collect fin sections from bull trout for genetic analysis. Field kits with supplies needed to collect and preserve fin clips for genetic analysis should be taken to all locations where bull trout could occur to ensure that genetic samples can be collected from all bull trout sampled. After the necessary numbers of fin clips are collected, further analysis should be conducted.

2. Continue to manage the cutthroat trout populations in the St. Joe River and Upper Priest Lake basin in a manner that will minimize interactions with rainbow trout and Yellowstone cutthroat trout.

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2001 ANNUAL PERFORMANCE REPORT

State of: Idaho Program: Fisheries Management F-71-R-26

Project: II - Technical Guidance Subproject: I-A Panhandle Region

Contract Period: July 1, 2001 to June 30, 2002

ABSTRACT

Panhandle Region fisheries management personnel provided private individuals, organizations, public schools, and state and federal agencies with technical review and advice on various projects and activities that affect the fishery resources in northern Idaho. Technical guidance also included numerous angler informational meetings, presentations, and letters, continuation of the Panhandle Region portion of the Idaho Fish and Game 1-800-ASKFISH and website fishing report program, and fishing clinics.

Author:

Ned Horner
Regional Fishery Manager

OBJECTIVES

1. To furnish technical assistance, advice and comments to other agencies, organizations, or individuals regarding projects that affect fishery resources in northern Idaho.

2. To promote the understanding of fish biology and fish habitat needs and the ethical use of the fishery resource through individual contact, public school curriculum, club meetings, public presentations, informational brochures and fishing clinics.

METHODS

Regional fisheries management personnel provided both written and oral technical guidance.

RESULTS AND DISCUSSION

The technical guidance provided by Panhandle Region fish management personnel focused on activities that directly affected fishery resources or resource users in north Idaho. Numerous presentations and programs were made to civic and sportsmen's groups throughout the year. Letters were sent to numerous individuals and organizations in response to specific questions about the fisheries in northern Idaho.

Fishing Clinics

Regional fishery management personnel coordinated with the Panhandle Region Reservist/Volunteer Coordinator, regional conservation officers, fish hatchery personnel, people from other state and federal agencies and sportsmen's groups to offer seven Free Fishing Day fishing clinics in the Panhandle Region. Department-sponsored clinics were held in Bonners Ferry at the Lions Club Snow Creek Pond, Coeur d'Alene at Ponderosa Golf Course, in the St. Maries area both in town and at Anderson Ranch Pond, at Round Lake State Park near Sandpoint, and at the Clark Fork and Mullan Fish Hatcheries. We also provided fish and guidance for a clinic at Priest Lake sponsored by the US Forest Service. The clinics were geared toward teaching young anglers how to fish (casting, baiting hooks, etc.), fish identification, the reasons for regulations, fishing ethics and how to clean fish. The emphasis was on education and not competition.

Fishing Reports

Regional fishery management personnel provided information on Panhandle Region fishing opportunities for the 1-800-ASKFISH and Idaho Fish and Game Internet Web Page angler information program. Knowledge of regional fisheries programs combined with input from tackle shops, local fishing experts and conservation officers were used to provide information on fishing opportunities.

Endangered Fish Species Issues

The Regional Fishery Manager provided information on the abundance and status of bull trout and westslope cutthroat trout populations in Panhandle Region waters to numerous individuals, organizations and personnel from state and federal agencies working on issues related to bull trout listing and the petition to list westslope cutthroat trout. The Regional Fisheries Manager coordinated with the Kootenai River sturgeon/burbot/trout research team, Kootenai Tribe, US Fish and Wildlife Service, British Columbia Ministry on Environment and the Fisheries Bureau to review and comment on issues related to white sturgeon *Acipenser transmontanus* flow requests, conservation culture, ecosystem (nutrient) issues, and transboundary management programs. Additional discussions were held with the research staff, State of Idaho Office of Species Conservation, U.S. Army Corps of Engineers, Bonneville Power Administration, US Fish and Wildlife Service, Kootenai Tribe of Idaho and British Columbia Ministry of Environment on the depressed status of Kootenai River burbot *Lota lota* and possible changes in water management in the Kootenai River system to hopefully avoid another ESA listing. The US Fish and Wildlife Service received a petition from American Wildlands and the Idaho Conservation League on February 2, 2000 requesting burbot in Idaho be listed as endangered under the Endangered Species Act. There was no action taken on the petition during this contract period.

Pend Oreille Lake Water Management

Fishery research personnel were responsible for completing all field activities, while the Fisheries Manager kept the public informed and involved in efforts to change lake level management on Pend Oreille Lake. Several sportsmen meetings were attended, articles were written and interviews were given to newspapers and the radio.

Fall population estimates for kokanee *Oncorhynchus nerka* in 2001 indicated that younger age classes of kokanee were at record high levels, but older kokanee were at record lows. Spawning escapement for wild fish in 2001 was the lowest on record with hatchery egg production (7 million eggs) exceeding wild egg deposition for the first time in history. Despite high numbers of younger kokanee, survival rates from age-1 to age-2 kokanee were still only about 20%. The predator bottleneck was still present despite nearly two years of liberal fishing regulations aimed at reducing the predator population.

The US Fish and Wildlife Service Biological Opinion on bull trout in Pend Oreille Lake required a drawdown to elevation 2,051 during the 2001-2002 winter to clean the shoreline gravel kokanee use for spawning. The BiOp also called for a continuation of the winter lake elevation/kokanee egg-to-fry survival study for the next six years, a winter pool elevation of 2,055 during the winter of 2002-2003, and an independent scientific review and recommendation for holding the lake at elevation 2,055 for one to three consecutive years during the fall/winter operations of 2003 to 2006. The Pend Oreille Utility District #1 (PUD) issued an notice of intent to sue the Corps of Engineers and USFWS over the requirement in the BiOp that would result in higher winter pool levels in future winters. Regional fish management personnel provided information to the PUD to meet Freedom Of Information Act requests. This case will be heard next reporting period.

An effort was made in the spring of 2002 to inform the angling public about the seriousness of the impending kokanee collapse and to try and get their support for needed management actions. A fishery workshop was held in late March to provide biological information to the general public. At this workshop we asked the public if they supported the formation of a Citizens Advisory Committee (CAC). The CAC would better define and prioritize social issues related to fishery recovery efforts. A CAC was formed in May and we began a new chapter in fisheries management for Pend Oreille Lake.

Box Canyon Dam Relicensing

The Regional Fishery Manager reviewed and commented on fisheries related issues associated with the relicensing of the Box Canyon Dam operated by the Pend Oreille Utility District of Newport, Washington. The PUD was a major opponent of higher winter pool levels in Pend Oreille Lake, saying the shift in the timing of water coming down the Pend Oreille River caused a loss of revenue. The Regional Environmental Staff Biologist attended most relicensing meetings and coordinated comments.

Miscellaneous

Coordination meetings were held with hatchery, research, enforcement and Fisheries Bureau personnel to insure management goals were achieved. Private pond permits, transport permits, requests for grass carp importation and fish tournament applications were reviewed and forwarded. Requests for commercial guiding activities were reviewed and commented on. Anglers were kept informed of regional fishing opportunities and management programs at club meetings, monthly Sportsmen Breakfasts, through informational articles written for Panhandle Region newspapers, and numerous interviews with television, newspaper and radio reporters. The Regional Fisheries Management staff presented several programs to Panhandle Region schools on cutthroat trout and participated in other Water Awareness Week activities.

2001 ANNUAL PERFORMANCE REPORT

State of: Idaho Program: Fisheries Management F-71-R-26

Project: III - Habitat Management Subproject: I-A - Panhandle Region

Contract Period: July 1, 2001 to June 30, 2002

ABSTRACT

Fish passage through culverts was evaluated in select watersheds in the Pend Oreille Lake and St. Joe River basins based on information volunteers collected during 1996 and 1997. These data were not analyzed until this report period. Twenty culverts were evaluated for fish passage that occurred in fish bearing streams and 17 (85%) of them were considered to violate at least one of the fish passage criteria specified in the Stream Channel Alteration Rules. Fourteen of these culverts occurred in the Pend Oreille Lake basin and three occurred in the St. Joe River basin. Seven other culverts were identified in fish bearing streams, but insufficient data were collected to determine if fish passage was a problem.

Authors:

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INTRODUCTION

Culverts can significantly reduce the amount of habitat available to migratory fish. Beechie et al. (1994) found that barriers caused by culverts reduced the amount of coho salmon *Oncorhynchus kisutch* summer rearing habitat by 13%. This decrease in summer habitat was considered greater than the sum total effect of all other forest management activities combined. Studies by Idaho Department of Lands on forested watersheds in Idaho have found that between 45-75% of culverts on fish bearing streams cause some type of fish passage problem (Idaho Department of Lands, unpublished data). Local bull trout problem assessments have stated that barriers created by culverts decrease available habitat to bull trout *Salvelinus confluentus*, eliminate migratory forms (fluvial and adfluvial) and increase the likelihood of local extinctions from catastrophic events. Locating and correcting these problem culverts can be vital in ensuring well connected stable fisheries persist into the future.

STUDY SITE

This project attempted to survey and identify culverts in important bull trout watersheds. The Pend Oreille and St. Joe basins were selected for this culvert inventory because they are two of the strongholds for bull trout in the Panhandle Region.

OBJECTIVES

1. Identify culverts that may be causing fish passage problems in important fishery streams in the Pend Oreille and St. Joe basins.

2. Prioritize problem culverts for repair or replacement.

METHODS

Volunteers were given maps identifying specific routes where culverts needed inspection. At each culvert where fish passage might be important volunteers were instructed to collect the culvert's length, diameter, and outlet and inlet drop, as well as velocity of water flowing through the culvert and the depth of the plunge pool at the culverts outlet. Directions on how to collect these measurements were provided to each of the volunteers (Appendix A). Eight routes were identified in the Pend Oreille Lake basin and 13 in the St. Joe River basin where culverts should be inventoried.

The data collected at each culvert location was compared to fish passage standards specified in the Stream Channel Alteration Rules (Water Resource Board 1993) to determine which culverts presented fish passage problems. A culvert must exceed the following criteria otherwise it would be considered in violation with the fish passage standards of the Stream Channel Protection Act:

1. Minimum water depths shall not be less than 3 inches during fish migrations.

2. Maximum water velocities through culverts shall not exceed the swimming ability of fish for more than a 48-hour period (see Table 1).

3. No drop into a culverts entrance (inlet) will be permitted.

4. A maximum drop of 1 foot is permitted from a culverts outlet when a holding pool is provided.

Table 1. Maximum water velocity (ft/sec) allowed through culverts before it is considered in violation of the fish passage standards of Idaho's Stream Channel Protection Act.

	Maximum allowed water velocity (ft/sec) through culvert	
Culvert Length (ft)	Trout (average 12" length)	Salmon and Steelhead
< 40	4.2	8.3
50	3.6	7.5
60	3.3	6.8
70	2.9	6.1
80	2.7	5.5
90	2.5	5.0
100	2.3	4.7
150	1.8	3.8
200	1.5	3.2

The data for each of the evaluated culverts was collected during September or October. During these months, stream flow is typically near or at its lowest, and the measured water velocities occurring through the culverts would be much slower than what would occur during the spring when cutthroat trout *O. clarki*, rainbow trout *O. mykiss* and bull trout often migrate upstream. To account for this discrepancy, Manning's flow equation (below) was used to back-calculate what the water velocities would be during the spring based on the measured water velocities.

$$Q = (1.49/n)(Rh^{2/3})(Se^{1/2})$$

Where: Q = Average flow velocity (ft/sec)
n = Manning's channel roughness value (dimensionless and based on the culvert's corrugation)
Rh = Hydraulic radius (ft) - the cross sectional area of culvert/the culvert's wetted perimeter
Se = Slope of the energy grade line – the gradient of the culvert.

Using Manning's Equation and the assumptions outlined below, Table 2 was developed to help evaluate whether the measured water velocities occurring through the culverts during September and October would relate to fish passage problems during the spring when cutthroat trout, rainbow trout and bull trout often migrate upstream. When developing Table 2 the following assumptions were made:

1. The maximum flow where fish passage needed to be provided would be equivalent to a two year peak flow event (WDFW 1999);

2. The culvert was sized to pass 50-year peak flow events as required by the Idaho Forest Practices Act;

3. The depth of the water in the culvert was equivalent to 5% of its diameter.

4. The hydraulic radius was based on a 60-inch diameter culvert; and

5. The corrugation occurring in the culvert was 3” x 1”.

Table 2. Maximum water velocity (ft/sec) allowed through culverts during September and October before it is considered to cause fish passage delays greater than 48 hours during spring runoff.

	Maximum allowed water velocity (ft/sec) through culvert	
Culvert Length (ft)	Trout (average 12” length)	Salmon and Steelhead
40	1.6	3.1
50	1.4	2.8
60	1.2	2.6
70	1.1	2.3
80	1.0	2.1
90	0.9	1.9
100	0.8	1.7
150	0.7	1.5
200	0.6	1.2

RESULTS

Volunteers drove 9 of the 21 routes detailed for culvert surveys. Six of these routes occurred in the Pend Oreille Lake basin (Figures 1-3) and three occurred in the St. Joe River basin (Figures 4-6). Twenty culverts were evaluated for fish passage that occurred in fish bearing streams and 17 (85%) of them were considered to violate at least one of the fish passage criteria specified in the Stream Channel Alteration Rules. Fourteen of these culverts occurred in the Pend Oreille Lake basin (Table 3 and Figures 1-3) and three occurred in the St. Joe River basin (Table 4 and Figures 4-6). Seven other culverts were identified in fish bearing streams, but not enough data were collected to determine if fish passage was a problem.

Eight of the 17 (53%) culverts that violated the fish passage standards resulted solely because the water velocity that would occur through them during spring would exceed the swimming ability of fish for more than a 48-hour period. Another six culverts (29%) were considered fish passage problems because of a combination of water velocity and the heights of the inlet and/or outlet drop. Two culverts were considered fish passage problems because of the height of the inlet and/or outlet drops.

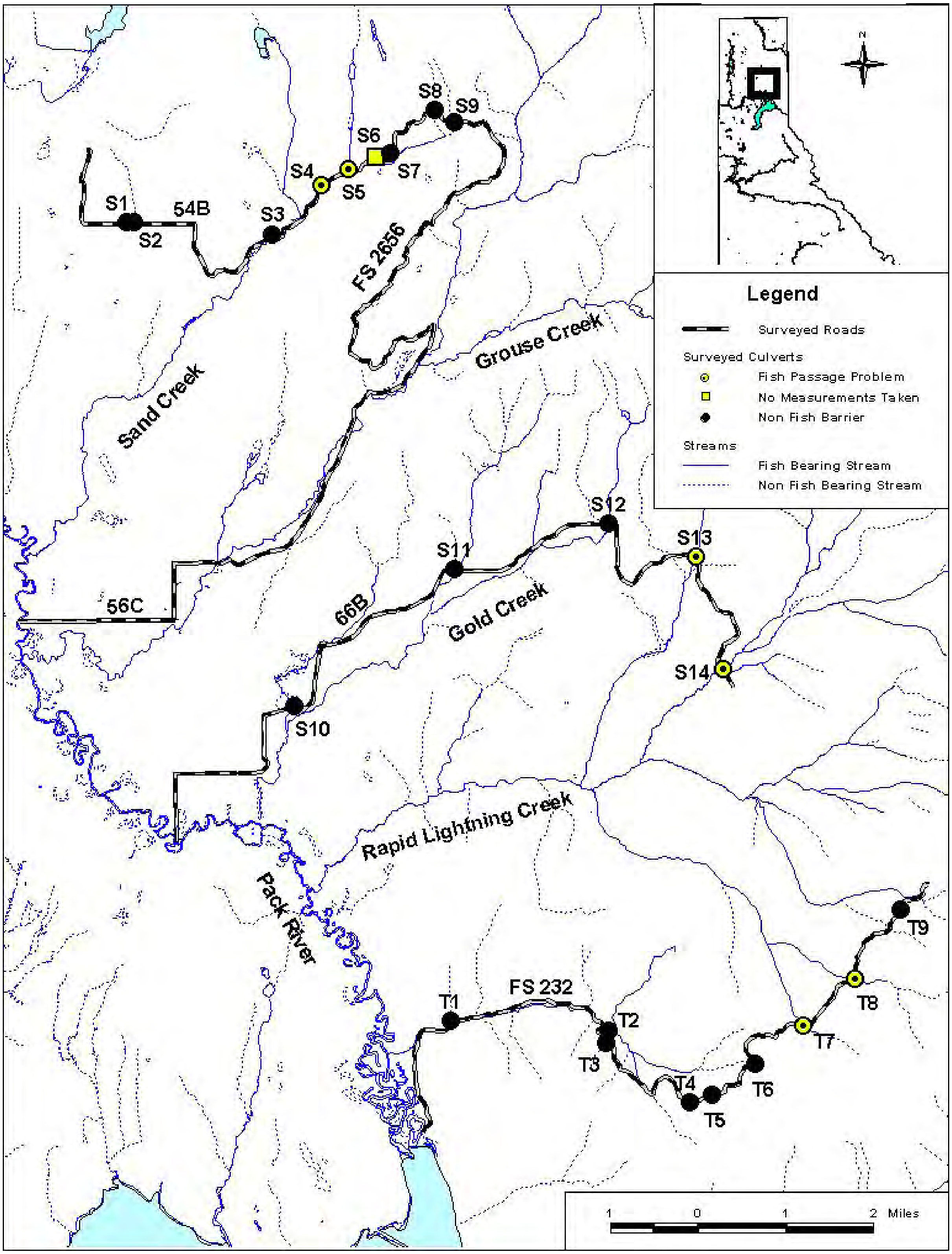

Figure 1. Location and status of culverts evaluated for fish passage during 1996 and 1997 in the Sand, Grouse, Rapid Lightning, and Trout Creek watersheds, of the Pend Oreille Lake basin, Idaho.

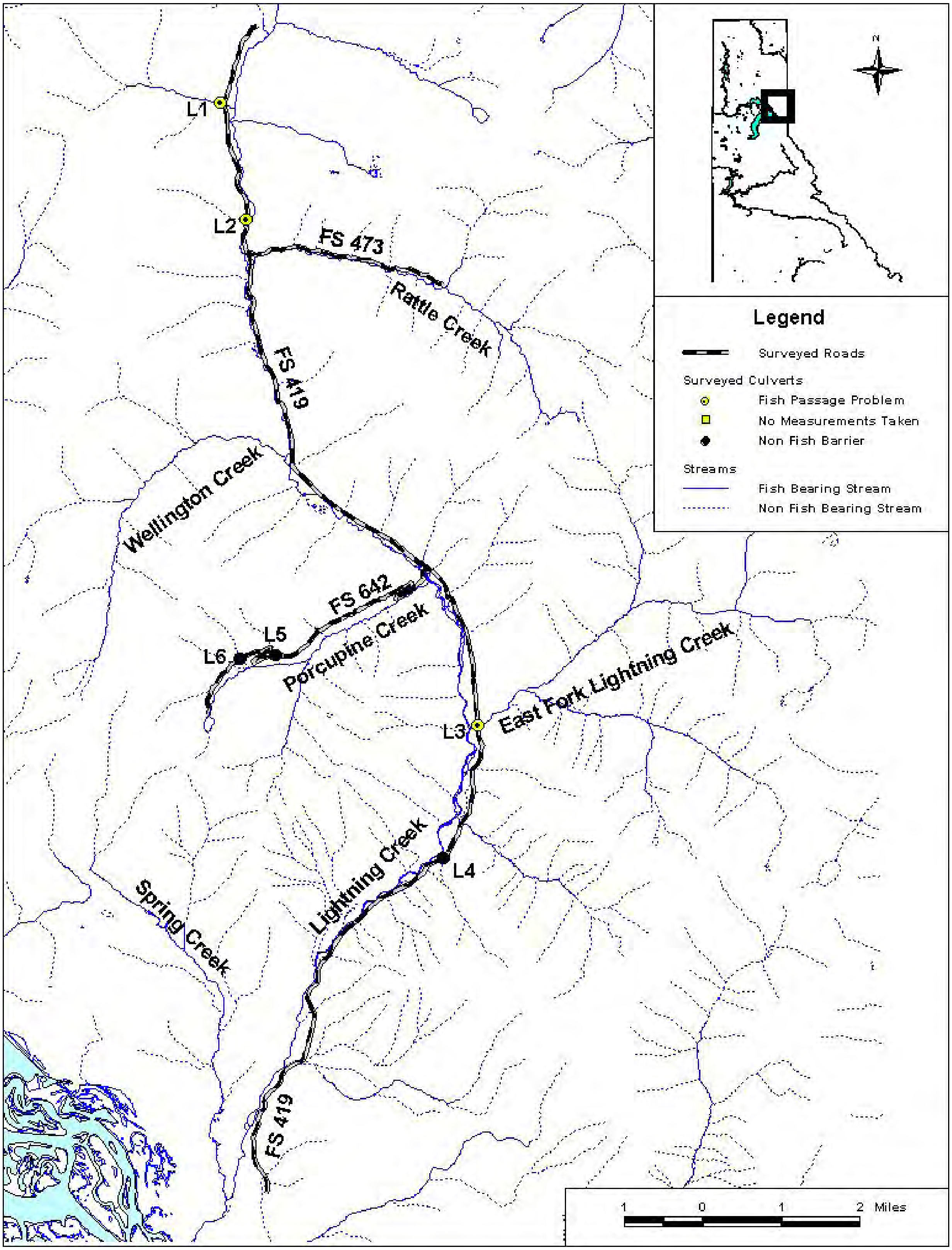

Figure 2. Location and status of culverts evaluated for fish passage during 1997 in the Lightning Creek watershed of the Pend Oreille Lake basin, Idaho.

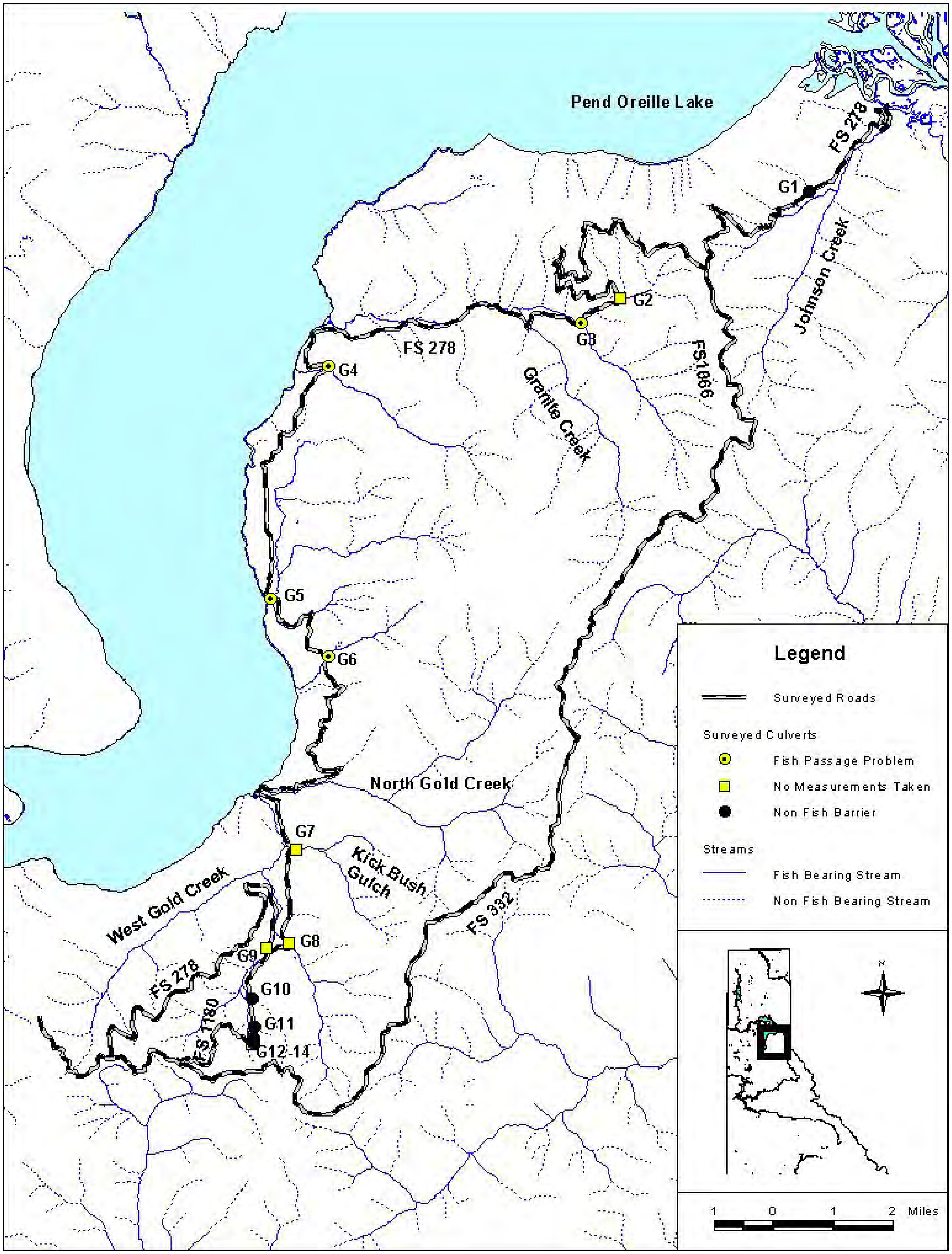

Figure 3. Location and status of culverts evaluated for fish passage during 1997 in the Johnson, Granite, Cedar, and Gold Creek watersheds, of the Pend Oreille Lake basin, Idaho.

Table 3. Details of culverts that were surveyed for fish passage during 1996 and 1997 in the Pend Oreille Lake basin, Idaho. The culvert ID numbers can be used to reference the location of each culvert on Figures 1-3. Cells highlighted in gray indicate which conditions were responsible for the culvert being considered a fish passage problem.

				Culvert Measurements					Fish	Fish	
Stream	Date Surveyed	Culvert ID Number	Road	Length (ft)	Diameter (in)	Outlet Drop (in)	Inlet Drop (in)	Velocity (ft/sec)	Bearing Stream	Passage Problem	Comments
Sand Creek / North Grouse Creek / Gold Creek											
Trib. of Sand Creek	10/27/96	S1	54B	ND	18	ND	ND	ND	No	No	Dry channel
Trib. of Sand Creek	10/27/96	S2	54B	ND	19	ND	ND	ND	No	No	Dry channel
Trib. of Sand Creek	10/27/96	S3	FS 215	27	18	16	0	ND	No	No	Plugged culvert
Sand Creek	10/27/96	S4	FS 215	39	50	6	0	1.7	Yes	Yes	Fish observed
Dennick Lake Creek	10/27/96	S5	FS 215	38.5	38	6	0	3.5	Yes	Yes	
Trib. of Sand Creek	10/27/96	S6	FS 215	39	60	ND	ND	ND	Yes	ND	
Trib. of Sand Creek	10/27/96	S7	FS 215	27	17	ND	ND	ND	No	No	
Trib. of Sand Creek	10/27/96	S8	FS 215	50	18	1	0	ND	No	No	
Sand Creek	10/27/96	S9	FS 215	35	26	8	0	ND	No	No	Shallow water
Trib. of Gold Creek	Sept 97	S10	66B	60	48	0	0	0.1	Yes	No	
Trib. of Gold Creek	Sept 97	S11	66B	42	50	0	0	slow	Yes	No	
Gold Creek	Sept 97	S12	66B	46	29	0	7	slow	Yes	Yes	
Johnson Creek	Sept 97	S13	66B	ND	ND	ND	ND	ND	Yes	Yes	Water subs out
Rapid Lightning Creek	Sept 97	S14	66B	32.5	88	0	0	3.4	Yes	Yes	
Trout Creek											
Trib. of Trout Creek	Sept 97	T1	FS 232	50	72	0	0	3.3	No	No	
Trout Creek	Sept 97	T2	FS 232	50	96	0	0	0.6	Yes	No	
Trib. of Trout Creek	Sept 97	T3	FS 232	35	30	8	0	3.5	No	No	
Trib. of Trout Creek	Sept 97	T4	FS 232	35	24	36	0	3.5	No	No	
Trib. of Trout Creek	Sept 97	T5	FS 232	35	24	48	0	2.9	No	No	
Trib. of Trout Creek	Sept 97	T6	FS 232	35	24	96	0	2.9	No	No	
Slate Creek	Sept 97	T7	FS 232	35	54	18	0	4.4	Yes	Yes	
Spring Creek	Sept 97	T8	FS 232	75	60	20	0	2.1	Yes	Yes	
Trib. of Done Creek	Sept 97	T9	FS 232	75	48	0	0	2.1	No	No	

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Table 3. Continued.

Stream	Date Surveyed	Culvert ID Number	Road	Culvert Measurements: Length (ft)	Diameter (in)	Outlet Drop (in)	Inlet Drop (in)	Velocity (ft/sec)	Fish Bearing Stream	Fish Passage Problem	Comments
Lightning Creek											
Quartz Creek	09/28/97	L1	FS 419	65	72	36	6	3.3	Yes	Yes	
Fall Creek	09/28/97	L2	FS 419	45	three, 48	24	4	3.0	Yes	Yes	
E.F. Lightning Creek	09/28/97	L3	FS 419	50	48	0	8	1.4	Yes	Yes	Side Channel
Trib. of Lightning Creek	09/28/97	L4	FS 419	40	24X36	0	0	ND	No	No	Dry channel
Trib. of Porcupine Creek	09/28/97	L5	FS 642	75	72	48	0	6.3	No	No	
Trib. of Porcupine Creek	09/28/97	L6	FS 642	ND	48	ND	0	ND	No	No	
Gold Creek / Johnson Creek / Granite Creek											
Trib. of W. Johnson Cr.	09/19/97	G1	FS 278	60	48	0	0	3.0	No	No	
Toms Gulch	09/19/97	G2	FS 278	45	72	4	0	ND	Yes	ND	Dry channel
Dry Gulch	09/19/97	G3	FS 278	50	144	0	0	1.7	Yes	Yes	
Falls Creek	09/19/97	G4	FS 278	50	72	48	4	4.2	Yes	Yes	
Cedar Creek	09/19/97	G5	FS 278	50	96	18		ND	Yes	Yes	Shallow water
North Twin	09/19/97	G6	FS 278	20	24	0	0	3.3	Yes	Yes	
Kick Bush	10/17/97	G7	FS 278	ND	ND	ND	ND	ND	Yes	ND	Dry channel
Gold Creek	09/19/97	G8	FS 278	50	72	0	0	ND	Yes	ND	Dry channel
Chloride Gulch	09/19/97	G9	FS 278	50	120	0	0	ND	Yes	ND	Dry channel
Trib. of Chloride Gulch	10/17/97	G10	FS 1180	ND	ND	ND	ND	ND	No	No	Dry channel
Trib. of Chloride Gulch	10/17/97	G11	FS 1180	ND	ND	ND	ND	ND	No	No	Dry channel
Trib. of Chloride Gulch	10/17/97	G12	FS 1180	ND	ND	ND	ND	ND	No	No	Dry channel
Trib. of Chloride Gulch	10/17/97	G13	FS 1180	ND	ND	ND	ND	ND	No	No	Dry channel
Trib. of Chloride Gulch	10/17/97	G14	FS 1180	ND	ND	ND	ND	ND	Yes	ND	Dry channel

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Table 4. Details of culverts that were surveyed for fish passage during 1996 in the St Joe River basin, Idaho. The culvert ID numbers can be used to reference the location of each culvert on Figures 4-6. Cells highlighted in gray indicate which conditions were responsible for the culvert being considered a fish passage problem.

Stream	Date Surveyed	Culvert ID Number	Road Culvert Occurs on	Culvert Measurements Length (ft)	Diameter (in)	Outlet Drop (in)	Inlet Drop (in)	Velocity (ft/sec)	Fish Bearing Stream	Fish Passage Problem	Comments
Bluff Creek											
Trib. of Bluff Creek	09/26/96	B1	FS 509	32	18	3	0	ND	No	No	Dry channel
Trib. of Bluff Creek	09/26/96	B2	FS 509	32	40	9	0	0.8	No	No	
Trib. of Bluff Creek	09/26/96	B3	FS 509	32	two, 24	0	0	0.4	No	No	Dry channel
Trib. of W.F. Bluff Creek	09/26/96	B4	FS 509	32	18	ND	ND	ND	No	No	
Trib. of W.F. Bluff Creek	09/26/96	B5	FS 509	ND	ND	ND	ND	ND	No	No	
Trib. of W.F. Bluff Creek	09/26/96	B6	FS 509	ND	ND	ND	ND	ND	No	No	
Trib. of W.F. Bluff Creek	09/26/96	B7	FS 509	ND	ND	ND	ND	ND	No	No	
Trib. of W.F. Bluff Creek	09/26/96	B8	FS 509	ND	ND	ND	ND	ND	Yes	ND	
Trib. of W.F. Bluff Creek	09/26/96	B9	FS 509	60	36	24	0	3.3	Yes	Yes	
Beaver Creek											
Trib. of Beaver Creek	09/26/96	Be1	FS 303	50	30	ND	ND	ND	No	No	Dry channel
Trib. of Beaver Creek	09/26/96	Be2	FS 303	45	30	ND	ND	ND	No	No	Dry channel
Trib. of Beaver Creek	09/26/96	Be3	FS 303	45	30	36	0	ND	No	No	Dry channel
Trib. of Beaver Creek	09/26/96	Be4	FS 303	50	30	0	0	ND	No	No	
Trib. of Beaver Creek	09/26/96	Be5	FS 303	50	36	ND	ND	ND	No	No	
Trib. of Beaver Creek	09/26/96	Be6	FS 303	ND	ND	ND	ND	ND	No	No	
Trib. of Beaver Creek	09/26/96	Be7	FS 303	ND	24	ND	ND	ND	No	No	
Trib. of Beaver Creek	09/26/96	Be8	FS 303	50	30	12	0	1.9	No	No	
Trib. of Beaver Creek	09/26/96	Be9	FS 303	50	36	48	0	2.4	No	No	
Trib. of Beaver Creek	09/26/96	Be10	FS 303	50	36	0	0	2.0	No	No	
Trib. of Beaver Creek	09/26/96	Be11	FS 303	40	30	6	0	ND	No	No	

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Table 4. Continued.

Stream	Date Surveyed	Culvert ID Number	Road Culvert Occurs on	Culvert Measurements Length (ft)	Diameter (in)	Outlet Drop (in)	Inlet Drop (in)	Velocity (ft/sec)	Fish Bearing Stream	Fish Passage Problem	Comments
East Fork Gold Creek / Simmons Creek											
E.F. Gold Creek	09/29/96	E1	FS 1222	60	72	6	0	4.3	Yes	Yes	
Trib. of E.F. Gold Creek	09/29/96	E2	FS 1222	60	26	3	0	3.0	No	No	
Trib. of N.F. Simmons	09/29/96	E3	FS 1219	48	24	0	0	ND	No	No	Dry channel
Trib. of N.F. Simmons	09/29/96	E4	FS 1219	40	24	0	0	ND	No	No	Dry channel
Trib. of N.F. Simmons	09/29/96	E5	FS 1219	60	36	0	0	ND	No	No	Dry channel
Trib. of N.F. Simmons	09/29/96	E6	FS 1219	60	36	24	0	3.3	No	No	
Trib. of N.F. Simmons	09/29/96	E7	FS 1219	60	36	12	0	4.3	No	No	
Trib. of N.F. Simmons	09/29/96	E8	FS 1219	60	24	ND	0	ND	No	No	
Trib. of N.F. Simmons	09/29/96	E9	FS 1219	70	48	0	0	4.7	No	No	
Trib. of N.F. Simmons	09/29/96	E10	FS 1219	60	36	8	8	3.3	No	No	
Spruce Creek	09/29/96	E11	FS 1278	60	60	0	40	3.3	No	No	
Trib. of Spruce Creek	09/29/96	E12	FS 1278	75	60	12	40	3.1	No	No	
Dolly Creek	09/29/96	E13	FS 1278	60	60	4	0	1.5	Yes	Yes	

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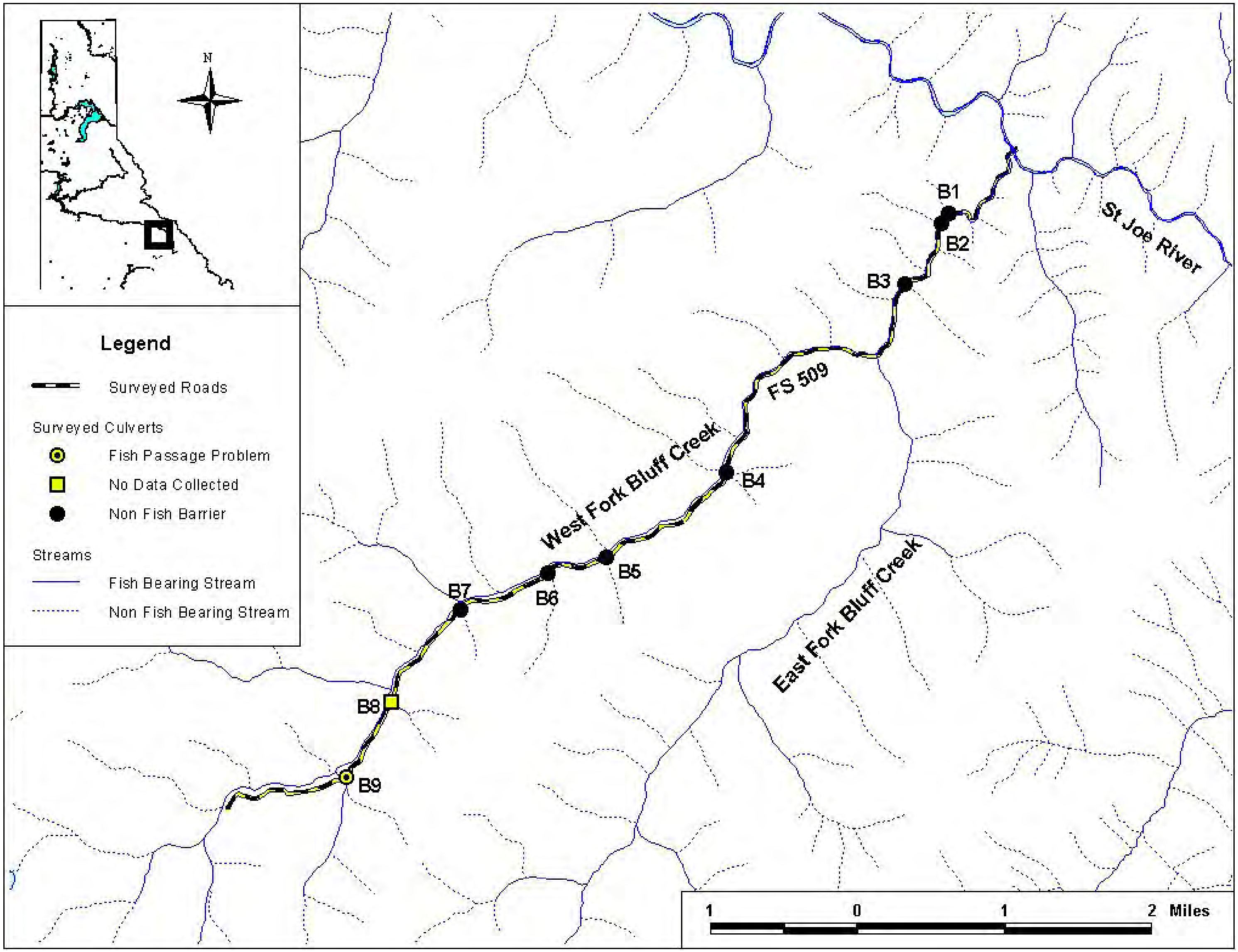

Figure 4. Location and status of culverts evaluated for fish passage during 1997 in the Bluff Creek watershed, of the St. Joe River basin, Idaho.

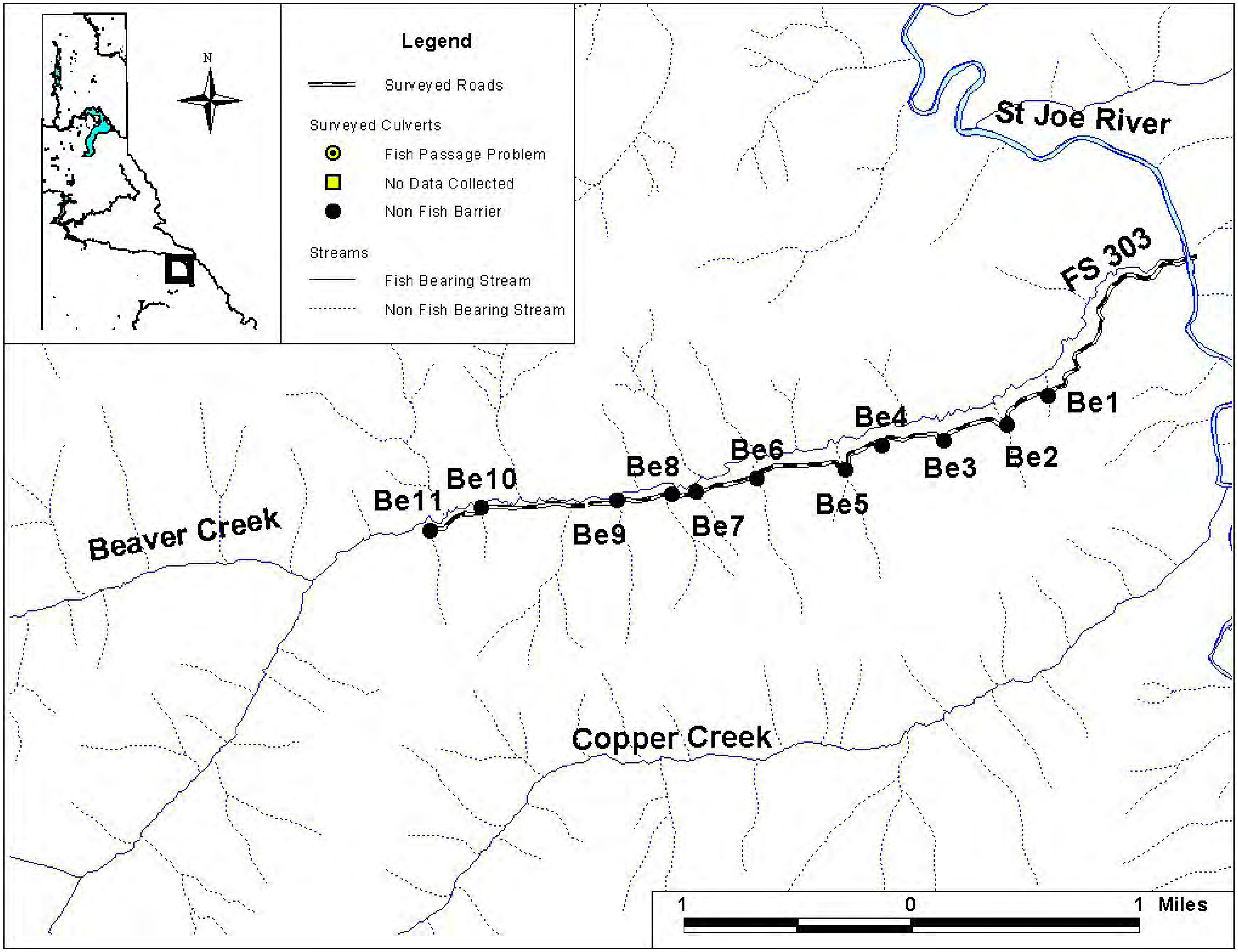

Figure 5. Location and status of culverts evaluated for fish passage during 1997 in the Beaver Creek watershed, of the St. Joe River basin, Idaho.

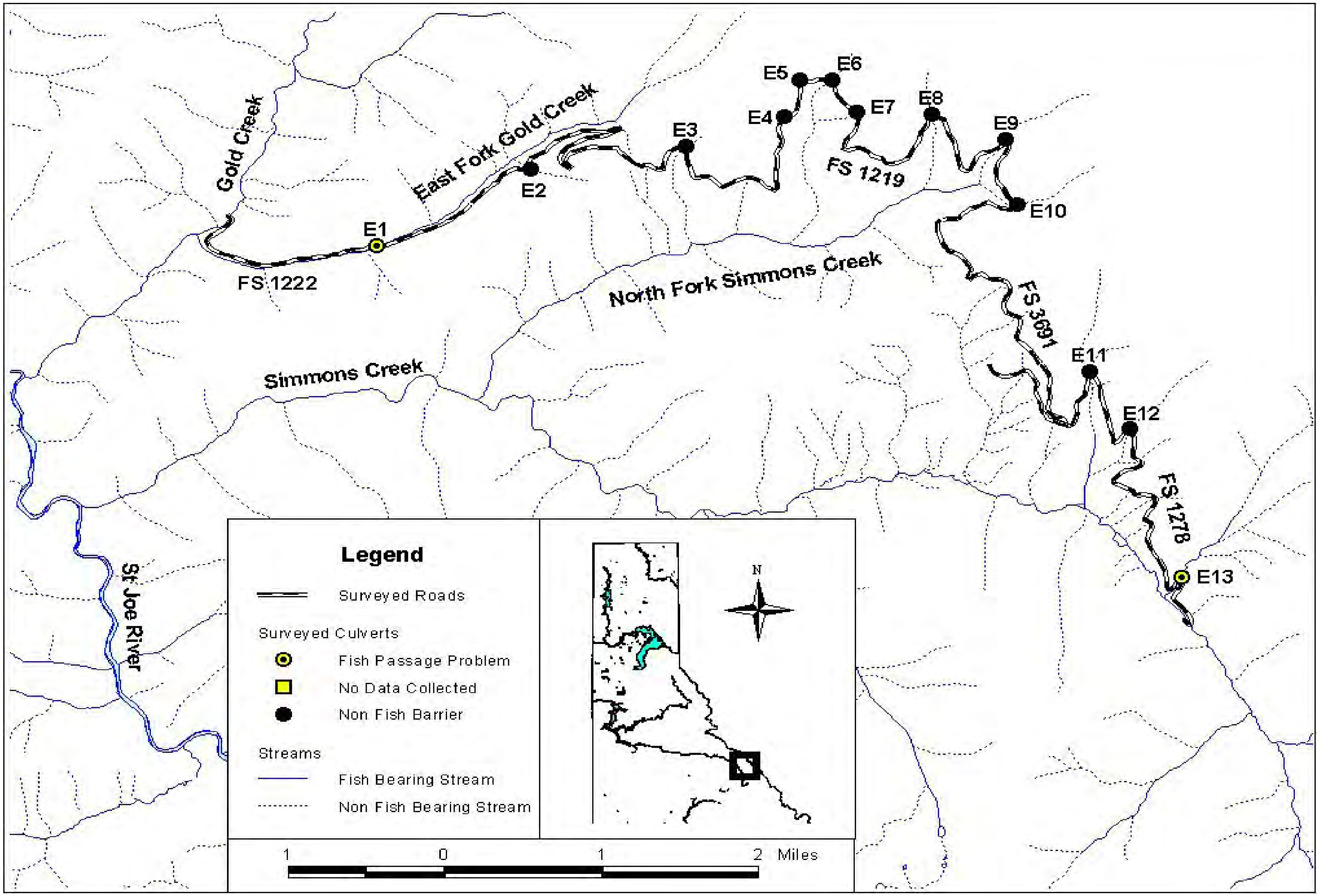

Figure 6. Location and status of culverts evaluated for fish passage during 1997 in the East Fork Gold and Simmons Creek watersheds, of the St. Joe River basin, Idaho.

The depth of water that occurs inside culverts was not measured to evaluate whether it exceeded the 3-inch minimum specified in Idaho's Stream Channel Alteration Rules. However, most culverts that are sized to pass 50-year peak flows or greater will have water depths less than 3 inches during low flow periods unless some alterations are made to maintain water depths (IDL 1998). Consequently, shallow water is a fish passage issue for all culverts where fall migrating fish, such as bull trout and kokanee *Oncorhynchus nerka kennerlyi* occur. For this reason, most culverts that occur in bull trout or kokanee streams that do not have some type of alteration to maintain water depths would be considered in violation of the Stream Channel Protection Act.

DISCUSSION

Eighty-five percent of the culverts that were surveyed were evaluated to be causing fish passage problems. Although, this seems alarmingly high, these findings are not much different than what has been found in other culvert inventories in Idaho (IDL, Unpublished data). These culverts can significantly decrease the range of available habitat to cutthroat trout and bull trout or isolate fish populations putting them at an increased risk of extinction (Horowitz 1978; Beechie et al. 1994). Improving fish passage through these culverts is important in ensuring healthy stable fish populations persist (Panhandle Bull Trout Technical Advisory Team 1998).

It's important to realize that most of the culverts surveyed were not complete fish barriers, and may only delay migration or block passage of smaller fish (< 3 inches). Fish occur upstream of most of these problem culverts, but the passage problem these culverts cause may result in increased stress, reduced growth and survival, and loss of migratory life-history types (Rieman and McIntyre 1993).

Westslope cutthroat trout were petitioned to be listed as threatened under the Endangered Species Act in 1997. A status review by the US Fish and Wildlife Service eventually found that they were not warranted for listing, although, the loss of migratory life-history types was evident and did give them concerns (Scott Deeds, USFWS, personal communication). Undoubtedly, problem culverts play a role in this loss of migratory life-history types.

Many alternatives are available to improve fish passage through these problem culverts (IDL 1998; WDFW 1999; Robison 2000). However, most can be remedied for less than $1,000 by installing an angle iron fish ladder (IDL 1998). Installing an angle iron fish ladder into a culvert will create holding pools, increases the water depth, slow the water velocity, and eliminate drop that occurs into the culverts inlet. Before installing a fish ladder into a culvert, one must ensure that it will not reduce the culvert's capacity to pass peak flows below what is required by law.

Money does not exist to replace or fix all these culverts at once. As money becomes available, those culverts with the highest priority should be replaced first. When prioritizing which culverts to upgrade or replace one should consider the following details:

1. What is the severity of the problem – is the culvert a complete barrier or does it just delay migration?

2. What type of fish live in the stream - bull trout streams would take precedence over others?

3. How important is the stream to the fishery – does it provide important spawning, rearing or overwinter habitat?

4. How much of the stream does the culvert block off or influence?

5. What is the cost of fixing the culvert?

Based on these considerations the evaluated culverts were placed in the following priority list for upgrading or replacement (Table 5). This prioritization was based largely on the data collected by volunteers and it is possible some the data is erroneous, was misinterpreted or false assumptions were made in calculations.

Table 5. Prioritization of evaluated culverts for replacement or upgrading. The culverts are listed by which stream they occurred on and their (culvert ID) and can be referenced on Tables 3 and 4 and Figures 1-6.

High Priority	Medium Priority	Low Priority
Rapid Lightning Creek (S14)	Dennick Lake Creek (S5)	Sand Creek (S4)
Quartz Creek (L1)	Johnson Creek (S13)	Gold Creek (S12)
Cedar Creek (G5)	Trib. Of W.F. Bluff Creek (B9)	Slate Creek (T7)
North Twin Creek (G6)	Dolly Creek (E13)	Spring Creek (T8)
E.F. Gold Creek (E1)		Fall Creek (L2)
		E.F. Lightning side channel (L3)
		Dry Gulch (G3)
		Falls Creek (G4)

RECOMMENDATIONS

1. Continue to evaluate culverts for fish passage in important watersheds. Coordinate these activities with other organizations to eliminate redundancy.

2. Improve data collection techniques to allow more accurate evaluation of culverts for fish passage problems.

3. Make efforts to visit high priority culverts to validate findings, and where warranted investigate funding sources to upgrade or replace culvert.

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APPENDIX

Appendix A. Instructions for stream culvert inventory.

INSTRUCTIONS FOR CULVERT MEASUREMENTS

1. Set or mark odometer mileage at beginning of the road.

2. Record stream name.

3. Record road name or number (i.e. Lightning Creek Rd. or FS 489).

4. Record mileage to first culvert. Identify culvert as #1, #2.... etc.

5. Make culvert measurements.

    a. **Culvert length**- use tape measure and measure from one end to the other. Record distance in feet and inches.

    b. **Culvert diameter**- measure across the widest point.

    c. **Culvert drop** -
        outlet (downstream end)- measure from the top of the culvert to the top of the water in the pool below.
        inlet (upstream end)- measure from the top of the water just above the culvert to the top of the water just inside the culvert.

    d. **Velocity**- measure the time (**in seconds**) that it takes a rubber ball, tennis ball, orange or a stick to float through the culvert. Do this **twice** and record the average time.

    e. **Plunge pool depth**- measure the depth of the water where it lands at the downstream end of the culvert.

    f. **Comments**- does the culvert empty onto rocks or into a pool.

TOOLS NEEDED

1. Tape measure
2. Staff (i.e. broom handle) marked in 6-inch increments, minimum 4 feet long for depth.
3. Tennis or rubber ball, orange or stick for velocity measurements.
4. Watch with second hand or stopwatch.
5. Data sheets and map
6. Hip boots (optional)

2001 ANNUAL PERFORMANCE REPORT

State of: Idaho   Program: Fisheries Management F-71-R-26

Project: IV – Lake Restoration   Subproject: I-A -Panhandle Region

Contract Period: July 1, 2001 to June 30, 2002

ABSTRACT

There were no lake restoration related activities in the Panhandle Region during this contract period.

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