FISHERY MANAGEMENT INVESTIGATIONS

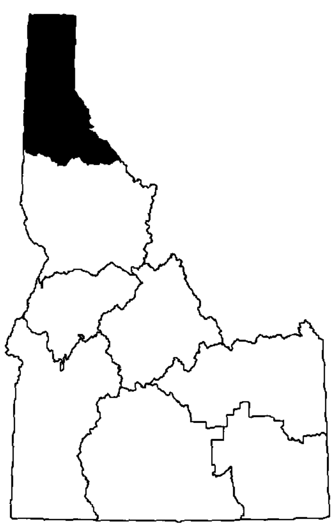
IDAHO DEPARTMENT OF FISH AND GAME

FISHERY MANAGEMENT ANNUAL REPORT

Cal Groen, Director

PANHANDLE REGION

2006



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Panhandle Region 2006 Fishery Management Report

TABLE OF CONTENTS

Page

List of Tables

Page

List of Figures

Page

List of Appendices

Panhandle Region 2006 Fishery Management Report

KOKANEE POPULATION STUDIES

ABSTRACT

A midwater trawl was used to estimate the kokanee *Oncorhynchus nerka* population in Coeur d'Alene Lake in late July, 2006. We estimated a near record low number of adult kokanee, with the total population of age-3 fish estimated at 33,900 or 3 fish/ha. We also estimated 91,000 age-2, 1,532,000 age-1, and 7.3 million age-0 kokanee for a total population estimate of 8.9 million fish in 2006. The standing stock of kokanee in Coeur d'Alene Lake was estimated at 5.5 kg/ha.

Spirit Lake kokanee population and relative year-class abundance are typically evaluated, annually. However, due to low lake levels in 2006 we were unable to launch our 9.12 m trawling boat at Spirit Lake and no estimate was made.

We counted a total of 3,145 kokanee spawners at five historic locations along the shoreline of Priest Lake in November. The numbers of kokanee spawners observed at each of the five sites on Priest Lake were: Copper Bay 1,288, Huckleberry Bay 43, Cavanaugh Bay 972, Hunt Creek beach 842, and Indian Creek beach 0.

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OBJECTIVES

1. Evaluate stock status of kokanee in Coeur d'Alene Lake.
2. Evaluate stock status of kokanee in Spirit Lake.
3. Estimate the number of spawning kokanee in Priest Lake.

INTRODUCTION

Although kokanee are not native, they are one of the most important sport fish species in the Panhandle Region. Kokanee first entered Lake Pend Oreille via the Clark Fork River during the winter flood of 1933 from fish that immigrated from Flathead Lake, Montana. Kokanee were stocked into Flathead Lake in 1916 and were originally from wild stocks from Lake Whatcom, Washington. Once kokanee were established in Lake Pend Oreille, Idaho Department of Fish and Game (IDFG) transplanted them to Coeur d'Alene, Spirit, and Priest Lakes in the 1930's. Self-sustaining populations were soon established and kokanee fisheries typically provided 50 to 90% of the angling effort in the big north Idaho lakes. Kokanee spawners in north Idaho are classified as "late spawners" typically using shoreline gravel rather than tributary streams and spawn November through early January. Annual monitoring of kokanee populations is critical to managing these important fisheries.

METHODS

Coeur d'Alene Lake

We used a midwater trawl, as described by Bowler et al. (1979), Rieman and Meyers (1990), and Rieman (1992), to estimate the kokanee population in Coeur d'Alene Lake. Twenty-two transects were trawled during the dark phase of the moon on July 19-20. 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). Kokanee were measured and weighed. Scales and otoliths were collected from representative length groups for age analysis.

Kokanee spawner lengths were determined by collecting a sample of fish by experimental gillnets on December 1. The net was set at depths of 3-5 m near Higgins Point for approximately one hour. 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. The average number of eggs produced per female kokanee was calculated using the following length to fecundity regression (Rieman 1992):

$$Y = 3.98x - 544$$

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

Spirit Lake

Kokanee population and relative year-class abundance are typically evaluated each year. However, due to low lake levels in 2006 we were unable to launch our 9.12 m trawling boat at Spirit Lake and no estimate was made.

Priest Lake 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 fives historic spawning areas on Priest Lake on November 8. 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). We were unable to survey Upper Priest Lake as low water levels prevented boats from entering the thoroughfare.

RESULTS

Coeur d'Alene Lake

Trawl results indicated the second lowest number of adult kokanee in 27 years, with the total population of age-3 fish estimated at 33,900 or 3 fish/ha, far below the 27 year mean of 790,000 and the 10 year mean of 238,000 age-3 kokanee (Table 1). We estimated 1,532,000 age-1 kokanee, nearly identical to the 27 year average of 1,552,850 and the highest number since 1994 (Table 1). Age-2 kokanee were estimated at 91,000; far below the 27 and 10-year means of 1.5 million and 259,000 respectively. The estimated population of age-0 kokanee was 7.3 million; significantly higher than the 27-year mean of 3.7 million fish. The standing stock of kokanee in Coeur d'Alene Lake was estimated at 25.71 kg/ha, a slight increase from the 2004 estimate of 23.77 kg/ha, the last time IDFG surveyed the lake. Consistent with previous years, the highest age-0 kokanee densities were in the northern section of the lake (Table 2).

Kokanee fry collected in the trawl ranged from 35 to 55 mm TL. Age-1 kokanee ranged from 90 to 180 mm, with a modal length of around 120 mm. Age-2 fish ranged from 180 to 250 mm, with a modal length of around 185 mm. Size of the age-3 kokanee at the time of trawling ranged from 270 mm to 340 mm (Figure 3). Typical of kokanee in Coeur d'Alene Lake, maturity was primarily at age-3 and all of the age-3 kokanee captured were mature.

A 50 minute gill net set on December 1 collected 114 kokanee spawners near Higgins Point in Wolf Lodge Bay. Males outnumbered females, with around 16% of the sample being females. Female mean length was 322 mm (TL), (N=18, SD=18.2 mm). Male mean and modal lengths were 373 and 410 mm respectively, (N=96 SD=31 mm). Mean length of spawners was comparable to 2005. Kokanee spawner length in Coeur d'Alene Lake during the past nine years has been longer than they have been since the late 1950's (Figure 4). Mean fecundity was estimated at 735 eggs per female based on a mean female spawner length of 322 mm, and PED was approximately 12.4 million eggs (Table 3). This is the second lowest PED in 28 years and far below the average (121 million). The average PED for the past 9 years is 35 million eggs.

Priest Lake

A total of 3,145 kokanee spawners were counted at five shoreline sites in Priest Lake (Table 4). No kokanee spawner survey was conducted on Upper Priest Lake as lower than usual water levels prevented us from boating through the thoroughfare. Mean lengths of six male and nine female kokanee were 399 and 375 mm, respectively (Figure 5). No significant change in mean length has been observed in Priest Lake adult kokanee over the past four years.

Number of kokanee spawners observed at each of the five sites on Priest Lake were: Copper Bay 1,288, Huckleberry Bay 43, Cavanaugh Bay 972, Hunt Creek beach 842, and Indian Creek beach 0 (Table 4).

DISCUSSION

Coeur d'Alene Lake

The age-2 and age-3 kokanee populations in Coeur d'Alene Lake remained below the long-term average; however, age-0 and age-1 estimates were above or near the long term average. As in the previous seven years, the low densities have resulted in much larger than usual kokanee. Fish from the age-3 population appeared to be similar in length to recent years but the age-3 estimate is the second lowest recorded in 27 years. Despite the low abundance, the late summer fishery remains very popular at the north end of the lake due to the size of mature fish and the high densities as adult kokanee stage to spawn. Age-0 kokanee numbers have been remarkably stable in the past 10 years. This may be the result of our underestimating the population of spawners. Rieman (1992) noted that capture efficiency decreases with increasing size. Hydroacoustic surveys confirmed the inefficiency of the trawl on large, adult kokanee, and may explain the high PED to fry survival rates observed in the past 10 years. The same comparison data indicates that the trawler is very efficient for age-0 kokanee (Fredericks et al. 2000).

The spawning escapement in 2006 was nearly the weakest since trawling began in 1979 (second only to 2001). PED was around 12 million eggs. Because of the size of mature kokanee (250-345 mm) in 2006, and the decreased capture efficiency with increasing size (Rieman 1992); we most likely underestimated the population of spawners. This suggests escapement of spawners the last few years was greater than trawl-based estimates indicate, and may partially account for the exceptionally high PED to fry survival rates since 1999 (Table 3).

Priest Lake

Priest Lake spawning kokanee numbers were down from 2005. We counted 3,145 kokanee spawners at five historic sites on Priest Lake compared to 4,961 in 2005. We have been counting kokanee spawners at these sites since 2001 and they averaged 3,442 fish per year. Most of the kokanee spawners in 2006 would have been progeny of the 2002 adults when only 1,825 spawning kokanee were counted.

The overall increase in kokanee spawners since 2002 is likely related to a change in water level management. Prior to 2002, timing of winter lake drawdown adversely affected spawning and incubation of kokanee. In 2001 the Idaho Water Resources Board (IWRB) and

IDFG proposed several amendments to the 1996 kokanee recovery plan suggesting the lake level be lowered starting October 1 in order to reach the 0.0 feet goal at the outlet gauge by November 1. Lower lake levels ensure a higher reproductive success rate because the water is at its lowest level before kokanee initiate spawning. Kokanee spawning activity in Priest Lake peaks in mid-November. Since 2002, Priest Lake has been drafted to near the 0.0 goal by October 31.

From the early 1950's to the early 1970's kokanee provided most of the fishing opportunity in Priest Lake with an annual harvest of 30,000-100,000 fish. The introduction of opossum shrimp *Mysis relicta* in the early 1960's lead to dramatic increases in lake trout *Salvelinus namaycush* numbers and elimination of the popular kokanee fishery in the late 1970's. In 1978 only 4,500 kokanee were harvested in Priest Lake. Based on trawling estimates the population of age 3 kokanee in Priest Lake in 1987 was only 2,776 fish (Mauser 1985).

Until recently, the Priest Lake kokanee population was considered all but extirpated. Changes in water level management have resulted in a rebounding kokanee population. Spawner count data indicates there were more kokanee today in Priest Lake than there has been in 20 years. Spawner counts are not the most accurate way to evaluate the population and we recommend re-implementation of yearly kokanee trawling, if documenting kokanee status in Priest Lake is considered a priority.

Estimates of kokanee number, density and standing crop would be useful in making comparisons to populations in Lake Pend Oreille and Lake Coeur d' Alene and to evaluate future management changes within the Priest Lake population. By re-establishing the long-term population monitoring program (midwater trawling) and with some adaptive management we may be able to offer anglers limited kokanee fishing opportunity again on Priest Lake.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor the kokanee population in Coeur d'Alene Lake and adjust age-0 Chinook salmon supplementation accordingly.

2. Continue to monitor kokanee spawner numbers on Priest and Upper Priest Lake and expand surveys to include lower sections of historic spawning tributaries.

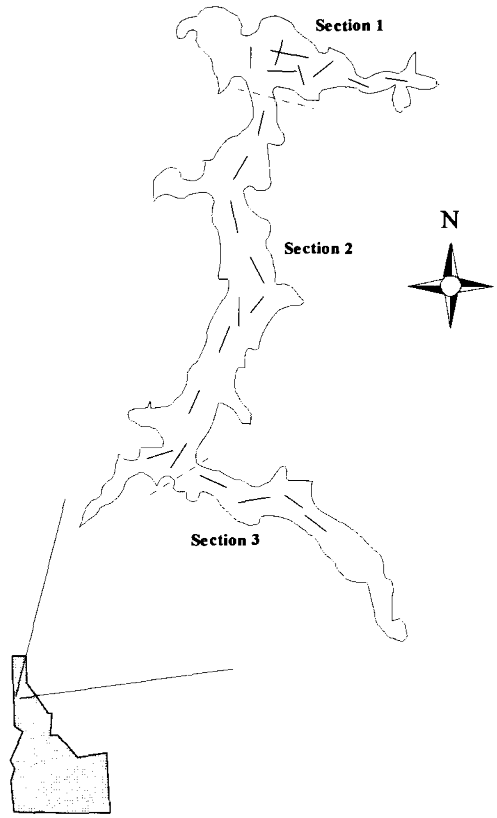

Figure 1. Location of 22 midwater trawling transects in three sections of Coeur d'Alene Lake, Idaho, used to estimate kokanee population abundance in 2006.

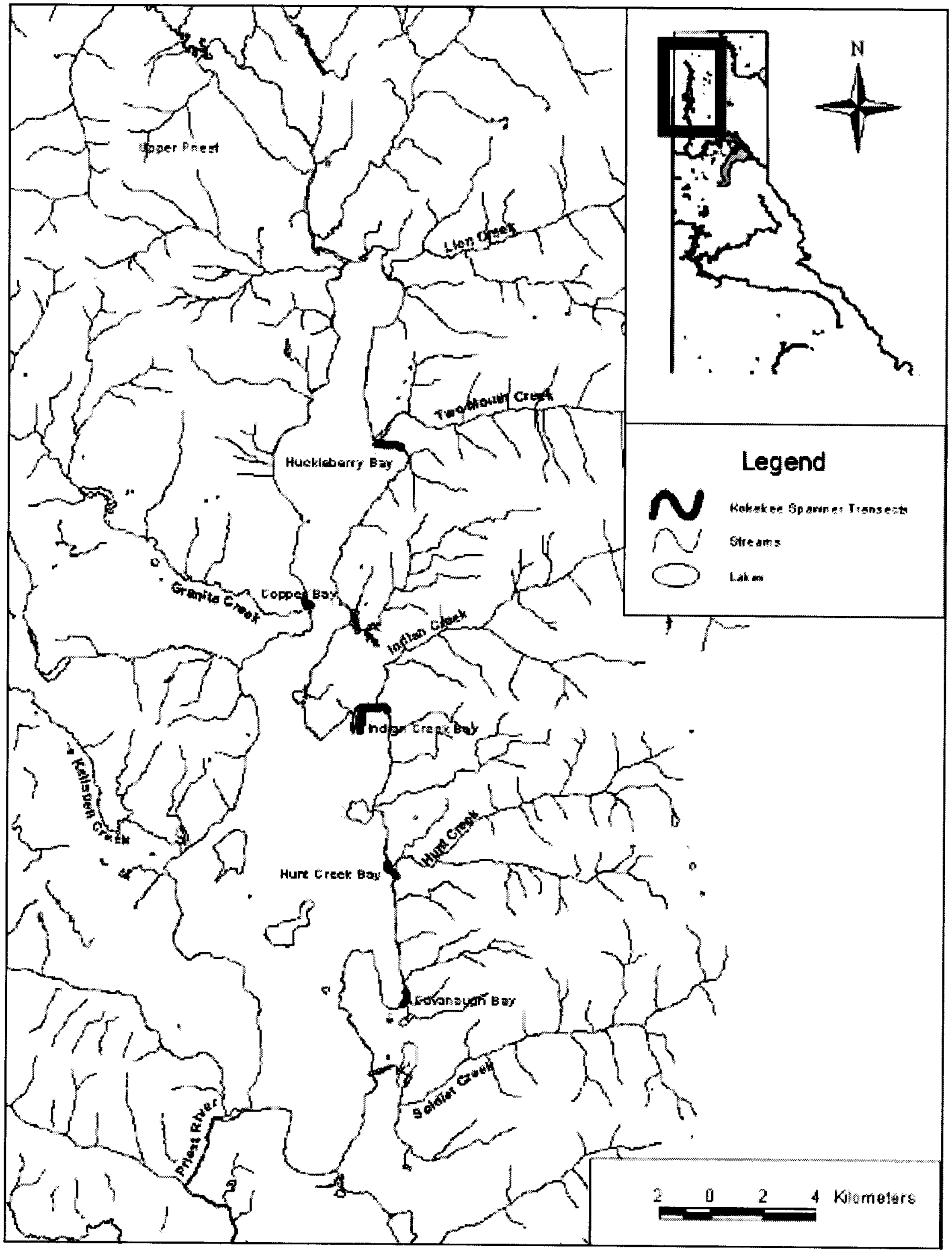

Figure 2. Location of kokanee spawner counts on Priest Lake, Idaho, 2006.

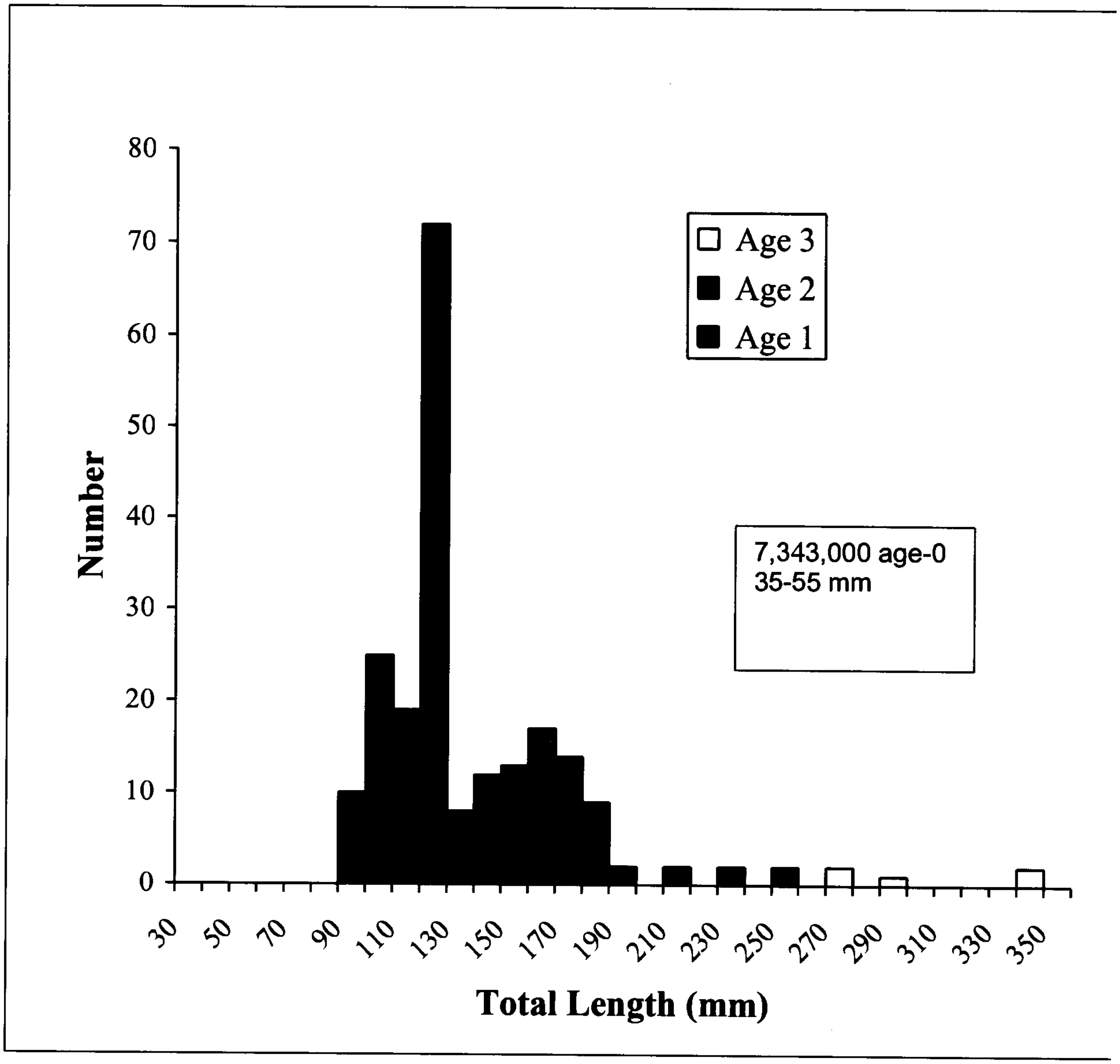

Figure 3. Length frequency and age of kokanee collected by midwater trawling in Coeur d'Alene Lake, Idaho, in 2006.

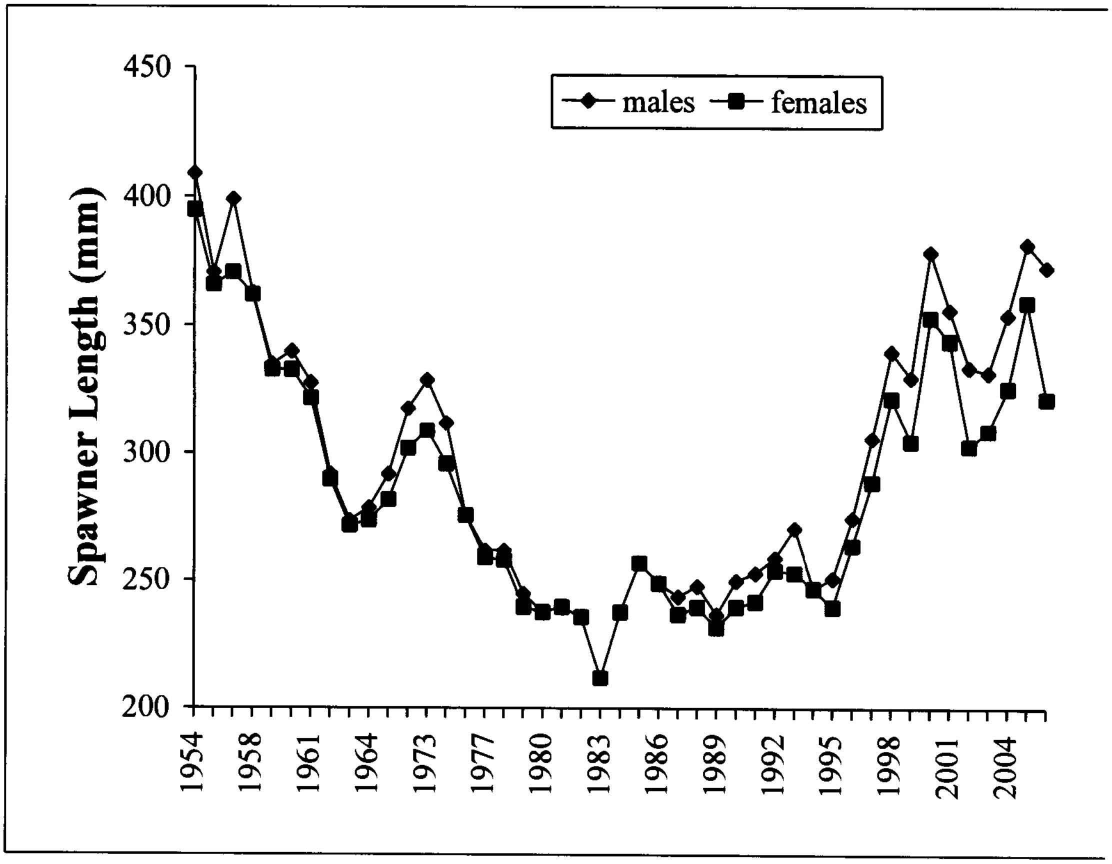

Figure 4. Mean total length of male and female kokanee spawners in Coeur d'Alene Lake, Idaho, from 1954 to 2006. Years where mean lengths were identical between sexes were a result of averaging male and female lengths.

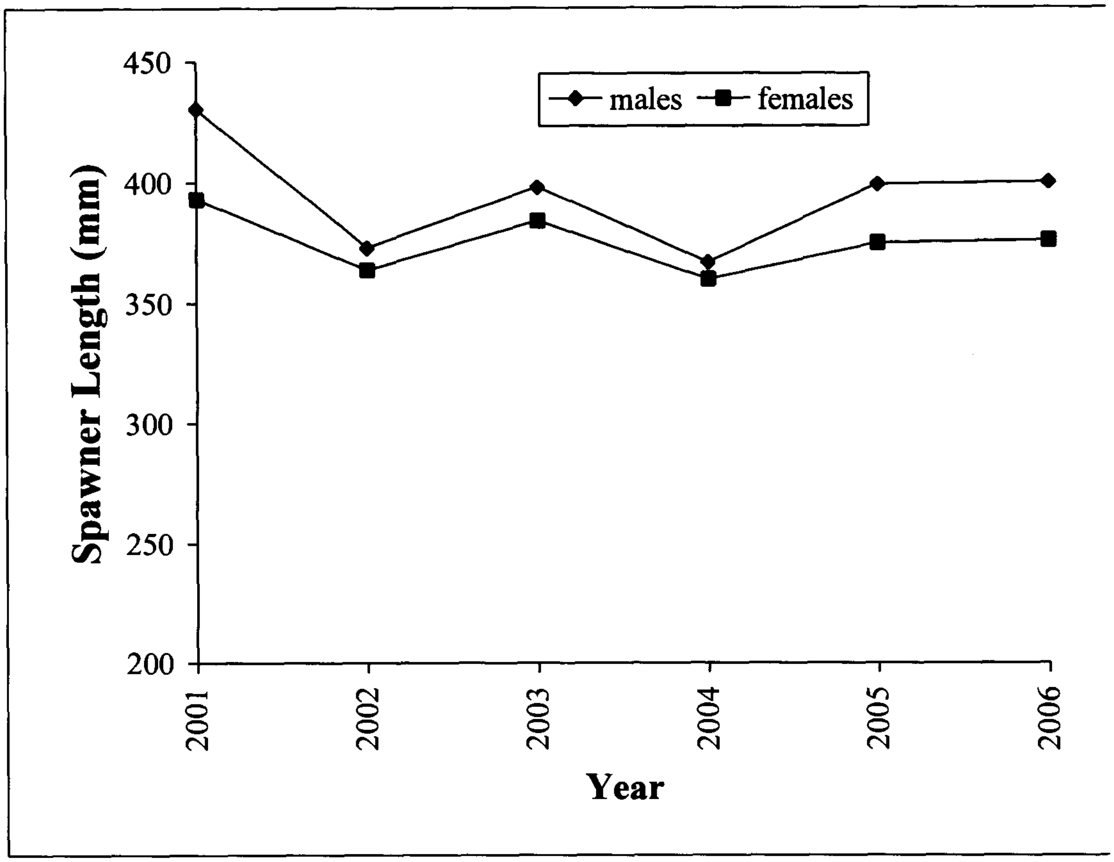

Figure 5. Mean total length of male and female kokanee spawners in Priest Lake, Idaho, from 2001 to 2006.

Table 1. Estimated abundance of kokanee made by midwater trawl in Coeur d'Alene Lake, Idaho, from 1979-2006 (No trawling estimate in 2005). To follow a particular year class of kokanee, read up one row and right one column.

Sampling	Age Class					Age
Year	Age 0	Age 1	Age 2	Age 3/4	Total	3/ha
2006	7,343,000	1,532,000	91,000	33,900	8,999,000	3
2004	7,379,000	1,064,000	141,500	202,400	8,787,000	21
2003	3,300,000	971,000	501,400	182,300	4,955,000	19
2002	3,507,000	934,000	695,200	70,800	5,207,000	7
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	146
1995	2,000,000	620,000	2,900,000	2,850,000	8,370,000	295
1994	5,950,000	5,400,000	4,900,000	500,000	12,600,000	51
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 $\bar{x}$	**3,722,181**	**1,552,850**	**1,571,773**	**790,600**	**7,513,927**	**82**

Table 2. Kokanee population estimates and standing crop (kg/ha) in each section of Coeur d'Alene Lake, Idaho, July 19-20, 2006.

Section	Age 0	Age 1	Age 2	Age 3	Kg/ha
1	6,781,756	130,874	15,353	3,833	4.75
2	495,664	151,873	27,299	16,402	1.57
3	65,325	1,249,020	48,365	13,658	19.39
Whole lake	**7,342,745**	**1,531,766**	**91,018**	**33,893**	5.5
(90% CI)	1,594,224	1,607,305	81,839	33,252	

Table 3. Estimates of female kokanee spawning escapement, potential egg deposition, fall abundance of kokanee fry, and their subsequent survival rates in Coeur d'Alene Lake, Idaho, 1979-2006.

Year	Estimated female escapement	Estimated potential number of eggs ($x10^6$)	Fry estimate the following year ($x10^6$)	Percent egg to fry survival
2006	16,900	12		28.9
2005	N/A	N/A	7.34	N/A
2004	101,000	76	*	*
2003	91,000	62	7.38	12.0
2002	35,000	25	3.30	13.2
2001	12,650	10	3.50	34.0
2000	37,700	32	7.10	22.2
1999	28,000	19	4.18	22.6
1998	39,000	26	4.09	15.7
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	256,716	86	1.86	2.20

* no estimate could be made due to missing trawl data in 2005.

Table 4. Counts of shoreline spawning kokanee salmon in Priest Lake and Upper Priest Lake, Idaho, 2001- 2006.

Location	2001	2002	2003	2004	2005	2006
Priest Lake						
Copper Bay	588	549	1237	1584	906	1288
Cavanaugh Bay	523	921	933	1673	916	972
Huckleberry Bay	200	49	38	359	120	43
Indian Crk Bay	222	0	0	441	58	0
Hunt Crk Mouth	232	306	624	2060	2961	842
Upper Priest Lake						
West shoreline	10	---[1]	---[1]	---[1]	---[1]	---[1]
Total	**1775**	**1825**	**2832**	**6117**	**4961**	**3145**

1 Upper Priest Lake was not included in the spawner counts due to low water in the thoroughfare and no access to Upper Priest Lake.

Panhandle Region 2006 Fishery Management Report

LAKE COEUR D'ALENE CHINOOK SALMON STUDIES

ABSTRACT

We counted 141 Chinook salmon *Oncorhynchus tshawytscha* redds in the Coeur d'Alene River drainage and 16 in the St. Joe River. A total of 57 Chinook salmon redds were excavated to reduce natural production in the Coeur d'Alene River. A total of 47,600 age-0 Chinook salmon were stocked at the Carlin Bay Cafe boat ramp in June. Chinook eggs were collected at Garrison Dam National Fish Hatchery, North Dakota, hatched at Cabinet Gorge Hatchery and were reared at the Nampa Hatchery. All fish were marked with a right ventral fin clip.

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INTRODUCTION

Fall Chinook salmon were introduced into Coeur d'Alene Lake in 1982 as a biological tool to help manage the kokanee population and to provide a yield fishery. The kokanee fishery peaked in 1979 with 578,000 fish harvested but then quickly collapsed by the early 1980's when kokanee became too numerous and stunted. Fall Chinook salmon were chosen as the preferred predator to reduce kokanee numbers for a variety of reasons: Their relatively short and determinant life cycle compared to other species (lake trout *Salvelinus namaycush,* Kamloops rainbow trout *O. mykiss*, walleye *Sander vitreus,* brown trout *Salmo trutta*); ability to manage predator/prey numbers; and the benefit provided by a Chinook fishery. Kokanee densities of 30-50 age 3 kokanee/ha provide the highest catch rates for desirable size (280 mm) fish. Chinook salmon management goals call for greater catches of 1.5-9 kg fish rather than fewer but bigger fish. A mix of hatchery and wild Chinook are used to achieve management goals.

METHODS

Department personnel used a helicopter to conduct redd surveys of Chinook salmon in the Coeur d'Alene River, North Fork Coeur d'Alene River, South Fork Coeur d'Alene River, Little North Fork Coeur d'Alene River and St. Joe River on October 2. We estimated the natural production of Chinook salmon based on these redd counts, an estimate of 4,000 eggs per redd, and a mean egg-to-smolt survival of 10%.

RESULTS

We counted 141 Chinook salmon redds in the Coeur d'Alene River drainage and 16 in the St. Joe River (Table 5). Conditions for counting were favorable (clear skies and clear water), and we were able to see most redds, easily.

Management goals call for no more than 100 Chinook salmon redds in the Coeur d'Alene River drainage, therefore, we destroyed 57 Chinook salmon redds in the Coeur d'Alene River on October 5. In an effort to reduce natural production, Department personnel used a high pressure fire pump mounted in our drift boat and shovels to excavate and destroy excess redds. The 57 redds that were destroyed were in a one mile section of river just upstream of the I-90 Kingston exit. This section of river was chosen because of the high concentration of redds and availability of boat access points. We estimated natural production based on the remaining 100 undisturbed redds to be 40,000 fish in 2006.

IDFG stocked 47,600 age-0 Chinook salmon at the Carlin Bay boat ramp during June 2006. Chinook eggs were collected at Garrison Dam National Fish Hatchery, North Dakota, hatched at Cabinet Gorge Hatchery and reared at the Nampa Hatchery. Mean size at release was 160 mm, and all fish were marked with a right ventral fin clip. The total age-0 hatchery and wild Chinook salmon entering Coeur d'Alene Lake in 2006 was estimated to be about 71,000 fish (Table 6).

DISCUSSION

The 47,600 hatchery Chinook salmon stocked in Coeur d'Alene Lake in 2006 were hatched at Cabinet Gorge Hatchery and reared at the Nampa Hatchery as they have been since 2003. The warmer water temperatures of Nampa Hatchery allow for accelerated growth resulting in an average size of 160 mm at time of release. Over the past 23 years we have stocked an average of 31,000 age-0 Chinook salmon in Coeur d'Alene Lake (Table 6).

For the second time since 1990 Chinook salmon redd counts have exceeded 100 and excess redds were destroyed. Additionally we made changes relative to both Chinook and kokanee bag limits in 2006. The bag limit on Chinook was raised from 2 to 6 fish and the kokanee bag limit was reduced from 25 to 6 fish. The aggregate limit for kokanee and Chinook salmon was set at 6 fish to reduce kokanee harvest and to encourage anglers to harvest more Chinook. Unfortunately it appears that many Chinook anglers continue to release all but the largest Chinook salmon.

Angler reports indicate wild Chinook salmon continue to make-up the majority of Chinook salmon caught in Coeur d'Alene Lake. During the Lake Coeur d'Alene Anglers Association Big One Derby in 2004, 90% of the fish caught were reported to be of wild origin. An alternate source of Chinook salmon eggs was located and in 2005 and 2006 we stocked juvenile Chinook salmon from Lake Sakakawea, North Dakota. These fish have no known disease problems and were stocks obtained from Lake Michigan. The goal was to stock fish that hopefully have more of an innate tendency to spend their entire life cycle in freshwater as opposed to their ocean dwelling counterparts that have a strong desire to migrate to the ocean as smolts.

MANAGEMENT RECOMMENDATIONS

1. Discontinue stocking age-0 hatchery Chinook salmon in 2007 until midwater trawling results indicate an increase in kokanee numbers.

2. Continue to monitor the recovery of the kokanee population.

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

4. Monitor the "Big One" Chinook derby to determine the contribution of hatchery Chinook salmon to the creel.

Table 5. Chinook salmon redd counts in the Coeur d'Alene River drainage, St. Joe River, and Wolf Lodge Creek, Idaho, 1990-2006.

Location	1990	91	92	93	94	95	96	97	98	99	2000	2001	2002	2003	2004	2005	2006
Coeur d'Alene River																	
Cataldo Miss to S.F. Cd'A R	41	11	29	80	82	45	54	18	11	7	16	18	14	27	24	30	30
S.F. Cd'A to L.N.F. Cd'A R	10	0	5	11	14	14	13	5	3	5	20	13	10	17	36	7	80
L.N.F. Cd'A to Steambt Cr	--	2	3	6	1	1	13	6	1	0	3	2	6	2	4	3	14
Steamboat Cr to steel bridge	--	--	1	0	0	2	0	3	0	0	0	1	0	0	2	0	7
Steel bridge to Beaver Cr	--	--	--	--	0	0	0	1	0	0	0	0	0	0	0	0	0
S. F. Cd'A River	--	--	--	--	13	--	4	0	0	0	5	4	3	5	4	8	10
L.N.F. Cd'A River	--	--	--	--	0	2	0	0	0	0	1	0	0	0	1	1	0
Coeur d'Alene R Subtotal	51	13	38	97	110	64	84	33	15	12	45	38	33	51	71	49	141
St. Joe River																	
St. Joe City to Calder	4	0	18	20	6	1	59	20	3	0	5	21	14	15	15	7	15
Calder to Huckleberry C.G.	3	1	1	4	0	0	5	2	1	0	0	15	4	9	3	3	1
Huckleberry C.G. to Marble Crk	3	0	2	0	1	0	7	2	0	0	0	--	0	3	0	0	0
Marble Creek to Avery	0	0	0	0	1	0	0	0	2	0	0	--	0	0	0	0	0
St. Joe River Subtotal	10	1	21	24	8	1	71	24	6	0	5	36	18	27	18	10	16
Wolf Lodge Creek	--	--	--	--	--	--	--	--	4	5	3	4	0	0	1	1	--
TOTAL	**66**	**14**	**63**	**121**	**118**	**65**	**155**	**57**	**25**	**17**	**53**	**78**	**51**	**78**	**90**	**59**	**157**

Table 6. Number of Chinook salmon stocked and estimated number of naturally produced chinook salmon entering Coeur d'Alene Lake, Idaho, 1982-2006. The number of chinook redds is the count from the previous fall.

	Hatchery Produced				Naturally Produced		
Year	Number	Stock	Rearing Hatchery	Fin Clip	Previous year redd counts	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	18,300	L. Michigan	Mackay	Left Ventral	--	--	18,300
1986	30,000	L. Michigan	Mackay	Right Ventral	--	--	30,000
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	36,400	Coeur d'Alene	Mackay	Adipose	52	20,800	57,200
1991	42,600	Coeur d'Alene	Mackay	Left Ventral	70	28,000	70,600
1992	10,000	Coeur d'Alene	Mackay	Right Ventral	14	5,600	15,600
1993	0	--	--	--	63	25,200	25,200
1994	17,300	Coeur d'Alene	Nampa	Adipose	100	40,000	57,300
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	12,600	Coeur d'Alene	Nampa	Adipose	84	33,600	46,200
1998	52,300	Priest Rapids	Cabinet G.	Left Ventral	57	22,800	75,100
1999	25,500	Big Springs	Cabinet G.	Right Ventral	25	10,000	35,500
2000	28,000	Big Springs	Nampa	Adipose	17	6,800	34,800
2001	0	--	--	--	53	21,200	21,200
2002	41,000	Big Springs	Nampa	Left Ventral	78	31,200	72,200
2003	44,800	Big Springs	Nampa	Right Ventral	51	20,400	65,200
2004	46,000	Big Springs	Nampa	Adipose	78	31,000	77,000
2005	26,300	L. Sacajawea	Nampa	Left Ventral	90	36,000	62,300
2006	47,600	L. Sacajawea	Nampa	Right Ventral	59	23,600	71,200

Panhandle Region 2006 Fishery Management Report

PEND OREILLE RIVER BASS EXPLOITATION STUDY

ABSTRACT

We tagged 440 largemouth bass *Micropterus salmoides* and 55 smallmouth bass *M. dolomieu* from the Pend Oreille River between April 26 and May 17 to evaluate their annual exploitation rates. Through May 17, 2007, 127 of the tagged largemouth bass and eight of the smallmouth bass were reported as being captured (Table 7). Adjusting for angler compliance, tag loss, and fish mortality we estimated that 64% to 71% of the tagged largemouth bass and 28% to 30% of the smallmouth bass were caught over a one year period. Between 26% and 43% of the largemouth bass that were caught were reported as being harvested whereas 50% of the smallmouth bass that were caught were reported as being harvested. Adjusting for angler compliance, tag loss, and fish mortality, exploitation for largemouth bass and smallmouth bass was estimated to be 30% and 15% respectively. All size classes of largemouth bass appeared equally vulnerable to exploitation as tagged largemouth bass were caught and harvested in proportion to the sizes that we tagged. Anglers were ineffective at catching the larger (>380 mm) smallmouth bass. We believe these exploitation rates will change the size structure of largemouth bass (fewer large fish), but will have little influence of smallmouth bass especially since anglers are not effective at catching larger fish. To help maintain the current size structure of largemouth bass in the Pend Oreille River more restrictive fishing regulations could be implemented including length restrictions, limit restrictions and seasonal closures.

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INTRODUCTION

Historically, the Pend Oreille River, Idaho, provided a fishery for salmonids including cutthroat trout *Oncorhynchus clarkii*, bull trout *Salvelinus confluentus and* mountain whitefish *Prosopium williamsoni* (Smith 1936). Warmwater game fish such as largemouth bass, black crappie *Pomoxis nigromaculatus* and pumpkinseed *Lepomis gibbosus* were introduced into the system in the early 1900 by the U.S. Fish Commission but remained at low levels until construction of Albeni Falls Dam in 1952 (Dice 1983).

The construction of Albeni Falls Dam changed the Pend Oreille River from a free-flowing system dominated by cobbles and gravels to a run-of-the river reservoir dominated by silt and sand (Bennett and DuPont 1993). Operational procedures at Albeni Falls Dam caused fluctuating water levels up to 3.5 m to increase power production and provide flood control (Dice 1983). After construction of Albeni Falls Dam the salmonid fishery likely declined due to fish passage barriers and changes in habitat (DuPont 1994). Construction of Albeni Falls Dam inundated shallow backwater areas that provided warmer water in the spring and summer – habitat often utilized by largemouth bass for spawning and rearing (Bennett and DuPont 1993). Despite the creation of these backwater areas a popular fishery for largemouth bass did not materialize as they represented only about 1% of the fish in this system in 1992 (Bennett and DuPont 1993). Some anglers learned to target spawning largemouth bass, but it only provided localized fishing for a short period of time. Work by DuPont (1994) suggested that the 3.5 m annual drawdown at Albeni Falls Dam was impacting the warmwater fishery because it forced these fish from preferred winter habitat (deeper calm backwater areas) to areas less hospitable. DuPont (1994) suggested that if drawdown was limited to 2 m it would increase winter habitat by about 7.5 times and presumably improve survival of largemouth bass.

Starting in 1996, the U.S. Army Corps of Engineers began holding water levels higher in the winter (2.1 m drawdown 3 out of 4 years) in an attempt to improve kokanee spawning success in Lake Pend Oreille. Work by Karchesky (2002) found that by 1999 the abundance and number of older largemouth bass had increased. As the largemouth bass fishery improved so did their popularity with anglers. Bass clubs started holding tournaments on the Pend Oreille River with great success. Smallmouth bass also began colonizing the river as they moved downstream from Montana. By 2005, smallmouth bass were one of the most abundant shoreline fish in the Pend Oreille River making the bass fishery even more popular (Bassista et al. In Press). With the increase in fishing pressure on bass in the Pend Oreille River, some anglers expressed concern that the larger fish were beginning to be removed and wanted more protection given to them. Regulations in the Pend Oreille River during 2006 allowed a daily harvest of six bass with none under 305 mm (12 inches). In an effort to evaluate angler impacts on the bass population in the Pend Oreille River we conducted a tagging study to evaluate angler exploitation.

OBJECTIVES

1. Evaluate angler exploitation on largemouth and smallmouth bass from the Pend Oreille River, Idaho, and determine what effect the angling pressure is having on the size structure of these fish.

2. Assist with a statewide effort to assess angler reporting rates of tagged fish.

STUDY SITES

The Pend Oreille River is located in northern Idaho beginning at the outlet of Lake Pend Oreille. The river flows 189 km through northern Idaho, Washington and southern British Columbia to where it joins the Columbia River near the United States-Canada border. The study area was confined between Albeni Falls Dam (operated by the U. S. Army Corps of Engineers) and the Long Bridge (beginning of the Pend Oreille River) spanning about 43 km of river and covering 3,887 ha during full pool (Figure 6). The Pend Oreille River is a large system with a drainage area of about 63,000 km^2 and average flow of roughly 697 m^3/sec (peak discharge 3,913 m^3/sec). At full pool, the Pend Oreille River has an average depth of 7.05 m, a maximum depth of 48.5 m, and a maximum width of 3.2 km (DuPont 1994). About 161 km of shoreline, including sloughs and islands, have a gentle to moderate slope consisting mostly of fine sediments (<4 mm), while about 16 km of shoreline is rocky, consisting predominately of rip-rap (DuPont 1994).

Albeni Falls Dam blocks upstream movement of fish in the Pend Oreille River and is located about 5 km upstream of the Idaho-Washington state line and 7 km downstream of the confluence of the Priest River. Albeni Falls Dam controls flow and water levels in the Pend Oreille River. Typically water levels are raised in mid-April and reach high pool (628.65 m in elevation) by early-June. Water levels are kept steady throughout the summer and drawdown typically begins in mid-September reaching low pool elevation by early-November. Since 1996, typically three out of every four years, water levels are lowered to 626.36 m elevation and the other year it is lowered to 625.14 m (full drawdown). This variable drawdown scenario has been designed to increase spawning gravel for kokanee in Lake Pend Oreille. The higher winter water levels increased the surface area of the Pend Oreille River by about 7%, which consists mostly of shallow backwater and slough habitat (Karchesky 2002).

METHODS

To evaluate exploitation of largemouth bass and smallmouth bass from the Pend Oreille River, we captured fish through electrofishing (using two engine powered Smith-Root electrofishing boats). Sampling occurred during six different days spanning from April 26 to May 17. All captured largemouth bass and smallmouth bass ≥ 300 mm that appeared to be in good health were marked with a Floy tag inserted below the dorsal fin and released immediately back to the water. Floy tags were marked with "IDFG", a reward value (non-reward, $10, $50, $100, and $200) and a phone number for anglers to call to report information about the fish captured and to receive their reward. These tags were generally applied at rates of 77%, 7%, 8%, 4%, and 4% respectively. The different reward values were used to estimate angler reporting rates based upon the high-reward methodology (Pollock et al. 2001). Tag reporting rate (λ), or angler compliance, was estimated as the relative return rate of non-rewards tag to the return rate of high-rewards tags (both $100 and $200 dollar tags were returned at similar rates and were considered high-reward tags; Butts et al. 2007):

$$\lambda = \frac{R_t N_r}{R_r N_t}$$

where R_t is the number of non-reward tags returned, N_t is the number of non-reward tags released, R_r is the number of high-reward tags returned, and N_r is the number of high-reward tags released (Butts et al. 2007).

To assess tag loss (Tag_l), about half the fish were double tagged. When anglers returned their tags they were asked if one or two tags were on the fish. The tag loss rate (Tag_{lr}) was calculated by dividing the number of double tagged fish that were reported by anglers as having one tag by the total number of fish that were doubled tagged. Data from the Pend Oreille River were pooled with other tag return data from around the state to calculate tag loss by species across the state (Butts et al. 2007). To calculate the actual number of bass in the Pend Oreille River that were lost from the data pool because they had lost their tag (for single tagged fish) or both of their tags (for double tagged fish) we used the following formula:

$$Tag_l = (Tag_{lr}S)+(Tag_{lr}^2D)$$

S = the number of fish single tagged and D = the number of fish double tagged.

Tagging mortality (Tag_m) was unknown but was suggested by Butts et al. (2007) to be about 15% for centrarchids based on reviews of work by Muoneke (1992), Hayes et al. (1997), Miranda et al. (2002) and Schultz and Robinson (2002). We believe that a 15% tagging mortality rate would be high for the bass in this study. All the fish we tagged were over 300 mm in length, whereas the studies Butts et al. (2007) reviewed evaluated mortality rates from different species (white bass, black crappie, and smallmouth bass) and smaller fish down to at least 200 mm. Smaller fish have been found to have higher mortality rates from the process of being electroshocked, handled and Floy tagged than larger fish (Bardygula-Nonn et al. 1995; Habera et al. 1996). Tranquilli and Childers (1982) suggests tagging related mortalities for largemouth bass in natural conditions would be around 5% and is what we believe would be more appropriate for this study.

The unadjusted exploitation rate (u) was calculated according to Ricker (1975) as the number of fish with non-reward tags caught by anglers that were harvested (R_h), divided by the number of fish released with non-reward tags (N_t). Adjustments were made to the exploitation estimates based on angler compliance, tag loss, and tag mortality, using the following formula:

$$u' = \frac{R_h/(N_t - Tag_l)}{\lambda(1-Tag_m)}$$

where the terms are defined as before (Butts et al. 2007).

To calculate annual exploitation we used only those tag returns from fish caught up until May 17, 2007 – a one year period. We also looked at where all of the fish were capture to determine if certain areas were more susceptible to harvest than others.

In an effort to evaluate if largemouth bass and smallmouth bass were more vulnerable to exploitation in certain areas of Pend Oreille River, we compared where we captured and released them to the percentage of them that were captured by anglers. We also looked at when these fish were captured (on a weekly basis) to assess how seasonal closures could influence exploitation. We compared length frequencies of the fish tagged to the fish caught and harvested by anglers to evaluate if anglers were effective at catching all sizes of fish and if they were selective in the size of fish they harvested.

RESULTS

We tagged 440 largemouth bass and 55 smallmouth bass from the Pend Oreille River during the period April 26 to May 17 (Table 7). Locations of released bass are depicted in Figure 1. Through May 17, 2007, 127 (29%) of the tagged largemouth bass and eight (15%) of the smallmouth bass were reported as being captured (Table 8).

By comparing return rates for the of the high dollar reward tags ($100 and $200) to the non-reward tags we calculated that angler compliance (percent of time anglers return non-reward tags) was about 39% for largemouth bass and 43% for smallmouth bass (Table 9). When we corrected for these angler compliance rates along with fish mortality rates (5%) and statewide tag loss rates (21% for largemouth bass and 24% for smallmouth bass) we calculated that 64% to 71% of the tagged largemouth bass and 28% to 30% of the smallmouth bass were caught over a one year period depending on whether we used high reward tags (assume 100% angler compliance) or non-reward tags (Table 10). Between 26% and 43% of the largemouth bass that were caught were reported as being harvested whereas 50% of the smallmouth bass that were caught were reported as being harvested (Table 10). Using non-reward tags and correcting for angler compliance, tag loss rates, and fish mortality, we calculated that annual exploitation (April 2006 to May 2007) for largemouth bass and smallmouth bass was about 30% and 15% respectively (Table 11).

There were three areas where largemouth bass were harvested at a higher proportion than they were released, which included Chuck Slough, Gypsy Bay and Morton Slough (Table 6). All three of these areas receive considerable pressure from bank anglers. Not enough smallmouth bass (8) were captured to effectively evaluate whether they were more vulnerable to exploitation in certain areas.

About 83% of the largemouth bass were reported as being caught between April 30 and June 24, whereas all smallmouth bass were reported as being caught between May 28 and July 15 (Figure 7). The size distribution of largemouth bass caught and harvested were similar to the size distribution that were tagged indicating angler's fishing techniques are not size selective and that they are not harvesting only larger fish (Figure 8). For smallmouth bass the size distribution of fish caught were smaller than what we tagged suggesting that anglers were not effective at catching larger smallmouth bass (Figure 9).

DISCUSSION

Largemouth Bass

We tagged 440 largemouth bass over 300 mm TL in the Pend Oreille River. Based on tag returns and correcting for angler compliance, tag loss and fish mortality; between 64% and 71% of these tagged largemouth bass were caught over a one year period. This data shows that largemouth bass in the Pend Oreille River are extremely vulnerable to angling, with all size classes being equally vulnerable. Seasonal habitat preferences of largemouth bass concentrate fish in specific river areas with little cover other than vegetation. Work by Karchesky (2002) found that radio tagged largemouth bass congregated in two geographic areas between November and mid-March. None of our tagged fish were reported as being caught during this period, likely because few people fish during this period and because largemouth bass feed relatively little when water temperatures decline below 50°F (Scott and Crossman 1973). However, Karchesky (2002) found that from mid-March through spring bass utilized specific near shore habitat (areas where we captured them through electrofishing) where they would be more susceptible to angling. This is the same time period when over 80% of the tagged fish were reported as being caught. Following spawning these largemouth bass tended to spread out and move away from shore making them more difficult to catch (Karchesky 2002).

Anglers reported releasing between 57 and 74% of the tagged largemouth bass caught. When we examined the percentage of bass anglers reported releasing in relation to the monetary value of the tag inserted in the fish; a positive trend was evident. In other words, the more the tag was worth - the more often an angler reported releasing the fish (Table 13). This suggests to us that anglers were less likely to go to the effort of reporting lower value tags on fish they released. This information suggests that the actual percent of largemouth bass > 300 mm that anglers caught and released in the Pend Oreille River was probably closer to 70%. If it were not for these high release rates, anglers could easily crop off the larger fish.

After considering angler reporting rates, fish mortality, and tag loss; the annual exploitation of largemouth bass in the Pend Oreille River was estimated to be 30%. Determining impact of a 30% annual exploitation rate on largemouth bass population size structure is not straight forward. Work by Rieman (1987) on northern Idaho lakes found fishing does have a direct effect on total annual mortality (natural and fishing mortality combined) of largemouth bass and will reduce the average size of fish in a system. The difficult part of assessing the impact is determining how angler exploitation will influence total mortality. Rieman (1987) found that increases in exploitation do not result in a strictly additive response to total mortality. One explanation is a portion of the fish that are killed by anglers over a year period would have died from natural causes if not killed by anglers (Ricker 1975).

Based on a relationship developed by Rieman (1987) from seven lakes in northern Idaho, when exploitation of largemouth is approximately 30% we could expect total mortality to be about 50%. This mortality rate is considerably higher than what Bassista et al. (In Press) found (34% total mortality) for largemouth bass in the Pend Oreille River. Strong and weak year classes produced by different drawdown scenarios and weather patterns make this estimate questionable. If we leave out two weak year classes (age-5 and age-6) from this analysis, the regression line of the catch-curve becomes much tighter (R^2 = 0.92 vs 0.73) and the total annual mortality rate becomes 38%. In addition, when we apply length at age data developed by Bassista et al. (In Press) to the fish we caught and tagged, we calculated a total annual mortality rate of 40% (R^2 = .92) for fish age-5 to age-15. The combination of this data suggests total annual mortality for largemouth bass (age-5 to age-15) was around 38 to 40%. If we look at how annual mortality has changed over the years (68% in 1992 – Bennett and DuPont 1993; 45% in 2000 - Karchesky 2002; 38% in 2005 - Bassista et al. In Press), it corresponds with changes in winter drawdown of water elevations; which we believe resulted in improved survival. This information suggests the modified 2005 estimate of 38% total annual mortality is relatively accurate. This annual mortality rate is still 12% lower than we predicted using our exploitation estimate and Rieman's (1987) correction for natural mortality.

We believe that this discrepancy is because the 30% annual exploitation rate on largemouth bass is a recent development on the Pend Oreille River and is just beginning to influence this fishery. Fishing pressure on largemouth bass has increased in recent years on the Pend Oreille River as the fishery has improved. Bass tournaments occur throughout the spring, summer and fall and local anglers now regularly target the river for bass. This is especially true during the spring when largemouth bass are concentrated near shore. Once anglers develop a search image for where to locate largemouth bass, fishing can be outstanding. Fishing pressure will likely continue to increase as the word spreads on the quality of this fishery. In addition, if the predominately catch-and-release attitude changes we could expect exploitation to increase significantly.

Work by Bassista et al. (In Press) on the Pend Oreille River in 2005 found the proportional stock structure of largemouth bass (PSd_Q = 37, RSD-P = 22, RSD-M = 1) in the Pend Oreille River is indicative of a balanced fish population (Anderson and Neumann 1996) with an abundance of larger fish present in the population. Our tagging efforts support this finding as 63% of the fish we tagged were > 350 mm and 32% were > 400 mm. If we assume that total annual mortality is around 50% (30% exploitation plus 20% natural mortality) we can expect to see the size structure of the largemouth bass population to change. This is especially true due to the slow growth rate of these fish. Bassista et al. (In Press) found that it takes 5 years for largemouth bass in the Pend Oreille River to reach 300 mm, 7 years to reach 400 mm, and 12 years to reach 500 mm. Based on the size distribution of bass we tagged (all fish were > 300 mm) 28.0% were > 415 mm, 16.6% were > 455 mm and 2.3% were > 500 mm, whereas with a 50% total annual mortality rate 25.0% would make it to 415 mm, 6.3% to 455 mm and 0.8% to 500 mm (Table 14).

Increased mortality will not cause the largemouth bass population to crash, but it will result in fewer large fish being caught. Rieman (1987) stated that exploitation rates of 15-30% provide quality fisheries whereas rates > 40% would result in overexploitation and the cropping of larger sized fish. Exploitation rates can be reduced through changes in the fishing regulations including length restrictions, limit restrictions, seasonal closures, and area closures. Because this is more of a social issue it lies largely in the hands of anglers to decide what they want as an end product and what type of restrictions they are willing to accept.

Size restrictions have proven to be effective at changing catch rates and the size structure of largemouth bass (Ming and McDannold 1975; Anderson 1980; Eder 1984; Novinger 1984; Davis et al. 1997; Wilde 1997). However, Wilde (1997) cautions that minimum size limits on largemouth bass often do not result in an increase in larger sized fish, although they will increase catch rates of smaller fish. Anderson (1980) and Noveinger (1984) found that minimum size limits were most effective in water bodies with low recruitment, fast growth and high mortality rates. Most of the research that Wilde (1997) evaluated occurred in the central and south-eastern United States where recruitment and fishing pressure is high. Often fishing pressure is so high that even with size restrictions fish are immediately cropped off when they reach a legal size (Ming and McDannold 1975). These waters also tend to have high recruitment and stunting will occur due to forage competition if younger fish are not significantly reduced (Ming and McDannold 1975). Wilde (1997) indicates that the best way to restructure year classes of largemouth bass is through the use of slot limits. This allows anglers to thin numbers of smaller fish which improves growth rates and it protects larger fish through the designated slot. Wilde (1997) cautions that although slot limits can be effective at restructuring sizes it usually will not increase catch rates. The Pend Oreille is different than most waters where Wilde (1997) conducted his research. Recruitment of largemouth bass is inconsistent as weak or almost non-existing year classes occur (Karchesky 2002; Bassista et al. In Press). In northern waters, potentially strong spawning recruitment can be followed by extremely high winter mortality resulting in weak year classes (Sheehan et al. 1990; Liter 1991; Pitlo 1992; DuPont 1994; Karchesky 2002). Exploitation in northern Idaho is also not so high that fish would be immediately cropped-off once they reached legal size. In other lakes in northern Idaho, minimum size limits have shown to increase the number of big fish although catch rates were lower than lakes with less restrictive regulations (Davis et al. 1997). Growth of largemouth bass in the Pend Oreille River has slowed from 1992 to 2006 as their abundance has increased (Bennett and DuPont 1993; Bassista et al. In Press); however, a 12 inch (305 mm) minimum size length has been in effect since 1984 and there is no indication that stunting of smaller fish is or has ever been an issue in the Pend Oreille River (Bennett and DuPont 1993; Bassista et al. In Press) or other north Idaho Lakes (Davis et al. 1997).

Because all sizes of largemouth bass (> 300 mm) in the Pend Oreille River appear equally vulnerable to exploitation, if larger size restrictions were put in place, once these fish reached a legal size we would anticipate their exploitation to increase as anglers would have to release smaller fish until they caught one of legal size. Currently, anglers who harvest fish do not appear to be size selective. If exploitation of larger fish increased high enough, cropping of larger fish could occur. In other words, we would see more fish up to that legal size and then their abundance would quickly drop as size increased. To help reduce this kind of effect, size restrictions could be combined with a reduced bag limit. For example most quality bass regulations in Idaho have a slot limit (none between 12 and 16 inches) accompanied with a two fish bag limit.

Reducing the bag limit would only decrease exploitation if anglers catch more fish than the proposed limit. We don't have creel data on the Pend Oreille River to indicate how many largemouth bass people catch and keep in a day. Upon talking to anglers who kept tagged bass on the Pend Oreille River, most appeared to keep at least two to three fish per outing with most being less than 400 mm. However, this data is very limiting. Based on a creel survey in Lake Pend Oreille, most anglers who harvest bass don't keep more than one fish per day (Chris Downs, IDFG, personal communication). Based on these limited data, a daily limit of two bass would not likely reduce exploitation of larger fish, but it would prevent excessive harvest and cropping of larger fish.

According to Rieman (1987) "the easiest way to decrease exploitation is to reduce fishing pressure." Seasonal closures are an easy way to reduce fishing pressure. In the past we have employed July 1 openers in some water bodies where anglers indicated they wanted to see more large bass. Rationale was, this would reduce harvest of fish during the spawning season when bass are most vulnerable. Data showed that 82% of the tagged largemouth bass were caught and harvested before July 1. This is not surprising as largemouth bass in the Pend Oreille River move into shallow water where warmer water temperatures occur in early spring and remain there until spawning is over (Bennett and DuPont 1993; Karchesky 2002). After spawning, these fish spread throughout the Pend Oreille River and become much more difficult to catch, especially for shore anglers. Clearly a July 1 opener would reduce exploitation of largemouth bass on the Pend Oreille River, but it would result in loss of harvest opportunities for shoreline anglers and influence bass tournaments.

Area closures could also reduce fishing pressure. Tag return data showed there were four areas where 81% of the tagged largemouth bass were caught on the Pend Oreille River. Having a July 1 opener in these areas would reduce harvest; however, area closures can be difficult to understand and enforce and complicates regulations. The four areas where most of the harvest occurs were some of the more popular spots for shoreline anglers, which would again result in loss of most harvest opportunity for shoreline anglers.

Based on bass angler input from the Pend Oreille River, there are three vocal user-groups that have expressed concerns about any changes in fishing regulations. These include: 1) harvest oriented shoreline anglers who mostly fish during the spring; 2) trophy fishermen who fish year-round, target larger fish and tend to be catch-and-release oriented; 3) tournament anglers who fish year-round, prefer larger fish and practice mostly catch-and-release except during tournaments when they want to keep five fish in their live well. We believe several alternatives are available that will maintain the size structure of larger bass in the Pend Oreille River including: size restrictions (slot or increase minimum size); reduced limits; and season closures. A season closure would exclude shoreline anglers and bass tournaments in the spring; whereas size and bag limits would restrict all harvest oriented anglers and the number and size of fish tournament anglers could keep in their live wells.

Smallmouth Bass

We tagged 55 smallmouth bass in the Pend Oreille River and based on the number of fish reported as being harvested, angler compliance, tag loss, and fish mortality we calculated a total exploitation rate of 15%. This is a relatively low exploitation rate indicating angler harvest would currently have a minimal impact on the smallmouth bass fishery (Rieman 1987). In addition, all smallmouth bass caught were less than 380 mm, indicating anglers are not effective at capturing larger fish. This is likely a result of differences in habitat use as smallmouth bass increase in size. Rankin (1986) found larger smallmouth bass preferred deeper water in the Flathead River. Telemetry work on Noxon Reservoir found that smallmouth bass > 350 mm would often use depths in excess of 7 m (Avista 1999). Anglers who are successful at catching large (> 400 mm) smallmouth bass, following spawning, consistently fish water deeper than 8 m (Pete Rust, IDFG, personal communication). Deep water is typically more difficult to fish for many reasons including an inability to see the fish or cover they are using and difficulties in detecting a bite. The difficulty of catching larger smallmouth bass suggests that once these fish exceed 400 mm in length, population size is driven by natural mortality.

Bassista et al. (in press) calculated the total annual mortality rate of smallmouth bass to be 69%. This is a very high mortality rate - which is expected when you have a rapidly expanding population of fish. In 2000, smallmouth bass represented about 0.5% of the fish in the Pend Oreille River (Karchesky 2002) and by 2005 they represented 7% of the catch (Bassista et al. In Press). Bassista et al. (in press) did not sample any smallmouth bass over seven-years old and over 85% of the fish were 3-years old or younger. As this population continues to expand, the abundance of larger fish should increase considerably.

Changes in the regulation are currently not needed to protect the size structure of smallmouth bass in the Pend Oreille River. In fact, we believe, regardless of the regulations, the abundance of larger (>400 mm) smallmouth bass will continue to increase into the near future.

MANAGEMENT RECOMMENDATIONS

1. Use angler's opinions to further evaluate fishing regulations that will decrease harvest and maintain the current size structure of largemouth bass in the Pend Oreille River.

2. Changes in the fishing regulations are not needed to protect the size structure of smallmouth bass in the Pend Oreille River.

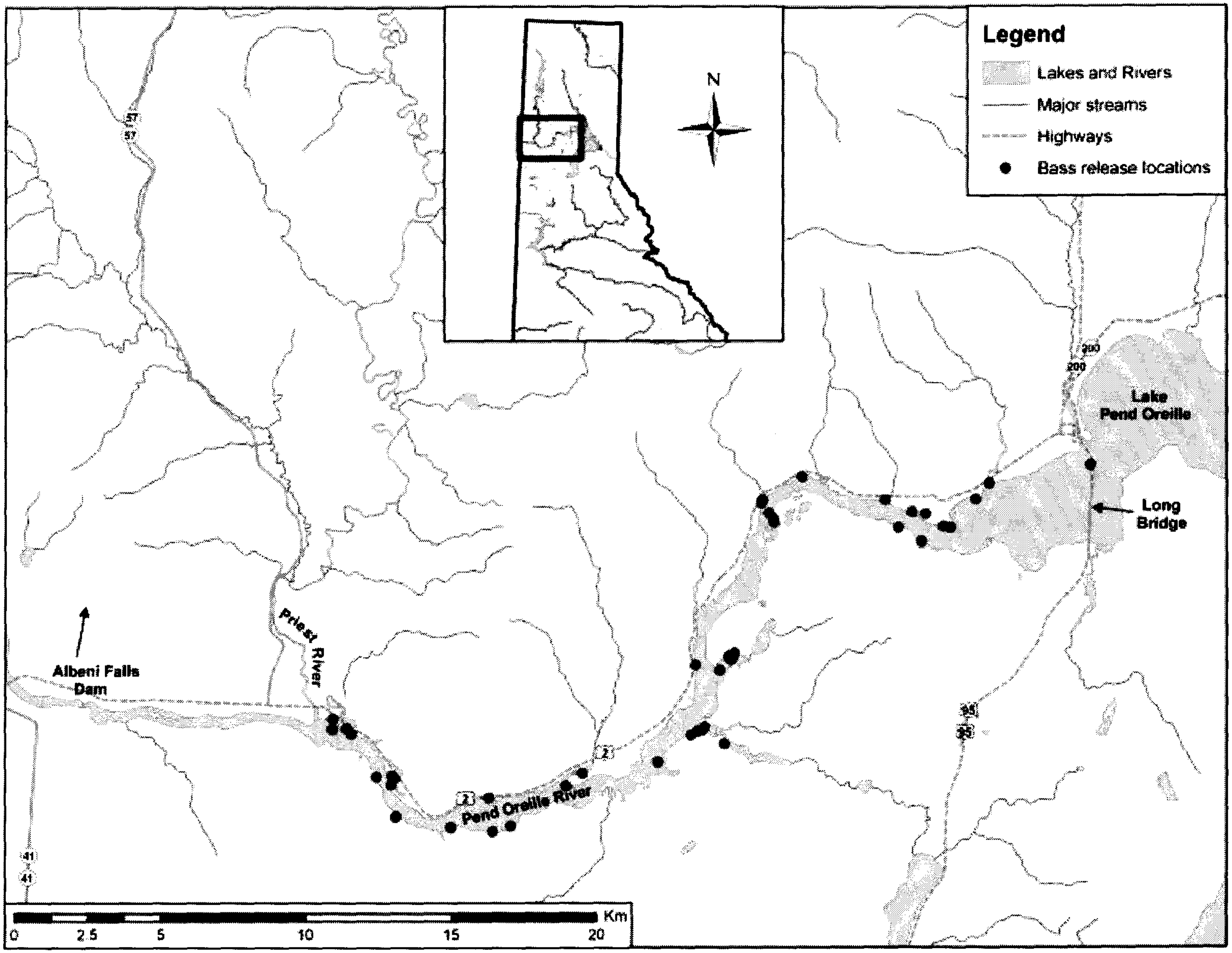

Figure 6. Release locations of 495 tagged bass on the Pend Oreille River, Idaho, during April and May, 2006.

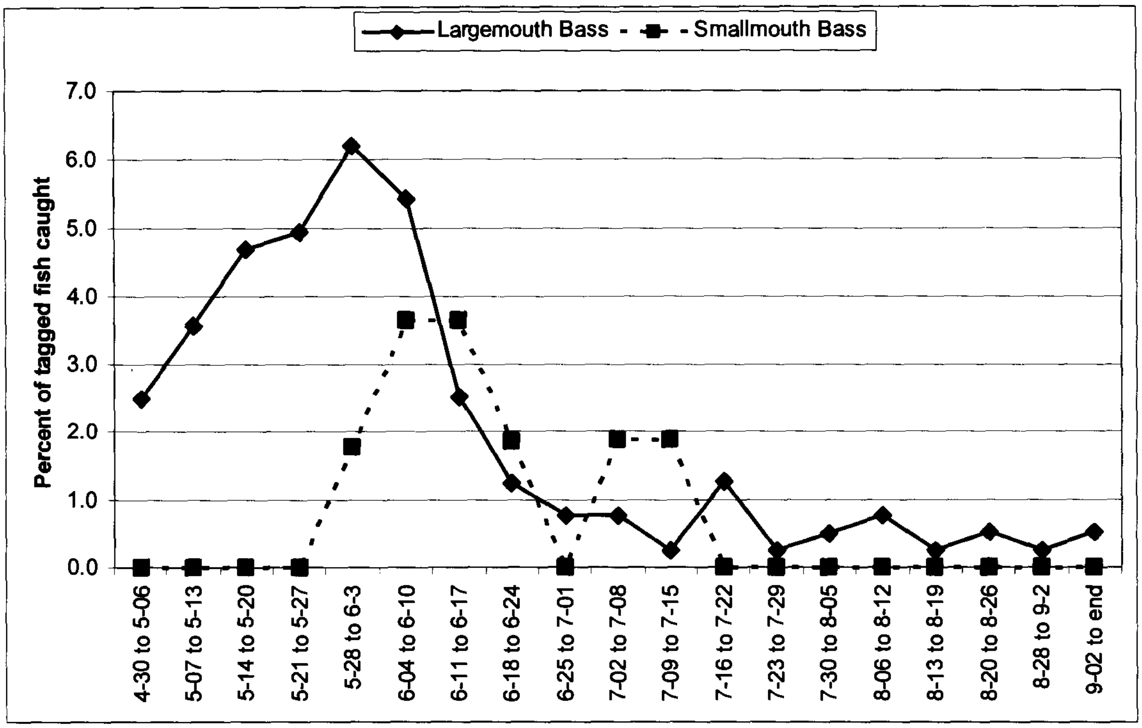

Figure 7. The weekly percentage of tagged largemouth bass and smallmouth bass that were caught on the Pend Oreille River, Idaho, from April 30, 2006 to May 17, 2007.

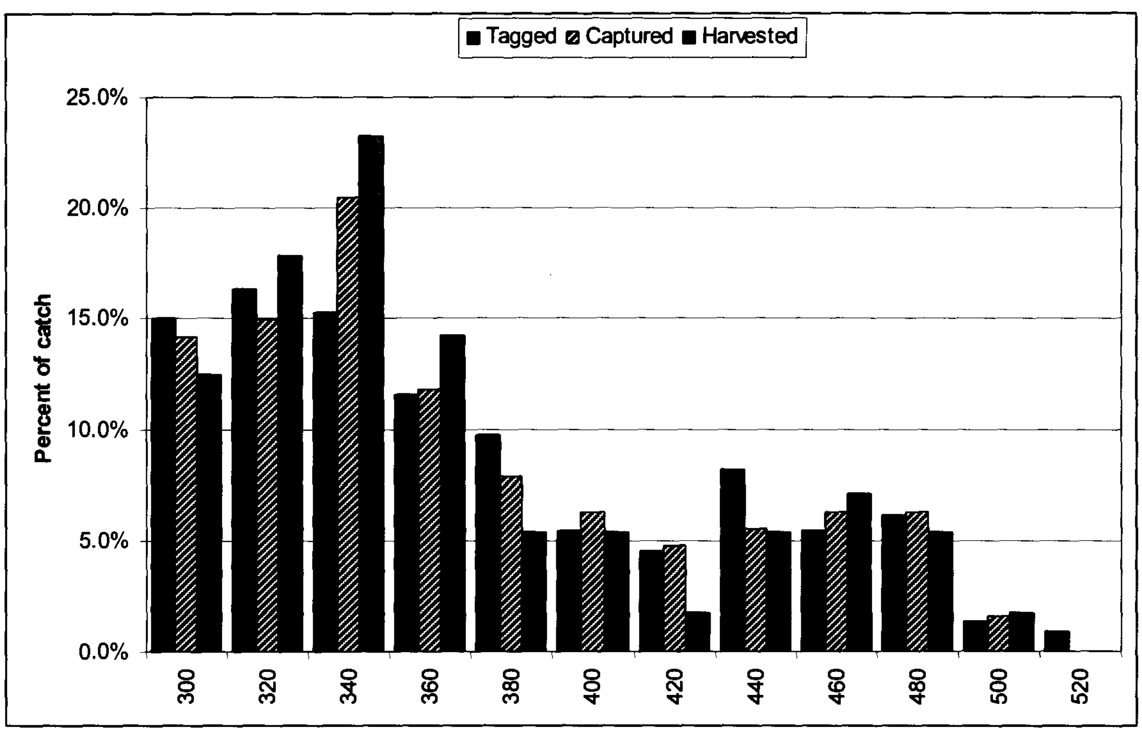

Figure 8. The comparison of length frequencies of largemouth bass from the Pend Oreille River, Idaho, that were tagged to those caught, and harvested by anglers.

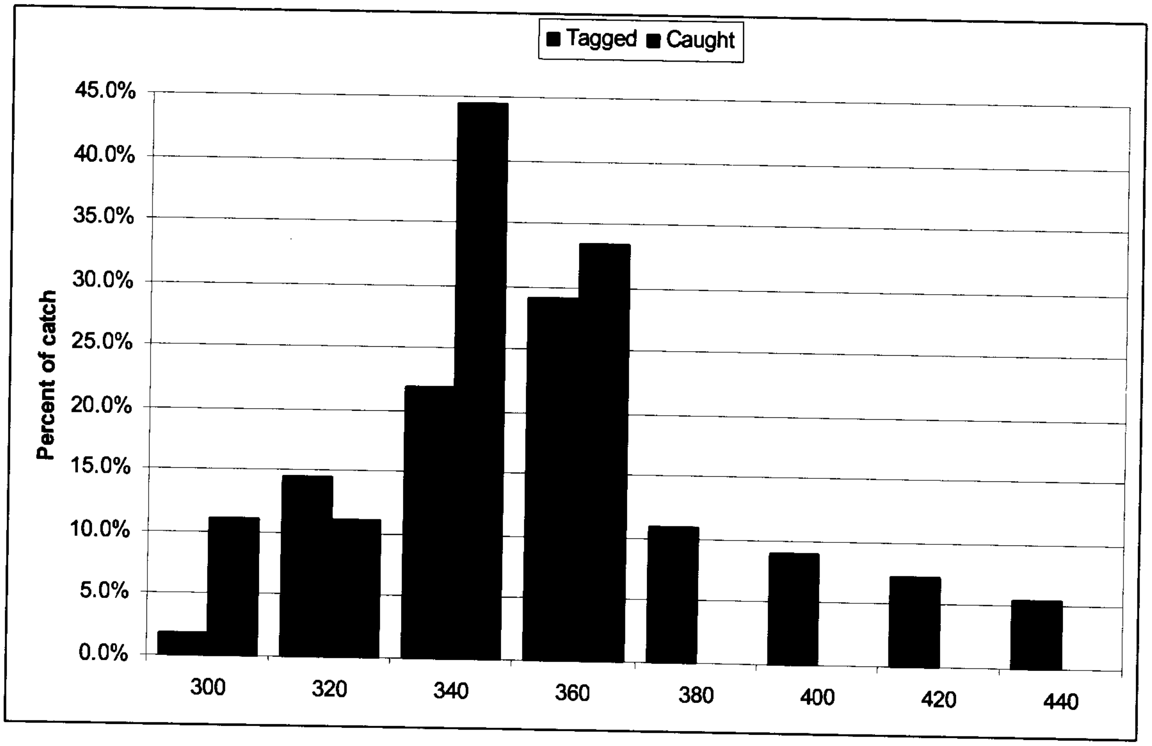

Figure 9. The comparison of length frequencies of smallmouth bass from the Pend Oreille River, Idaho, that were tagged to those caught by anglers.

Table 7. Number of largemouth bass and smallmouth bass Floy tagged from the Pend Oreille River, Idaho, between April 26 and May 17, 2006.

Reward value	**Largemouth**	**Smallmouth**	**Total tagged**
0	333	37	370
$10	37	5	42
$50	37	5	42
$100	17	3	20
$200	16	5	21
All tags	440	55	495

Table 8. Number of largemouth bass (LMB) and smallmouth bass (SMB) that were tagged with reward tags on the Pend Oreille River, Idaho, between April 26 and May 17, 2006 that anglers reported harvesting or catching and releasing through May 9, 2007.

	Harvested						Caught and released					
Species	$0	$10	$50	$100	$200	Total	$0	$10	$50	$100	$200	Total
LMB	38	6	7	2	3	56	36	9	12	7	7	71
SMB	2	1	0	1	0	4	2	0	1	1	0	4

Table 9. Angler compliance rates for largemouth bass and smallmouth bass on the Pend Oreille River, Idaho, based on the number of fish initially tagged (N) and reported as being caught (R), for both high reward ($100 and $200) and non-reward tags.

	High reward			Non-reward			Angler
Species	N	R	%	N	R	%	compliance
Largemouth bass	33	19	0.576	333	74	0.222	0.386
Smallmouth bass	8	2	0.250	37	4	0.108	0.432

Table 10. Catch, release and harvest rates of largemouth bass and smallmouth bass from the Pend Oreille River, between April 26, 2006 and May 17, 2007, based on high reward tags ($100 and $200 tags) and non reward tags and corrected for angler compliance, tag loss and fish mortality.

Fate of	Largemouth bass		Smallmouth bass	
tagged fish	High $	Non-reward	High $	Non-reward
Caught	0.636	0.709	0.276	0.296
Released	0.737	0.568	0.500	0.500
Harvested	0.263	0.432	0.500	0.500

Table 11. Exploitation rates of largemouth bass and smallmouth bass from the Pend Oreille River, Idaho, between April 26, 2006 and May 17, 2007 calculated using the number of non-reward fish that were tagged and harvested by anglers, angler compliance rates, tag loss rates and fish mortality rates reported in the table below.

	Non-reward fish		Angler	Tag loss	Fish	Exploitation	
Species	tagged	harvested	compliance	rate	mortality	Unadjusted	Adjusted
Largemouth bass	333	32	0.386	0.213	0.05	0.096	0.304
Smallmouth bass	37	2	0.432	0.236	0.05	0.054	0.147

Table 12. Number and percent of tagged largemouth bass that were released at various locations in the Pend Oreille River, Idaho, in comparison to the number and percent that were harvested between April 2006 and May 2007.

	Tagged		**Harvested**	
Release locations	**Number**	**Percent**	**Number**	**Percent**
Chuck Slough	16	4	4	7
Cocolalla Slough	76	19	9	16
Dover slough	12	3	1	2
Dover slough 2	4	1	1	2
Gypsy Bay	70	15	13	23
Morton Slough	112	25	20	35
Riley Creek Slough	23	5	3	5
Rocky Point	3	1	1	2
South shore - slough opposite of Dover	5	1	1	2
South shore opposite of Thama	6	4	1	2
Thama Slough 1	53	12	3	5

Table 13. Percent of tagged largemouth bass caught from the Pend Oreille River that was reported as being released in relation to the value of the tag it had attached.

$0	$10	$50	$100	$200
0.57	0.60	0.63	0.78	0.70

Table 14. The actual age and size distribution of largemouth bass tagged in the Pend Oreille River, Idaho, in 2006 compared to what could be expected in the future if total annual mortality remained at 50%.

Age	Size (mm)	Actual	50%
5	> 300	100.0%	100.0%
6	> 360	53.5%	50.0%
7	> 415	28.0%	25.0%
8	> 435	22.8%	12.5%
9	> 455	16.6%	6.3%
10	> 470	10.9%	3.1%
11	> 485	6.2%	1.6%
12	> 500	2.3%	0.8%
13	> 515	0.9%	0.4%
14	> 530	0.5%	0.2%
15	> 540	0.2%	0.1%

UPPER PRIEST LAKE BULL TROUT ENHANCEMENT PROJECT

ABSTRACT

In an effort to reverse the decline of bull trout and westslope cutthroat abundance in Upper Priest Lake, Idaho, gill nets were used from June 15-26th, 2006 to target and reduce the lake trout population. Harbor Fisheries, Inc. of Baileys Harbor, Wisconsin was contracted to gill net and remove lake trout *S. namaycush* from Upper Priest Lake using their 47 foot commercial gill net boat. The 12-day effort, funded by U.S. Fish and Wildlife Service yielded a catch of 723 lake trout, all of which were removed. The average size of lake trout captured was 498.8 mm. We fished a total of 73,609 m of gill net during the 12 day effort with an average of 6,134 m of gill net/day. Catch rates fluctuated during the first half of the effort followed by a precipitous decline during the last five days.

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INTRODUCTION

Introduced lake trout have the tendency to suppress other native and non-native species through predation and or competition (Donald and Alger 1993, Fredenberg 2002). Historically native bull trout provided a trophy fishery in Upper Priest Lake with an annual catch of 1,800 fish in the 1950's (Bjorn 1957). Bull trout harvest was eliminated in 1984, but no positive response in the fishery ensued (Mauser et al. 1988). The bull trout population in Priest Lake is considered functionally extinct while the population in Upper Priest Lake is severely depressed (DuPont et al. In Press).

Native westslope cutthroat trout were also historically abundant in Priest Lakes with 30 fish limits common in the 1940's (Mauser et al 1988). Over harvest, interspecific and intraspecific competition, and degradation of spawning habitat all lead to the decline of cutthroat trout in the Priest Lakes. Harvest of cutthroat was eliminated in 1988.

In Upper Priest Lake the lake trout population appears to have grown rapidly in the past 25 years. Lake trout were not known to be present in Upper Priest Lake until mid-1980s at which time they were thought to have begun migrating from Priest Lake (Mauser 1986). In 1998 the Upper Priest Lake lake trout population was estimated at 859 fish (Fredericks and Vernard 1999). In an effort to reduce threats to dwindling bull trout and cutthroat populations, IDFG has been using gill nets to reduce lake trout abundance in Upper Priest Lake since 1998. Between 150 and 1,100 lake trout have been removed annually from Upper Priest Lake.

METHODS

Harbor Fisheries, Inc. of Baileys Harbor, Wisconsin was contracted to gill net and remove lake trout from Upper Priest Lake in 2006 using their 47 foot commercial gill net boat. Funding for this contract was provided by the U. S. Fish and Wildlife Service. Gill nets used in Upper Priest Lake were 100 m long by 3 m high and were designed with multiple panels of graded mesh sizes ranging from 63.5 mm to 89 mm randomly arranged in each net. Individual gill nets were tied together end to end to create a continuous net ranging from 823 m to 1,646 m. Using a variety of mesh sizes reduces the overall effects of size selectivity and allows us to sample fish as small as 150 mm.

Gill nets were fished from June 15 through June 26, 2006. Nets were set throughout the lake and were moved based on catch rates at a particular site and the discretion of the netting crew. Gill nets were set perpendicular to shore when fishing shoreline areas and at various angles when fishing deeper offshore areas. Nets were set at depths ranging from 10-31 m. A concerted effort was made to avoid incidental bull trout captures by avoiding areas known to hold concentrations of bull trout.

During our removal effort lake trout were measured, examined for tags or clips and killed. All processed lake trout were filleted and given to various food banks throughout the Idaho Panhandle for distribution to the indigent.

RESULTS

During our 12 day effort to suppress lake trout abundance in Upper Priest Lake, we fished a total of 73,609 m of gill net averaging 6,134 m net/day. A total of 723 lake trout were caught and removed. Daily catch of lake trout ranged from 6 to115 fish. Lake trout ranged from 122-880 mm with a mean of 498.8 mm total length (Figure 10). A total of 21 bull trout were captured, with 17 released alive and 4 incidental mortalities. Bull trout ranged from 405-770 mm with a mean length of 604 mm. Catch rates of lake trout peaked in the middle of our 12 day effort followed by a precipitous decline during the last five days. The decline in catch after June 22 was due to a declining lake trout population (Figure 11).

DISCUSSION

We have known for years that Upper Priest Lake cannot be treated as a closed system and until lake trout immigration from Priest Lake is minimized our removal efforts are a temporary fix. Idaho Department of Fish and Game is currently working with various other agencies to investigate methods to prevent the upstream migration of lake trout from Priest Lake to Upper Priest Lake.

MANAGEMENT RECOMMENDATIONS

1. Duplicate 2006 lake trout removal efforts with the same contractor, Harbor Fisheries (Bailey's Harbor, Wisconsin), in 2007.

2. Conduct a lake trout population abundance estimate. Duplicating our 2006 effort in 2007 should enable us to estimate how many lake trout are immigrating into Upper Priest Lake on yearly basis.

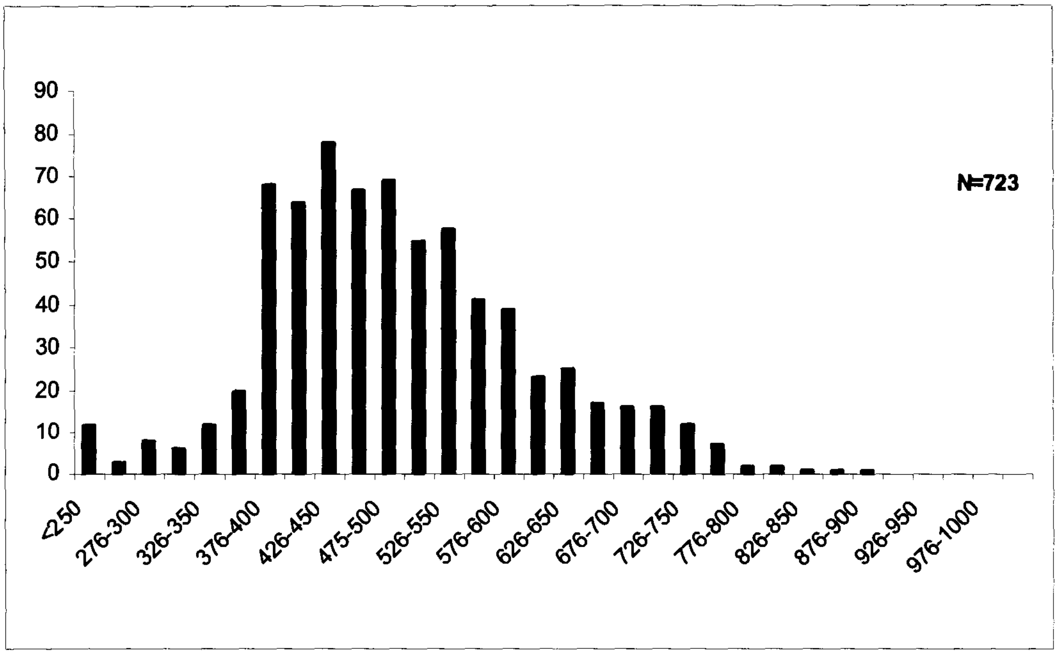

Figure 10. Length frequency of lake trout caught in gill nets in Upper Priest Lake, Idaho from June 15 through June 26, 2006.

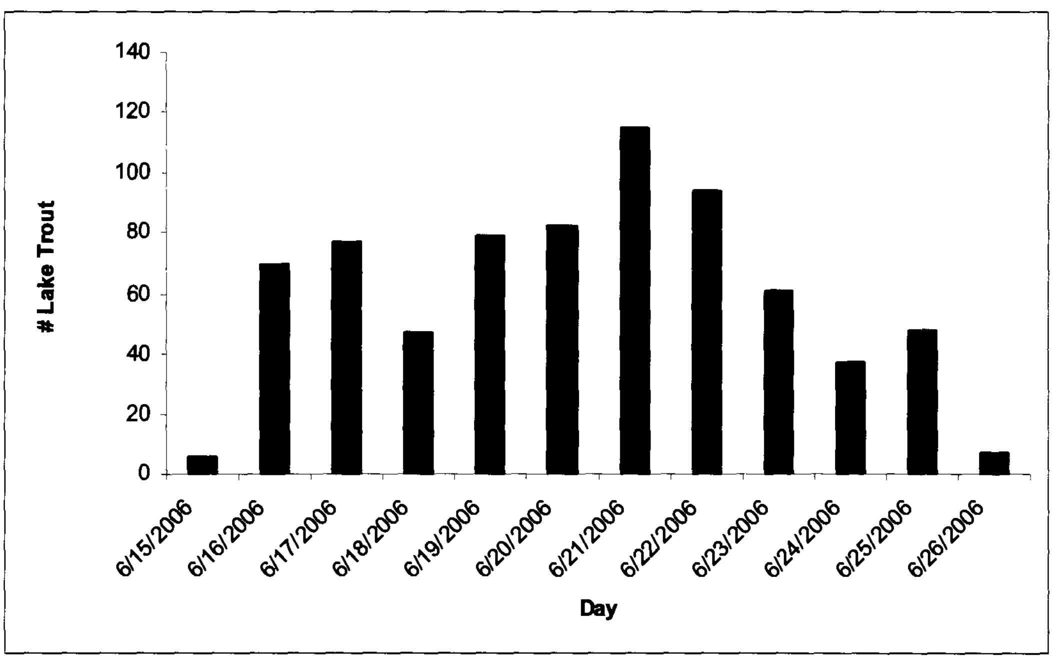

Figure 11. Catch rate of lake trout caught per day by gill nets in Upper Priest Lake, Idaho from June 15 through June 26, 2006. Nets set per day remained relatively constant.

Panhandle Region 2006 Fishery Management Report

BULL TROUT REDD COUNTS

ABSTRACT

We conducted bull trout redd counts in tributaries of Priest River, Pend Oreille Lake, Kootenai River, St. Joe River, and Little North Fork of the Clearwater River in September and October 2006 to add to the long-term trend data set. These counts were used to estimate spawning run size, help with management strategies, assess restoration activities and evaluate whether federal recovery goals were met in each of the core areas that occur in the IDFG Panhandle Region.

We counted 29 redds in the Upper Priest Lake basin, 1,256 bull trout redds in the Pend Oreille Lake and Priest River drainage, 33 redds in the Kootenai River drainage, 83 redds in the St. Joe River drainage, and 115 redds in the Little North Fork of the Clearwater River drainage. Improving trends in bull trout redd abundance was apparent for the Pend Oreille Lake, Little North Fork Clearwater River and St. Joe River basins whereas a decline in redd numbers was apparent in the Priest Lake basin. Redds have only been counted for five years in Idaho tributaries of the Kootenai River.

Five federally designated Bull Trout Recovery Core areas occur in the IDFG Panhandle. These are the Priest Lake, Pend Oreille Lake, Kootenai River, Coeur d'Alene Lake and North Fork Clearwater River core areas. Four recovery goals must be met in each of the core areas before bull trout can be considered as "recovered." Currently, all four of the recovery goals are being met in only the Pend Oreille Lake core area. The Kootenai River core area may also reach all of its recovery goals once higher flows return to the basin. The Priest Lake and Coeur d'Alene Lake core areas are far from meeting all of their recovery goals and considerable progress must occur before these bull trout populations can be considered as recovered.

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INTRODUCTION

Bull trout within the Klamath and Columbia River basins were listed as threatened on June 10,1998 under the federal Endangered Species Act. As a result of this listing, recovery plans for bull trout in specific geographic areas (recovery units) were developed by experts in the field (USFWS 2002). Each recovery unit is separated into core areas (river or lake basins) and for each core area it describes conditions, defines recovery criteria, and identifies specific recovery actions for bull trout. The IDFG Panhandle Region encompasses part or all of the following recovery units: Clark Fork River, Kootenai River, Coeur d'Alene Lake Basin, and Clearwater River. Core areas of these recovery units that occur in the Panhandle Region are Priest Lake, Pend Oreille Lake, Kootenai River, Coeur d'Alene Lake, and the North Fork Clearwater River (USFWS 2002).

The overall goal of the Bull Trout Draft Recovery Plan is to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range so that the species can be delisted (USFWS 2002). To accomplish this goal, the following recovery criteria addressing distribution, abundance, habitat and connectivity were identified.

1. Maintain the current distribution of bull trout and restore their distribution in previously occupied areas.
2. Maintain stable or increasing trends in abundance of bull trout.
3. Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.
4. Conserve genetic diversity and provide opportunity for genetic exchange.

For core areas that occur within or overlap into the Panhandle Region, the distribution and abundance recovery criteria will be met when the total number of stable local populations and the total number of adult bull trout have reached the levels indicated in Table 15.

Trend recovery criteria will be met when the overall bull trout populations in specified core areas are accepted, under contemporary standards of the time, to be stable or increasing, based on at least 10 years of monitoring data.

Connectivity criteria will be met when migratory forms are present in all local populations and when intact migratory corridors among all local populations in the core area provide opportunity for genetic exchange and diversity.

Bull trout have been found to have a strong fidelity to their natal streams (Spruell et al. 1999). Typically, redds are relatively easy to count (Pratt 1984) and can be a measure of the number of reproductive adults. These attributes make redd counts an appropriate technique for evaluating trends in adult bull trout population strength. In addition, redd counts are relatively quick and inexpensive to conduct when compared to other techniques such as weiring, netting, or electroshocking. For these reasons, the status of bull trout populations in each of the core areas will be evaluated through redd counts. Bull trout redds are being counted in each of the core areas in the IDFG Panhandle Region. These counts will not only allow us to evaluate the status of bull trout in each of the core areas as it pertains to recovery, but it will also help guide future management decisions and assess the success of recovery actions.

STUDY SITES

Bull trout redds were counted in tributaries of the Priest River, Pend Oreille Lake, Kootenai River, St. Joe River, and Little North Fork Clearwater River drainages where bull trout are believed to spawn (Figures 12-17). These watersheds make up all or part of five different core areas that occur in the IDFG Panhandle Region (USFWS 2002). These core areas are Priest Lake, Pend Oreille Lake, Kootenai River, Coeur d'Alene Lake and North Fork Clearwater River. The boundary of the Kootenai River and North Fork Clearwater River core areas extend outside of the Panhandle Region. 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.

OBJECTIVES

1. Quantify bull trout redds and spawning escapement in Priest Lake, Pend Oreille Lake, Kootenai River, Coeur d'Alene Lake and North Fork Clearwater River core areas.

2. Assess whether bull trout abundance in each of the core areas meets recovery criteria outlined in the federal Bull Trout Draft Recovery Plan.

3. Explore new streams to determine if bull trout spawning is occurring in undocumented locations.

METHODS

Bull Trout Spawning Surveys

Bull trout redds were counted in selected tributaries of the Priest Lake, Priest River, Pend Oreille Lake, Kootenai River, St. Joe River, and Little North Fork of the Clearwater River basins where bull trout were known or believed to occur. Counts in each of these basins were summarized in the core area they occurred in. Redd counts in the Middle Fork East River, North Fork East River and Uleda Creek (tributaries of Priest River) were added to the Pend Oreille Lake core area in 2003 when these bull trout were documented to spend their adult life in Pend Oreille Lake (DuPont et al. In Press b). All redds were counted at similar times (September and October) as had occurred in the past (DuPont et al., in press c). Survey techniques and identification of bull trout redds followed the 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). To reduce observer variability in bull trout redd counts, attempts were made to use only those individuals who attended a bull trout redd count training exercise on September 20, 2005. To add to our knowledge on preferred bull trout spawning areas and to help evaluate recovery efforts, the location of redds were recorded on maps and/or GPS units during redd counts. Sections of the Kootenai River and North Fork Clearwater core areas occurred outside the Panhandle Region. Redd count data for these areas were collected from non-Panhandle Region personnel responsible for conducting these surveys.

To help assess potential limiting factors, any man-made fish passage barriers noticed during the redd counts were documented. We also attempted to ascertain who the responsible parties were for the documented barriers.

Data Analysis

To estimate spawning escapement or population abundance (depending on recovery area) of bull trout in streams, we used Downs and Jakubowski (2006) findings where on average, 3.2 adult bull trout entered tributaries of Lake Pend Oreille for every redd that was counted during annual redd count surveys. We decided to use this adult to redd ratio because this estimation came from one of the core areas in the Panhandle Region and because it is the same as Fraley and Shepherd (1998) found in the Flathead Lake system. Baxter and Westover (1999) and Downs and Jakubowski (2003) found that repeat spawning is common for adfluvial bull trout where 90-100% of the surviving bull trout spawned in consecutive years. For this reason we decided to use the total spawning escapement calculated from redd counts from the Priest, Pend Oreille and Coeur d'Alene Lake core areas as an estimate for the total number of adults that occurred there. We recognize this will give us a conservative estimate, as bull trout in every tributary in the Panhandle do not spawn every year (DuPont et al., in press b). The one exception to this is for the Little North Fork Clearwater, where research by Schriever and Schiff (2002) found that anywhere from 50-75% of the adult bull trout return to spawning grounds in consecutive years. Consequently, for the Little North Fork Clearwater we multiplied the spawning escapement by 1.33 (75% repeat spawners) to estimate how many adults occurred in the core area. The total number of adult bull trout associated with each tributary and each core area was compared to the criteria specified in the Bull Trout Draft Recovery Plan to determine the status of different bull trout populations.

To evaluate whether the numbers of adult bull trout in each core area were stable or increasing, we used a linear regression with sample year as the independent variable and the number of redds as the dependent variable. Other studies have used regressions to evaluate whether bull trout populations were stable or increasing; however in each of these cases they either used non-parametric techniques (Rieman and Myers 1997) or converted the redd counts using a $\log_e$ transformation (Maxell 1999). We decided not to convert the data or use non-parametric techniques because we believe it is easier for most individuals to visualize trends and understand how bull trout abundance is changing if the actual redd count data are used (no transformation or ranking of the data). Over time, if it seems other techniques are better suited to evaluate whether bull trout populations are stable or increasing, we are not opposed to changing our form of analysis.

For a simple linear regression, if the slope of the regression line is greater than or equal to zero and 10 or more years of redd count data exists, then a bull trout population can be considered as stable or increasing. A significant ($P < 0.10$) slope of the regression line is preferred before one determines that a particular population is stable or increasing; however, a statistically significant relationship is not necessary to come up with this conclusion. As the abundance of individuals in a population reaches its carrying capacity and/or stabilizes (slope of regression line near zero), it is impossible for a significant relationship to occur. When a statistically significant relationship ($P < 0.10$) does not occur, interpretation and professional judgment must be used to determine if the amount of variation seen around a regression line is too great for a particular population to be considered stable or increasing.

RESULTS

Priest Lake Core Area

A total of 29 bull trout redds were counted in the Upper Priest River basin on October 4, 2006 (Figure 12 and Table 16). The majority of these redds were counted in Upper Priest River (26 out of 29). The North Fork Indian Creek, a tributary of Priest Lake was also surveyed, and no bull trout redds were observed. Brook trout *S. fontinalis* redds have been observed in many of the same streams. For this reason, any redds smaller than 350 mm in diameter were not included in the bull trout redd counts. The number of redds counted in 2006 was the same as was observed in 2005, but was over 13 times lower than what was counted in 1985 when similar reaches were compared (Figure 18 and Table 16). Expanding the number of redds observed by 3.2 fish/redd, the spawning escapement of bull trout for the Upper Priest Lake basin is estimated to be 93 fish. This is considerably lower than the recovery goal of 1,000 adults for the Priest Lake Basin (Table 14). A downward trend is evident in the abundance of bull trout in the Priest Lake core area, especially if one evaluates redds counted during 1985 and 1986 (Figure 18 and Table 18).

One man-made barrier was noted during our survey that we believe blocks upstream migration of bull trout. This barrier is a U.S. Forest Service culvert located where F.S. road 1013 crosses Gold Creek 501,277.23 m E; 5,405,797.18 m N. (T63N, R5W, section 17).

Pend Oreille Lake Core Area

A total of 1,256 bull trout redds were counted in the Pend Oreille Lake core area during October 9-17, 2006, of which 794 (63%) were in the six index streams (Trestle, East Fork Lightning, Gold, North Gold, Johnson, and Grouse creeks) (Figure 13 and 14, and Table 19). This is the highest number of redds observed (316 more than the previous high) since these counts began in 1983. Despite these high counts, the percentage of redds observed in the six index streams (63%) is the third lowest ever recorded. This is not a reflection of low counts in the index streams, rather the information is skewed by increasing numbers of redds observed in other streams. After two relatively low counts in Trestle Creek in 2004 and 2005, a record high count (395, 31% of observed redds) was documented in 2006. Record high redd counts were also observed in five other streams including Wellington Creek, Twin Creek, Granite Creek, Gold Creek and Middle Fork East River (Table 19). Expanding the number of redds observed by 3.2 fish/redd, the spawning escapement of bull trout for Pend Oreille Lake core area is estimated to be 4,038 fish (this includes 19 fish passed upstream of Cabinet Gorge Dam) (Table 20). This exceeds the recovery goal of 2,500 adults for the Pend Oreille Lake Core area (Table 15 and 17). Seven tributaries in the Pend Oreille Basin had an estimated spawning escapement of 100 adults or at least 32 redds were counted, and four other tributaries had spawning escapements of between 90 and 100 adults (Table 19 and 20). The recovery goal states at least six populations with over 100 adults must occur in the Pend Oreille Lake Core area (Table 15 and 17).

When the redd counts were analyzed from 1983 to 2006 (1986, 1988-91 and 1995 were not evaluated) the linear regression showed a positive slope of 4.1 redds/year (Figure 19 and Table 18) although this regression was not significant ($P = 0.241$). However, if we only evaluate that data from 1992 to 2006 (1995 was not evaluated) a significant ($P < 0.001$) positive trend was calculated (36.9 redds/year).

Besides the dams located on the Pend Oreille River (Albeni Falls Dam) and Clark Fork River (Cabinet Gorge Dam, Noxon Rapids Dam and Thompson Falls Dam), several other man-made migration barriers to bull trout were know to occur in the Pend Oreille Lake core area. This includes the city water diversion on Strong Creek and the hatchery and city water diversion on Spring Creek. Currently, spawning and rearing bull trout populations are not known to occur in Strong Creek and Spring Creek. A barrier (old log crossing) on Uleda Creek (tributary to the Middle Fork East River), which was a total block to upstream movement to bull trout, was blasted out in 2004 by the Idaho Department of Lands (funding was provided by the U.S. Fish and Wildlife Service). Removal of this barrier more than tripled the amount of spawning and rearing habitat in Uleda Creek. Four bull trout redds were counted upstream of this barrier in 2004, although none were located upstream of it in 2005 or 2006.

In addition to these man-made barriers, excessive bedload deposition has caused channel intermittency on lower Lightning Creek, Rattle Creek, Savage Creek, East Fork Lightning Creek and Granite Creek. We recognize bedload deposition is a natural process; however, we believe poor past timber management and poor road construction and maintenance practices have attributed to an increase in the amount of bedload deposition. This in turn is believed to increase the length and duration of the channel intermittency in these streams. Each of these streams support spawning and rearing bull trout populations and in the past over 100 adults historically ascended them. Work occurred on Granite Creek in 2005 and 2006 to eliminate the intermittent stream reach.

In 2006, all four recovery goals were being met in the Pend Oreille Lake core area for the second straight year. This includes an adult bull trout population of over 2,500 fish (4,054 in 2006), six local populations with over 100 adults (7 in 2006), a stable or increasing population (increasingly significantly in 2006) and efforts were being made to maintain the current distribution of bull trout and restore their distribution in previously occupied areas.

Three different groupings of streams (all streams, index streams and Lightning Creek tributaries) were evaluated separately to help determine why we were seeing improvements in the abundance of bull trout between 1992 and 2006. All three showed increasing trends in redd counts since 1992, although the slope for all three was different (Table 18). When evaluating all streams combined (22 streams) there has been on average an increase of about 36.9 redds/year (slope). This averaged out to an increase of 1.7 redds/stream every year. The slope for the six index streams was about 17.0 redds/year, which equates to an increase of 2.8 redds/stream each year. When evaluating only the Lightning Creek tributaries (7 streams) there has been an average increase of 6.9 redds/year and an annual average increase of 1.0 redds/stream.

Kootenai River Core Area

Three tributaries (North Callahan, South Callahan and Boulder creeks) were surveyed on October 5 and 10, 2006 for bull trout redds in the Idaho portion of the Kootenai River core area and a total of 33 redds were counted (Figure 15 and Table 21). This was only the fifth year redds were counted in all three tributaries. The 33 redds counted during 2006 were the second highest total over a five year period. Expanding the number of redds observed by 3.2 fish/redd, the spawning escapement of bull trout for the Idaho portion of the Kootenai River core area in 2006 was estimated to be 106 fish.

Given only five years of redd count data exists for the three Kootenai River tributaries in Idaho, trend analysis would be unreliable. The current five year trend is positive, increasing at a rate of 0.9 redds per year (slope), although this trend is not significant (Table 18 and Figure 20).

Within the Montana portion of the Kootenai River core area, 140 redds were counted during 2006 (Table 21). This converts (3.2 fish/redd) to an estimated spawning escapement to 448 fish. When combined with the Idaho spawning escapement (106 fish), the total spawning escapement for the Kootenai River core area equals 554 fish. No corrections were made for fish that do not spawn every year to come up with the total number of adult fish that occur in the core area. As a result, the estimated spawning escapement of 554 for the entire Kootenai River core area is conservative. The recovery goal is 1,000 fish (Table 17). During 1999, an estimated 733 bull trout occurred in the Montana section of the core area. No streams were surveyed in Idaho during that year, but based on the average number of redds counted over the past five years (28 redds), the total number of adult bull trout that occurred in the entire Kootenai River core area likely exceeded 800 fish.

Two local populations (spawning tributaries) were believed to have over 100 adults associated with them in the Kootenai River core area during 2006. These tributaries include Quartz Creek (163 adults) and O'Brien Creek (208 adults). In 2006, it was estimated that North Callahan Creek had a spawning escapement of 93 adults. To reach the recovery goal for this core area there must be five populations with over 100 adults (Table 17). During 1999, five local populations were believed to have had at least 100 adults, assuming North Callahan Creek followed similar trends as was observed in Montana.

Trend analysis (linear regression) of bull trout redds in three Montana tributaries that have been counted consistently since 1990 indicate this population is significantly ($P = 0.037$) increasing (Table 18 and Figure 21). Redd counts that occurred from 2002 to 2006 are all lower than what was counted between 1998 and 2001, although they are higher than what was observed between 1990 and 1996 (Figure 21). Starting in 1996, bull trout redds have been consistently counted in five Montana streams. Analysis of this data suggests that since 1996 the bull trout population has decreased slightly (Table 18 and Figure 21). Although the abundance of bull trout appears to be down from what was observed in from 1998 to 2001, if we look at a longer time frame (1991 to 2006) the populations appears to be increasing. This leads us to the conclusion that the bull trout population in the Kootenai River core area is stable or increasing.

Coeur d'Alene Lake Core Area

IDFG counted 83 redds in three index stream reaches of the St. Joe River drainage on September 26, 2006 (Table 22 and Figure 16). The U.S. Forest Service surveyed another eight streams on September 16, 2006 and counted eight redds bringing the total number of redds counted in the St. Joe River to 91 (Table 22). This is the second most redds ever counted, second only to the 93 redds counted in 2005. All documented redds were counted in four different streams (Medicine Creek, Wisdom Creek, Heller Creek and Yankee Bar). The 71 redds counted in Medicine Creek (also a record high) represented 78% of all redds counted in the entire Coeur d'Alene Lake core area during 2006. No attempts were made to search for bull trout redds in the Coeur d'Alene River basin. Expanding the number of redds observed by 3.2 fish/redd, the spawning escapement of bull trout for the Coeur d'Alene Lake core area was estimated to be 291 fish, which is considerably lower than the recovery goal of 1,100 adults (Tables 15 and 17).

An upward trend (non-significant P = 0.115) in the abundance of bull trout redds since 1992 was calculated (increasing by 2.0 redds/year) for the Coeur d'Alene Lake core area if one evaluates all the streams surveyed (Figure 22 and Table 18). Many of these streams have not been surveyed consistently and some stream reaches were surveyed by individuals inexperienced in counting redds. If we evaluate only streams that have been consistently surveyed by experienced counters (the three index streams), a significant (P = .009) upward trend (increasing by 3.2 redds/year) was evident (Figure 22 and Table 18). Based on this significant increasing trend we concluded that this population is stable or increasing.

Several complete and/or partial barriers exist in streams where we believe bull trout spawning and rearing is occurring. Red Ives Creek has a diversion dam within 2 km of the mouth that we believe blocks most upstream migration of bull trout, however there are reports of a few spawning bull trout upstream of the dam. Entente Creek has a culvert barrier upstream of observed bull trout redds and there appears to be suitable habitat in the drainage additional spawning and juvenile rearing. There are culverts that appear to be barriers on Cascade and Bluebells creeks, although juvenile bull trout have been found upstream of them. Other barriers may occur in streams that we believe have the potential to support spawning and rearing bull trout populations.

North Fork Clearwater River Core Area

Bull trout redd surveys were conducted on September 27 in the upper Little North Fork Clearwater River basin. During this survey, 115 redds were counted, which was an all time high since redd counts were initiated in 1994 (Figure 17 and Table 23). We did not survey Canyon Creek or Buck Creek during 2006 due to their remote location. Five redds were counted in Buck Creek in 2003. Since 2001 we have started evaluating new streams to better assess locations of spawning bull trout in the Little North Fork Clearwater River. What we are observing is that bull trout spawn in many different streams, but not necessarily on a consistent basis (Table 23).

To calculate the spawning escapement of bull trout in the Little North Fork Clearwater River, we added 10% to the total redd count (multiply by 1.11) to account for streams not surveyed in 2005 (Buck Creek represented 10% of redds in 2003). Then, by expanding this corrected number of redds (128) by 3.2 fish/redd, the spawning escapement of bull trout for the upper Little North Fork Clearwater River was estimated to be 408 fish. The U.S. Forest Service counted 70 redds in the North Fork Clearwater River and Breakfast Creek drainages in 2006 (Table 24). Not all streams were surveyed in the North Fork Clearwater River drainage every year due to their remote locations and time constraints. Based on previous redd counts (Table 24), it is believe that during 2006 about 30% of redds within the basin were not counted due to time and access constraints. By adding 30% to this count (multiply by 1.43), the estimated number of redds was 100. By expanding this corrected number of redds (100) by 3.2 fish/redd, the spawning escapement of bull trout for the North Fork Clearwater River and Breakfast Creek drainages was estimated to be 320 fish. When combined with the upper Little North Fork Clearwater River, this gives us a total spawning escapement of 728 bull trout for the North Fork Clearwater River core area. We multiplied the spawning escapement by 1.33 (at least 25% are not repeat spawners), which gives us a total of 969 adult bull trout that occurred in the North Fork Clearwater Core area during 2006. This is considerably lower than the recovery goal of 5,000 adult bull trout (Table 17).

It is difficult to evaluate the trend in the number of redds counted in the North Fork Clearwater core area. Difficulty stems from the irregularity in counting the same stream reaches throughout the years, adding new reaches, and inconsistency in counting redds that were created by resident fish. If we only look at those stream reaches counted consistently in the Little North Fork Clearwater (Lund Creek, Little Lost Lake Creek, Lost Lake Creek and the Little North Fork Clearwater upstream of Lund Creek) a significant ($P < 0.001$) increasing trend (increasing by 5.0 redds/year) was evident (Figure 23 and Table 18). From 2001-2006, the stream reaches we surveyed for redds in the Little North Fork Clearwater River and North Fork Clearwater River was relatively consistent. When we evaluated only this data, an increasing significant ($P = 0.018$) trend (increasing by 19.0 redds/year) was observed (Figure 24 and Table 18).

No natural barriers to bull trout migration were identified in the Little North Fork Clearwater River basin. However, the Clearwater Region staff has identified barriers in the North Fork Clearwater River that are believed to block upstream migration to bull trout in Isabella Creek (unknown cause), Quartz Creek (land slide), and Slate Creek (culvert).

DISCUSSION

Priest Lake Core Area

Bull trout redd counts from 1985 to 2006 indicate the bull trout population in the Upper Priest Lake basin has declined significantly. The number of bull trout spawning in these tributaries appears to be a fraction of what it was historically. Some of the smaller tributaries (Trapper Creek, Lime Creek, Cedar Creek and Bench Creek) have not had any redds counted in them for at least two years, where only 10 years ago counts of one to four redds were common. Even in some of the larger tributaries (Gold Creek and Hughes Fork) where 20 or more redds were counted on an annual basis during the 1980's, fewer than three redds were counted annually between 2002 and 2006. Only Upper Priest River had redd counts of any appreciable number (> 20). This information supports work conducted on Upper Priest Lake where bull trout numbers appeared to be declining significantly and only larger bull trout remain (DuPont et al., in press a). 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. 2002; Donald and Alger 1993). If this is true, we may continue to see even further declines in the bull trout population from Upper Priest Lake. Bull trout redd counts by Mauser (1986) document this trend on tributaries of Priest Lake where the number of redds observed in 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 Priest Lake. These findings add to the urgency for significantly reducing the lake trout population in Upper Priest Lake. Delays in correcting this problem could result in significant losses to or the extirpation of this bull trout population.

One promising note is that after considerable declines in bull trout redd counts since the 1980's, redd counts have remained relatively steady since 1992, albeit very low. The reason this bull trout population hasn't totally crashed, similar to what occurred in Priest Lake, may be because intensive gill netting has occurred in Upper Priest Lake since 1997 to remove lake trout. These efforts have removed over 5,000 lake trout at a rate of over 500 lake trout a year trout since 1997 (DuPont et al. In Press d). During 1998, it was estimated that about 75% of the lake trout (912 in all) were removed from Upper Priest Lake, (Fredericks et al. 2002). Unfortunately, lake trout appear to repopulate Upper Priest Lake by migrating up from Priest Lake through the thoroughfare (Fredericks et al. 2002). During lake trout removal efforts in Upper Priest Lake in 2003-2006 an increase in the number of bull trout between 300 and 500 mm in length was observed (DuPont et al., In Press d), indicating that juvenile bull trout survival may be increasing as a result of gill netting efforts. Continued lake trout removal coupled with blocking migration of lake trout through the thoroughfare is necessary for this bull trout population to persist.

The total bull trout spawning escapement for the Priest Lake core area was estimated at 93 fish in 2006. This is considerably lower than the recovery goal of 1,000 adult fish with at least five local populations having over 100 adults. Few of the tributaries of Priest Lake have been surveyed for redds since 1986 when Mauser (1986) documented the collapse of this population. Bull trout are known to still occur in some of the tributaries of Priest Lake (DuPont et al., In Press e), but probably contribute few adult fish to the entire core area. North Indian Creek, one of the few tributaries of Priest Lake where juvenile bull trout occur, was surveyed in 2004 and 2006, but no redds were located.

The recovery goal of 1,000 adult fish appears to be reasonable for the Priest Lake core area, especially since in the early 1970s, annual harvests of over 1,000 bull trout were common with a peak harvest in 1978 of about 2,300 fish (Mauser et al. 1988). However, increases in bull trout numbers in Priest Lake tributaries are unlikely with the thriving lake trout population that occurs in the lake. The best opportunity for restoring a viable bull trout population is in the Upper Priest Lake basin, where it may be possible to control the lake trout population. Redd counts in 1985 only surveyed about 21% of what we believe is high quality spawning habitat in the Upper Priest Lake basin. In this survey, 80 redds were counted. If all the high quality habitat were surveyed, about 380 redds would have been counted, assuming they were distributed similarly in the un-surveyed areas. The 380 redds when multiplied by 3.2 (adults/redd) gives us a rough estimate of 1,216 adult fish that occurred in the Upper Priest Lake basin in 1985. To get back to these types of bull trout numbers, the lake trout population must be significantly reduced and maintained at a low level. Any hope of accomplishing this relies on controlling the immigration of lake trout from Priest Lake (Fredericks et al. 2002). We are unsure of what influence the expanding brook trout population in tributaries will have on restoring bull trout in the Upper Priest Lake basin.

One man-made barrier was noted during our survey that we believe blocks upstream migration of bull trout. This barrier is a U.S. Forest Service culvert located where F.S. road 1013 crosses Gold Creek (T63N, R5W, Section 17). Currently, bull trout habitat below this culvert is not fully utilized, but spawning and rearing habitat should not be artificially limited for this depressed population.

Pend Oreille Lake Core Area

Record high numbers (1,256) of bull trout redds were counted in the Pend Oreille Lake core area in 2006. These redd counts indicate that this core area is the most abundant and stable bull trout population in northern Idaho and possibly the state. Evaluation of the spawning tributaries (22 in all) since 1983 show the trend is increasing at a rate of 7.4 redds/year, although this trend was not significant ($P = 0.241$). When we evaluated only those redds counted since 1992, a significant increasing trend was evident. In 2006, record high redd counts were observed in six different tributaries (Trestle Creek, Granite Creek, Gold Creek, Wellington Creek, Morris Creek and Middle Fork East River) and in four other streams (Savage Creek, Char Creek, Sullivan Creek and Uleda Creek) the highest counts in at least the past nine years were observed. These counts indicate that this bull trout population is increasing throughout the core area, not just in a few key tributaries. This information is very promising and suggests that the bull trout population in the Pend Oreille Lake core area can remain strong even if catastrophic events were to impact several spawning tributaries.

After two consecutive low counts in Trestle Creek during 2004 and 2005, record high numbers were observed in 2006. We are unsure why the redd counts in Trestle Creek were low during 2004 and 2005 and why they increased to record highs in 2006. There doesn't seem to be a correlation with environmental variables to explain the fluctuations and similar patterns were not observed in other Pend Oreille Lake tributaries.

Redd counts in the Middle Fork East River and Uleda Creek were added to the Pend Oreille Lake core area in 2003 when these bull trout were documented to spend their adult life in Pend Oreille Lake (DuPont et al. In Press b). Redd counts were first conducted in the Middle Fork East River basin in 2001; however, only a portion of the area bull trout are known to spawn in were counted. In 2002, the redd counts covered the entire stream reach where bull trout are believed to spawn, but the counts occurred in mid October after brook trout had began spawning, and it was difficult to ascertain which species built the redd. The first year we believe accurate redd count information were collected was 2003 when all know spawning areas were assessed and counts occurred on September 30 after the bull trout finished spawning and before brook trout had begun. Future redd counts in the Middle Fork East River drainage should continue to occur near the end of September, two weeks before redd counts occur in the rest of the Pend Oreille Lake core area.

The significantly increasing trend in the number of redds counted since 1992 (all streams combined) is believed to be largely a response to changes in fishing regulations in Pend Oreille Lake that occurred in 1994 (harvest changed from 2 to 1 fish) and 1996 (changed to catch-and-release). If improvements in habitat were the main reason for the increasing trends we would expect to see these increases in only a few tributaries where habitat improvement projects have occurred. Those streams having high variability in their redd counts typically have unstable and/or degraded habitat conditions (Rieman and Myers 1997) such as Rattle Creek, Grouse Creek, Johnson Creek and the Pack River. However, periodic increases in the number of redds counted in these streams indicate they have the potential to support strong, stable bull trout populations once improvements occur. Those streams where consistently low redd counts have occurred since 1986 (Lightning Creek, Savage Creek, Morris Creek and Porcupine Creek) may require considerable time and money to recover the population and/or they may have little potential to support high numbers of bull trout.

In the Lightning Creek tributaries, numbers of bull trout redds have been increasing at a slower rate than other tributaries of Pend Oreille Lake. Habitat in the Lightning Creek tributaries is believed to be degraded and of lower quality than the other bull trout tributaries in Pend Oreille Lake (PBTTAT 1998), suggesting that the abundance of bull trout in Lightning Creek were and continue to be suppressed more by the quality of the habitat than past fishing pressure. Significant efforts to protect and restore habitat in tributaries of Lake Pend Oreille, have been occurring and likely have contributed to the increase in bull trout numbers we have seen since 1992 (Downs and Jakubowski 2003). These types of efforts are necessary to ensure bull trout populations will continue to increase in the Pend Oreille Lake core area.

Efforts are also occurring to increase the distribution and/or population strength of bull trout in the Pend Oreille Lake core area by addressing man-made barriers. All of the barriers believed to be suppressing bull trout abundance are being evaluated and/or efforts are being taken to correct the problem. For example, a historic stream crossing that occurred about 0.6 km upstream from the mouth of Uleda Creek, a tributary of the Middle Fork East River, was removed in 2004. Removing this barrier more than tripled the amount of available high quality spawning and rearing habitat for bull trout in this stream. Uleda Creek is an important stream reach in the Middle Fork East River basin for this bull trout population as the highest densities of juvenile bull trout and no brook trout were found to occur there. Removal of this barrier could lead to significant increases in this bull trout population and results should be recognized after one bull trout generation (6-8 years). Work is also going on to evaluate entrainment and the possibility of creating upstream fish passage over Albeni Falls Dam on the Pend Oreille River (Geist et al. 2004) and Cabinet Gorge Dam on the Clark Fork River (Lockard et al. 2003). Improvements in fish passage at these dams could result in significant increases in the bull trout population in the Pend Oreille Lake core area.

Efforts to correct an intermittent stream reach on Granite Creek occurred in 2005 and 2006 (Chris Downs, IDFG, personal communication). This intermittent stretch of stream occurred about 1 km upstream from the mouth and has blocked bull trout migration to one of the top bull trout streams in the core area. In past years, bull trout were trapped and transported past this barrier. In 2006, surface flows occurred throughout this reach of stream allowing bull trout to migrate naturally, and record high counts were observed in Granite Creek in 2006.

Intermittent stream reaches are also a problem for bull trout migration on lower Lightning Creek, Rattle Creek, Savage Creek and East Fork Lightning Creek. The U.S. Forest Service halted new road construction and timber harvest in the Lightning Creek watershed in 1984 in an effort to help reverse this problem (Chad Baconrind, US Forest Service, personal communication). A watershed assessment of this area is planned and funded (AVISTA Corp.) to evaluate what can be done to reduce or eliminate habitat and barrier problems (Chris Downs, IDFG, personal communication).

The biggest threat to the entire bull trout population in the Pend Oreille Lake core area is believed to be from lake trout that occur in the lake (LPOBTWAG 1999). Findings from Donald and Alger (1993) suggest that over time bull trout will not persist in the presence of lake trout. Priest Lake and Flathead Lake, Montana have experienced dramatic declines in bull trout numbers as lake trout numbers increased (Mauser 1986; Deleray et al. 1999). Work on Pend Oreille Lake indicates the lake trout population is also expanding rapidly (DuPont et al. In Prep). The kokanee population (major prey item for lake trout and bull trout) is a fraction of what it once was and is at risk of collapsing if changes don't occur soon. If kokanee collapse, we would likely see bull trout declines shortly after as occurred in both Priest Lake and Flathead Lake. Lake trout numbers are being reduced in Lake Pend Oreille through angler incentive programs, trap netting, and gill netting in areas where lake trout congregate - especially during the spawning season.

In 2006, all four bull trout recovery goals were met in the Pend Oreille Lake core area for the first time since they were developed and this is the only core area in the Panhandle to do so. This includes an adult bull trout population of over 2,500 fish (4,038 in 2006), six local populations with over 100 adults (7 in 2006), a stable or increasing population (increasingly significantly in 2006) and efforts were being made to maintain the current distribution of bull trout and restore their distribution in previously occupied areas.

After recovery goals are met in the Pend Oreille Lake core area for a period of five or more years, we believe the IDFG and U.S. Fish and Wildlife Service should allow a limited harvest of bull trout on Pend Oreille Lake. We believe that allowing limited harvest of bull trout will keep anglers interested and concerned about the species, which inevitably will lead to more support for continued efforts to improve this fishery. Any harvest allowed on this fishery should not exploit weak local populations or result in not meeting any of the stated recovery goals.

Kootenai River Core Area

North and South Callahan creeks are the only two streams that appear to be important for spawning bull trout in the Idaho portion of the Kootenai River core area. Thirty-three redds were counted in both of these tributaries, which suggests the spawning escapement was 106 adults. Many other streams were surveyed in the Idaho portion of the Kootenai River drainage, but bull trout redds were only found in Boulder Creek (Walters, IDFG, personal communication). The majority of the bull trout population in the Kootenai River core area occurs in Montana. During 2006, 81% of observed redds were counted in Montana and in 2005, 90% of redds also occurred in that part of the drainage. Although bull trout spawning in Idaho are included in the same core area as fish spawning in Montana, Kootenai Falls appears to separate these fish (O'Brien Creek in Montana is also downstream of the falls). In addition, bull trout upstream and downstream of the falls likely have different life cycles. Evidence indicates that fish spawning downstream of the falls in North and South Callahan creeks and O'Brien Creek are mostly adfluvial coming from Kootenay Lake, B.C. Canada (Jody Walters, personal communication, IDFG). The bull trout that spawn upstream of the Falls in Montana (Quartz Creek, Bear Creek, Pipe Creek and West Fisher River) appear to have a fluvial life cycle where they overwinter in Kootenai River (Jody Walters, personal communication, IDFG). Telemetry work has shown that bull trout can navigate Kootenai Falls, but it appears bull trout that spawn below the falls mix very little with bull trout from above the falls. For this reason, we should not expect to see the same trends in bull trout abundance between these two populations. This is especially true beings that Canada allows harvest of bull trout in Kootenay Lake whereas it is catch-and-release in Idaho and Montana.

The total estimate of adult bull trout that occurred in the entire Kootenai River core area was 554 fish during 2006. This estimate is believed to be conservative, as during 2006, it was believed that low flows may have blocked or prevented bull trout from entering many of the spawning streams (Mike Hensler, MFWP, personal communication). In fact, the drop in bull trout numbers from 2002 to 2006 in the Kootenai River watershed may be in response to the drought that occurred over this period (Mike Hensler, MFWP, personal communication).

Entrainment of bull trout from Lake Koocanusa through Libby Dam may be helping to strengthen the population of bull trout in the Kootenai River core area. Redd counts downstream of Libby Dam more than doubled after the floods of 1996 and 1997. Lake Koocanusa has a thriving bull trout population and entrainment of fish through Libby Dam could be high in flood years. To test whether entrainment of bull trout over Libby Dam were contributing to the spawning escapement in Montana tributaries, Montana Fish, Wildlife and Parks put radio transmitters in many of the bull trout located just downstream of Libby Dam. During this study, none of the radio tagged bull trout made migrations into known spawning tributaries in Montana (Mike Hensler, MFWP, personal communication). Most of these fish remained near Libby Dam, although some made migrations downstream into Idaho. It's still not clear what role entrainment plays in the population status of bull trout in the Kootenai River Core area.

Based on our results, it appears that only two of the four recovery goals are currently being met in the Kootenai River core area (Table 17 - the population is stable or increasing and all known man-made barriers have been removed or corrected (excluding Libby Dam). Despite this report, we may not be that far from meeting all the bull trout recovery goals for this core area. During 1999, we believe five bull trout populations had spawning escapements over 100 adults - which would meet the recovery goal, and the spawning escapement for the entire core area was probably over 800 fish (the goal is 1,000 adults). Based on radio telemetry studies, many bull trout located downstream of Libby Dam do not spawn every year, and consequently, many more adults were in the core area than redd counts indicate. Possibly over 1,000 adult bull trout occurred in the core area during 1999 and if the drought cycle ends, it is very likely we will see bull trout numbers bounce back.

Coeur d'Alene Lake Core Area

Redd counts in the Coeur d'Alene Lake Core area indicate that three or four streams (Medicine Creek, Wisdom Creek, Heller Creek and the upper St. Joe River) located in the upper St. Joe River basin are responsible for producing all or the vast majority of the bull trout in the entire core area (88 of 91 redds were counted in these three streams). In the 1930s, most major tributaries in the St. Joe River and some in the St. Maries Rivers were documented to have bull trout (IDFG 1933). This apparent loss of bull trout populations in so many tributaries makes it critical that we learn more about major mortality events and other factors limiting populations. Answers to these types of questions may be necessary before proper actions can be taken to restore this bull trout population.

About 91% (83 out of 91) of the bull trout redds counted during 2006 were in Medicine Creek and Wisdom Creek. These streams occur within 3 km of each other. This puts almost the entire bull trout population in the Coeur d'Alene Lake core area at risk from one catastrophic event. Currently, a dense stand of lodge pole pine and large amounts of dead and dying trees occur in this area, which makes it a prime spot for an intense fire. Despite these alarming facts, when we evaluated the trend in abundance of redds in the three index streams (Medicine Creek, Wisdom Creek and the upper St. Joe River) an increasing trend was evident. Couple this with the highest two redd counts during 2005 and 2006 and it gives us some confidence that the bull trout populations in the index streams are not in jeopardy of collapsing in the near future. The nine redds counted outside the three index streams in 2006 were the highest observed since 1996. Hopefully we will continue to see bull trout spawn in more tributaries in the future, which would reduce their risk of collapse from one catastrophic event.

Redd surveys in Medicine Creek have consistently produced the highest counts in the Coeur d'Alene Lake core area, and the 71 redds counted in 2006 were a record high and represented about 78% (71 out of 91) of all the redds counted. It is believed that Medicine Creek is critical to the persistence of bull trout in the Coeur d'Alene Lake core area. Ironically, the habitat in Medicine Creek has been manipulated. Several stream segments still remain channelized from mining activities that occurred in the early 1900's. These channelized stream reaches provide poor spawning and rearing habitat. The U.S. Forest Service should investigate the potential for habitat restoration in Medicine Creek.

Currently, only one of the bull trout recovery goals are being met in the Coeur d'Alene Lake core area – the population appears to be stable or increasing. Man-made barriers still exist that block bull trout migrations and the adult population size is estimated to be 291 fish. The current recovery plan asks for a stable or increasing population, with full access to potential spawning streams, and at least 1,100 adult spawners, 300 of which must occur in the Coeur d'Alene River watershed. Obviously, considerable efforts must occur before this bull trout population will ever approach recovery goals. As efforts to improve this bull trout population occur, the recovery goals should be re-evaluated to determine whether they can realistically be reached.

No attempts were made to survey tributaries of the Coeur d'Alene River for bull trout redds due to the fact spawning and rearing has not been documented in these waterbodies.

There have been unverified anglers reports suggesting bull trout have been caught in the Coeur d'Alene River. However, snorkel surveys are conducted on an annual basis in the Coeur d'Alene River and no bull trout have ever been observed since these surveys began in 1973. Two different anglers indicated they caught bull trout from the South Fork Coeur d'Alene River at the mouth of Bear Creek. Bear Creek is known to have a strong brook trout population and brook trout are often misidentified as bull trout, even by experienced individuals. A snorkel survey covering 34 km of the South Fork Coeur d'Alene River occurred during 2006 and no bull trout were observed. Electrofishing or snorkeling should occur in areas where bull trout reports commonly occur to help substantiate their validity.

North Fork Clearwater River Core Area

The 185 redds counted in the North Fork Clearwater River (NF) and Little North Fork Clearwater River (LNF) during 2006 was the second highest ever observed (highest occurred in 2005 – 193 redds). Seven different tributaries were not surveyed in the core area where bull trout are known to spawn during 2006. If these streams had been surveyed, bull trout redd counts would certainly have exceeded the number of redds counted in 2005. The number of stream reaches surveyed for bull trout redds has changed over the years and only since 2001 has the number of stream reaches surveyed occurred in a somewhat consistent manner. From 2001 to 2006, an increasing trend was observed in the number of redds counted in the NF and LNF basins. If we combine this data, bull trout redds have been increasing at a rate of about 19 redds/year over about 28 streams. This increasing trend is significant leading us to believe that indeed the bull trout population in the North Fork Clearwater River Core area is stable or increasing.

For the first time, more bull trout redds were counted in the LNF basin than in the NF basin. Despite this difference, it is unlikely more bull trout actually spawned in the LNF basin than in the NF basin during 2006 for four reasons: 1) The NF basin is over five times larger than the LNF basin; 2) Due to the remote nature and large size of the NF basin many potential spawning streams are not surveyed; 3) Six known spawning streams were not surveyed in the NF basin during 2006 (only eight streams are regularly surveyed in the LNF basin); 4) Fishermen indicate bull trout numbers in the NF have increased substantially over the last 10 years.

The 115 redds observed in the LNF was about 40% higher than observed in previous years suggesting this population may be in an exponential growth phase. If so, we could continue to see large increases in redd counts over the next few years. Increasing numbers of redds in tributaries of the LNF do not appear to be related to improving habitat conditions, as most of these stream are fairly remote with little human activity. The improvements in bull trout numbers can be attributed to fishing regulation changes in 1994. A long lived species such as bull trout can easily be exploited especially when they congregate in pools and during migratory events (DuPont et al. In Press f).

Currently, two of the four recovery goals are being be met in the North Fork Clearwater River core area (Table 17). There are around 20 local populations in the recovery area, (the goal is 11), and we believe the population is stable or increasing. The two goals not being met are due to barriers existing in the North Fork Clearwater River watershed that should be corrected and the estimated adult population size of 969 is well short of the goal of 5,000. Due to the remote nature of this core area many potential spawning tributaries are not surveyed making this population estimate conservative. However, even if we doubled our adult bull trout estimate (1,938 fish) based on unsurveyed streams we would still be well short of the 5,000 fish recovery goal.

The recovery goal for the entire North Fork Clearwater core area (5,000 adults) is twice that of the Pend Oreille Lake core area (2,500 adults). The Pend Oreille Lake core area is believed to support the strongest bull trout population in Idaho. The sterile nature of the streams in the North Fork Clearwater core area is believed to limit primary production and in- turn fish biomass in many of these tributaries. As a result, we should not expect to see the same number of bull trout as occurs in the Pend Oreille Lake core area where many of the spawning tributaries are low elevation spring fed streams, and a large stable lake provides high survival for maturing juveniles and over-wintering adults. We do not believe the recovery goal of 5,000 adults in the North Fork Clearwater River core area is realistic. We suggest that this portion of the recovery plan be re-evaluated and a more realistic goal be developed.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor bull trout spawning escapement through redd counts in the Priest Lake, Pend Oreille Lake, Kootenai River, St. Joe River and Little North Fork Clearwater River watersheds.

2. Using redd counts; continue to evaluate the status of bull trout in each of the core areas occurring in the Panhandle Region.

3. Investigate new streams/stream reaches where bull trout spawning may be occurring.

4. Continue to provide annual training to all people who will be conducting redd counts in the Panhandle Region.

5. Discuss with the U.S. Forest Service the feasibility of habitat restoration in Medicine Creek and/or Wisdom Creek.

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

7. Re-evaluate the recovery goals for the North Fork Clearwater River core area.

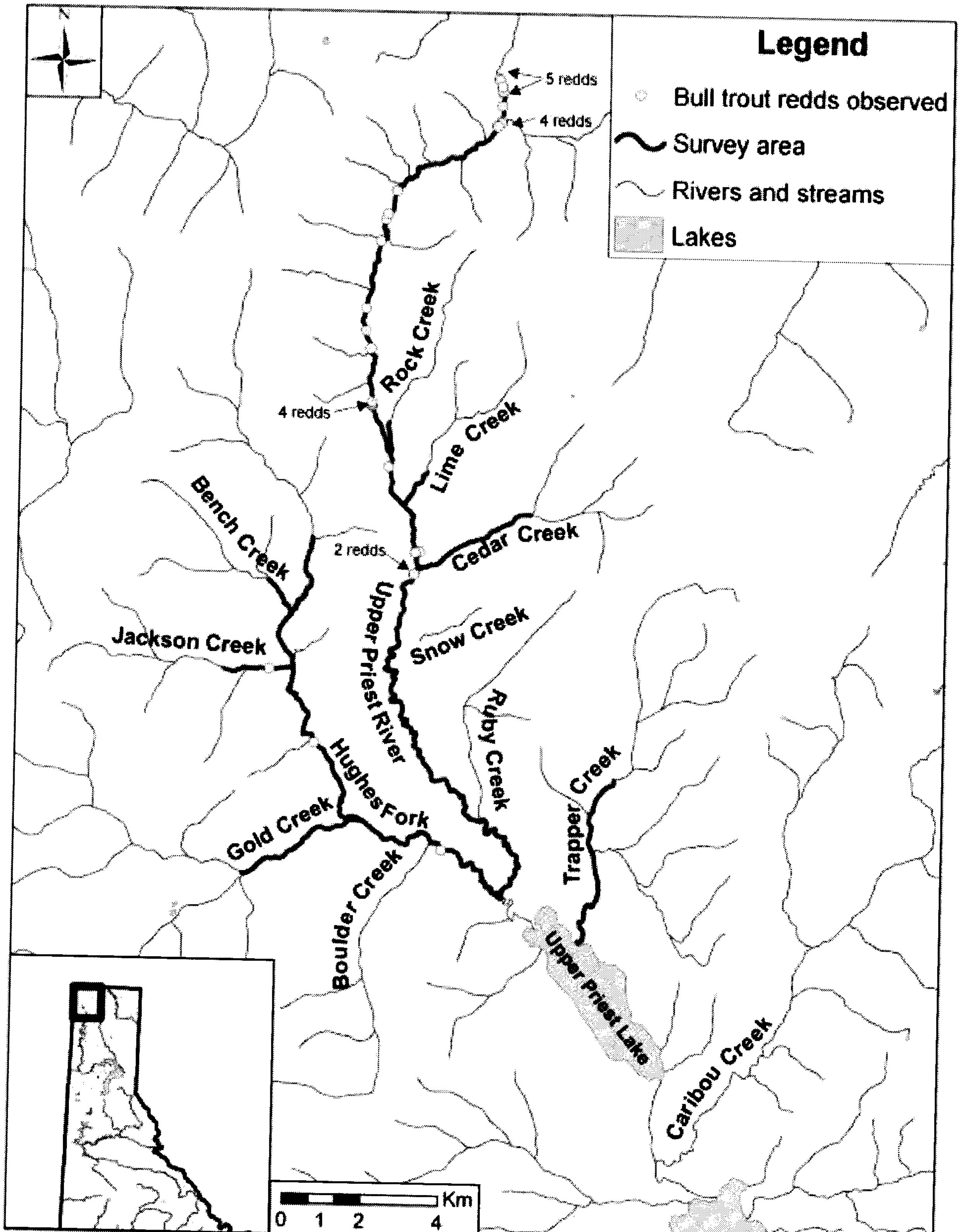


Figure 12. Stream reaches surveyed for bull trout redds in the Upper Priest Lake basin, Idaho, during October 4, 2006, and the locations of observed redds.

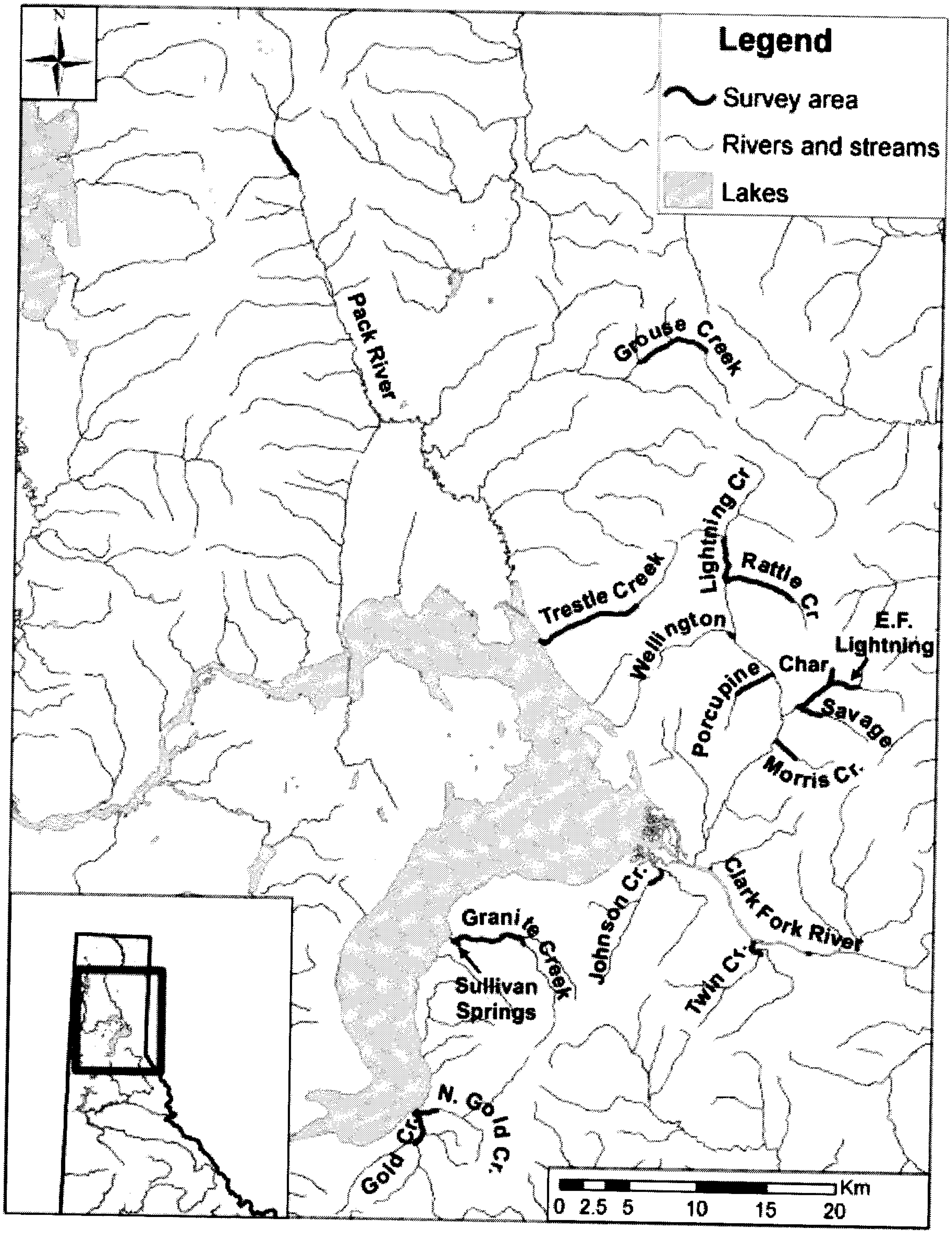


Figure 13. Stream reaches surveyed for bull trout redds in the Pend Oreille Lake basin, Idaho, on October 9-17, 2006.

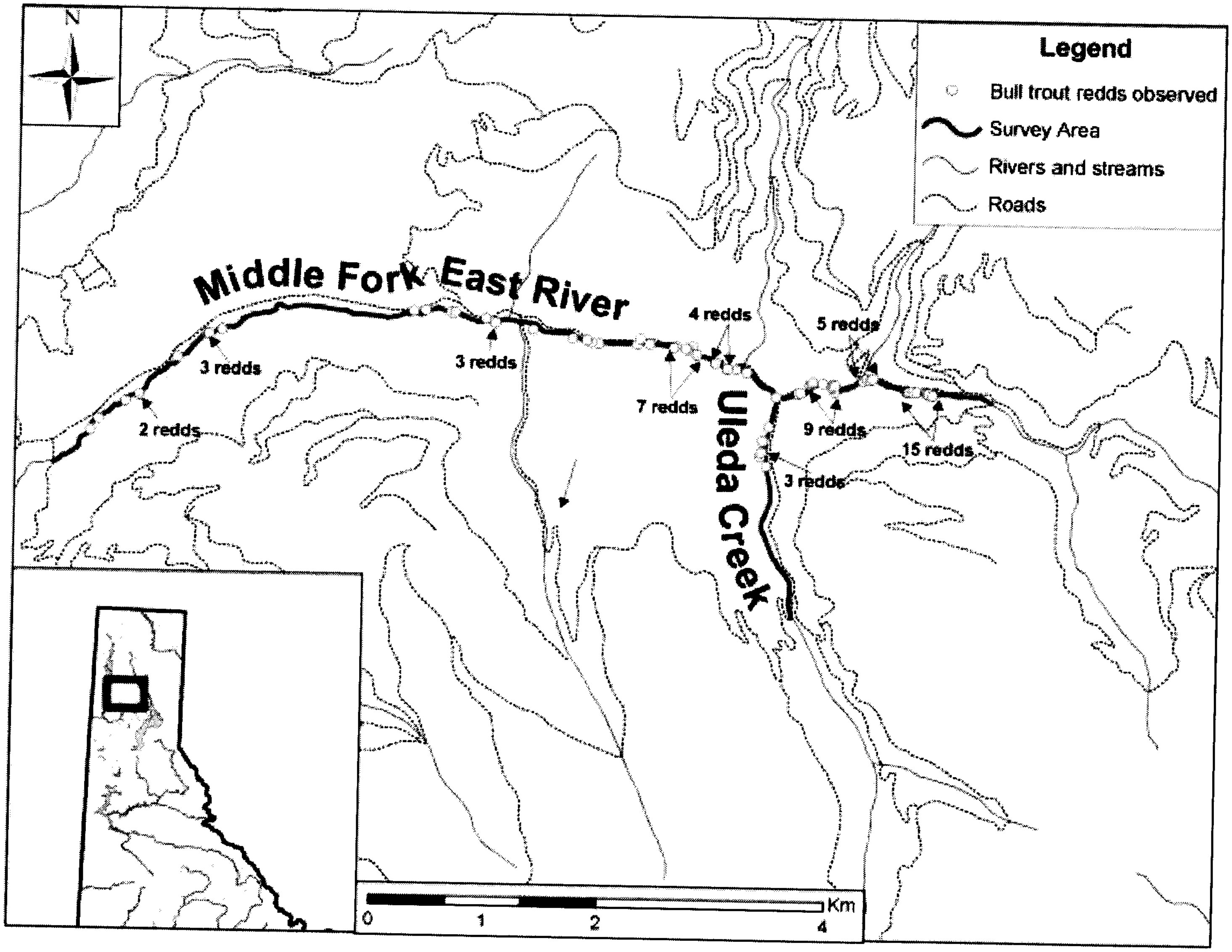


Figure 14. Stream reaches surveyed for bull trout redds in the Middle Fork East River basin, Idaho, on October 3, 2006, and the locations of where redds were observed.

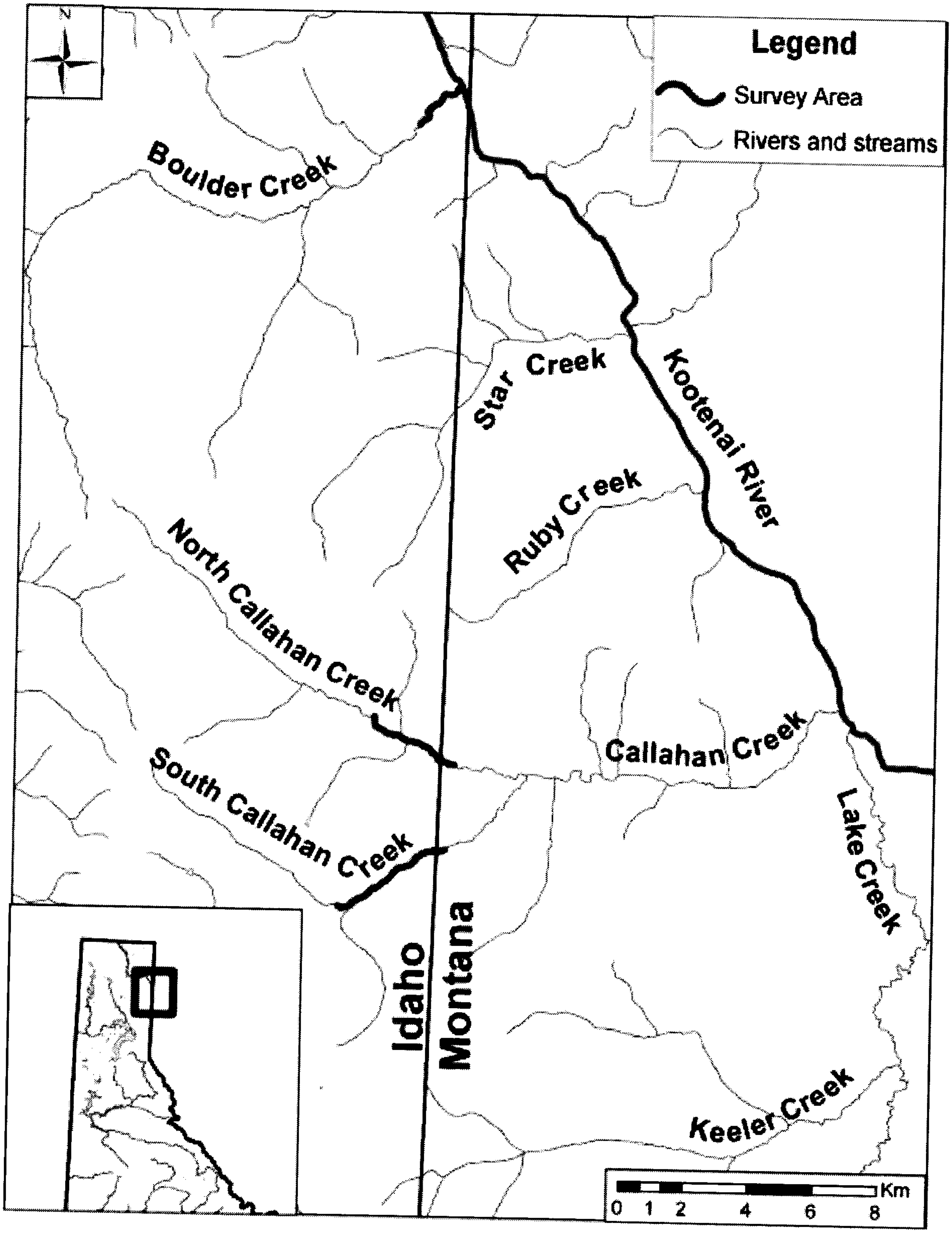


Figure 15. Stream reaches surveyed for bull trout redds in the Kootenai River watershed, Idaho, from October 5 and 10, 2006.

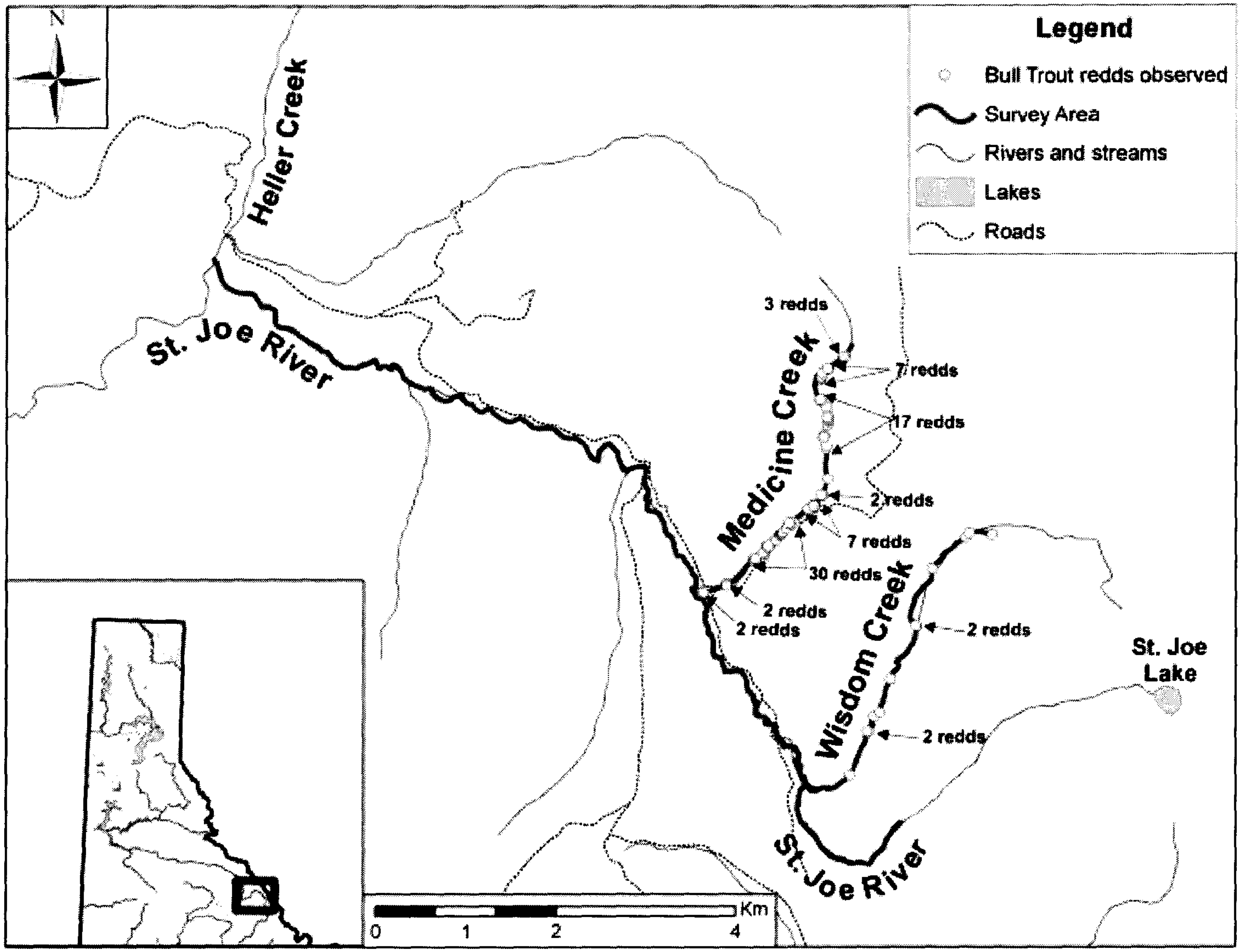


Figure 16. Stream reaches surveyed for bull trout redds in the St. Joe River basin, Idaho, on September 26, 2006, and the locations where redds were observed.

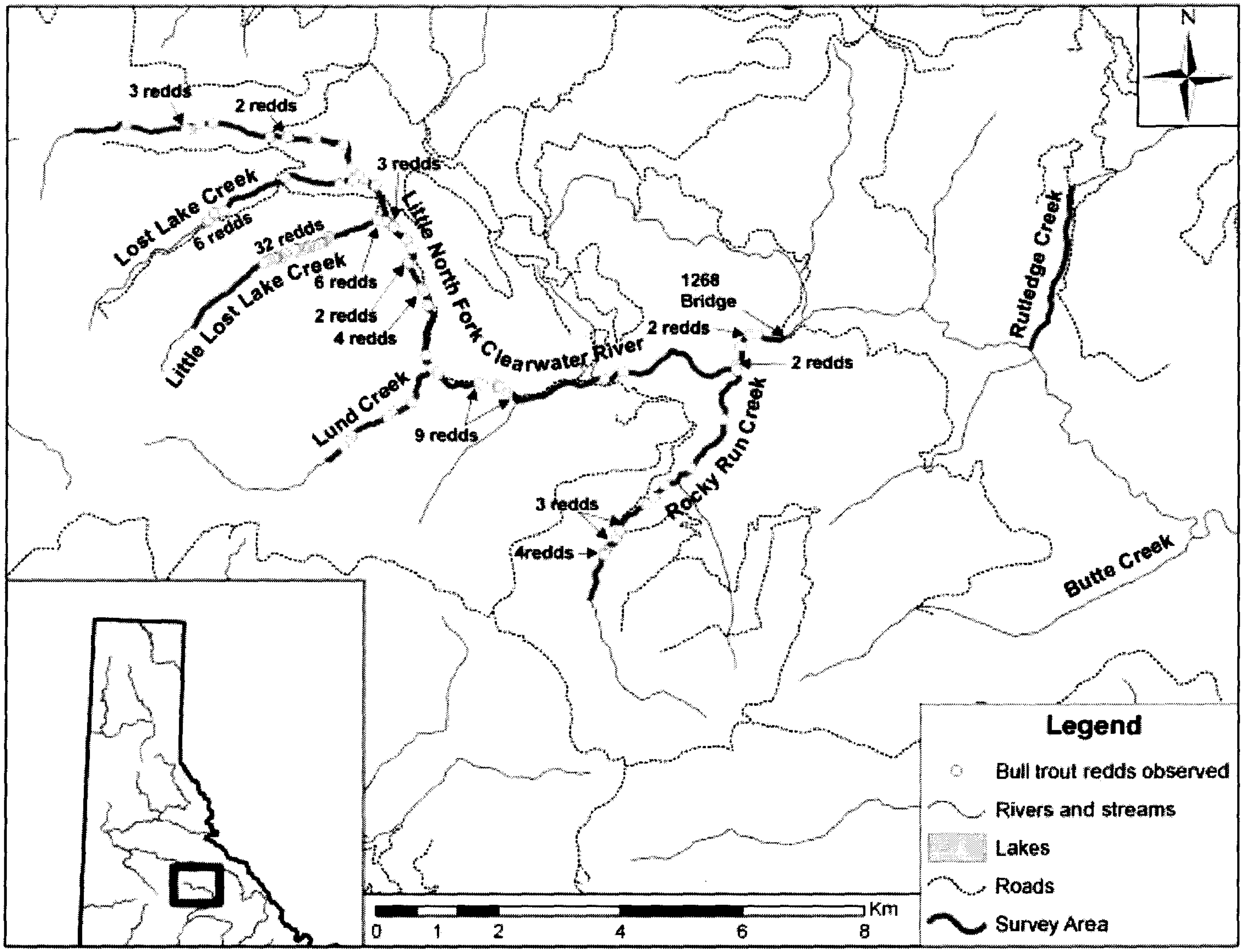


Figure 17. Stream reaches surveyed for bull trout redds in the Little North Fork Clearwater River basin, Idaho, on September 27 2006, and the locations where redds were observed.

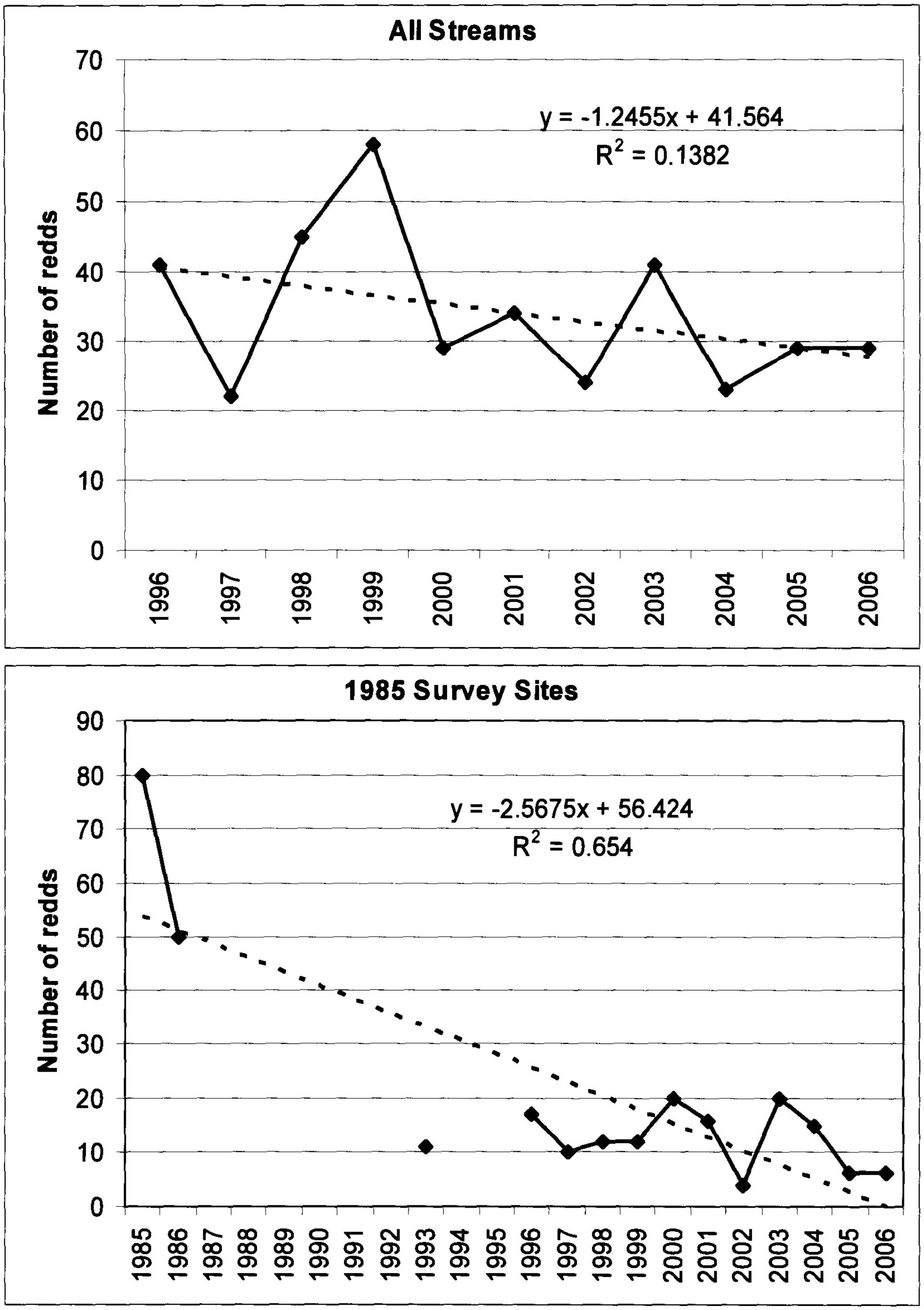


Figure 18. Linear regressions depicting trends in bull trout redd counts (all streams combined and only those sites surveyed during 1985) over time in the Priest Lake core area (Upper Priest Lake basin only), Idaho.

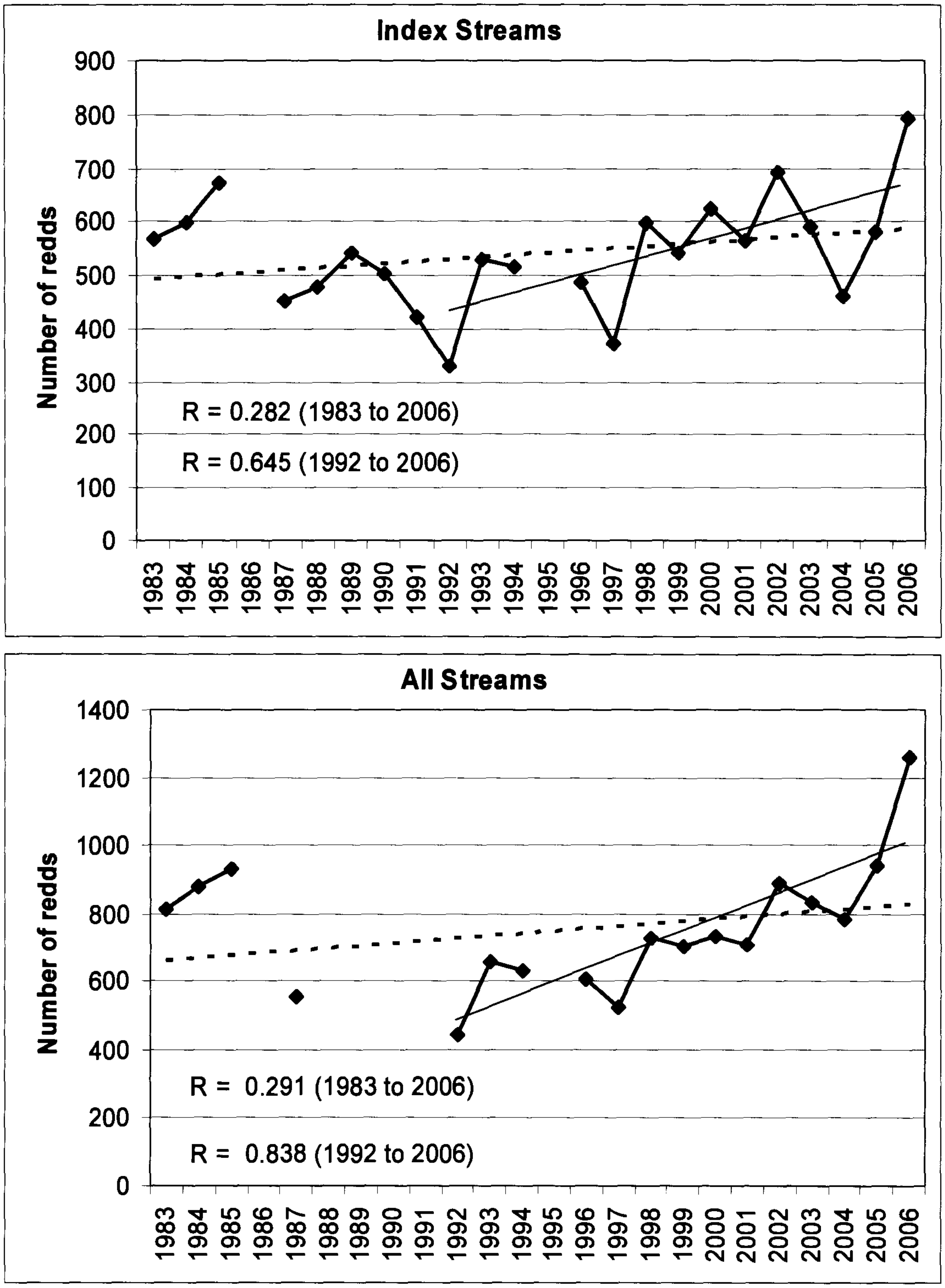


Figure 19. Linear regressions depicting trends in bull trout redd counts (six index streams and all streams combined) over time in the Pend Oreille Lake core area, Idaho. Dashed trend lines are for redd counts between 1983 and 2006 whereas solid trend lines are for redd counts between 1992 and 2006.

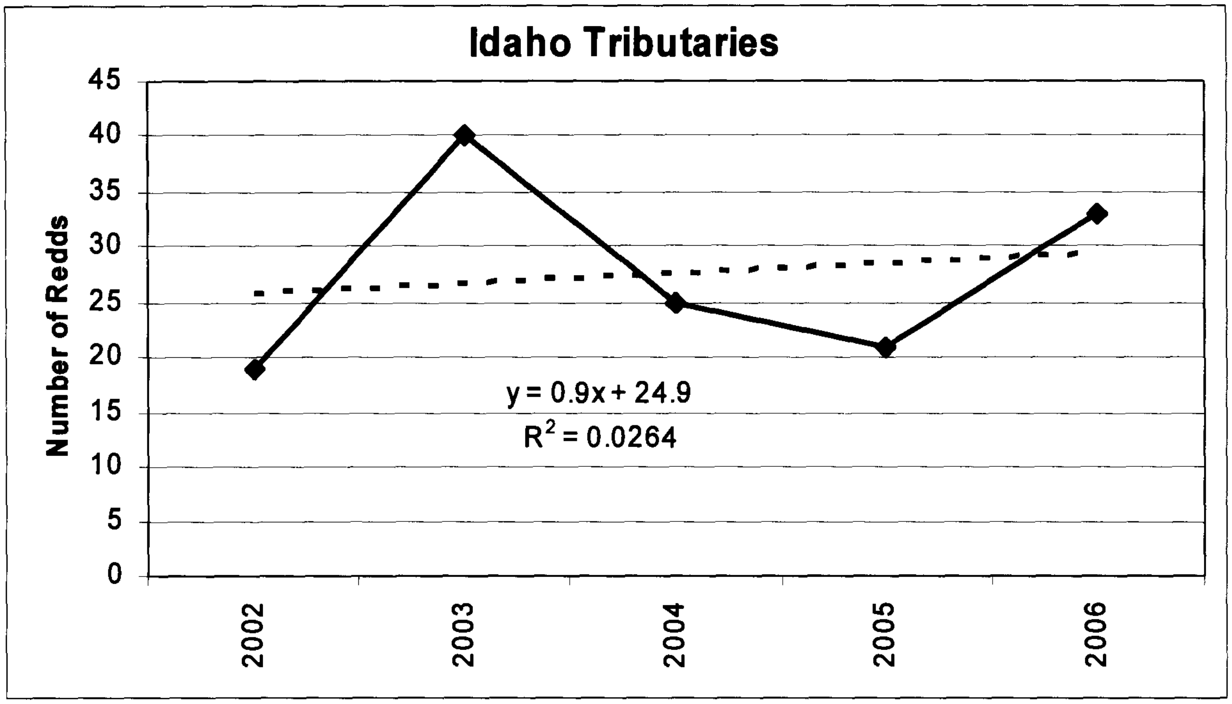
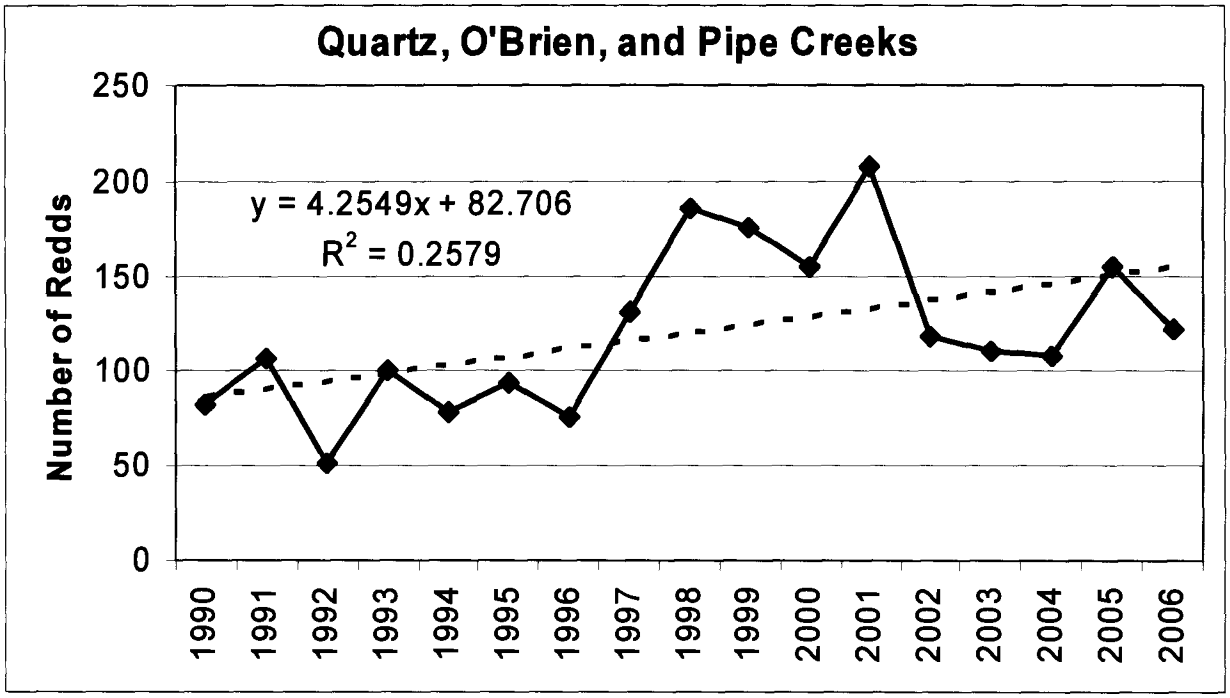


Figure 20. Linear regressions depicting trends in bull trout redd counts in tributaries in the Idaho section of the Kootenai River core area.



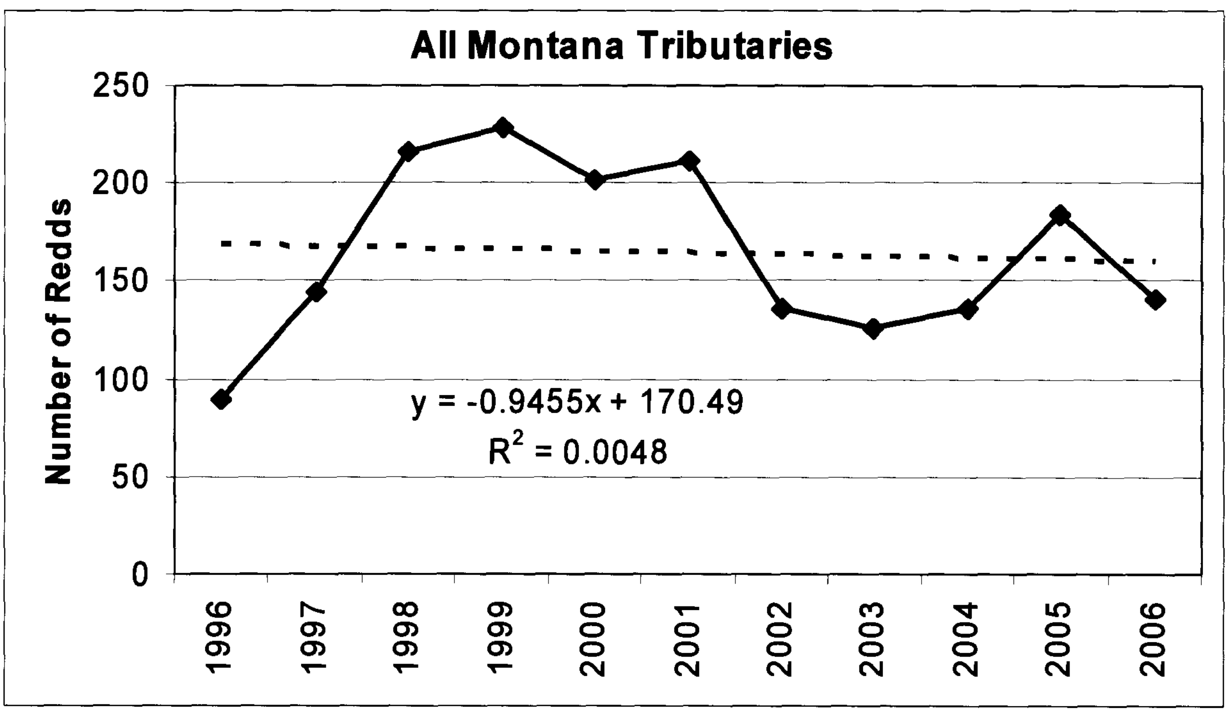


Figure 21. Linear regressions depicting trends in bull trout redd counts in select tributaries (Quartz, O'Brien, and Pipe Creeks) and all tributaries in the Montana section of the Kootenai River core area.

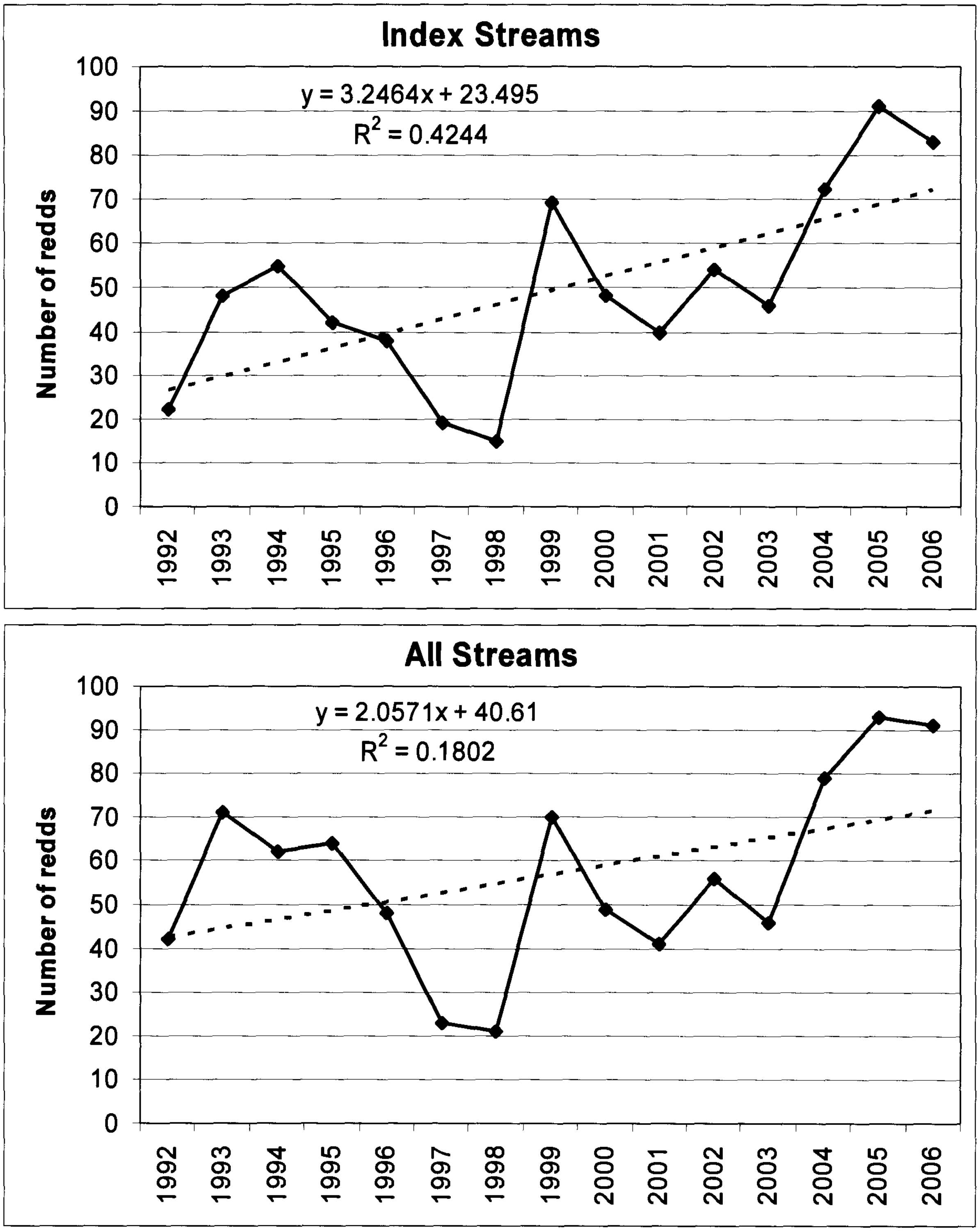
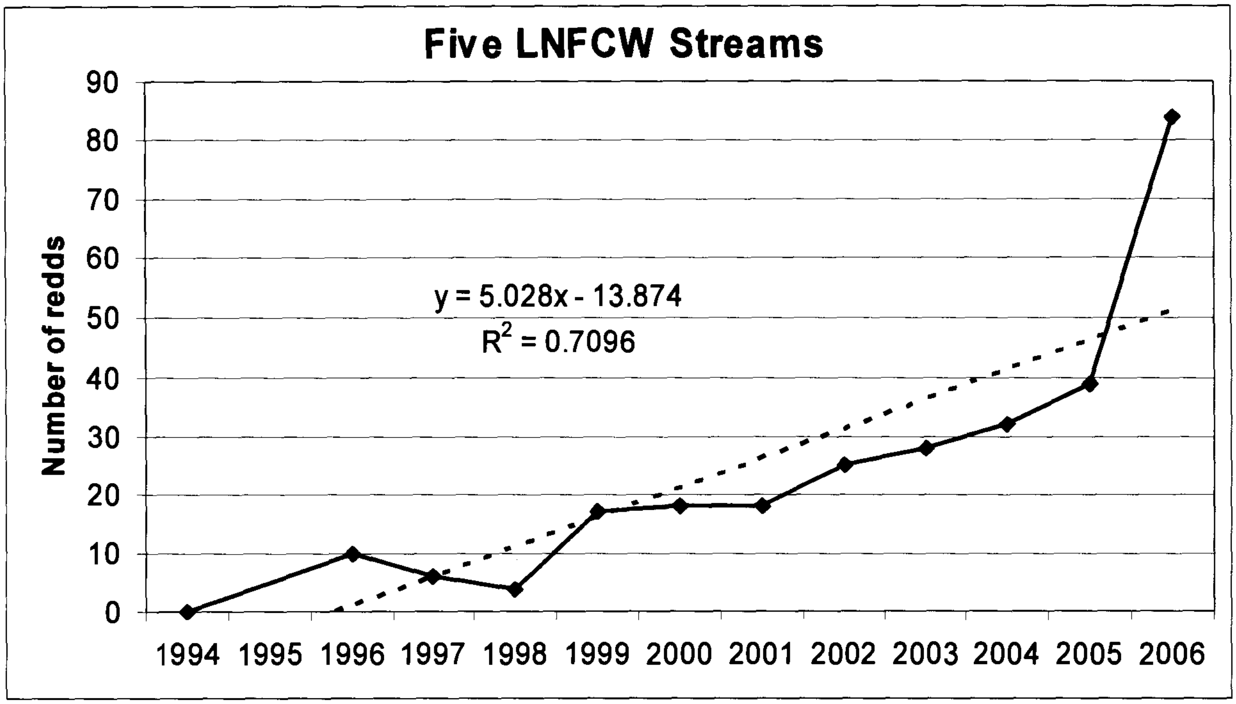


Figure 22. Linear regressions depicting trends in bull trout redd counts (three index streams and all streams combined) over time in the St. Joe River section of the Coeur d'Alene Lake core area, Idaho.



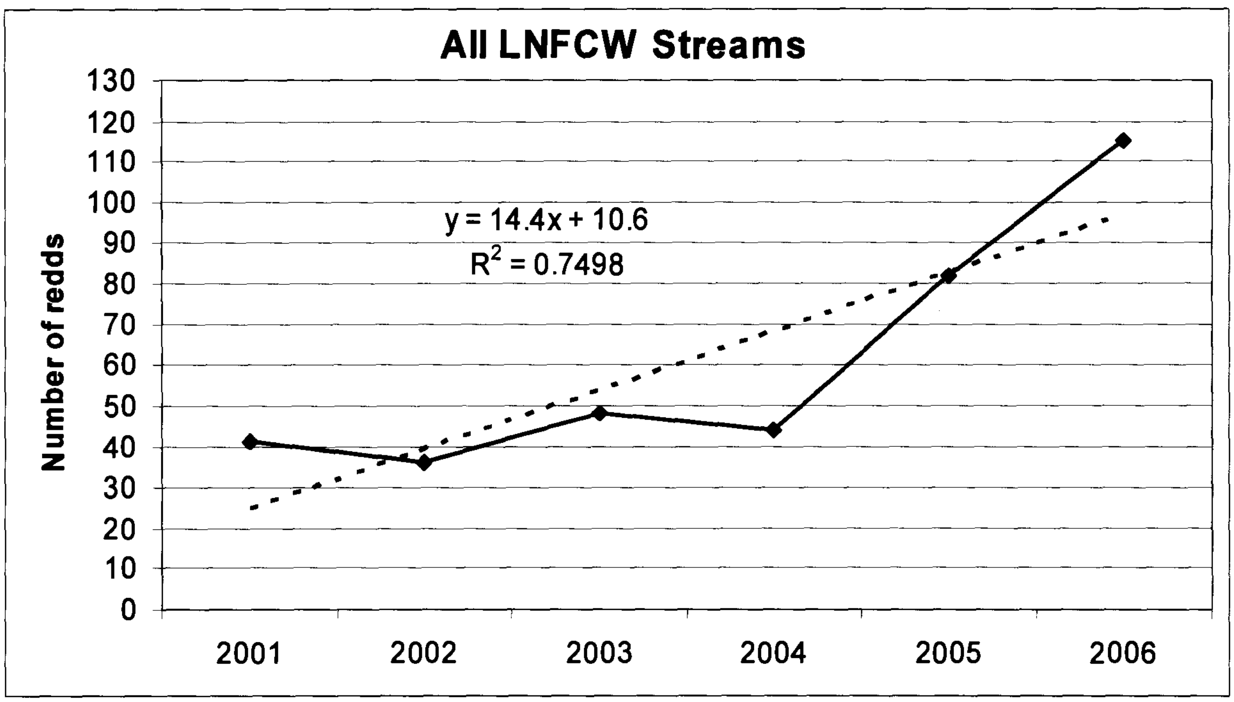
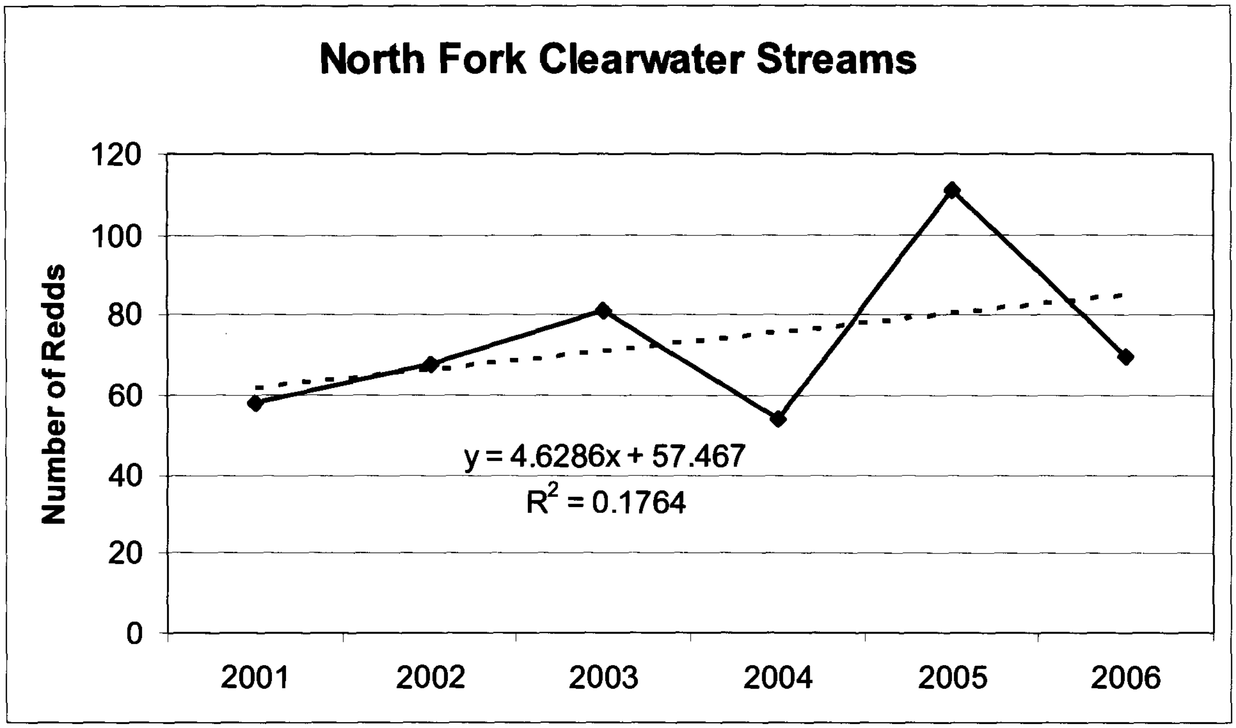


Figure 23. Linear regressions depicting trends in bull trout redd counts (five consistently counted streams and all streams combined) over time in the Little North Fork Clearwater River basin, Idaho.



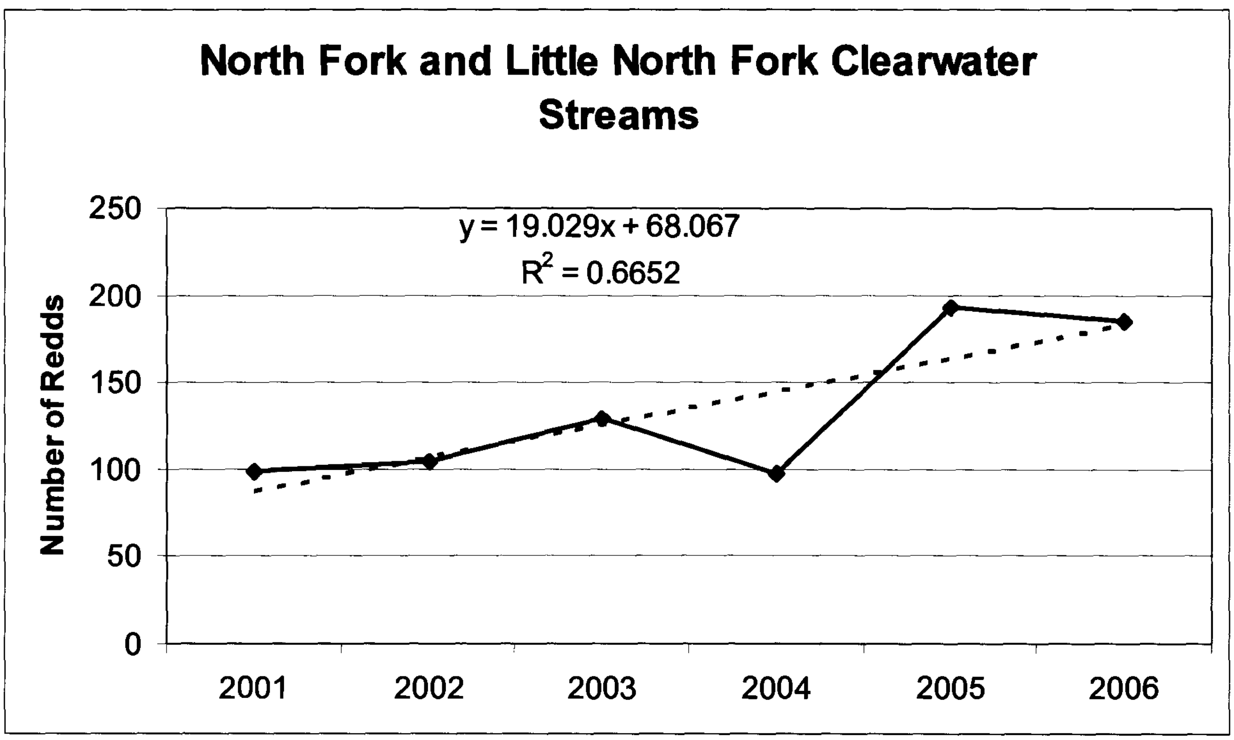


Figure 24. Linear regressions depicting trends in bull trout redd counts from 2001 to 2006 in the North Fork Clearwater River and the Little North Fork Clearwater River, Idaho, combined.

Table 15. Abundance criteria required before bull trout can be considered as recovered in the following basins of Northern Idaho (USFWS 2002).

	Recovery Criteria		
Core area	**Minimum number local of populations that have more than 100 adults**	**Minimum number of adults in the entire core area.**	**Trend in abundance**
Priest Lake basin	5	1,000	Stable or Increasing
Pend Oreille Lake basin	6	2,500	Stable or Increasing
Kootenai River basin[a]	5	1,000	Stable or Increasing
Coeur d'Alene Lake basin	NA	1,100[b]	Stable or Increasing
North Fork Clearwater River basin[c]	11 (>100 adults not required)	5,000	Stable or Increasing

[a] This core area includes tributaries in Idaho and Montana.

[b] This value is the desired annual spawning escapement - not the total number of adults in the core area. At least 800 must occur in the St. Joe River and 300 in the Coeur d'Alene River.

[c] Only the Little North Fork Clearwater River, a tributary of the North Fork Clearwater River basin, occurs in the Panhandle Region.

Table 16. Description of bull trout redd count transect locations, distance surveyed and number of redds counted in the Priest Lake basin, Idaho, from 1985 to 2006.

Stream	Transect Description	Length (km)	1985	1986	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Upper Priest Riv.	Falls to Rock Cr.	12.5	--	--	--	--	--	--	15	4	15	33	7	7	17	8	5	13	21
	Rock Cr. to Lime Cr.	1.6	--	--	--	2	1	1	2	0	3	7	0	2	0	0	0	0	1
	Lime Cr. to Snow Cr.	4.2	12[a]	5[a]	--	3	4	2	8	1	10	9	9	5	1	16	12	3	4
	Snow Cr. to Hughes Cr.	11.0	--	--	--	0	0	--	0	3	7	4	2	8	3	13	2	10	0
	Hughes Cr. to Priest Lk.	2.3	--	--	--	0	0	--	0	--	--	0	0	--	--	--	--	--	--
Rock Cr.	Mouth to F.S. trail 308	0.8	--	--	0	0	--	--	2	1	0	--	0	0	0	--	1	0	0
Lime Cr.	Mouth upstream 1.2 km	1.2	4[b]	1[b]	0	0	--	--	0	2	0	1	0	0	0	0	0	0	0
Cedar Cr.	Mouth upstream 3.4 km	3.4	--	--	--	0	2	1	0	1	0	0	0	0	0	0	0	0	0
Ruby Cr.	Mouth to waterfall	3.4	--	--	0	0	--	--	--	0	0	--	--	--	0	--	--	0	--
Hughes Cr.	Trail 312 to trail 311	2.5	1	17	7	3	2	0	1	4	0	1	0	0	0	1	0	0	0
	Trail 311 to F.S. rd. 622	4.0	35[c]	2[c]	2	0	7	1	2	0	0	0	0	0	0	1	2	1	1
	F.S. road 622 to mouth	7.1	4[d]	0[d]	--	1	--	--	2	3	1	0	2	6	1	0	1	1	1
Bench Cr.	Mouth upstream 1.1 km	1.1	1	2	0	2	2	0	1	0	0	0	0	0	0	0	0	0	0
Jackson Cr.	Mouth to F.S. trail 311	2.2	--	--	4	0	0	0	0	0	0	--	--	--	0	0	0	0	1
Gold Cr.	Mouth to culvert	3.7	24	23	5	2	6	5	3	0	1	1	9	5	2	2	0	1	0
Boulder Cr.	Mouth to waterfall	2.3	--	--	0	0	0	--	0	0	0	--	0	--	--	--	--	0	--
Trapper Cr.	Mouth upstream 5.1 km	5.0	--	--	--	4	4	2	5	3	8	2	0	1	0	0	0	0	--
Caribou Cr.	Mouth to old rd crossing	2.6	--	--	--	1	0	0	0	0	0	--	--	--	--	--	--	--	--
All stream reaches combined		83.8	80[e]	48[e]	18	18	28	12[f]	41	22	45	58	29	34	24	41	23	29	29
Only those stream reaches evaluated during 1985-6		23.8[g]	80	48	14[h]	11	21[h]	8[f]	17	10	12	12	20	16	4	20	15	6	6

[a] Redds were counted from Lime Creek to Cedar Creek, which is about 1/2 the distance that is currently counted.
[b] Redds were counted from the mouth to FS road 1013, which is about 1/4 of the distance that is currently counted.
[c] About 2/3 of the distance was counted in 1985 and 1986 that is currently counted.
[d] Redds were counted from FS road 622 to the FS Road 1013, which is about 1/3 of the distance that is currently counted.
[e] Redds were counted in about 1/5 of the stream reaches where they are currently counted.
[f] Observation conditions impaired by high runoff.
[g] During 1985 and 1986 about 15 km of stream was counted.
[h] Two of the sites were not counted.

Table 17. The status of bull trout populations during 2006 in each of the cores areas that occur in the Idaho Panhandle Region. core areas highlighted in grey have met all their recovery goals.

Core area	2006 adult bull trout population estimate	Recovery goal	No. of local populations that have more than 100 adults	Recovery goal	Is this population stable or increasing?	Have 10 or more years of data been collected?	Are there streams that have known man-made barriers that block bull trout migrations?
Priest Lake	93	1000	0	5	no	yes	yes - Gold Creek
Kootenai River	554	1000	2	5	yes	yes	None in Idaho
Pend Oreille Lake	**4038**	**2500**	**7**	**6**	**yes**	**yes**	**yes - Clark Fork and Pend Oreille rivers**
Coeur d'Alene Lake	291	1100	1	NA	yes	yes	Yes - Red Ives, Entente, Cascade and Bluebell
N.F. Clearwater River	969	5000	20[a]	11[a]	yes	no	None in L.N.F. Clearwater

[a] A total of 100 adults or more are not required.

Table 18. Statistics for the linear regression of bull trout redds counted in different watershed in bull trout recovery core areas included in the Idaho Panhandle Region during 2006.

Streams/Core area	Years evaluated	No. of observations	R value	R square	P value	Slope (Redd Coefficient)	Redd Standard Error
Upper Priest - 1985 sites	1985-2006	14	-0.809	0.654	0.000	-2.568	0.539
Upper Priest - all streams	1996-2006	11	-0.372	0.138	0.260	-1.245	1.037
Kootenai River - Idaho streams	2002-2006	5	0.162	0.026	0.794	0.900	3.158
Kootenai River - three MT streams	1990-2006	17	0.508	0.258	0.037	4.255	1.864
Kootenai River - all MT streams	1996-2006	11	-0.069	0.005	0.840	-0.945	4.541
Pend Oreille - index streams	1983-2006	22	0.282	0.080	0.203	4.136	3.142
Pend Oreille - index streams	1992-2006	14	0.645	0.416	0.013	16.964	5.799
Pend Oreille - all streams	1983-2006	18	0.291	0.085	0.241	7.404	6.079
Pend Oreille - all streams	1992-2006	14	0.838	0.702	0.000	36.882	6.931
Lightning Creek - all tribs	1992-2006	14	0.799	0.638	0.001	6.900	1.501
St Joe River - index streams	1992-2006	15	0.651	0.424	0.009	3.246	1.049
St Joe River - all streams	1992-2006	15	0.425	0.180	0.115	2.057	1.217
LNF Clearwater - five streams	1996-2006	12	0.842	0.710	0.001	5.028	1.017
LNF Clearwater - all streams	2001-2006	6	0.866	0.750	0.026	14.400	4.160
NF Clearwater - all streams	2001-2006	6	0.420	0.176	0.407	4.629	5.001
NF and LNF Clearwater	2001-2006	6	0.816	0.665	0.048	19.029	6.749

Table 19. Number of bull trout redds counted per stream in the Pend Oreille Lake, Idaho, Core area, from 1983 to 2006.

Stream	1983[a]	1984	1985	1986[b]	1987	1988	1989	1990	1991[c]	1992	1993	1994	1995[d]	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
CLARK FORK R.	--	--	--	--	--	--	--	--	--	2	8	17	18	3	7	8	5	5	6	7	8	1	--	3
Lightning Cr.	28	9	46	14	4	--	--	--	--	11	2	5	0	6	0	3	16	4	7	8	8	9	22	9
East Fork	110	24	132	8	59	79	100	29	--	32	27	28	3	49	22	64	44	54	36	58	38	77	50	51
Savage Cr.	36	12	29	--	0	--	--	--	--	1	6	6	0	0	0	0	4	2	4	15	7	15	7	25
Char Cr.	18	9	11	0	2	--	--	--	--	9	37	13	2	14	1	16	17	11	2	8	7	14	15	20
Porcupine Cr.	37	52	32	1	9	--	--	--	--	4	6	1	2	0	0	0	4	4	0	0	5	10	14	8
Wellington Cr.	21	18	15	7	2	--	--	--	--	9	4	9	1	5	2	1	22	8	7	7	8	7	6	29
Rattle Cr.	51	32	21	10	35	--	--	--	--	10	8	0	1	10	2	15	13	12	67	33	37	34	34	21
Johnson Cr.	13	33	23	36	10	4	17	33	25	16	23	3	4	5	27	17	31	4	34	31	0	32	45	28
Twin Cr.	7	25	5	28	0	--	--	--	--	3	4	0	5	16	6	10	19	10	1	8	3	6	7	11
Morris Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	0	7	1	1	3	16
Strong Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	0	--	0	--	--
NORTH SHORE																								
Trestle Cr.	298	272	298	147	230	236	217	274	220	134	304	276	140	243	221	330	253	301	335	333	361	102	174	395
Pack River	34	37	49	25	14	--	--	--	--	65	21	22	0	6	4	17	0	8	28	22	24	31	53	44
Grouse Cr.	2	108	55	13	56	24	50	48	33	17	23	18	0	50	8	44	50	77	18	42	45	28	77	55
EAST SHORE																								
Granite Cr.	3	81	37	37	30	--	--	--	--	0	7	11	9	47	90	49	41	25	7	57	101	149	132	166
Sullivan Springs	9	8	14	--	6	--	--	--	--	0	24	31	9	15	42	10	22	19	8	15	12	14	15	28
North Gold Cr.	16	37	52	8	36	24	37	35	41	41	32	27	31	39	19	22	16	19	16	24	21	56	34	30
Gold Cr.	131	124	111	78	62	111	122	84	104	93	120	164	95	100	76	120	147	168	127	203	126	167	200	235
West Gold Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4
PRIEST RIVER																								
M. F. East River	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	8	21	20	48	71
Uleda Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	4	3	7	4	7
N. F. East River	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	0	0
Total 6 index streams[e]	570	598	671	290	453	478	543	503	423	333	529	516	273	486	373	597	541	623	566	691	591	462	580	794
Total of all streams	814	881	930	412	555	478	543	503	423	447	656	631	320	610	527	726	705	732	710	890	836	781	940	1256

[a] A significant portion of Grouse Creek was not counted.
[b] A significant portion of Rattle Creek and East Fork Lightning Creek were not counted.
[c] Represents partial counts due to early snow fall.
[d] Observation conditions impaired by high runoff.
[e] Index streams include Trestle, East Fork Lightning, Gold, North Gold, Johnson, and Grouse creeks.

Table 20. The estimated number of adult bull trout associated with each tributary where redds were counted in the Pend Oreille Lake, Idaho, Core area from 1983 to 2006. Stream counts shaded in gray indicate when over 100 adults were associated with it. Total counts shaded in gray indicate when the entire population exceeded 2,500 fish.

Stream	1983	1984	1985	1986	1987	1988	1989	1990	1991[a]	1992	1993	1994	1995[b]	1996	1997	1998	1999	2000	2001	2002	2003	2004[d]	2005	2006[f]
CLARK FORK R.	--	--	--	--	--	--	--	--	--	6	26	54	58	10	22	26	16	16	19	22	26	3	0	10
Lightning Cr.	90	29	147	45	13	--	--	--	--	35	6	16	0	19	0	10	51	13	22	26	26	29	70	29
East Fork	352	77	422	26	189	253	320	93	--	102	86	90	10	157	70	205	141	173	115	186	122	246	160	163
Savage Cr.	115	38	93	--	0	--	--	--	--	3	19	19	0	0	0	0	13	6	13	48	22	48	22	80
Char Cr.	58	29	35	0	6	--	--	--	--	29	118	42	6	45	3	51	54	35	6	26	22	45	48	64
Porcupine Cr.	118	166	102	3	29	--	--	--	--	13	19	3	6	0	0	0	13	13	0	0	16	32	45	26
Wellington Cr.	67	58	48	22	6	--	--	--	--	29	13	29	3	16	6	3	70	26	22	22	26	22	19	93
Rattle Cr.	163	102	67	32	112	--	--	--	--	32	26	0	3	32	6	48	42	38	214	106	118	109	109	67
Johnson Cr.	42	106	74	115	32	13	54	106	80	51	74	10	13	16	86	54	99	13	109	99	0	102	144	90
Twin Cr.	22	80	16	90	0	--	--	--	--	10	13	0	16	51	19	32	61	32	3	26	10	19	22	35
Morris Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	3	0	22	3	3	10	51
Strong Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	0	--	0	--	--
NORTH SHORE																								
Trestle Cr.	954	870	954	470	736	755	694	877	704	429	973	883	448	778	707	1056	810	963	1072	1066	1155	326	557	1264
Pack River	109	118	157	80	45	--	--	--	--	208	67	70	0	19	13	54	0	26	90	70	77	99	170	141
Grouse Cr.	6	346	176	42	179	77	160	154	106	54	74	58	0	160	26	141	160	246	58	134	144	90	246	176
EAST SHORE																								
Granite Cr.	10	259	118	118	96	--	--	--	--	0	22	35	29	150	288	157	131	80	22	182	323	477	422	531
Sullivan Springs	26	23	41	--	19	--	--	--	--	0	77	99	29	48	134	32	70	61	26	48	38	45	48	90
North Gold Cr.	51	118	166	26	115	77	118	112	131	131	102	86	99	125	61	70	51	61	51	77	67	179	109	96
Gold Cr.	419	397	355	250	198	355	390	269	333	298	384	525	304	320	243	384	470	538	406	650	403	534	640	752
West Gold Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13
PRIEST RIVER																								
M.F. East River	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	26	67	64	154	227
Uleda Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	13	10	22	13	22
N.F. East River	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	0	0
Trap and Transport	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	35	35	35	40	29	19
Total 6 index streams	1824	1914	2147	928	1450	1530	1738	1610	1354	1066	1693	1651	874	1555	1194	1910	1731	1994	1811	2211	1891	1478	1856	2541
Total of all streams	2602	2817	2972	1318	1776	1530	1738	1610	1354	1430	2099	2019	1024	1951	1686	2323	2256	2342	2307	2883	2710	2539	3037	4038
Lightning Cr.-Total	873	452	829	116	322	229	290	84	0	220	261	180	26	244	78	287	348	276	357	374	319	481	429	522

[a] A significant portion of Grouse Creek was not counted.
[b] A significant portion of Rattle Creek and East Fork Lightning Creek were not counted.
[c] Represents partial counts due to early snow fall.
[d] Observation conditions impaired by high runoff.
[e] Index streams include Trestle, East Fork Lightning, Gold, North Gold, Johnson, and Grouse creeks.
[f] Large early spawning kokanee made it difficult to distinguish between bull trout redds and kokanee redds in Sullivan Springs and Trestle Creek.

Table 21. The number of bull trout redds counted per stream in the Idaho and Montana sections of the Kootenai River Core area from 1990 to 2006.

Stream	Length (km)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
IDAHO																		
North Callahan Creek	3.3	--	--	--	--	--	--	--	--	--	--	--	--	13	30	17	12	29
South Callahan Creek	4.3	--	--	--	--	--	--	--	--	--	--	--	--	4	10	8	8	4
Boulder Creek	1.8	--	--	--	--	--	--	--	--	--	--	--	2	2	0	0	1	0
MONTANA																		
Quartz	16.1	76	77	17	89	64	67	47	69	105	102	91	154	62[d]	55	49	71	51
O'Brien	6.9	--	25	24	6	7	22	12	36	47	37	34	47	45	46	51	81	65
Pipe	12.9	6	5	11	6	7	5	17	26	34	36	30	6[a]	11	10	8	2	6
Bear - Trib of Libby Cr.	6.9	--	--	--	--	--	6	10	13	22	36[b]	23	4[c]	17	14	6	3	14
West Fisher	16.1	--	--	--	2	0	3	4	0	8	18	23	1	1	1	21	27	4
Idaho Total	9.4	0	0	0	0	0	0	0	0	0	0	0	2	19	40	25	21	33
Montana Total	58.9	82	107	52	103	78	103	90	144	216	229	201	212	136	126	135	184	140
Quartz/O'Brien/Pipe	35.9	82	107	52	101	78	94	76	131	186	175	155	207	118	111	108	154	122
Total all streams	68.3	82	107	52	103	78	103	90	144	216	229	201	214	155	166	160	205	173

[a] A human built dam (stacked up cobble) was constructed downstream of the traditional spawning area.
[b] This count includes redds constructed by resident and migratory fish.
[c] Libby Creek was dewatered at the Highway 2 bridge, downstream of Bear Creek spawning sites, during the bull trout spawning run.
[d] A log jam may have been a partial barrier.

Table 22. The number of bull trout redds counted by stream in the St. Joe River basin, Idaho, from 1992 to 2006. Counts shaded in gray are index streams that have been surveyed by the Idaho Department of Fish and Game since 1995. All other stream reaches are counted by the U.S. Forest Service and/or volunteers.

Stream Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Aspen Cr.	--	--	--	--	--	--	--	--	--	--	0	--
Bacon Cr.	0	--	--	--	--	--	--	--	--	--	--	--
Bad Bear Cr.	--	0	0	--	--	--	--	--	--	--	--	0
Bean Cr.	14	--	--	0	--	--	--	--	--	--	--	--
Beaver Cr.	2	2	0	0	0	0	1	0	--	0	0	0
Bluff Cr.- East Fork	0	--	--	--	--	--	--	--	--	--	--	--
California Cr.	2	4	0	2	3	0	--	--	0	0	0	0
Copper Cr.	--	--	0	--	0	--	--	--	--	--	0	0
Entente Cr.	--	--	--	--	--	--	--	0	--	--	1	0
Fly Cr.	1	--	--	0	0	0	2	0	--	--	1	0
Gold Cr. Lower mile	--	0	--	--	--	0	--	0	--	--	--	0
Gold Cr. Midde	--	--	--	0	--	--	--	0	--	--	--	--
Gold Cr. Upper	--	2	--	--	1	1	0	--	--	--	--	--
Gold Cr. All	--	--	--	--	--	--	--	--	--	1	0	--
Heller Cr.	0	0	0	0	--	1	0	0	0	--	0	0
Indian Cr.	0	0	--	--	--	--	--	--	--	--	--	--
Medicine Cr	11	33	48	17[a]	23[a]	13[a]	11[a]	48[a]	43	16	42	28
Mosquito Cr.	0	--	0	0	4	0	2	--	--	--	--	--
Quartz Cr.	--	--	--	--	--	--	--	--	--	--	0	--
Red Ives Cr.	--	0	1	1	0	1	0	0	0	0	0	0
Ruby Cr.	0	1	--	8	--	--	--	--	--	--	--	--
Sherlock Cr.	0	3	0	2	1	1	0	1	0	--	--	0
Simmons Cr. - Lower	--	0	0	0	--	--	--	--	--	0	--	--
Simmons Cr. - NF to Three Lakes	--	5	0	--	--	--	--	--	--	--	--	--
Simmons Cr. - Three Lakes to Rd 1278	--	3	5	5	0	0	0	0	--	--	--	--
Simmons Cr. - Rd 1278 to Washout	--	0	0	0	1	0	1	0	--	--	--	--
Simmons Cr. - Upstream of Washout	--	0	--	--	--	0	--	--	--	--	--	--
Simmons Cr. - East Fork	--	--	0	--	--	--	--	--	--	--	--	--
St. Joe River - below Tento Creek	--	--	--	--	0	--	--	--	--	--	--	--
St. Joe River - Spruce Tree to St. Joe Ldg.	--	--	--	0	--	--	--	--	--	--	--	--
St. Joe River - St. Joe Ldg to Broken Leg	--	--	--	4	--	--	--	--	--	--	--	--
St. Joe River - Broken Leg Cr upstream	--	--	--	0	--	--	--	--	--	--	--	--
St. Joe River - Bean to Heller Cr.	0	0	--	--	--	--	--	--	--	--	--	--
St. Joe River - Heller to St. Joe Lake	10[b]	14[b]	3[b]	20	14	6	0	10	2	11	3	9
Three Lakes Creek	--	--	--	--	0	--	--	--	--	--	--	--
Timber Cr.	--	0	1	0	--	--	--	--	--	--	--	--
Wampus cr	--	0	0	--	--	--	--	--	--	--	--	--
Washout cr.	--	3	0	0	0	0	--	--	--	--	--	--
Wisdom Cr	1	1	4	5	1[a]	0	4	11	3	13	9	9
Yankee Bar	1	0	--	--	--	0	--	--	1	0	0	0
Total - Index Streams	22	48	55	42	38	19	15	69	48	40	54	46
Total - All Streams	42	71	62	64	48	23	21	70	49	41	56	46
Number of streams reaches surveyed	16	23	19	21	16	17	12	13	8	9	14	14

Aspen Cr.	--	--	--
Bacon Cr.	--	--	--
Bad Bear Cr.	--	--	--
Bean Cr.	--	--	--
Beaver Cr.	0	0	0
Bluff Cr.- East Fork	--	--	--
California Cr.	0	0	0
Copper Cr.	0	--	--
Entente Cr.	--	--	--
Fly Cr.	0	0	--
Gold Cr. Lower mile	--	--	--
Gold Cr. Midde	--	--	--

Table 22. Continued.

Stream Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gold Cr. Upper	--	--	--									
Gold Cr. All	0	--	--									
Heller Cr.	7	1	5									
Indian Cr.	--	--	--									
Medicine Cr.	**[illegible]**	**62**	**71[b]**									
Mosquito Cr.	0	0	--									
Quartz Cr.	--	--	--									
Red Ives Cr.	0	1	0									
Ruby Cr.	--	--	--									
Sherlock Cr.	0	0	0									
Simmons Cr. - Lower	--	--	--									
Simmons Cr. - NF to Three Lakes	--	--	0									
Simmons Cr. - Three Lakes to Rd 1278	--	--	0									
Simmons Cr. - Rd 1278 to Washout	--	--	--									
Simmons Cr. - Upstream of Washout	--	--	--									
Simmons Cr. - East Fork	--	--	--									
St. Joe River - below Tento Creek	--	--	--									
St. Joe River - Spruce Tree to St. Joe Ldg.	--	--	--									
St. Joe River - St. Joe Ldg to Broken Leg	--	--	--									
St. Joe River - Broken Leg Cr upstream	--	--	--									
St. Joe River - Bean to Heller Cr.	--	--	--									
St. Joe River - Heller to St. Joe Lake	**9**	**10**	**0**									
Three Lakes Creek	--	--	--									
Timber Cr.	--	--	--									
Wampus cr	--	--	--									
Washout cr.	--	--	--									
Wisdom Cr.	**11**	**19**	**12**									
Yankee Bar	0	0	3									
Total - Index Streams	**72**	**91**	**83**									
Total - All Streams	79	93	91									
Number of streams reaches surveyed	13	11	11									

[a] These counts differed from what the U.S. Forest Service counted.

[b] These counts did not include from California Creek to Medicine Creek, a reach where bull trout spawning typically occurs.

Table 23. Number of bull trout redds counted per stream in the Little North Fork Clearwater River basin, Idaho, from 1994 to 2006. Numbers in parentheses are redds smaller than 300 mm in diameter.

Stream	Length (km)	1994[a]	1996	1997	1998	1999	2000	2001	2001[b]	2002	2003	2004	2005	2006
Buck Creek	4.8	--	--	--	--	--	--	--	--	--	5	--	--	--
Canyon Creek	5.5	--	--	--	--	--	--	--	--	--	0	--	--	--
Butte Creek	1.2	--	--	--	--	--	--	--	5	0	--	--	--	--
Rutledge Creek	2.9	--	--	--	--	--	--	--	--	--	1	1	6	0
Rocky Run Creek	4.7	--	--	--	--	--	--	--	--	5	1	3	21	13
Lund Creek	3.9	0	7	2	2	1	1	13	5	7	7 (1)	5	19	7
Little Lost Lake Creek	3.9	0	1	1	1	7	3	1	--	2 (4)	4 (3)	15 (1)	1	34 (4)
Lost Lake Creek	3.0	0	0	0	0	--	1	--	--	0	--	1	--	10
Little North Fork Clearwater River														
1268 Bridge to Lund Cr.	7.0	--	--	--	--	--	--	--	17	6	13	8	16	18
Lund Cr. To Lost Lake Cr.	3.8	--	--	3	1	9	8	3	12	5 (2)	7	5	11	16
Lost Lake Cr. to Fish Lake	5.4	0	2	0	0	--	5	1	--	5	5 (1)	5	6	13
Total for all streams	31.6	0	10	6	4	17	18	18	39	30 (6)	43 (5)	42 (2)	80	111 (4)

[a] Streams were surveyed between 9/16/1994 and 9/19/1994 - one week earlier than surveys in following years.
[b] These redds were counted by personnel from the Clearwater Region.

Table 24. Number of bull trout redds counted per stream in the North Fork Clearwater River and Breakfast Creek basins, Idaho, from 1994 to 2006. These streams all occur in the IDFG Clearwater Region and were counted by personnel from the Clearwater Region or U.S. Forest Service.

Stream Surveyed	Length (km)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
North Fork Clearwater River														
Black Canyon		--	--	--	--	--	--	--	--	1	--	--	--	--
Bostonia Creek	0.6	0	0	0	0	0	4	1	1	1	18	12	15	14
Boundary Creek	1.6	--	--	--	--	--	--	--	--	--	2	3	10	--
Collins Creek		--	--	--	--	--	--	--	0	--	--	--	--	--
Goose Creek	5.6	--	--	--	--	--	--	--	1	0	2	1	12	8
Hidden Creek		--	--	--	--	--	--	--	--	1	0	--	--	--
Isabella Creek	4.5	--	--	--	--	--	--	--	--	1	1	0	0	--
Kelley Creek - North Fork		--	--	--	--	--	--	--	14	--	--	--	--	--
Lake Creek	3.7	--	--	--	--	--	--	19	7	20	14	5	2	5
Little Moose Creek		--	--	--	--	--	--	--	0	--	--	--	--	--
Long Creek	2.9	--	--	--	--	--	--	--	--	5	0	8	10	1
Moose Creek	2.4	--	--	--	--	--	--	0	0	0	0	--	0	0
Niagra Gulch	0.8	--	--	--	--	--	--	2	5	6	10	3	4	2
Orogrande Creek	2.4	--	--	--	--	--	--	--	--	--	--	--	0	--
Osier Creek		--	--	--	--	--	--	3	0	2	0	--	--	--
Placer Creek	0.5	3	1	2	2	2	7	4	2	4	6	2	3	5
Pollock Creek		--	--	--	--	--	--	--	--	--	1	--	--	--
Quartz Creek	1.6	--	--	--	--	--	--	--	4	0	0	0	0	--
Ruby Creek		--	--	--	--	--	0	0	--	--	--	--	--	--
Skull Creek	2.9	--	--	--	--	--	--	--	--	0	6	5	3	--
Slate Creek	0.2	--	--	--	--	--	--	--	--	?	?	?	3	--
Swamp Creek	4.3	--	--	--	--	--	--	2	0	1	0	0	2	--
Upper North Fork	1.6	--	--	--	--	--	--	--	--	--	7	3	6	--
Vanderbilt Gulch	3.2	--	--	--	--	--	--	--	24	18	13	12	41	35
Weitas Creek		--	--	--	--	--	--	1	--	--	--	--	--	--
Windy Creek		--	--	--	--	--	2	--	--	--	--	--	--	--
Breakfast Creek														
Floodwood Creek		--	--	--	--	--	--	--	--	4	0	0	0	--
Gover Creek		--	--	--	--	--	--	--	--	--	1	0	0	--
Stony Creek		--	--	--	--	--	--	--	--	4	0	0	--	--
Total for all streams		3	1	2	2	2	13	32	58	68	81	54	111	70

Panhandle Region 2006 Fishery Management Report

MOYIE RIVER FISHERIES ASSESSMENT

ABSTRACT

The fishery in the Moyie River was assessed during 2005 and 2006 through a mark-and-recapture study and initiation of a snorkel trend study. Findings from this study indicate that the Moyie River provided a unique fishery in the Idaho Panhandle Region where one could expect low fishing pressure (exploitation was 6% on rainbow trout and 10% on brook trout) and to catch rainbow trout over 325 mm (RSD-325 was 19) and brook trout over 250 mm (RSD-250 was 39). About 77% of the trout in the Moyie River were rainbow trout and 23% were brook trout. Cutthroat trout also occurred in the Moyie River, but represented < 1% of the trout. Rainbow trout and brook trout densities throughout the Moyie River were low (200 rainbow trout ≥ 200 mm/km; 43 brook trout ≥ 200 mm/km), but rainbow trout densities were considered good (1.11 fish/100 m^2) where pool and deep run habitat occurred. Growth of rainbow trout was slow in the Moyie River (they reach 300 mm by age-5), but their relative weight (W_r = 97) was similar to other rainbow trout populations. Slow growth was believed to be related to limiting amounts of dissolved inorganic nitrogen. The abundance of wild rainbow trout is believed to have increased since 1975 and appeared to be related to decreased exploitation rates, favorable weather patterns, habitat enhancement, and cessation of all fish stocking. Mountain whitefish *Prosopium williamsoni* were the most abundant fish sampled (60% relative abundance) during the spring electrofishing, but represented only 9% of the fish observed during August snorkel surveys. This data suggests that mountain whitefish migrate out of the Idaho reach of the Moyie River during the summer. Establishment of 20 designated snorkel transects will allow the fishery in the Moyie River to be evaluated in a consistent and repeatable manner.

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INTRODUCTION

Historically (1940-1960), the Moyie River provided high quality fishing largely due to the stocking of (10,000 to 50,000) catchable rainbow trout and low fishing pressure (Goodnight and Watkins 1976; Goodnight 1979). However as stocking rates subsided, catch rates dropped and fishing pressure declined (Goodnight 1979; Fredericks et al. 2002a). In 1998 it was determined that fewer than 15% of the stocked fish were caught by anglers, which was considerably lower than the recommended 40% statewide return rate and not a good economical use of sportsmen dollars (Fredericks et al. 2002a). In addition, Canadian fish mangers were concerned about the stocking of fish that tested positive for infectious pancreatic necrosis (IPN) from the Clark Fork Hatchery into the Kootenai River drainage (Fredericks et al. 2002b). Based on these reasons, it was determined that stocking of rainbow trout into the Moyie River would be discontinued. Studies in 1975 (Goodnight and Watkins 1976), 1978 (Goodnight 1979), 1984 (Horner and Rieman 1984), and 1999 (Fredericks et al. 2002b) all found that a significant wild rainbow trout population existed in the Moyie River, but would likely not support high harvest rates. Based on these findings, wild trout regulations (2 trout) were adopted for the entire Moyie River in 2000.

It's unclear what the native trout species were in the Moyie River. Goodnight (1977) stated that cutthroat trout are the only indigenous trout species on the Moyie River. Moyie Falls (25 m high) on the lower river (3 km from the mouth) was believed to have blocked all access to rainbow trout. The wild rainbow trout population was believed to have developed after planting hundreds of thousands of rainbow trout in the river and its tributaries over the past 80-100 years Goodnight (1977). As early as 1975, cutthroat trout represented less than 1% of the trout species in the Moyie River (Goodnight and Watkins 1976). It was believed that blocked access to spawning tributaries (Spokane International Railroad blocked access to many tributaries in the 1950's; Goodnight 1977) and competition with introduced species (rainbow trout and brook trout) were responsible for the demise of cutthroat trout in the Moyie River. Despite the presence of Moyie Falls, some still believe rainbow trout may be native to the Moyie River. This stems from findings on the Yaak River, another tributary of the Kootenai River in Montana, where native redband rainbow trout are found upstream of large impassible falls (Muhlfeld et al. 1999). In the Yaak River, native redband trout are found throughout the watershed, and are the only species that occur in some of the tributaries (Muhlfeld et al. 1999). In the Moyie River, rainbow trout are uncommon in the tributaries (Horner and Rieman 1984; Walters 2006) where either brook trout or cutthroat trout are the dominant species. These findings tend to support the belief that rainbow trout are not native to the Moyie River. Bull trout are native to the Moyie River, but no spawning populations are known to occur in Idaho. There is an adfluvial bull trout population that migrates out of Moyie Lake, in Canada, downstream 40-80 km to spawn in tributaries of Moyie River (John Bell, British Columbia Ministry of Environment, personal communication). It is possible bull trout migrated downstream into tributaries in Idaho when better tributary access occurred.

The Moyie River was managed as a wild trout fishery beginning in 2000. No evaluation of the fish population has been conducted since the management change. The goal of this study was to assess the fishery in the Moyie River and set up a protocol that will allow us to evaluate this fishery on a more consistent basis.

OBJECTIVES

1. Estimate game fish species composition, growth, size structure, exploitation, distribution and abundance in the Moyie River.

2. Develop sites on the Moyie River that can be snorkeled on a regular basis to evaluate fish densities and trends in their abundance.

3. Compare fish densities and size distribution to those reported historically.

STUDY SITES

The Moyie River originates at the outlet of Moyie Lake in British Columbia and flows 93 km through Canada and 42 km through Idaho before it enters the Kootenai River. Moyie Falls (25 m high) occurs about 2.7 km upstream from its mouth and is a natural barrier to fish migration. Moyie Falls Dam occurs just upstream of Moyie Falls and impounds about 2 km of the river (Figure 1).

The Moyie River has two distinctly different morphologies. From the U.S.-Canada border downstream to around Meadow Creek (15.5 km from mouth), the river can typically be categorized as a B3 stream type, which is characterized as having a gradient ranging from 2-4% and predominately cobble substrate with moderately steep valleys and gentle side slopes (Rosgen 1996). Downstream of Meadow Creek the river typically can be categorized as an A2 stream type, which is characterized as having a gradient ranging from 4-10% and predominately boulder substrate with steep side slopes and confined valleys (Rosgen 1996). This reach of river is often referred to as the canyon section. Large woody debris is scarce in the entire river and is likely related to the intense logging that historically occurred throughout the river valley. Long stretches of riffle habitat are also common throughout the river although bedrock pools are common in the lower reach. In 1990, the Pacific Gas and Electric Company added a parallel natural gas line that crossed the Moyie River eight times. To stabilize these crossings they constructed boulder drop structures across the river. For mitigation of this project, they also constructed around 20 bank barbs along the river (Chip Corsi, IDFG, personal communication). These structures have been successful in creating more complexity and pool habitat in this river.

Access to the Moyie River, like the morphology, is distinctly different upstream and downstream of Meadow Creek. Upstream of Meadow Creek access is relatively easy as a road parallels its entire length. Two developed and several undeveloped campgrounds occur in this reach. About two thirds of the land bordering this section of river is private. Downstream of Meadow Creek, access is limited with roads reaching the river in only a couple places. To fish the river one must hike through steep rugged country. About one third of the land bordering this section of river is private.

No developed boat ramps occur along the Moyie River except at Moyie Reservoir. Undeveloped access occurs at road crossings from the U.S.-Canada border downstream to Twin Bridges. Starting around mid-July, shallow water restricts floating to shallow water crafts such as one man pontoon boats and canoes. Downstream of Twin Bridges floating is recommended only for experienced whitewater rafters.

As part of this study we electroshocked the river using a drift boat. Due to access and floatability, this method only occurred from the U.S.-Canada border downstream to Twin Bridges, 18.8 river km (Figure 25). Snorkeling occurred at 20 different sites located throughout the entire river (Figure 25).

METHODS

Age, Growth, Mortality and Species Abundance

We electrofished the Moyie River from the U.S. Canada Border downstream to Twin Bridges (18.8 km in length) during 2005 (July 18-21) and 2006 (June 27-29 and July 6-7) using a single drift boat mounted electrofishing unit. Attempts were made to capture all fishes. In an effort to save time in 2005, only trout species were netted during three of the four days. In 2005, we also captured fish through angling on July 26 and 27. All captured fish were identified to species and measured to the nearest millimeter. Scales and weights were taken from a representative sample of brook trout and rainbow trout (only 2006), and all salmonids were either marked with a caudal punch, or Floy tag to assist with a population estimate (see population estimates below for details).

Relative abundance was calculated for both 2005 (only for the one day that all fish were netted) and 2006 efforts (June 27-29). Length frequency graphs were constructed for rainbow trout and brook trout. We calculated the Relative Stock Density for rainbow trout and brook trout (RSD-10) based on the length information we collected using the following formula (Anderson and Neumann 1996):

$$RSD = \frac{Number\ of\ fish \geq specified\ length}{Number\ of\ fish \geq stock\ length} \text{ X } 100$$

The specified length for rainbow trout was set at 325 mm (RSD-325) and 250 mm (RSD-250) for brook trout, the same as used by Fredericks et al. (2002b) in their fishery assessment of the Moyie River. The stock length for rainbow trout was 200 mm and 125 mm for brook trout which are considered the minimum length that most anglers like to catch (Anderson and Neumann 1996). RSD values calculated for this study were compared to work conducted in 1984 (Horner and Rieman 1984) and 1999 (Fredericks et al. 2002b) to evaluate if any changes in the size structure of rainbow trout and brook trout occurred over the past seven years.

Weights of rainbow trout and brook trout were used to calculate their relative weights (W_r), which is an index of their plumpness and physiological well-being (Anderson and Neumann 1996). W_r is calculated using the following formula:

$$W_r = (W/W_s) \text{ X } 100$$

where W is the weight of an individual fish and W_s is a length-specific standard weight predicted by a weight-length regression constructed to represent the species as a whole. For rainbow trout this regression is defined as $\log_{10} W_s = -5.194 + (3.098 \text{ X } \log_{10}$ Total Length) and for brook trout it is defined as $\log_{10} W_s = -5.085 + (3.043 \text{ X } \log_{10}$ Total Length) (Murphy et al. 1991). Minimum lengths of 200 mm for rainbow trout and 130 mm for brook trout were used in an effort to reduce differences in growth forms between juvenile and adult fish (Murphy et al. 1991). W_r values well below 100 may indicate food or feeding problems whereas W_r values well above 100 may indicate an abundance of food or low population abundance.

Scales collected from rainbow trout were pressed on acetate slides and projected with a microfiche reader. Each scale was read by at least two people. When these two individuals disagreed on the age of a particular fish, a third person read the scale to break the tie.

Distances between the focus and annuli were measured and using the Fraser Lee method (Carlander 1981), mean length at age for each species were calculated. Instantaneous mortality (Z) for rainbow trout and brook trout were determined by catch curves (Ricker 1975). Catch curves were constructed by graphing the natural log (ln) of the catch as a function of age and instantaneous mortality was estimated by the absolute value of the slope of the descending right limb. Instantaneous mortality can be used to determine annual survival (S) by:

$$S = e^{-z}$$

where Z = instantaneous total mortality, S = annual survival, and A = annual mortality or 1-S.

Population Estimates

In 2006, we conducted mark-and-recapture electrofishing runs to estimate the abundance of salmonids in the Moyie River from the U.S.-Canada border downstream to Twin Bridges (18.8 km). Fishes were captured using a single drift boat mounted electrofishing unit. Attempts were made to capture all fish seen while electrofishing, and all captured fish were identified to species and measured to the nearest millimeter. All salmonids were either marked with a caudal tail punch, or an orange Floy T-bar tag was inserted below the dorsal fin. Three marking runs occurred on consecutive days (June 27-29) with the recapture runs occurring on July 6 and 7. We also used snorkeling (August 15, 2006) at 10 predetermined snorkel sites as a recapture run (see snorkel survey below for techniques). We used an adjusted Petersen estimate (Ricker 1975) to calculate the population size (N) for all salmonids species where three or more fish were recaptured.

$$N = \frac{(M+1)(C+1)}{R+1}$$

with a sampling variance of:

$$V(N) = \frac{N^2(C-R)}{(C+1)(R+2)}$$

Where:

M = the number of marked fish,
C = catch or sample taken from the population, and
R = number of recaptured marks in the sample

The Peterson estimate operates under the following assumptions:

1. Marked fish did not lose their marks.
2. Fish were not overlooked when recaptured.
3. Marked and Unmarked fish were equally vulnerable during recapture runs (non learning behavior).
4. Marked fish must redistribute in the population when released.
5. The population was closed (no movement in or out of study area)
6. No mortality occurred during the estimate.

Exploitation Estimates

To evaluate exploitation of rainbow trout and brook trout in the Moyie River, all fish > 200 mm captured through electrofishing (June 27 to July 7, 2006) were inserted with Floy tags below the dorsal fin and released immediately back to the water. Floy tags were marked with "IDFG", a reward value (non-reward, $10, $50, $100, and $200) and a phone number for anglers to call to report information about the fish captured and to receive their reward. These tags were generally applied at rates of 77%, 7%, 8%, 4%, and 4% respectively. The different reward values were used to estimate angler reporting rates based upon the high-reward methodology (Pollock et al. 2001). Tag reporting rate (λ), or angler compliance, was estimated as the relative return rate of non-reward tags to the return rate of high-reward tags (both $100 and $200 dollar tags were returned at similar rates and were considered high-reward tags; Butts et al. 2007):

$$\lambda = \frac{R_t N_r}{R_r N_t}$$

where R_t is the number of non-reward tags returned, N_t is the number of non-reward tags released, R_r is the number of high-reward tags returned, and N_r is the number of high-reward tags released (Butts et al. 2007).

To assess tag loss (*Tag_l*), roughly half the fish were double tagged. When anglers returned their tags they were asked if one or two tags were attached to the fish. The tag loss rate (Tag_{lr}) was calculated by dividing the number of double tagged fish that were reported by anglers as having one tag by the total number of reported fish that were actually doubled tagged. Data from the Moyie River were pooled with other tag return data from around the state to calculate tag loss by species across the state (Butts et al. 2007). To calculate the actual number of rainbow trout and brook trout that were lost from the data pool because they had lost their tag (for single tagged fish) or both of their tags (for double tagged fish) we used the following formula:

$$Tag_l = (Tag_{lr}S)+(Tag_{lr}^2D)$$

where S = the number of fish single tagged and D = the number of fish double tagged.

Tagging mortality (Tag_m) was unknown but was suggested by Butts et al. (2007) to be about 15% for salmonids.

The unadjusted exploitation rate (*u*) was calculated according to Ricker (1975) as the number of fish with non-reward tags caught by anglers that were harvested (R_h), divided by the number of fish released with non-reward tags (N_t). Adjustments were made to the exploitation estimate (u') based on angler compliance, tag loss, and tag mortality, using the following formula:

$$u' = \frac{R_h /(N_t - Tag_l)}{\lambda(1 - Tag_m)}$$

where the terms are defined as before (Butts et al. 2007).

To calculate annual exploitation we used only those tag returns from fish caught up until July 7, 2007 – a one year period. We used capture timing (on a weekly basis) to judge how seasonal closures could influence exploitation. We compared length frequencies of the fish tagged to the fish caught and harvested by anglers to evaluate if anglers were effective at catching all sizes of fish and if they were selective in the size of fish they harvested.

Snorkel Survey

To help evaluate the status of the fishery in the Moyie River, we selected 20 snorkel transects spread from the U.S.-Canada border downstream to Moyie Reservoir (Figure 25). These snorkel transects were selected based on what we believed was good rainbow trout, cutthroat trout and brook trout habitat, and efforts were made to distribute these transects throughout the entire reach of river (37 km). In an effort to accurately locate and duplicate snorkel surveys in the future, transect locations were recorded as waypoints using a Global Positioning System (Appendix A). In addition, photographs of each site were taken with permanent landmarks in the photo including starting and ending points of each transect (Appendix B).

The methods described below were used when conducting our snorkel surveys on the Moyie River and are the same as we use when conducting snorkel surveys in all rivers in the Panhandle. We suggest these techniques be followed to ensure data is collected in a consistent comparable manner.

Snorkel techniques used at each transect was based on sightability and transect width. Intent was to be reasonably certain that all fish in transects were visible to the divers and few or no fish were overlooked. In the wider transects or in more turbid water, where one diver could not easily see fish across the river, two divers were used, one on each side of the river. Divers began at the upstream end of transects and snorkeled downstream, as the size of the rivers generally precluded upstream counts. When snorkeling in pairs we tried to remain even with each other and the snorkeler counted only those fish that passed. This prevents double counting of fish. In areas where pocket water was the dominant habitat or shallow turbulent water limited visibility, transects were snorkeled upstream. In these habitats, the snorkeler often moves too fast through the reach to make accurate counts. Where woody debris or boulders were common, the snorkeler would often maneuver around the obstacle to ensure all fish were counted. We periodically duplicated counts using different divers to check for accuracy. If noticeable differences occurred in fish counts or length estimates between snorkelers, we discussed potential reasons and the transect in question was re-snorkeled.

When snorkeling in calm water, we have found that it is best to remain fairly motionless and near the surface. Too much motion can spook fish downstream, even out of the survey area. Snorkeling near the stream edge or away from where most of the fish are holding can also significantly reduce spooking fish downstream. It's also important to snorkel to the very end of transects, which typically should be the tail-out of a pool, glide or run. We have often observed large numbers of fish moving downstream in-front of snorkelers until they reach the end of the transect (tail-out). At this point, fish will often swim back upstream past the snorkelers to access deeper water. If the snorkeler did not swim to the end of the reach, these fish would remain at the end of the transect and go uncounted. For this reason, no transect should end in the middle of a pool, run or glide.

Estimates of fish abundance were limited to age 1+ fish (>75 mm), as summer counts for young of the year fishes are typically unreliable. Most YOY cutthroat trout will be smaller than 80 mm during surveys in August 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. In addition, any rainbow trout or brook trout observed with an orange Floy tag were noted for use in a mark-recapture population estimate (see details above). Prior to snorkeling each observer practiced guessing the lengths of plastic pipes to ensure accurate estimates lengths were made. Throughout the snorkel surveys we periodically held these practice sessions to maintain accuracy.

After completing fish counts, we measured the length and width of each transect with a rangefinder to determine the surface area (m^2) surveyed. At least four width measurements should be taken to get an average stream width of transects surveyed. Characteristics of transects were also recorded at each site. This information could help explain why changes in counts occur over time. Transect characteristics collected included: habitat type, maximum depth, amount and type of available cover, water temperature and visibility (see Appendix C for data sheets). Research by Thurow et al. (2006) has found that the accuracy of snorkel counts can vary from year to year based on water temperature, flow and visibility. They suggest correction factors should be developed based on variables to make counts more comparable from year to year. To accomplish this, periodic efforts in the future should be made to calculate actual population estimates (mark/recapture efforts) for particular snorkel reaches. Over time differences between actual population estimates from snorkel counts can be modeled using temperature, flow and visibility to develop a correction factor.

Periodically, channel shifting, bedload movement, and/or blow outs will alter a site and habitat composition. Many transects were originally selected because they represented good habitat for particular fish species (cutthroat trout and/or bull trout). When a transect changes drastically, continuing to conduct counts at this site may lead to low density estimates, which could lead to false assumptions about the fishery. Consequently, when a transect changes substantially so that it does not represent its original characteristics, a new transect should be selected. Old photographs and habitat descriptions should be evaluated before a decision to move transects is made. New transects should be selected based on the following prioritized conditions: 1) closeness to original transect, 2) similarity to original site, 3) access (avoid posted private property), and 4) permanence for future study (avoid areas where the channel appears to be shifting constantly).

We conducted our snorkel surveys on August 15 and 16, 2006. Due to limited visibility, snorkeling before this date was deemed ineffective. Based on these findings we recommend all future snorkel surveys occur during the third week of August. We suggest snorkeling transects at least once every three years.

We used one-man pontoon boats to access our snorkel sites. Boats larger than one-man pontoon boats would not be effective due to the shallow water conditions encounter during the third week in August. When floating the Moyie River, one should be aware of a dangerous rapid called "Hole in the Wall". We highly recommend portaging around this rapid. The location of this rapid is show on Figure 25 and its coordinates can be found in Appendix A.

Fish counts for each transect were converted to density (fish/100 m^2) to standardize the data and make it possible to compare counts within the watershed as well as to other watersheds. An average density of salmonid species (all sizes) including rainbow trout ≥ 300 mm were calculated for the entire Moyie River as well as for the Canyon Reach (transects 1-10) and the Upper Reach (transects 11-20). These averages were calculated by summing the total number of fish counted in a particular reach of stream and dividing it by the total area snorkeled. It is important to note that this is not the same as calculating an average from the density recorded at each snorkel transect within a particular reach or stream. In the future, the densities of these fishes can be compared to future snorkel surveys to evaluate trends in abundance. Snorkel surveys have occurred on the Moyie River in the past (Goodnight and Watkins 1979;

Horner and Rieman 1984). The length of river snorkeled was recorded in these surveys, but not the width of the river. For comparative purposes, we also summarized our data as fish/km.

To evaluate whether densities of cutthroat trout differed between the Canyon Reach and Upper Reach in the Moyie river we conducted a t-Test (assuming equal variances) on the density of fish in each of the transect sites. We used a p-value ≤ 0.10 to denote when a significant difference in density occurred between stream reaches. This value is often used to show significance when evaluating fish and wildlife populations for management purposes (Peterman 1990; Johnson 1999; Anderson et al. 2000).

Productivity

To assess the relative productivity of the Moyie River and to determine if quantities of phosphorus or nitrogen could be influencing the growth and abundance of desired fishes, we collected water samples at a bridge crossing 9.6 km downstream of the U.S.-Canada border. All water samples were collected using a Van-Dorn water sampling device and placed in a 250-mL plastic bottle that has been pre-rinsed with de-ionized water. Each 250-mL sample is a composite of three water grabs taken from near the surface, mid, and bottom of the water column. One composite sample was taken at left, right, and mid-channel to total 3 samples. All samples were immediately stored on ice in standard food-grade coolers the field. At the close of the field day, samples were shipped via Fed-Ex, overnight delivery to Aquatic Research Incorporated Laboratory (ARI, Inc., Seattle, WA) for analysis. Upon arrival at ARI, Inc. water samples were analyzed for total phosphorous (TP), total dissolved phosphorous (TDP), soluble reactive phosphorous (SRP), total nitrogen (TN), nitrite-nitrate, ammonia, and total organic carbon (TOC). Minimum detection limits for TP and TDP is 2.0 $\mu g \cdot L^{-1}$, 1.0 $\mu g \cdot L^{-1}$ SRP, 10.0 $\mu g \cdot L^{-1}$ for nitrite+nitrate, 5.0 $\mu g \cdot L^{-1}$ ammonia, and 0.5 $mg \cdot L^{-1}$ for TOC. Results from these water samples were compared to other systems.

RESULTS

Age, Growth, Mortality and Species Abundance

Over 4,300 fishes from the Moyie River were sampled through electrofishing during 2005 and 2006 to evaluate their relative abundance (Table 25). During both years, mountain whitefish, rainbow trout and brook trout were the most abundant species sampled representing over 90% of the catch (Table 25). Cutthroat trout represent less than 1% of the fishes collected.

Rainbow trout ranged in total length from 75 to 500 mm with most (95% in 2005, 92% in 2006) between 100 and 300 mm (Figure 26). The RSD-325 values (The percent of rainbow trout $\geq$ 200 mm that were $\geq$ 325 mm) obtained from electrofishing data was 14 in 2005 and 19 in 2006, both of which were lower than the 22 observed in 1999 (Table 26). When we evaluated RSD-325 values that were derived from angling data, they were higher in 2005 (16) than in 1999 (10) and 1984 (10). Relative weights (W_r) of rainbow trout sampled during 2006 were 96 for 200 mm fish and increased to 97 once they exceeded 330 mm (Figure 27). In 1999, the average W_r for all rainbow trout greater than 200 mm was 91 whereas in 2006 it averaged 97.

Ninety scales from rainbow trout ranging from 92 to 440 mm we used to determine age at length. Rainbow trout from the Moyie River reached about 94 mm by their first year and grew between 50 and 60 mm each subsequent year (Table 27). Growth rates of rainbow trout were similar as to what was recorded during 1999 and less than what was recorded during 1984

(Table 27). When compared to other rivers in the Panhandle region, rainbow trout in the Moyie River showed the slowest growth rates (Table 28). Based on the catch curve analysis of rainbow trout age 2 to age 7, instantaneous mortality was 0.840 in 2005 and 0.875 in 2006. This converts to total annual mortality rates of 57% and 58% in 2005 and 2006 respectively. Annual mortality for rainbow trout on the Moyie River was calculated to be 41% in 1999 and 42% in 1984.

Brook trout collected ranged in total length from 35 to 479 mm with most (95% in 2005, 87% in 2006) being between 120 and 270 mm (Figure 26). The RSD-250 values (The percent of brook trout ≥ 125 mm that were ≥ 250 mm) obtained from electrofishing data was 35 in 2005 and 39 in 2006, both of which were lower than the 40 documented in 1999 (Table 26). When we evaluated RSD-250 values that were derived from angling data, they were higher in 2005 (67) than in 1999 (33). Relative weights (W_r) of brook trout sampled during 2006 were 97 for 130 mm fish and increased past 100 once they exceeded 170 mm (Figure 27). In 1999, the average W_r for all brook trout greater than 130 mm was 101 whereas in 2006 it averaged 107.

Mountain whitefish collected ranged in total length from 35 to 465 mm with most (92% in 2005 and 2006) being between 140 and 300 mm (Figure 28). About 4% of the mountain whitefish sampled in 2005 were ≥ 300 mm whereas about 2% were ≥ 300 mm in 2006.

Population Estimates

Population estimates were conducted on rainbow trout, brook trout and mountain whitefish in an 18.8 km reach of the Moyie River extending from the U.S.-Canada Border downstream to Twin Bridges (18.8 km). Based on these estimates around 24,000 rainbow trout, 1,500 brook trout, and 22,000 mountain whitefish ≥ 125 mm occurred in this reach of river (Table 29). This converted to about 1,300 rainbow trout, 80 brook trout, and 1,200 mountain whitefish ≥ 125 mm for each km of river. When we evaluated only those fish ≥ 200 we calculated there were about 200 rainbow trout, 40 brook trout and 400 mountain whitefish in each km of river (Table 29). About 20 rainbow trout ≥ 300 mm were estimated to occur in each km of river whereas not enough mountain whitefish and brook trout ≥ 300 mm were recaptured to conduct a population estimate (Table 29).

When compared to other rivers in the Panhandle Region the density of rainbow trout and cutthroat trout combined in the Moyie River is high (Table 30). However, when we evaluated only those rainbow trout and cutthroat trout ≥300 mm, densities were 8 to 10 times lower than most other rivers (Table 30).

Exploitation Estimates

We tagged 278 rainbow trout and 168 brook trout from the Moyie River between June 27 and July 7, 2006 (Table 31). Through July 7, 2007, 11 (4%) of the tagged rainbow trout and 10 (6%) of the brook trout were reported captured (Table 32).

By comparing return rates for the high dollar reward tags ($100 and $200) to the non-reward tags, we calculated that angler compliance (Percent of time anglers return non-reward tags) was about 36% for rainbow trout and brook trout (Table 33). When we corrected for these angler compliance rates along with fish mortality rates (15%) and statewide tag loss rates (15.0% for rainbow trout and 16.5% for brook trout) we calculated that 10% to 15% of the tagged rainbow trout and 23% of the brook trout were caught over a one year period depending on whether we used high reward tags (assume 100% angler compliance) or non-reward tags

(Table 34). Between 60% and 67% of the rainbow trout that were caught were reported as being harvested whereas 44% of the brook trout that were caught were reported as being harvested (Table 34). Using non-reward tags and correcting for angler compliance, tag loss rates, and fish mortality, we calculated that annual exploitation (July 2006 to July 2007) for rainbow trout and brook trout was about 6% and 10% respectively (Table 35).

Most (85%) of the rainbow trout and brook trout were reported being caught during June and July (Figure 30). The size distribution of both rainbow trout and brook trout caught were similar to the size distribution that were tagged indicating angler fishing techniques are equally effective in catching all sizes of fish (Figure 31).

Snorkel Survey

Twenty transects were snorkeled in the Moyie River watershed on August 15-16, 2006 to evaluate the fishery. Water temperatures ranged from 14-19°C during the survey, 75% (15 out of 20) of sampled transects consisted of pool habitat and large substrate was the dominate form of cover in all but one transect. Forty-five percent (9 out of 20) of the transects had maximum depths ≥2 m (Table 36). A total of 617 rainbow trout, 30 brook trout, 1 cutthroat trout, 91 mountain whitefish, 208 largescale sucker *Catostomus macrocheilus* and 100 longnose sucker *Catostomus catostomus* were counted during this survey (Table 37).

Rainbow trout were observed in 19 of the 20 transects snorkeled. Densities of rainbow trout (all size classes) in these transects ranged from 0.00 to 2.83 fish/100 m^2 with an overall average of 1.11 fish/100 m^2 (Table 37). About 15% of the rainbow trout observed were estimated to be ≥300 mm in length and their overall density was calculated to be 0.17 fish/100 m^2. Rainbow trout densities were similar (t-test = 0.48) between the canyon reach and upper reach (Figure 32 and Table 38). When we evaluated only those rainbow trout ≥300 mm, densities were higher in the upper reach (Figure 32 and Table 38), although this difference was not significant (t-test = 0.15) The density of rainbow trout observed in 2006 was considerably higher than what was observed in previous snorkel surveys in the Moyie River (Table 39). Previous surveys did not occur at the same time or in the same locations as occurred during 2006.

Brook trout were observed in 5 of the 20 transects we snorkeled, all of which occurred in the upper reach (Table 37). Densities of brook trout in these transects ranged from 0.00 to 0.32 fish/100 m^2 with an overall average of 0.05 fish/100 m^2 (Table 37). Most of the brook trout observed were associated with large woody debris which made their detection difficult. Ten percent of the brook trout observed were ≥ 300 mm. The density of brook trout observed in 2006 was considerably higher than what was observed in previous snorkel surveys in the Moyie River (Table 39).

Mountain whitefish were observed in 14 of the 20 transects we snorkeled (Table 37). Densities of mountain whitefish in these transects ranged from 0.00 to 0.72 fish/100 m^2 with an overall average of 0.16 fish/100 m^2 (Table 37). Mountain whitefish densities were higher in the canyon reach than the upper reach (Table 38). No mountain whitefish observed were ≥ 225 mm. The density of mountain whitefish observed in 2006 was similar to what was observed in previous snorkel surveys in the Moyie River (Table 39).

When compared to other rivers in the Panhandle Region where snorkel surveys occur, the overall trout density in the Moyie River was similar to the Little North Fork Clearwater River, St. Joe River and N.F. Coeur d'Alene River (Table 40). However, densities of larger trout (≥ 300 mm) and whitefish in the Moyie River tended to be lower than occurred in similar rivers (Table 40).

Productivity

Water samples were analyzed for total dissolved phosphorous (TDP), soluble reactive phosphorous (SRP), total phosphorous (TP), ammonia, nitrite-nitrate (NO3+N02), and total nitrogen (TN) to assess the relative productivity of the Moyie River. Results from these water samples are shown on Table 41. Concentrations of SRP and dissolved inorganic nitrogen (ammonia and nitrite-nitrate combined) found in the Moyie River are below levels that are considered to limit primary productivity (Table 42).

DISCUSSION

The Moyie River is the only river in the Panhandle Region where rainbow trout over 325 mm and brook trout over 250 mm are relatively common. Add to this low fishing pressure, and it becomes evident that the Moyie River provides a fishing opportunity that is unique in this area. About 77% of the trout in the Moyie River are rainbow trout and 23% are brook trout. Cutthroat trout also occur in the Moyie River, but represent < 1% of the trout.

Rainbow trout

Rainbow trout were either the most abundant or second most abundant fish observed in the Moyie River depending on the time of the year. The population estimate derived from only electrofishing suggests that the density of rainbow trout was high (1,278 trout/km) in the Moyie River when compared to other north Idaho rivers. However, while electrofishing we often observed tagged rainbow trout swimming away from the electrofishing boat. It appeared that once the rainbow trout had been electrofished they learned to avoid the boat, which is a violation of one of the assumptions when conducting a mark and recapture population estimate (marked and unmarked fish should be equally vulnerable during recapture runs). This explains why we did not recapture rainbow trout ≥ 200 mm in length. Reynolds (1996) suggests using different techniques when marking and recapturing fish to avoid these types of problems. Based on these conclusions, we believe the rainbow trout population estimate derived from recapture data from electrofishing is high and unreliable. Instead we should rely only on the snorkeling recapture data for the population estimate on rainbow trout. Based on this data, densities of rainbow trout were low (200 fish/km) in the Moyie River when compared to other rivers in the Panhandle, especially for those fish ≥ 300 mm in length (20 fish/km).

The low density of rainbow trout in the Moyie River is likely a factor of the habitat conditions. Long stretches of shallow riffle habitat occur in the Moyie River. When shocking this habitat, few rainbow trout were ever observed. Most rainbow trout were captured in pools and runs. It is believed that historic logging practices and floodplain development (railroads, roads, and residential development) reduced pool quality and quantity in the Moyie River (DEQ 2006).

Despite the overall low density of rainbow trout in the Moyie River, where pools and deeper runs occurred, rainbow trout were often abundant. Transects that were snorkeled in 2006 mostly occurred in pools and deeper run habitat. When this data was compared to other rivers in the Panhandle Region where snorkel surveys occur, the overall trout density (primarily rainbow trout or cutthroat trout) in the Moyie River (1.16 fish/100 m^2) was similar to some of the more popular river fisheries in the Panhandle including the St. Joe River (1.18 fish/100 m^2), North Fork Coeur d'Alene River (1.08 fish/100 m^2) and the Little North Fork Clearwater River (1.75 fish/100 m^2). This information suggests that although the overall densities of rainbow trout may be low in the Moyie River, good fishing can be had in many of the pools and deeper runs.

Although the abundance of rainbow trout in the pools and runs is good in the Moyie River, these fish tend to be smaller than what occurs in other Panhandle Rivers. Based on snorkel surveys, the density of trout ≥ 300 mm in the Moyie River was 0.17 fish/100 m^2, whereas it was 0.39 fish/100 m^2 St. Joe River, 0.23 fish/100 m^2 North Fork Coeur d'Alene River and 0.78 fish/100 m^2 the Little North Fork Clearwater River.

The smaller size of rainbow trout in the Moyie River is mostly due to slow growth rates. When compared to the growth of rainbow trout populations in the Coeur d'Alene, Kootenai and Spokane rivers, they were the slowest. Rainbow trout in the Moyie River reach 300 mm at about five years of age whereas they reach 300 mm by age 3 or 4 in other rivers. The slower growth rates of rainbow trout in the Moyie River are likely due to its low productivity. The glaciated granitics that dominate the landscape in this watershed contribute very little nutrients to the river. Water samples indicate that the river is nitrogen limited. Productivity could be increased in the Moyie River through a nutrient enrichment program. A nutrient enrichment program has been implemented on the Kootenai River, Idaho, and has been successful at improving primary productivity, fish growth and fish abundance (Hardy In Prep). Despite the slower growth rates, when compared to the length specific standard weight, the relative weight of rainbow trout in the Moyie River is near average (W_r = 97).

The annual mortality rates calculated for rainbow trout in 2005 and 2006 (57-58%) is considered high. A combination of slow growth and high annual mortality rates would certainly explain why fewer rainbow trout reached larger sizes in the Moyie River. It's appears confusing that the annual mortality rates we calculated for 2005 and 2006 (57-58%) would be so much higher than was calculated for 1999 (41%) and 1984 (42%), considering there were more rainbow trout in the Moyie River in 2005 and 2006. There are a couple explanations for this. For a catch curve to be accurate in portraying annual mortality rates, all size classes of fish used in the analysis must be equally vulnerable to capture (Ricker 1975). If larger fish are less vulnerable to capture, it will cause annual mortality calculations to increase. Based on the recapture of tagged fish, it was evident that the larger fish were able to avoid capture more than smaller fish. In an effort to correct for this problem, we only used those fish captured during the three marking runs in our analysis. We also conducted a catch curve on our snorkel data to evaluate annual mortality of rainbow trout. Through snorkeling we believe that all size classes of fish used in the analysis were equally vulnerable to capture or observation in this case. We used the number of fish in 75 mm size groupings for the x-axis instead of number of fish in each age class as is typically done. Using this technique we calculated an annual mortality rate of 55%. When we used this same methodology on the electrofishing data we calculated a 59% annual mortality. Based on this data, it would suggest that the larger fish were slightly less vulnerable to capture than the smaller fish during the marking electrofishing run, but not enough to explain the large difference in mortality rates between 2005-2006 and the earlier data (1999 and 1984). To avoid this type of problem in the future, we suggest electrofishing when flows are higher and more turbid (>1,500 cfs – similar to what occurred during 1999 sampling), or electrofishing at night.

The other explanation that may explain why the calculated annual mortality rate was so high for rainbow trout in 2005 and 2006 is that recruitment and or survival of rainbow trout has increased in recent years. For a catch curve to be accurate in portraying annual mortality, the mortality rate must be steady over time (Ricker 1975). If survival or recruitment of rainbow trout was increasing during the years of our analysis, it would cause higher mortality rates to be calculated. Our data suggests that mortality rates and/or recruitment of rainbow trout increased in recent years. The 2006 electrofishing data found 26% of the salmonids were rainbow trout, whereas in 1999 11% of the salmonids were rainbow trout. Comparisons of snorkel survey data shows that there were two to three times more rainbow trout in 2006 than in 1975 and 1984 despite heavy stocking in the earlier years.

Reasons for the increase in abundance in rainbow trout in 2006 could be partly related to changes in annual exploitation. Annual exploitation rates have declined over the years from 27% in 1975 (Goodnight and Watkins 1976), 14% in 1998 (using data from Fredericks et al. 2002a), 10% in 1999 (using data from Fredericks et al. 2002b) and 6% in 2006. We believe this is largely due to decreased fishing pressure, which we believed mirrored the number of fish stocked. In 1975, over 14,000 rainbow trout were stocked into the Moyie River. Stocking stopped in 1977 and resumed again in 1983 at a reduced effort (5,000-10,000 a year). Stocking continued until1998 until it was determined that there was less than a 15% return to creel and which was not a good economical use of sportsmen dollars. In 2000, the fishing regulations were changed from 6 fish to 2 fish to help protect the wild fish. We believed this also helped further reduce angler exploitation.

Another reason we believe the rainbow trout population has increased between 1999 and 2006 is due to changes in weather patterns. From 1991 to 1999 air temperatures in Bonners Ferry were significantly below average during three different winters (December through February) whereas between 2000 and 2006 below average winter temperatures occurred only once and this was not extreme (Figure 33). Work by DuPont et al. (In Press) found that the year after unusually cold winters, 40-50% declines in cutthroat trout density were observed in the St. Joe River and Coeur d'Alene River. Others have also found winter to be a major period of fish mortality based largely on the severity of the winter and subsequent losses of stored energy (Reimers 1963; Hunt 1969; Whitworth and Strange 1983). Long extended cold periods appear to have the most impact on smaller fish (Shutter and Post 1990; Meyer and Griffith 1997). Severe winters may have even more of an effect on rainbow trout in the Moyie River due to the poor habitat conditions. The average winter temperature in Bonners Ferry over the last nine years (life span of Moyie River rainbow trout) is the warmest on record, which presumably has increased overwinter survival of younger rainbow trout in the Moyie River.

We also believe the cessation of stocking also improved the abundance of wild rainbow trout in the Moyie River between 1999 and 2006. Rainbow trout were last stocked into the Moyie River in 1998. Numbers of wild trout have been found to increase once stocking has been stopped (Weber and Fausch (2003) and the references therein). Stocked fish can negatively affect wild fish through competition, disease transmission, predation, genetic contamination, and long term displacement (Weber and Fausch 2003). Vincent (1987) found that after four years of not stocking hatchery rainbow trout in the Madison River the number of wild rainbow trout had increased eight fold. When stocking stopped in 1977 in the Moyie River, a 52% reduction in wild rainbow trout numbers was observed a year later (Goodnight 1979). In the Moyie River, Goodnight (1979) believed that stocking buffered the impact of angling effort on wild rainbow trout. When stocking stopped, effort and exploitation increased on wild fish. In the Madison River, relatively low fishing pressure occurred during and after stocking and consequently anglers did not have the ability to further suppress the wild trout population (Vincent 1987). Angling effort quickly dropped on the Moyie River when stocking stopped (Goodnight 1979). No follow up surveys were conducted after 1977 to see if this allowed the wild trout population to improve, although we suspect it did.

In 1990, the Pacific Gas and Electric Company added a parallel natural gas line that crossed the Moyie River eight times. To stabilize these crossings they constructed boulder drop structures across the river. For mitigation of this project, they also constructed around 20 bank barbs along the river (Chip Corsi, IDFG, personal communication). These structures created more complexity and pool habitat in the river, and when shocking these areas there were noticeably more fish. Although not evaluated, we suspect these structures also improved spawning habitat as spawning sized gravels appeared more abundant around them. Continued efforts to improve pool habitat and complexity would likely increase the population abundance of rainbow trout in this system.

The rainbow trout population in the Moyie River appeared to be in better condition in 2006 than it had been in the past 30 years. A combination of lower fishing pressure, favorable weather conditions, not stocking fish and habitat enhancement all appeared to play a role in improving this fishery. However, we still must be careful when managing this rainbow trout population. We believe that increased angler harvest could result in cropping off of the larger fish. Rieman (1987) stated that annual mortality rates > 40% will result in cropping off of longer lived fish such as largemouth bass. Some of the fish we collected in the Moyie River exceeded 450 mm. Based on the growth rates we observed (50 mm a year), these fish were likely 8 or more years old. It's not clear what the annual mortality rates were in 2006 due to the presumably expanding rainbow trout population, although we believe it dropped below 40%. As this river becomes more popular, which we believe it will, due to the unique fishing opportunity it provides. It may be necessary to put size restrictions on this rainbow trout to preserve the quality of the fishery.

One of the popular ways to fish the Moyie River is by floating. However, often by mid-July flows become too low to float drift boats and rafts. That leaves less than two months where people can effectively float and fish the Moyie River. Often, suitable flows for floating occur in April and May when the fishing season is closed. Good insect hatches can also occur during this time potentially making it a good time to fish. Based on the low exploitation that occurs on the Moyie River we believe the Moyie River could be opened all year to increase fishing opportunities and still have a minimal impact on the rainbow trout population. Most of the tagged fish were caught in June and July which suggests that some additional but minor harvest would occur in May. We would expect little harvest during winter as no fish were reported as being caught between October and March. If the popularity of this river increases, restrictions may be needed to protect the size structure of this rainbow trout population. This is especially true as it appeared most anglers attracted to this fishery are harvested oriented. About 2/3 of the tagged rainbow trout reported as being caught were harvested. If exploitation increases, additional protection to rainbow trout could be provided through implementing size restrictions or shortening the season. This decision would be largely depended on public preference.

Other things to consider when managing this rainbow trout population is the effects global warming may have on this fishery. It has been argued that global warming can cause warmer or more extreme variations in water temperatures and flows (Whited et al. 2007). As we mentioned earlier, winter air temperatures have been the warmest on record over the past 9 years. We believe this has improved overwinter survival for rainbow trout in the Moyie River; however, summer air temperatures (in Bonners Ferry) have also been the warmest on record over the last nine years. Extreme summer water temperatures in the Spokane River, Idaho, were believed to have increased mortality and been a significant factor in the decline of rainbow trout in the 1990s (Ned Horner, IDFG, personal communication). Water temperatures in the North Fork Coeur d'Alene River and St. Joe River has also seen record highs over the last nine years; however, cutthroat trout numbers are near or at the highest densities they've seen over the last 40 years (DuPont et al. In Press). Potentially, summer water temperatures were lethal to rainbow trout due to warm water flows from the Spokane River. Even with lethal water temperatures, the Spokane River should be able to support rainbow trout if significant cold water refugia occurred (streams, springs, ground water), which does not appear to be the case in the Idaho reach. The Moyie River also receives much of its flow from Moyie Lake, which occurs about 100 km upstream of Idaho. Within that 100 km, numerous tributaries enter the river and likely an abundance of springs and groundwater flow. These flows all help reduce water temperatures below typical surface temperatures of Moyie Lake. For these reasons, we do not believe water temperatures have reached lethal levels on the Moyie River. If water temperatures continue to climb in the Moyie River, we may eventually reach the tipping point where the benefits received from higher winter survival are outweighed by increased summer mortality. Insuring that tributaries are kept well shaded and the floodplain fully connected should help maintain summer water temperatures at acceptable levels.

Moller and VanKirk (2003) have found that rainbow trout in the South Fork Snake River appear to have a competitive advantage over Yellowstone cutthroat trout *O. Clarkii bouvieri* where flows were less flashy (lower peak flows and higher low flows). They speculate these types of flows provide better rearing conditions for first year rainbow trout that occur in the main river, and by restoring a more flashy system rainbow trout recruitment would decline. We evaluated the flow data on the Moyie River for the past 75 years. Over the last nine years there have been two of the top five peak flow events. When we evaluated flow flashiness (peak flows/minimum flows) it has been extremely variable over the last nine years, but is trending upward if we evaluate it through a 9-year rolling average (Figure 34). At this point, we do not feel that flows are causing significantly lower first year survival of rainbow trout. However, if the Moyie River system continues to exhibit greater flow extremes it could cause rainbow trout numbers to decline. Providing stable complex habitat that could hold spawning gravels and provide refuge for fish during higher flows could help counter the negative effects of a flashy system (Beechie et al. 2006). Fausch et al. (2001) found that successful invasions of rainbow trout could be accounted for by the timing of rainbow trout fry emergence and months with low probability of flood disturbance. In other words, if floods occur when rainbow trout fry emerge from gravels they will have lower survival rates. This suggests that if shifting climatic patterns cause the timing of floods to change it could affect survival of rainbow trout. Peak flows on the Moyie River typically occur in May and do not appear to have changed significantly in recent years. If warmer climates cause runoff to occur earlier, it could change survival of emerging rainbow trout. No studies have been conducted to determine when rainbow trout spawn in the Moyie River, and as a result we are unsure of how earlier runoff would effect this fishery.

Brook trout

Brook trout were the third most abundant fish sampled from the Moyie River and represented between 15% and 23% of the trout. Brook trout were sampled that ranged between 123 mm and 370 mm in total length. The RSD-250 (the percent of brook trout ≥ 125 mm that were ≥ 250 mm) ranged between 35 and 39, which is similar to that documented in 1999 (40). When compared to the length specific standard weight, brook trout in the Moyie River exhibit a healthier than average body condition (W^r = 107).

Brook trout densities were relatively low in the Moyie River (78 fish ≥ 125 mm/km), largely due to the dominance of riffle habitat in the river where few brook trout were observed or captured. If one focuses on the pools and deeper runs they can experience good fishing.

We are aware of no other river in the Panhandle Region that offers this type of brook trout fishery. Most of the rivers in this region have few brook trout in them, and catching one through angling is uncommon. In the Moyie River, one can expect to catch brook trout larger than 250 mm. Outside of the Moyie River, only smaller tributaries provide consistent brook trout fishing, and most of these fish are smaller than 200 mm.

Brook trout numbers appear to have increased over the years based on snorkel surveys. Estimated brook trout abundance increased from 2 fish/km in 1975 (Goodnight and Watkins 1976) to 9 fish/km in 1984 (Horner and Rieman 1984) to 14 fish/km in 2006. The snorkel data is questionable however, as not the same areas were snorkeled during each year and it was difficult to see brook trout as they often were hiding in wood or boulders. During 2006, brook trout were only observed in the Upper Reach, although past surveys have identified them in the Canyon Reach (Goodnight and Watkins 1976).

Exploitation appears to have declined for brook from 14% in 1999 to 10% in 2006. Based on reported tag returns, about 44% of the brook trout that were caught were harvested. The limit for brook trout in 2006 was 25 fish a day. This limit is essentially unobtainable in the Moyie River, although it does not appear to be having a negative impact on this fishery.

Mountain whitefish

Mountain whitefish in the Moyie River displayed an unusual behavior. While electrofishing during the spring (late June and early July), mountain whitefish were the most abundant fish sampled (53-60% relative abundance) and ranged in length from 35 mm to 465 mm. However, when we snorkeled in August, mountain whitefish only represented 9% of the fish we observed, and none were larger than 225 mm. This suggests to us that adult mountain whitefish migrate out of the Idaho reach of the Moyie River during the summer. This is also supported by historic snorkel data where whitefish were not abundant in August (Goodnight and Watkins 1976; Horner and Rieman 1984). These whitefish do not migrate downstream as impassible falls would prevent them from returning. Therefore, these fish must migrate upstream into Canada, and in all likelihood migrate all the way to Moyie Lake. Other fish are known to have outlet spawning lifecycles including bull trout (DuPont et al. 2007), rainbow trout (Lindsey et al. 1959) and cutthroat trout (Cope 1957); however, we are not aware of any other data that indicates mountain whitefish also display this behavior. Outlet spawning bull trout occur in Moyie Lake and migrate 40 to 80 km downstream before they enter tributaries to spawn. This makes it seem plausible that mountain whitefish could also display similar or identical behavior. Mountain whitefish don't generally migrate significant distances and if they display migratory behavior they must swim over 100 km from Moyie Lake to reach Idaho. Mountain whitefish would return to Idaho by November or December to spawn, and then more than likely, remain in Idaho through the winter and spring until July when they would migrate back upstream.

Typically, fish develop migratory life cycles because it increases their reproductive potential through a combination of increased survival, growth and gamete production (Gross 1991). We're not sure what the benefit would be for mountain whitefish to leave the river in Idaho during the summer. It could be food related or temperature related. Another possibility is these mountain whitefish evolved in Moyie Lake, similar to the mountain whitefish that once flourished in Priest Lake. Then, over time they expanded their spawning range. These fish probably developed this unique life cycle thousands of years ago, so the conditions they face now are not what caused or allowed them to develop this behavior. A tagging or telemetry study would be necessary to confirm this suspected life history pattern.

Cutthroat trout

Based on sampling it does not appear that a viable cutthroat trout population occurs in the Moyie River. We collected 4,302 fishes through electrofishing and only four were cutthroat trout. While snorkeling we observed 1,047 different fishes and only one cutthroat trout. Cutthroat trout abundance has been extremely low as far back as 1975 when 280 fish were observed through snorkeling and only one cutthroat trout was documented. Densities of cutthroat trout observed through snorkeling were one fish/km in 1975 (Goodnight and Watkins 1976) three fish/km in 1984 (Horner and Rieman 1984) and < 1 fish/km in 2006. Based on these numbers it is unlikely that a fluvial cutthroat trout population occurs in the Moyie River. In all likelihood the cutthroat trout we sampled or observed were flushed from tributary streams or from Canada. The same numbers of cutthroat trout (3) were sampled in 2006 as pumpkinseed sunfish *Lepomis gibbosus*, which we assumed were flushed out of Robinson Lake. Cutthroat trout occur in many of the tributaries of the Moyie River and often are the most common species that occur (Walters 2006).

The absence of cutthroat trout in the Moyie River can likely be explained by competition with rainbow trout and brook trout, lost access to many of the tributaries, degraded main stem habitat and high historic fishing mortality. Both rainbow trout and brook trout have been found to displace rainbow trout from river and stream habitat (Behnke 1992), and they are the most abundant trout in the river. Access to many of the tributaries has been blocked by road and railroad construction (Horner and Rieman 1984), which would prevent establishment of fluvial cutthroat trout in these streams. Loss of pool habitat and large woody debris has likely resulted from historic logging practices and floodplain development (railroads, roads, homes) (DEQ 2006). Fluvial cutthroat trout depend on this type of habitat for survival (DuPont et al. In Press). Historically, fishing pressure was much higher in the Moyie River. Much of the pressure was created by the heavy stocking of rainbow trout (20,000 to 50,000 fish annually). In an effort to harvest rainbow trout, it was likely that considerable cutthroat trout harvest occurred. Cutthroat trout are considered an easy fish to catch (Trotter 1987) which may be a result of evolving in unproductive waters where aggressive feeding must occur to obtain adequate food supplies (Rieman and Apperson 1989). Lewynsky (1986) found that cutthroat trout are significantly more vulnerable to angling than rainbow trout. When exposed to similar fishing regulations, higher catch rates of cutthroat trout could lead to a dominance of rainbow trout where they occupy the same waters (Lewynsky 1986).

If there is a desire to rebuild the fluvial cutthroat trout population in the Moyie River, considerable effort would have to occur to be successful. This would entail reducing the rainbow trout and brook trout population, improving access to tributary streams, improving main stem habitat and restricting cutthroat trout harvest. We believe the time and money commitment that it would take to accomplish these goals makes it unrealistic to restore fluvial cutthroat trout back into the Moyie River. Instead, we believe efforts should be made to protect the cutthroat trout that occur in the tributaries.

One thing that we should consider is, if native bull trout and whitefish have outlet spawning life cycles from Moyie Lake, it is possible that at one time native cutthroat trout also had this same life cycle. If this were the case, cutthroat trout migrations would likely occur sometime between March and June. Sampling during this time period, although difficult due to flow conditions, would provide us more information on the life history of Moyie River cutthroat trout.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor the fishery in the Moyie River every three to five years. Snorkel surveys could occur every three years due to its relative ease and minimal time constraints (2 days).

2. Conduct future mark-and-recapture studies when flows are >1,500 cfs (similar as occurred during the 1999 sampling effort) to help insure all size classes of rainbow trout will be equally vulnerable to capture.

3. Consider sampling during April or May to evaluate if adfluvial cutthroat trout occur in the Moyie River.

4. Due to low exploitation rates, open the fishery year round to provide more fishing opportunity.

5. Encourage habitat improvement efforts within the Moyie River that will increase pool frequency and complexity. These types of efforts should increase the abundance of trout and make them more resilient to flood events.

Table 25. The number and relative abundance of all fishes sampled from the Moyie River, Idaho, through electrofishing during 2005 (July 19) and 2006 (June 27 to July 7).

	2005		2006	
Species	Number	Relative abundance	Number	Relative abundance
Mountain whitefish	216	53%	2340	60%
Rainbow trout	133	33%	931	24%
Brook trout	24	6%	260	7%
Longnose dace	17	4%	153	4%
Longnose sucker	5	1%	89	2%
Largescale sucker	8	2%	85	2%
Slimy sculpin	4	1%	27	1%
Cutthroat trout	1	<1%	3	<1%
Pumpkinseed	0	0%	3	<1%
Brown bullhead	0	0%	1	<1%
Kokanee	0	0%	1	<1%
Torrent sculpin	0	0%	1	<1%
Total	408	100%	3894	100%

Table 26. The relative stock density (RSD) of rainbow trout (RSD-325) and brook trout (RSD-250) sampled from the Moyie River, Idaho, during 1984 (Horner and Rieman 1984), 1999 (Fredericks et al. 2002b), 2005 and 2006.

Sample technique	1984	1999	2005	2006
		Rainbow trout		
Electrofishing		22	14	19
Angling	10	10	16	
		Brook trout		
Electrofishing		40	35	39
Angling		33	67	

Table 27. Comparison of total length (mm) at age for rainbow trout in the Moyie River, Idaho, during 2006, 1999 (Fredericks et al. 2202b), and 1984 (Horner and Rieman 1984).

	Age					
Year	1	2	3	4	5	6
2006	94	149	199	258	316	359
1999	98	150	205	260	334	391
1984	96	160	228	297		

Table 28. Comparisons of total length (mm) at age for rainbow trout populations in rivers within the Idaho Department of Fish and Game Panhandle Region.

	Age					
Location and Citation	1	2	3	4	5	6
Moyie River	94	149	199	258	316	359
N.F. Coeur d'Alene River Lewynsky (1986)	70	125	220	302	374	454
Kootenai River Walters (2003)	179	253	318	374	358	
Spokane River Davis et al. (1997)	194	258	358	397	410	

Table 29. Population estimates (N), using an adjusted Petersen estimate, of rainbow trout, brook trout and mountain whitefish in the Moyie River, Idaho, from the U.S.-Canada border downstream 18.8 km to Twin Bridges, during 2006.

Species and	Recapture					90% CI		
size class (mm)	Method	M	C	R	N	UL	LL	Fish/km
Rainbow trout ≥ 125	Electrofish	398	300	4	24,020	40,016	8,023	1,278
Rainbow trout ≥ 200	Snorkel	355	232	21	3,770	5,001	2,540	201
Rainbow trout ≥ 300	Snorkel	58	64	9	384	558	209	20
Brook trout ≥ 125	Electrofish	139	114	10	1,464	2,125	803	78
Brook trout ≥ 200	Electrofish	108	73	9	807	1,179	435	43
Mountain whitefish ≥ 125	Electrofish	1,094	788	38	22,153	27,770	16,535	1,178
Mountain whitefish ≥ 200	Electrofish	612	299	24	7,356	9,628	5,084	391

Table 30. Comparisons of density estimates (fish/river km) of rainbow trout (RBT) and cutthroat trout (WCT) combined in rivers within the Idaho Department of Fish and Game Panhandle Region including the Moyie River, Coeur d'Alene River, Spokane River (Davis et al. 1997; Bennett and Underwood 1988), and St. Joe River (Nelson et al. 1997).

River and year	RBT & WCT all sizes	RBT & WCT ≥300 mm
Moyie 2006	1,278	20
Kootenai 2003	122	40
Coeur d'Alene 2006	496	157
Spokane 1991	330	116
Spokane 1985	1,288	206
St. Joe 1995	780	150

Table 31. Number of rainbow trout and brook trout Floy tagged from the Moyie River, Idaho, between June 27 to July 7, 2006.

Reward Value	Rainbow trout	Brook trout	Total tagged
0	205	161	366
$10	25	1	26
$50	23	3	26
$100	14	2	16
$200	11	1	12
All tags	278	168	446

Table 32. Number of rainbow trout (RBT) and brook trout (BRK) that were tagged with reward tags on the Moyie River, Idaho, between June 27 and July 7, 2006 that anglers reported harvesting or catching and releasing through July 7, 2007.

	Harvested						Caught and released					
Species	$0	$10	$50	$100	$200	Total	$0	$10	$50	$100	$200	Total
RBT	4	1	1	2	0	8	1	1	0	1	0	3
BRK	6	0	1	0	0	7	3	0	0	0	0	3

Table 33. Angler compliance rates for rainbow trout and brook trout combined on the Moyie River, Idaho, based on the number of fish initially tagged (N) and reported as being caught (R), for both high reward ($100 and $200) and non-reward tags.

High Reward			Non-reward			Angler
N	R	%	N	R	%	Compliance
28	3	0.107	366	14	0.038	0.357

Table 34. Catch, release, and harvest rates of rainbow trout and brook trout from the Moyie River, Idaho, between July 7, 2006 and July 7, 2007, based on high reward tags ($100 and $200 tags) and non reward tags and corrected for angler compliance, tag loss and fish mortality.

Fate of	Rainbow trout		Brook trout	
tagged fish	High $	Non-reward	High $	Non-reward
Caught	0.147	0.098	NA	0.228
Released	0.333	0.400	NA	0.556
Harvested	0.667	0.600	NA	0.444

Table 35. Exploitation rates of rainbow trout (RBT) and brook trout (BRK) from the Moyie River, Idaho, between July 7, 2006 and July 7, 2007 calculated using the number of non-reward fish that were tagged and harvested by anglers, angler compliance rates, tag loss rates and fish mortality rates reported in the table below.

	Non-rewward fish		Angler	Tag loss	Fish	Exploitation	
Species	Tagged	Harvested	compliance	rate	mortality	Unadjusted	Adjusted
RBT	205	3	0.357	0.150	0.15	0.015	0.057
BRK	161	4	0.357	0.165	0.15	0.025	0.098

Table 36. Characteristics of transects snorkeled in the Moyie River, Idaho, during August 15-16, 2006.

Reach	Transect	Date	Time	Temperature	Visibility (m)	Habitat type	Max depth (m)	Dominant cover	Percent cover	Length (m)	Average width (m)	Area (m^2)
Moyie Lake to Twin Bridges	M01	8/16/2006	17:33	18.5	8.0	Pool	3	LS	15	100	16.00	1,600
	M02	8/16/2006	16:45	19.0	8.0	Run/Pool	1.75	LS	30	71	25.40	1,803
	M03	8/16/2006	16:11	18.5	8.0	Pool	3.5	LS	40	100	16.40	1,640
	M04	8/16/2006	14:25	18.0	8.0	Run	1.75	LS	20	115	25.50	2,933
	M05	8/16/2006	13:50	18.0	8.0	Pool/Run	2.5	LS	30	103	20.60	2,122
	M06	8/16/2006	13:18	17.0	7.0	Run	1.5	LS	50	104	24.20	2,517
	M07	8/16/2006	11:15	15.0	7.0	Pool	5	LS	20	72	24.60	1,771
	M08	8/16/2006	10:36	15.0	7.0	Pool	6.5	LS	15	100	30.20	3,020
	M09	8/16/2006	10:00	14.5	7.0	Pool	1.75	LS	15	85	24.00	2,040
	M10	8/16/2006	9:35	14.0	7.0	Run	1.1	LS	5	53	25.40	1,346
Twin Bridges to Canada	M11	8/15/2006	18:15	18.0	8.0	Pool	1.2	LS	40	176	30.83	5,427
	M12	8/15/2006	17:25	18.0	8.0	Riffle/PW	1	LS	60	94	22.83	2,146
	M13	8/15/2006	16:50	18.0	8.0	Pool	1.3	LS	30	107	31.83	3,406
	M14	8/15/2006	16:05	19.0	8.0	Pool	1.5	LS	30	57	24.50	1,397
	M15	8/15/2006	14:50	17.5	8.0	Run	1.2	LS	10	132	31.50	4,158
	M16	8/15/2006	13:15	16.0	8.0	Pool	5	LS	20	125	27.17	3,396
	M17	8/15/2006	12:15	16.0	8.0	Pool	2	LS	15	120	29.77	3,572
	M18	8/15/2006	11:10	15.0	8.0	Pool	2.5	LWD	15	100	31.20	3,120
	M19	8/15/2006	10:30	15.0	8.0	Pool	2.5	LS	10	145	22.10	3,205
	M20	8/15/2006	9:20	14.0	8.0	Run	1.2	LS	10	206	24.71	5,091
Total	20 sites									2,165		55,709

Table 37. Number and density (fish/100 m2) of fishes observed while snorkeling transects in the Moyie River, Idaho, during August 15-16, 2006.

Reach	Transect	Area (m^2)	Rainbow Trout Number counted ≥300mm	Rainbow Trout Number counted All sizes	Rainbow Trout Density (No./100 m^2)	Brook Number counted	Brook Density (No./100 m^2)	Cutthroat trout counted	Mountain whitefish Number counted	Mountain whitefish Density (No./100 m^2)	Salmonid density	Largescale sucker counted	Longnose sucker counted
Moyie Reservoir to Twin Bridges (Canyon Reach)	M01	1,600	1	6	0.38	0	0.00	0	0	0.00	0.38	15	0
	M02	1,803	0	14	0.78	0	0.00	0	2	0.11	0.89	0	0
	M03	1,640	3	39	2.38	0	0.00	0	0	0.00	2.38	14	0
	M04	2,933	10	83	2.83	0	0.00	1	10	0.34	3.21	1	0
	M05	2,122	4	23	1.08	0	0.00	0	2	0.09	1.18	14	0
	M06	2,517	0	8	0.32	0	0.00	0	4	0.16	0.48	0	0
	M07	1,771	4	17	0.96	0	0.00	0	0	0.00	0.96	0	0
	M08	3,020	4	42	1.39	0	0.00	0	17	0.56	1.95	0	0
	M09	2,040	2	7	0.34	0	0.00	0	0	0.00	0.34	0	0
	M10	1,346	0	0	0.00	0	0.00	0	8	0.59	0.59	0	0
Twin Bridges to Canada (Upper Reach)	M11	5,427	2	26	0.48	10	0.18	0	0	0.00	0.66	64	0
	M12	2,146	6	26	1.21	2	0.09	0	1	0.05	1.35	0	0
	M13	3,406	18	95	2.79	7	0.21	0	4	0.12	3.11	0	0
	M14	1,397	2	10	0.72	0	0.00	0	10	0.72	1.43	0	0
	M15	4,158	12	45	1.08	1	0.02	0	5	0.12	1.23	0	0
	M16	3,396	2	54	1.59	0	0.00	0	6	0.18	1.77	0	0
	M17	3,572	4	9	0.25	0	0.00	0	4	0.11	0.36	0	0
	M18	3,120	11	54	1.73	10	0.32	0	6	0.19	2.24	100	100
	M19	3,205	2	25	0.78	0	0.00	0	0	0.00	0.78	0	0
	M20	5,091	5	34	0.67	0	0.00	0	12	0.24	0.90	0	0
Total	20 sites	55,709	92	617	1.11	30	0.05	1	91	0.16	1.32	208	100
Canyon	1-10	20,792	28	239	1.15	0	0.00	1	43	0.21	1.36	44	0
Upper	11-20	34,917	64	378	1.08	30	0.09	0	48	0.14	1.31	164	100

Table 38. The average density (fish/100 m^2) of salmonids observed while snorkeling the Moyie River, Idaho, during August 15-16, 2006.

Species	Canyon Reach	Upper Reach	Entire River
Rainbow trout (all sizes)	1.15	1.08	1.11
Rainbow trout (≥ 300 mm)	0.13	0.18	0.17
Brook trout	0.00	0.09	0.05
Cutthroat trout	< 0.01	0.00	< 0.01
Mountain Whitefish	0.21	0.14	0.16

Table 39. The average number of fishes/km observed while snorkeling the Moyie River, Idaho, during 1975 (Goodnight and Watkins 1976), 1984 (Horner and Rieman 1984) and 2006.

Species	1975	1984	2006
Rainbow trout (all sizes)	153	78	285
Rainbow trout (≥ 300 mm)	NA	2	42
Brook trout	2	9	14
Cutthroat trout	1	3	<1
Mountain Whitefish	37	65	42

Table 40. Comparisons of densities (fish/100 m^2) of salmonids determined through snorkel surveys in rivers within the Idaho Department of Fish and Game Panhandle Region during 2005 or 2006.

River	Trout (all sizes)	Trout (≥300 mm)	Whitefish	Salmonids
Moyie River	1.16	0.17	0.16	1.33
L.N.F. Clearwater River	1.74	0.78	1.16	2.90
St. Joe River	1.18	0.39	1.05	2.23
N.F. Coeur d'Alene River	1.08	0.23	4.26	5.57
L.N.F. Coeur d'Alene River	0.35	0.07	0.01	0.43
S.F. Coeur d'Alene River	0.58	0.04	0.42	1.00

Table 41. Concentrations (µg/l) of total dissolved phosphorous (TDP), soluble reactive phosphorous (SRP), total phosphorous (TP), ammonia, nitrite-nitrate (NO3+NO2), and total nitrogen (TN) collected from the Moyie River, Idaho, 9.6 km downstream of the U.S.-Canada border on July 11, 2006.

Location	TDP	SRP	TP	Ammonia	NO_3+NO_2	TN
Left bank	4	<1	7	<5	<10	119
Right bank	3	<1	7	<5	<10	109
Middle	3	<1	7	<5	<10	131

Table 42. Comparisons of concentrations (µg/l) of total dissolved phosphorus (TDS), soluble reactive phosphorus (SRP) and dissolved inorganic nitrogen (DIN – ammonia and NO3+NO2 combined) between what is considered as limiting in rivers (Ashley and Stockner 2003), the Moyie River and the Kootenai River (Hardy In Prep).

River	TDP	SRP	DIN
Limiting	<2-3	<1	<20
Moyie River	3-4	<1	10
Kootenai 2006	<2	<1	120

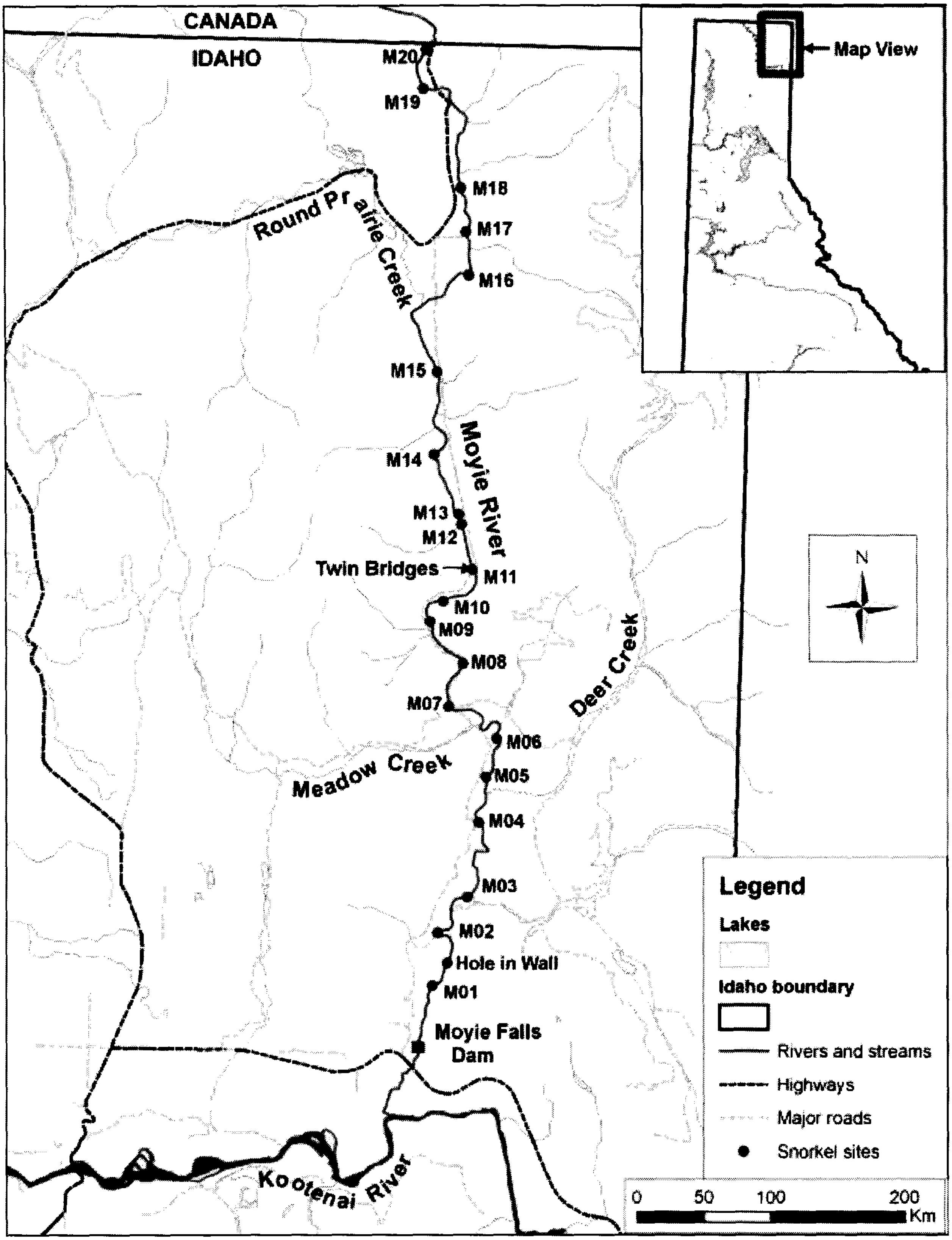
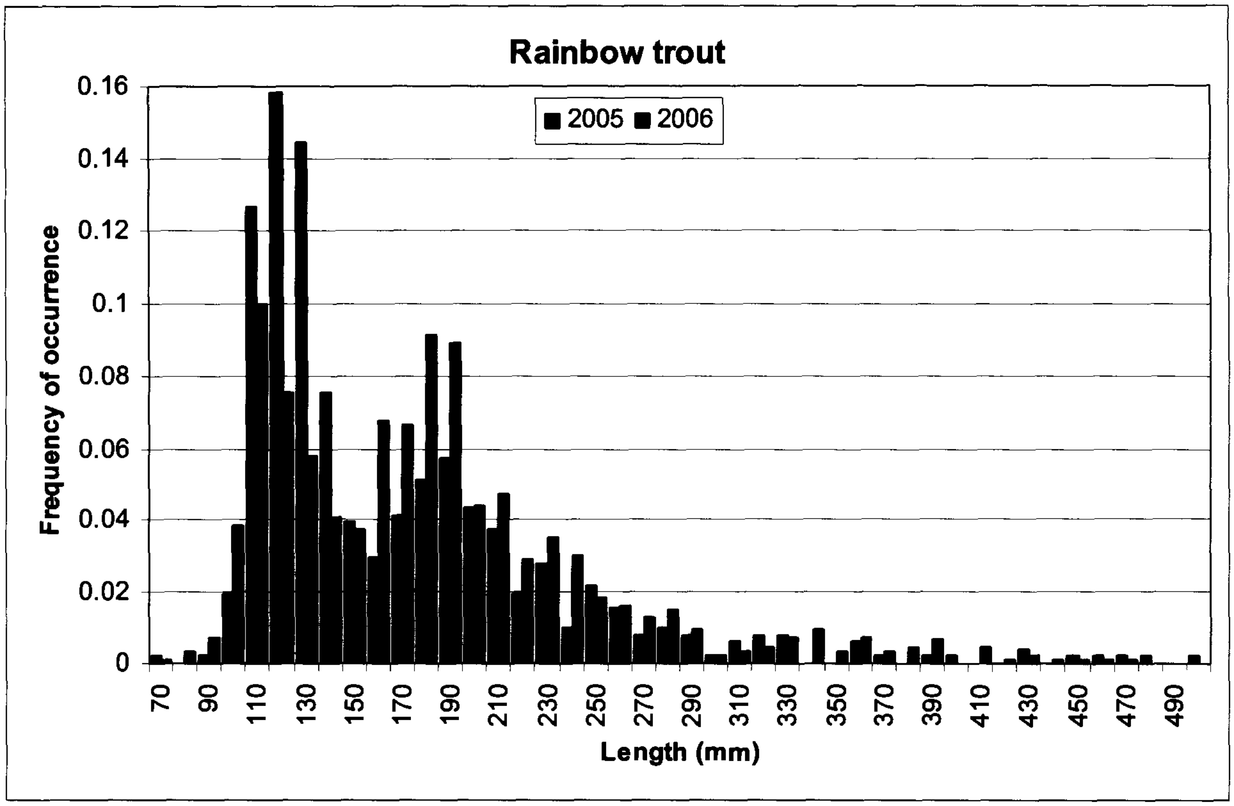


Figure 25. The location of Moyie River, Idaho, study sites including the location of the 20 transects that were snorkeled.



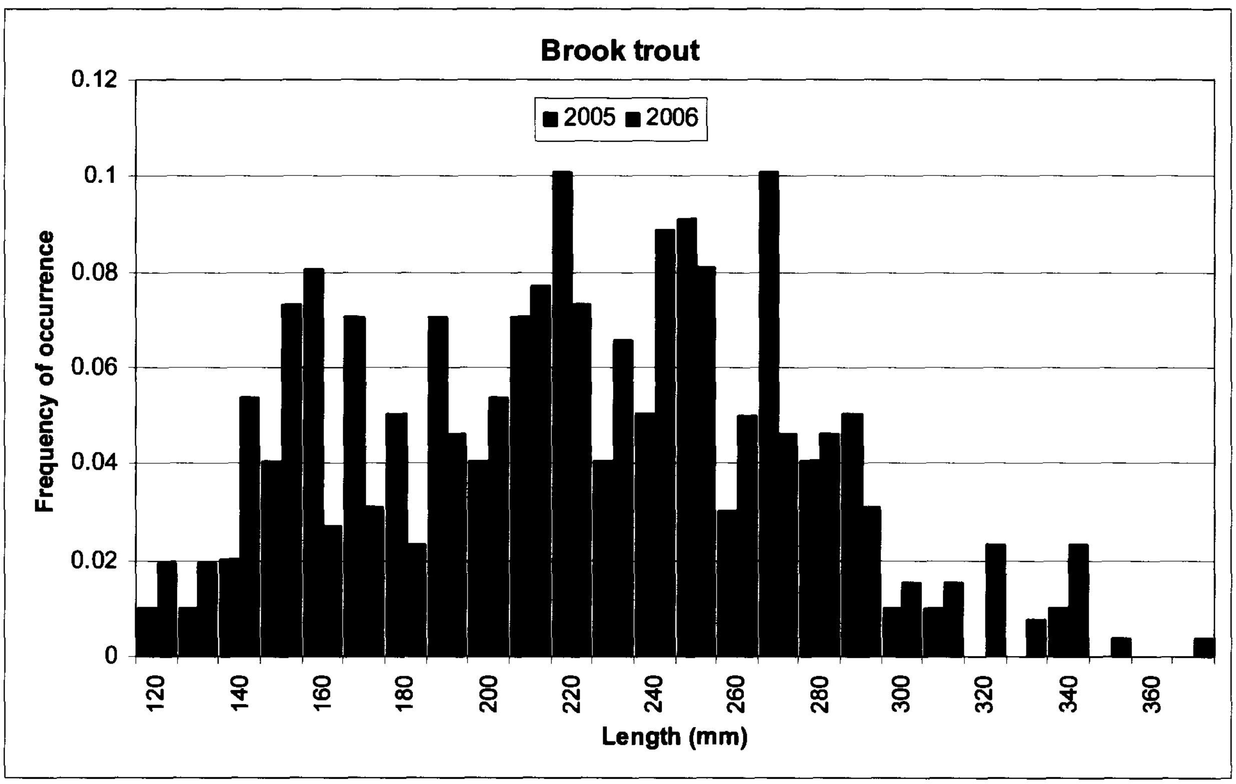
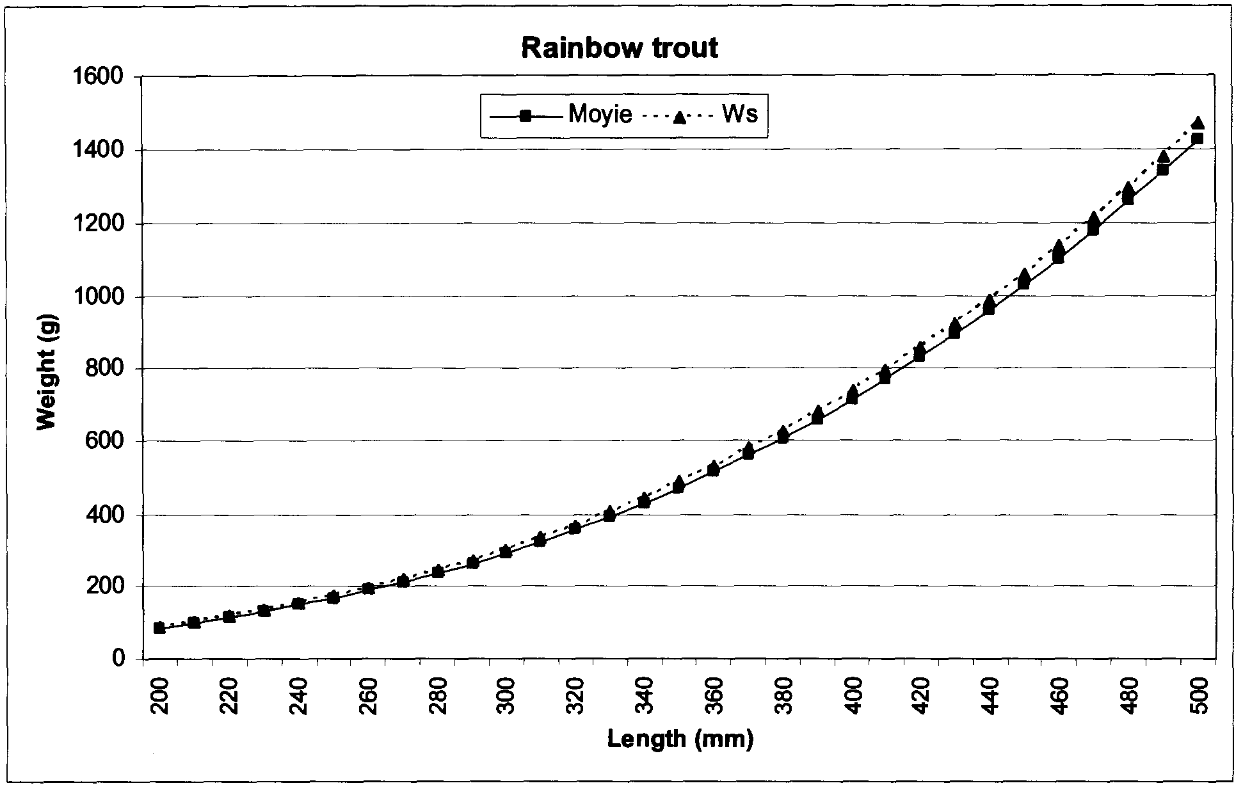


Figure 26. Length frequency histograms of rainbow trout and brook trout sampled by electrofishing the Moyie River, Idaho during 2005 and 2006.



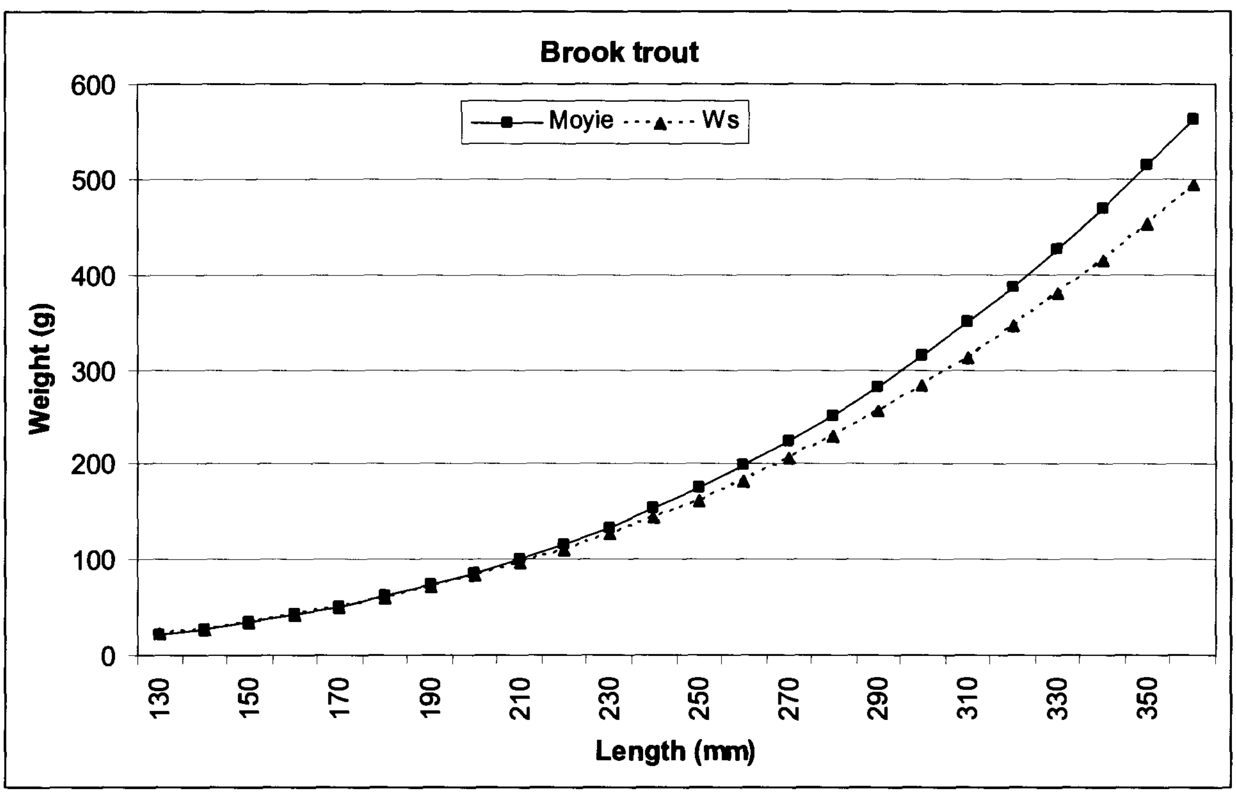


Figure 27. Comparisons of weight length regressions of rainbow trout and brook trout from the Moyie River, Idaho, to a length-specific standard weight (Ws) constructed to represent the species as a whole (Murphy et al. 1991).

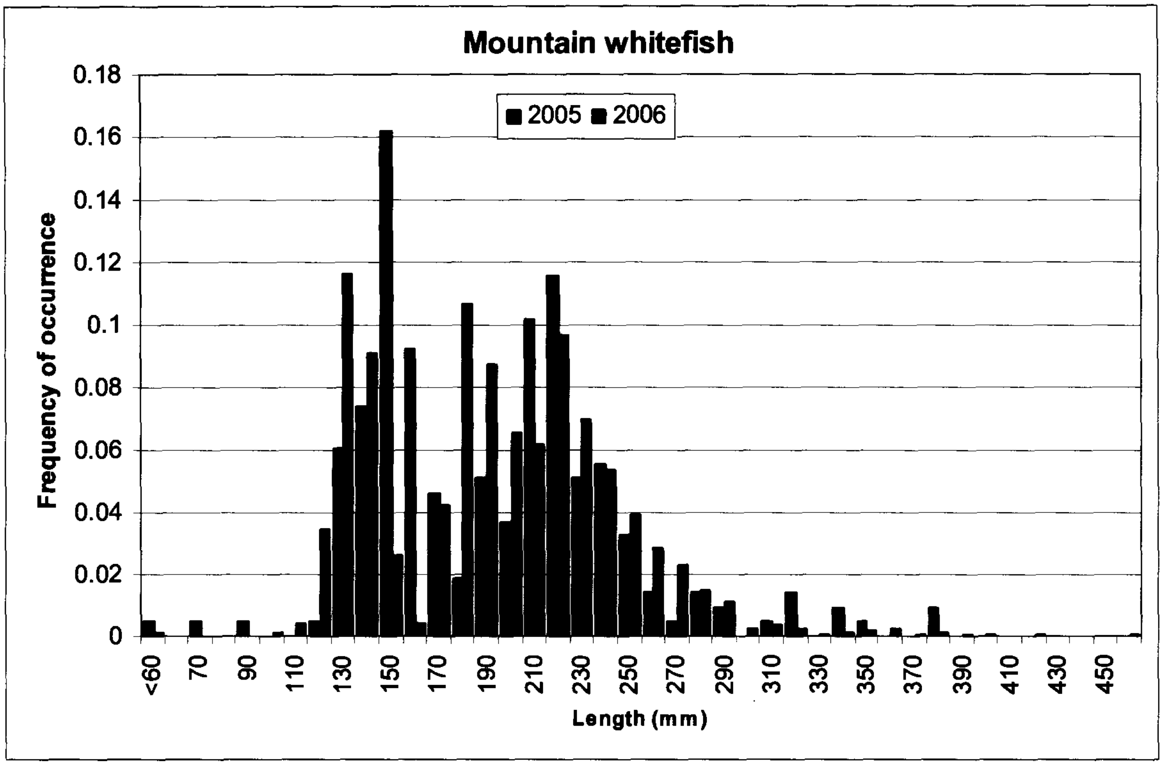


Figure 28. Length frequency histograms of mountain whitefish sampled by electrofishing the Moyie River, Idaho, during 2005 and 2006.

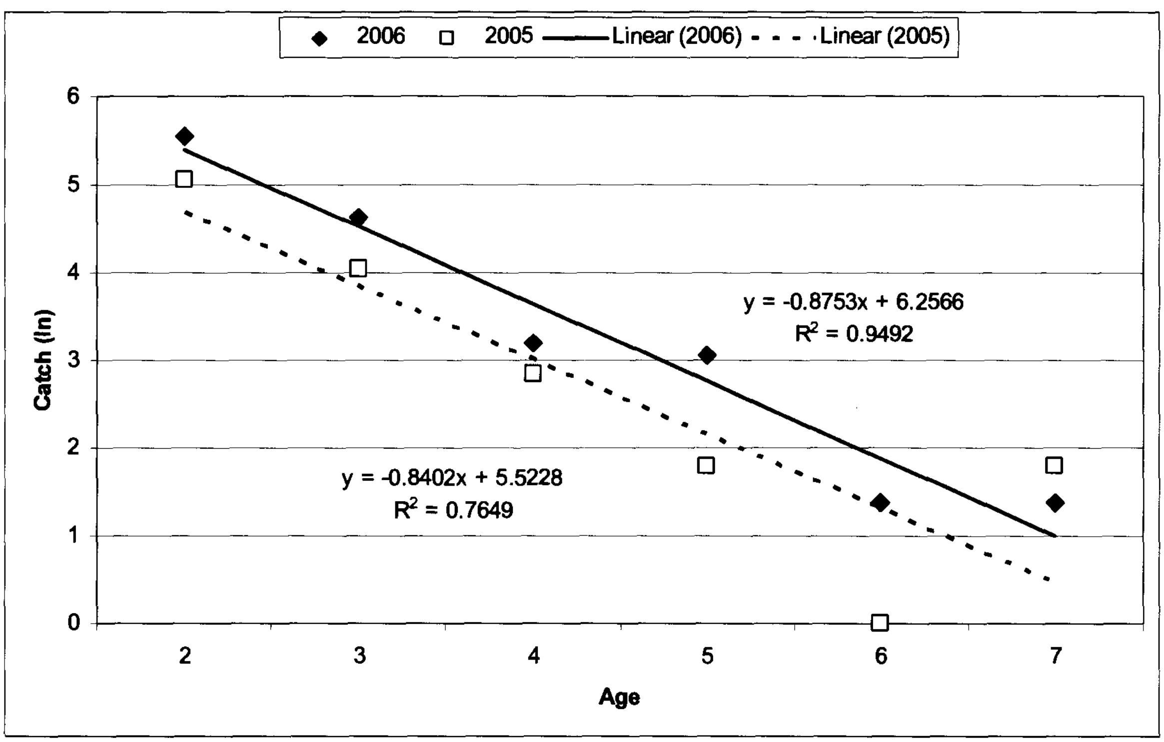


Figure 29. Catch curve used to estimate instantaneous mortality of rainbow trout sampled from the Moyie River, Idaho, during 2005 and 2006.

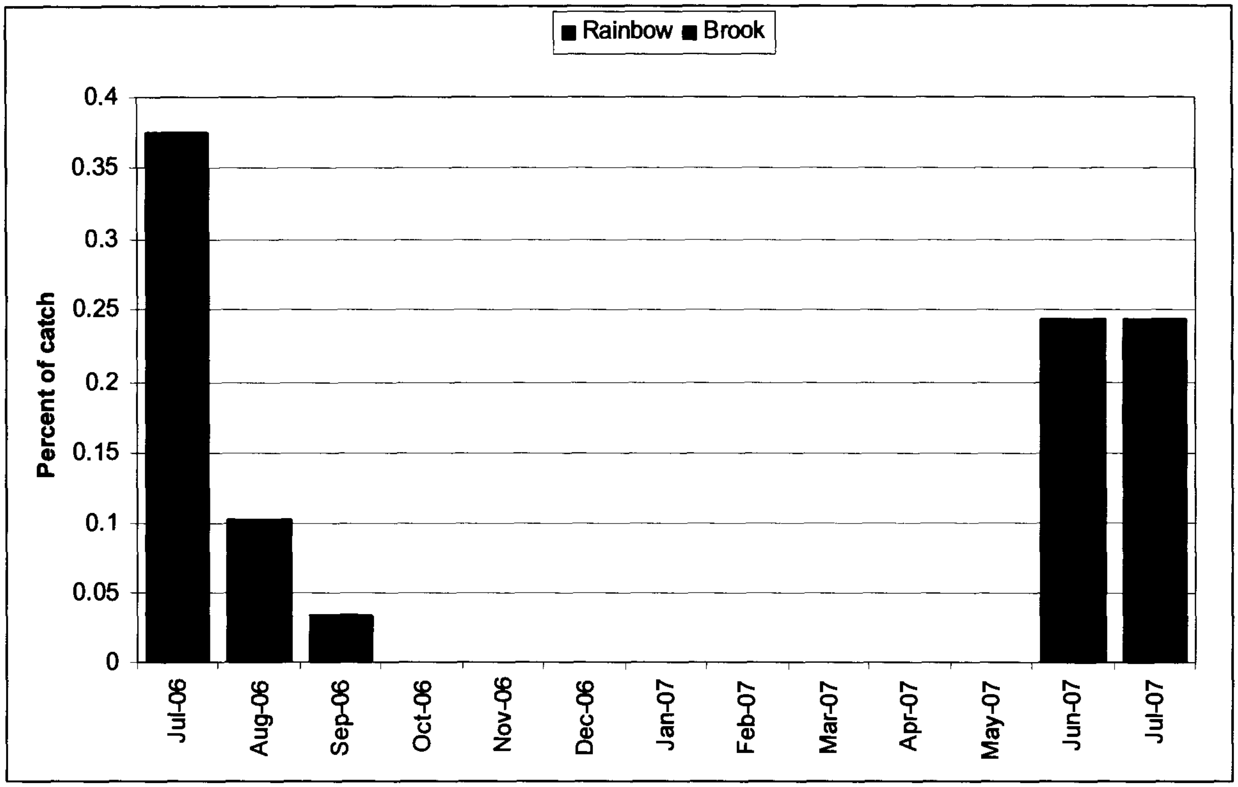


Figure 30. The monthly percentage of rainbow trout and brook trout that were reported, through tag returns, as being caught from the Moyie River, Idaho, from July 1, 2006 to July 7, 2007. Catches during June and July, 2007 were weighted assuming a 58% annual mortality rate.

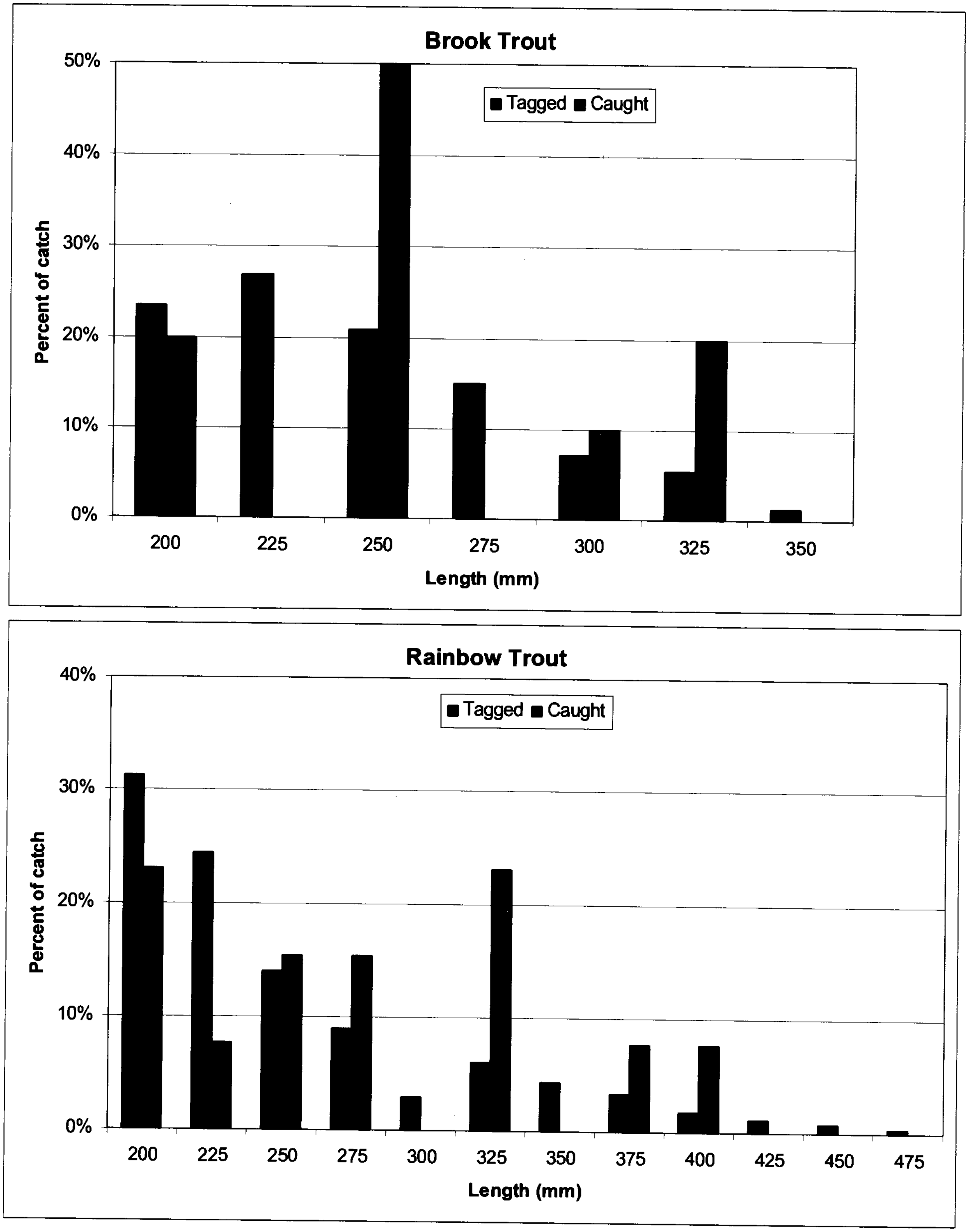


Figure 31. The comparison of length frequencies of brook trout and rainbow trout from the Moyie River, Idaho, that were tagged to those caught by anglers.

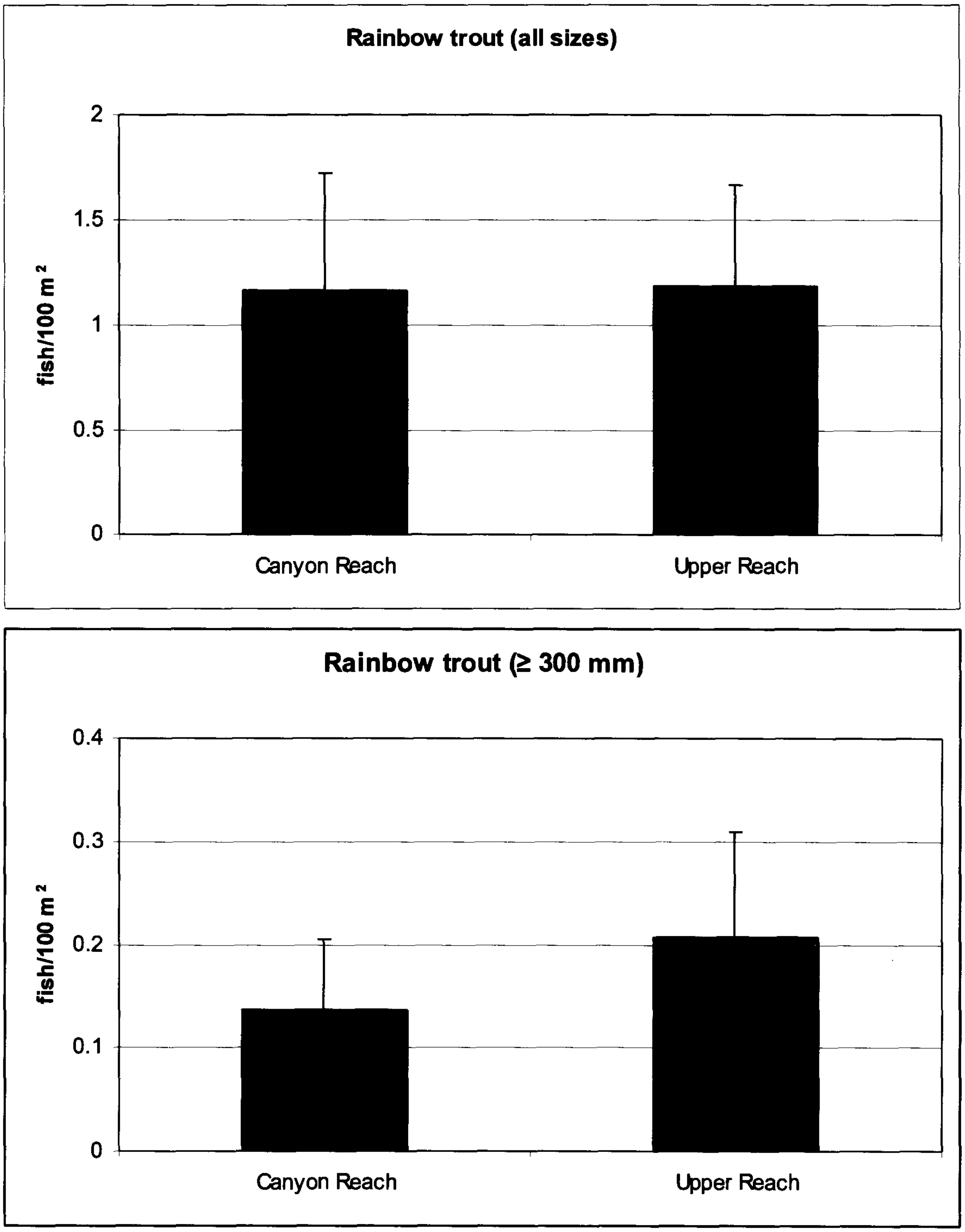


Figure 32. The average density (fish/100 m^2) and 90% confidence intervals of rainbow trout (all sizes and only fish ≥300 mm) observed while snorkeling transects in the Canyon Reach and Upper Reach of the Moyie River, Idaho, during 2006.

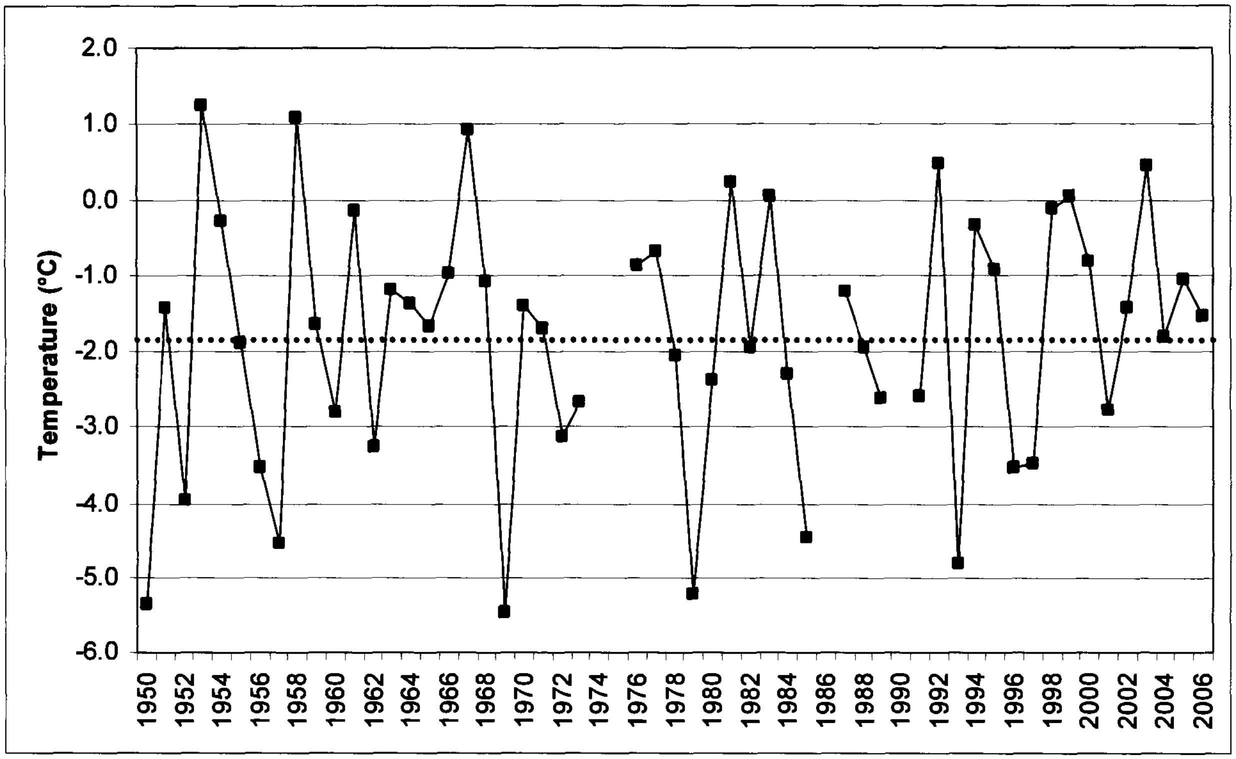
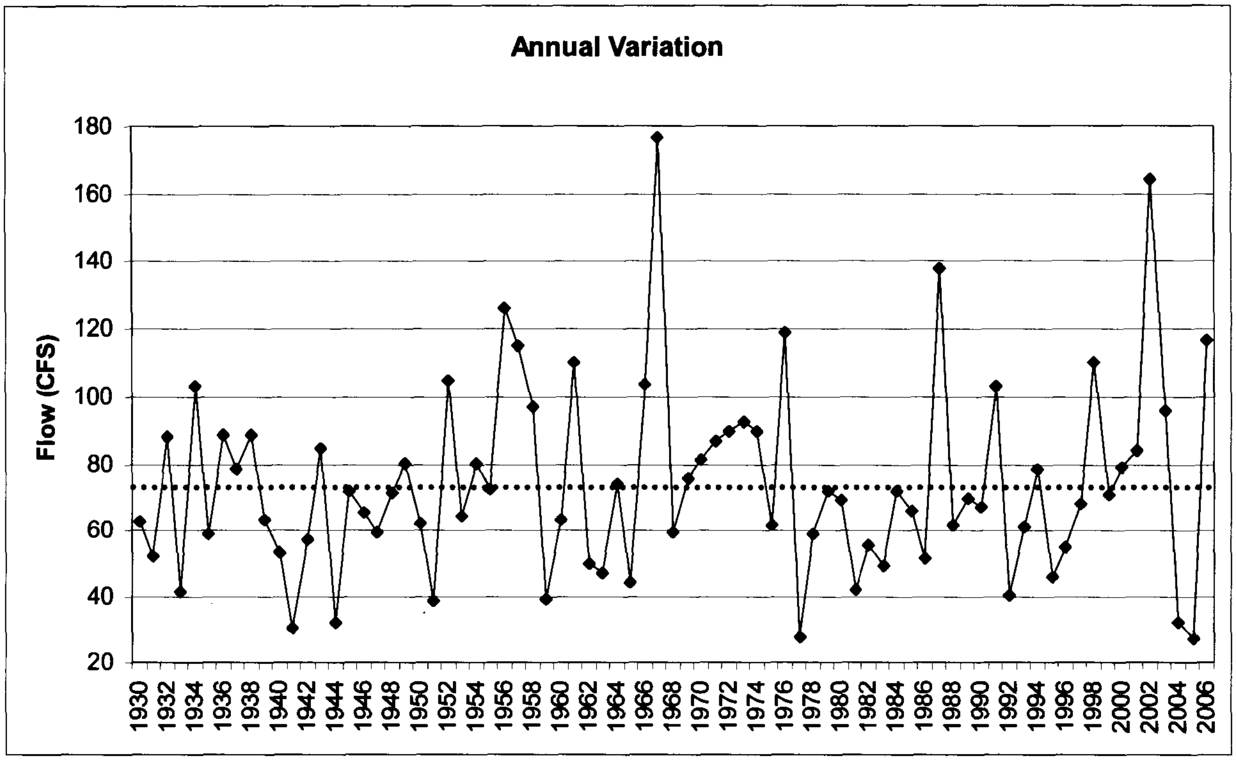


Figure 33. Average Bonners Ferry, Idaho air temperature for winter months (February through March) 1950 to 2006. The dotted line indicates the average winter temperature that occurred between 1950 and 2006.



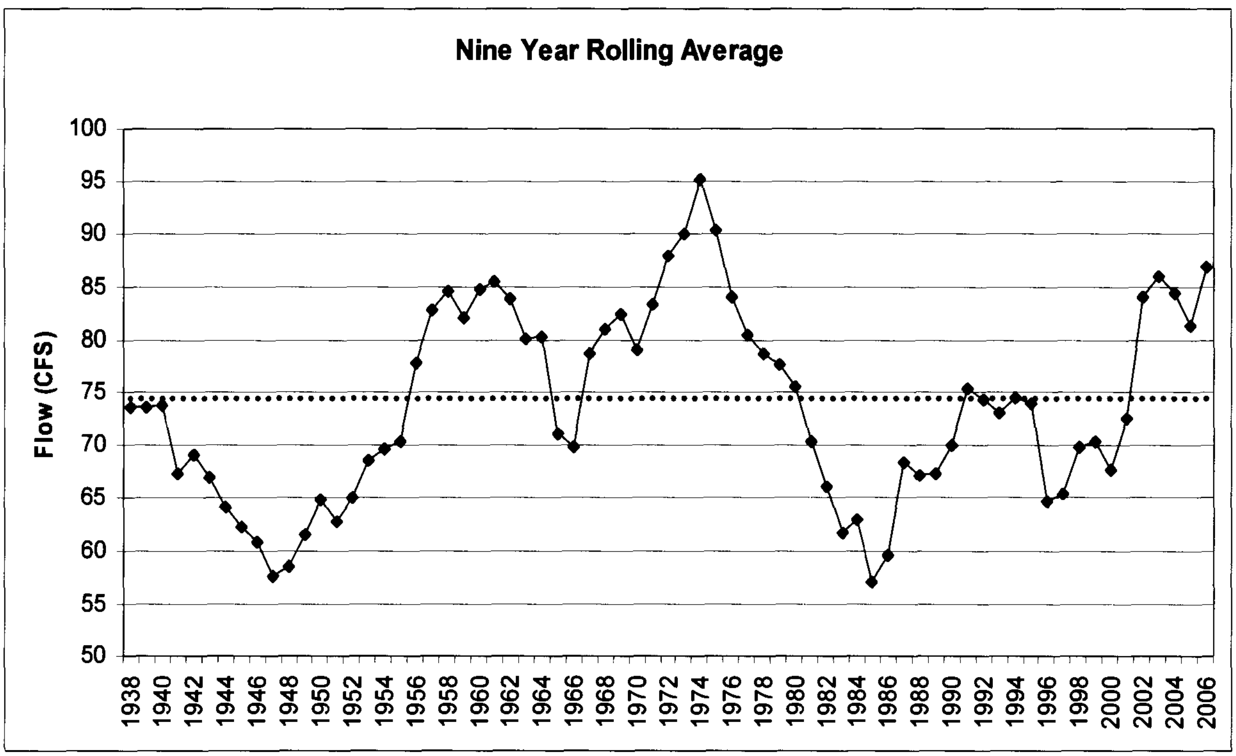
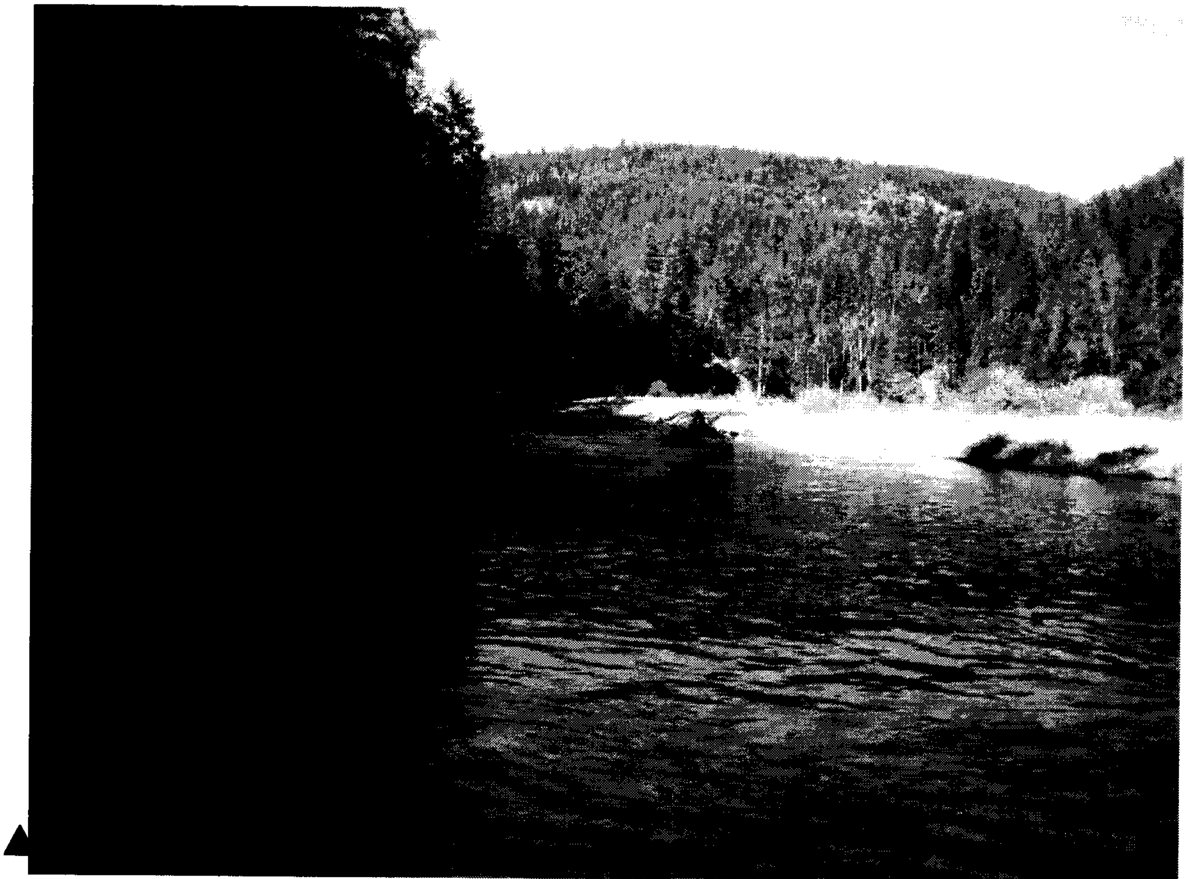


Figure 34. Flow flashiness (annual peak flow/annual low flow) in the Moyie River from 1930 to 2006 using annual calculations and a nine year rolling average. The dotted line indicates the average flow flashiness over the period of record.

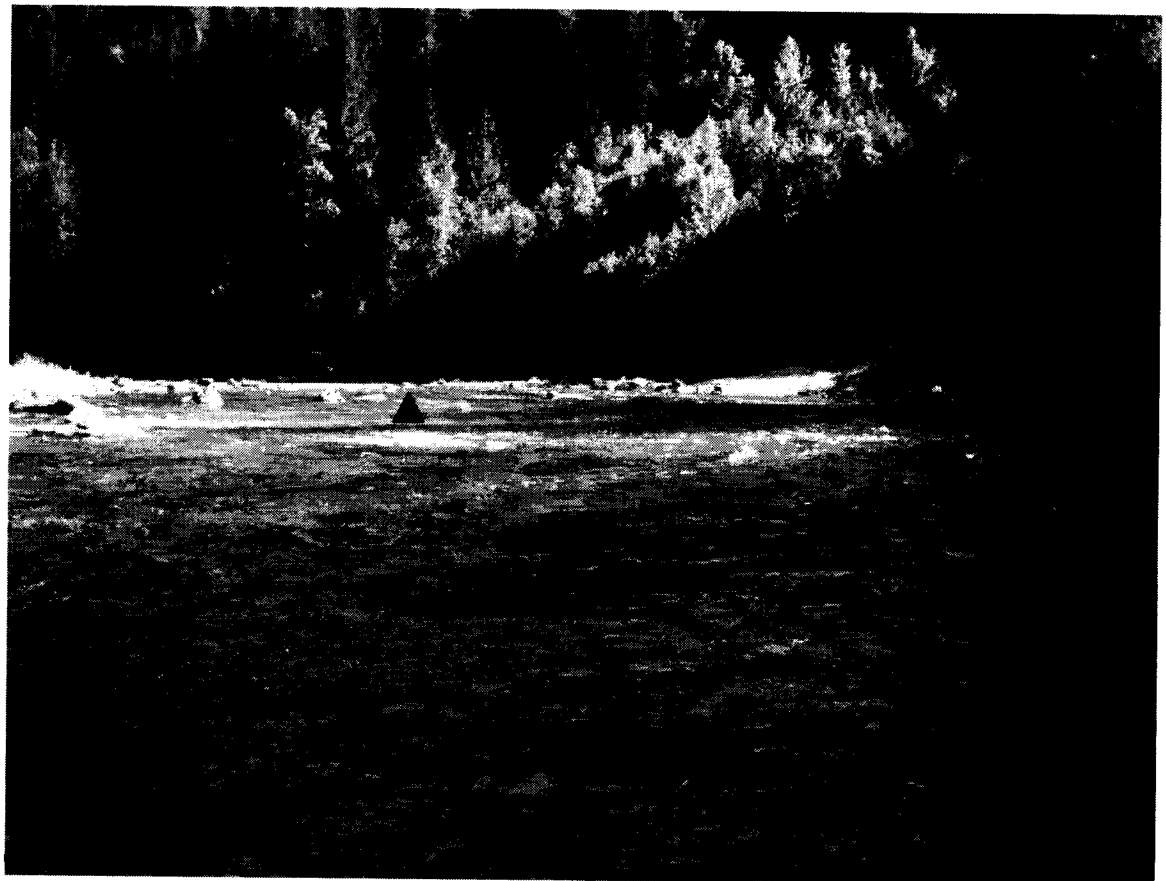
Appendix A. Global Position System coordinates for snorkel sites in the Moyie River, Idaho. Coordinates are in Latitude and Longitude (decimal degrees) and the map datum is WGS 84.

Transect	Latitude	Longitude	Elevation (ft)
M1	48.75036598	-116.17039089	2010
Hole in Wall	48.75646080	-116.16462951	2035
M2	48.76437617	-116.16889933	2085
M3	48.77412817	-116.15717892	2127
M4	48.79405816	-116.15319458	2205
M5	48.80628945	-116.15084563	2236
M6	48.81646022	-116.14706883	2275
M7	48.82477909	-116.16680386	2360
M8	48.83636372	-116.16146785	2390
M9	48.84725207	-116.17528877	2416
M10	48.85289325	-116.17024706	2427
M11	48.86145000	-116.15865371	2443
M12	48.87336882	-116.16371001	2455
M13	48.87613216	-116.16493964	2458
M14	48.89172192	-116.17546312	2482
M15	48.91398526	-116.17500429	2507
M16	48.93960983	-116.16316603	2552
M17	48.95088240	-116.16484274	2561
M18	48.96241497	-116.16721189	2575
M19	48.98814658	-116.18352273	2610
M20	48.99828667	-116.18286995	2620

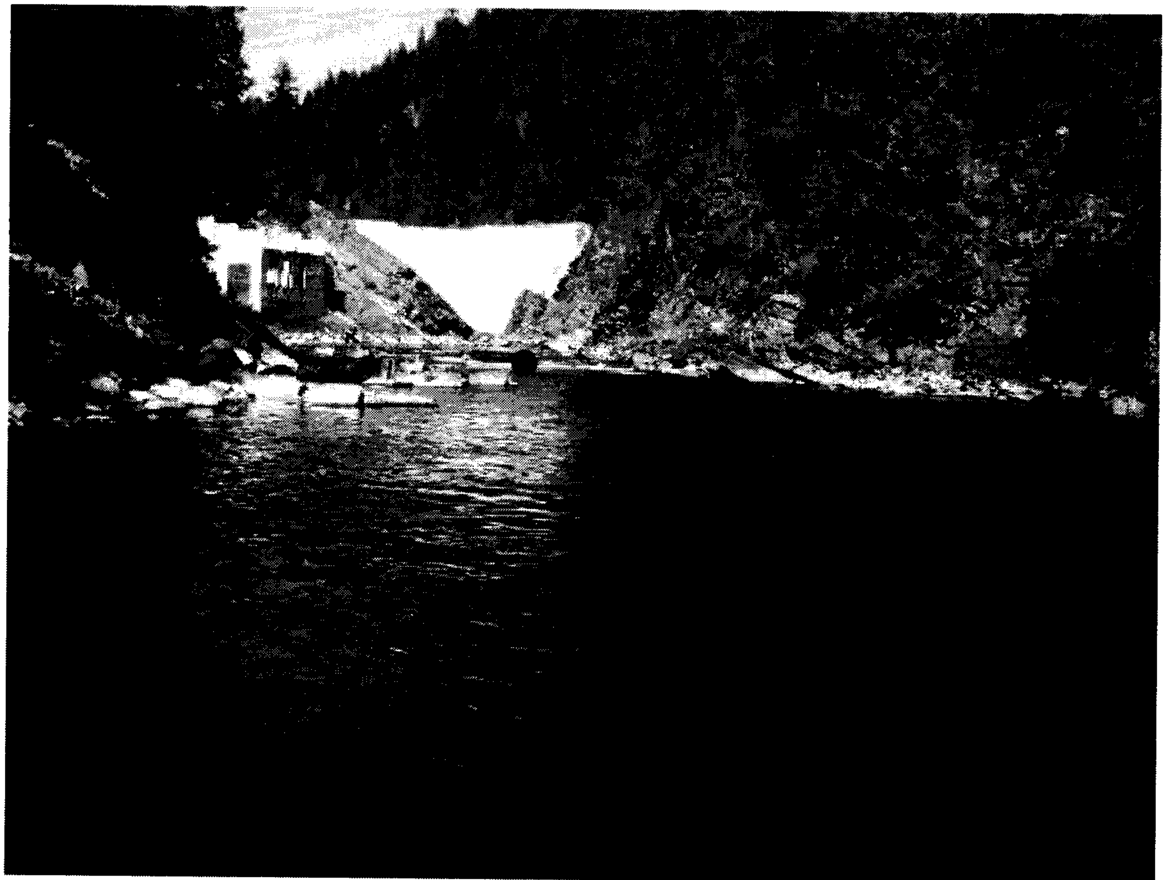
Appendix B. Photographs depicting locations of snorkel transects, starting (green circle) and stopping (red triangle) points and approximate distance of stream to snorkeled in the Moyie River, Idaho. These photos were taken in 2005.



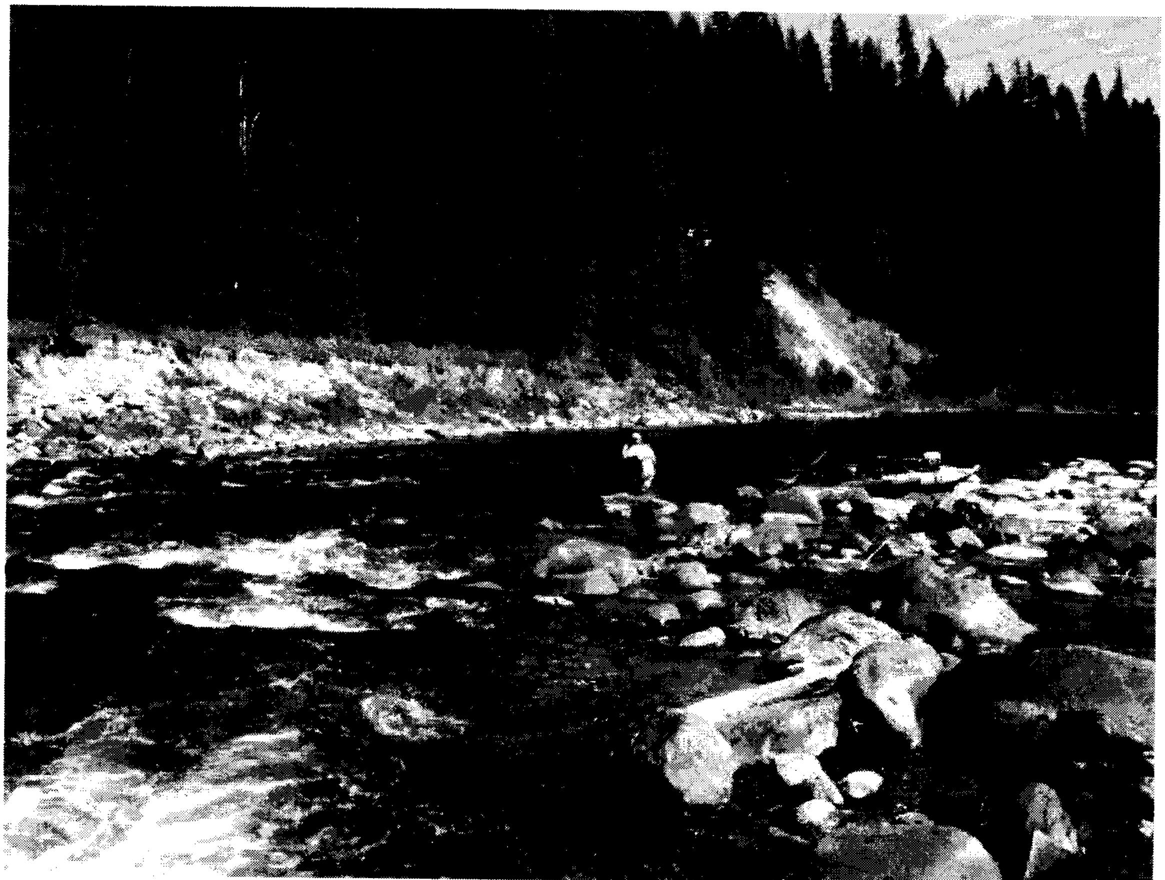
M01
Long pool up from reservoir. 100 m long



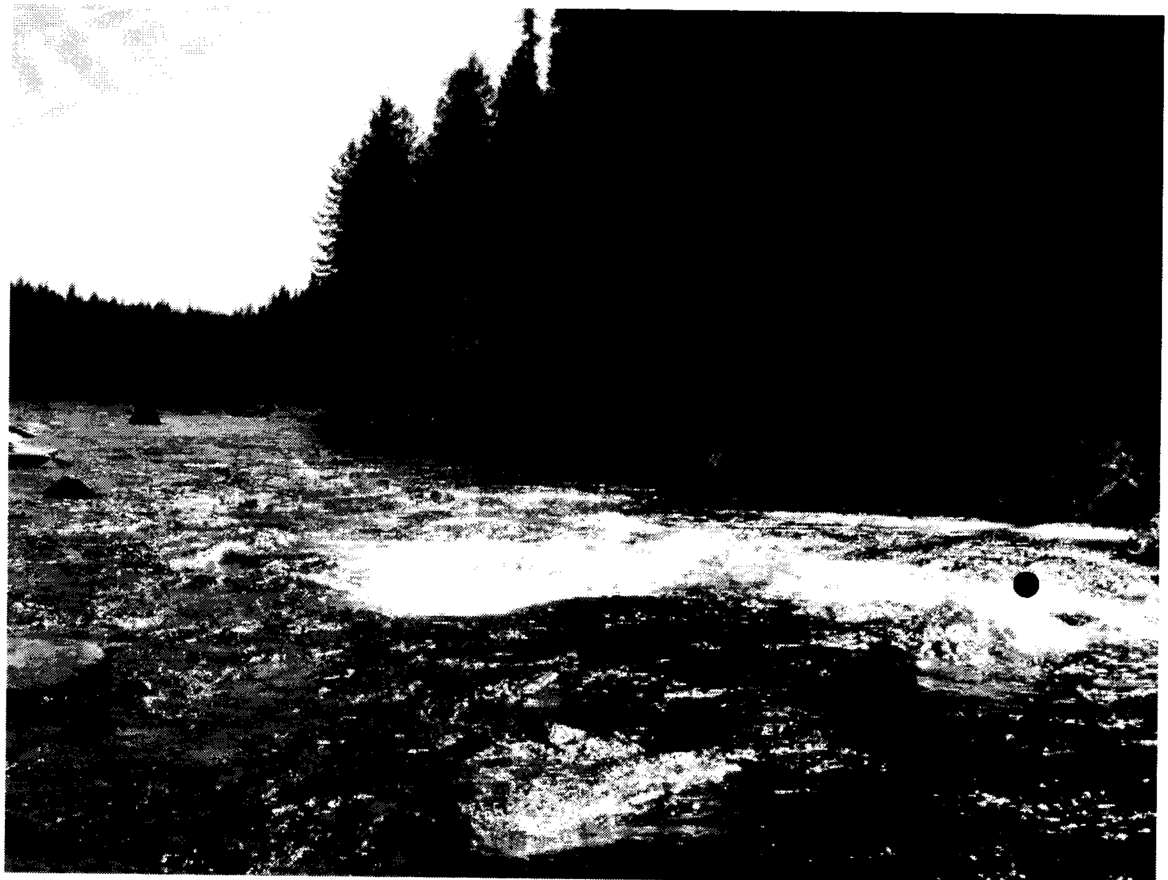
M02
Run that ends near debris slide. 71 m long



M03
Long slow pool below old dam. 100 m long (half way down pool)



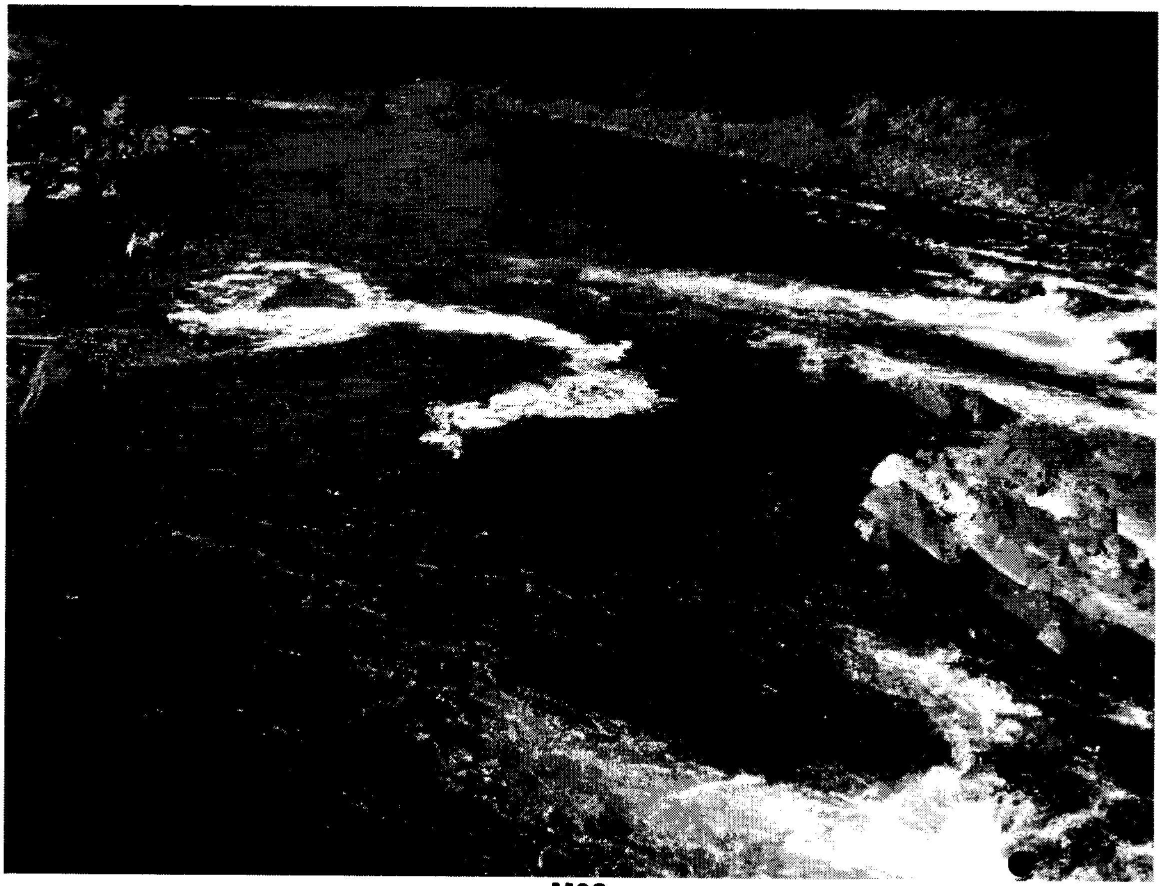
M04
Long pool run. 115 m long



M05
Pool along rock face. 103 m long

M06
Downstream of Meadow Creek Camp Ground. 104 m long

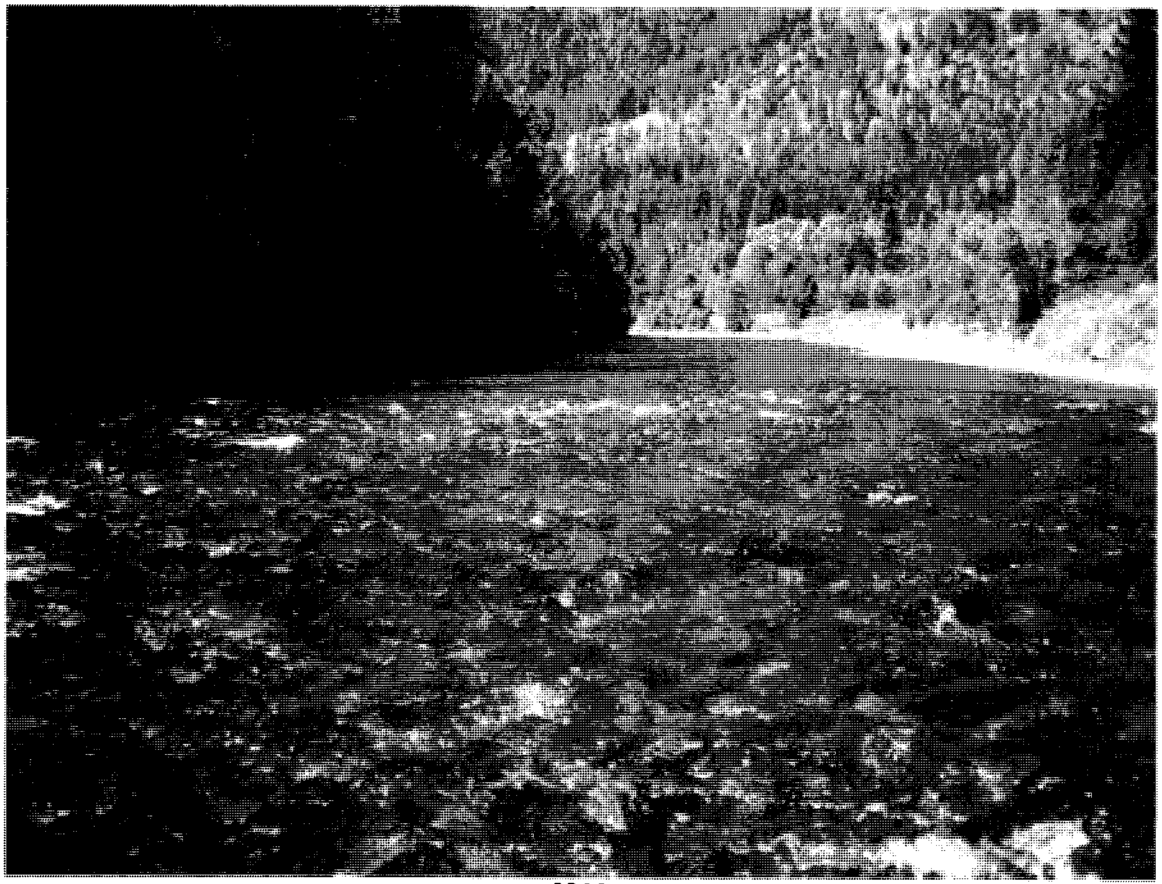
M07
Bedrock pool. 72 m long.



M08

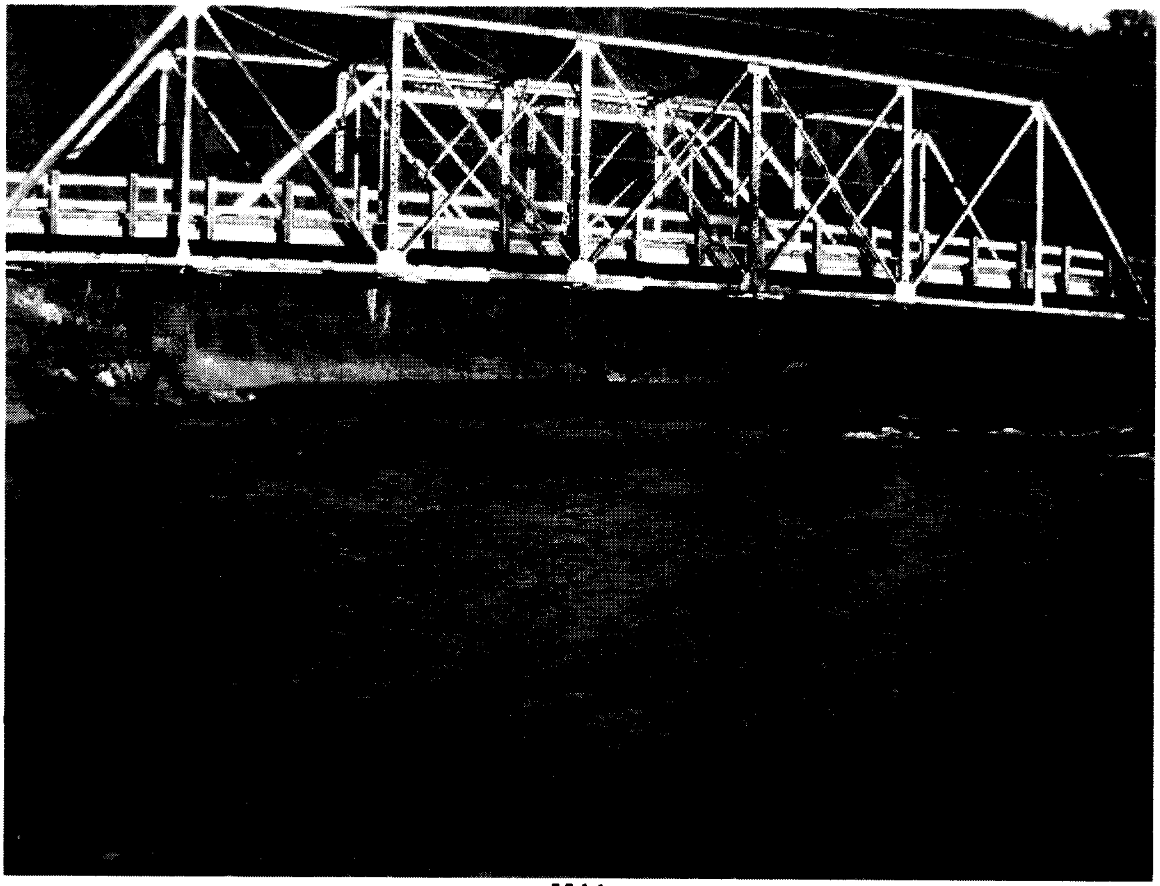
Big deep bedrock pool next to road. 100 m long

M09
Nice pool. 85 m long



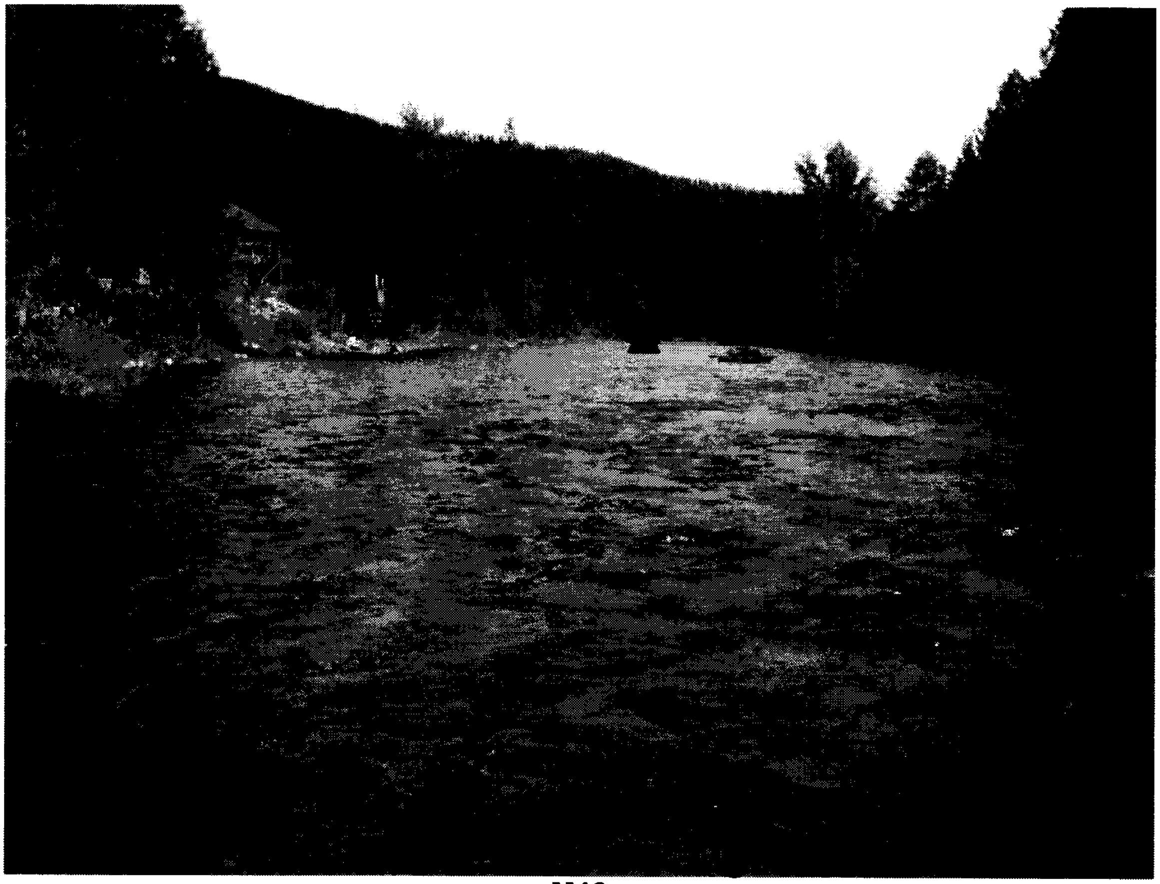
M10

Shallow run. End at point. 53 m long.



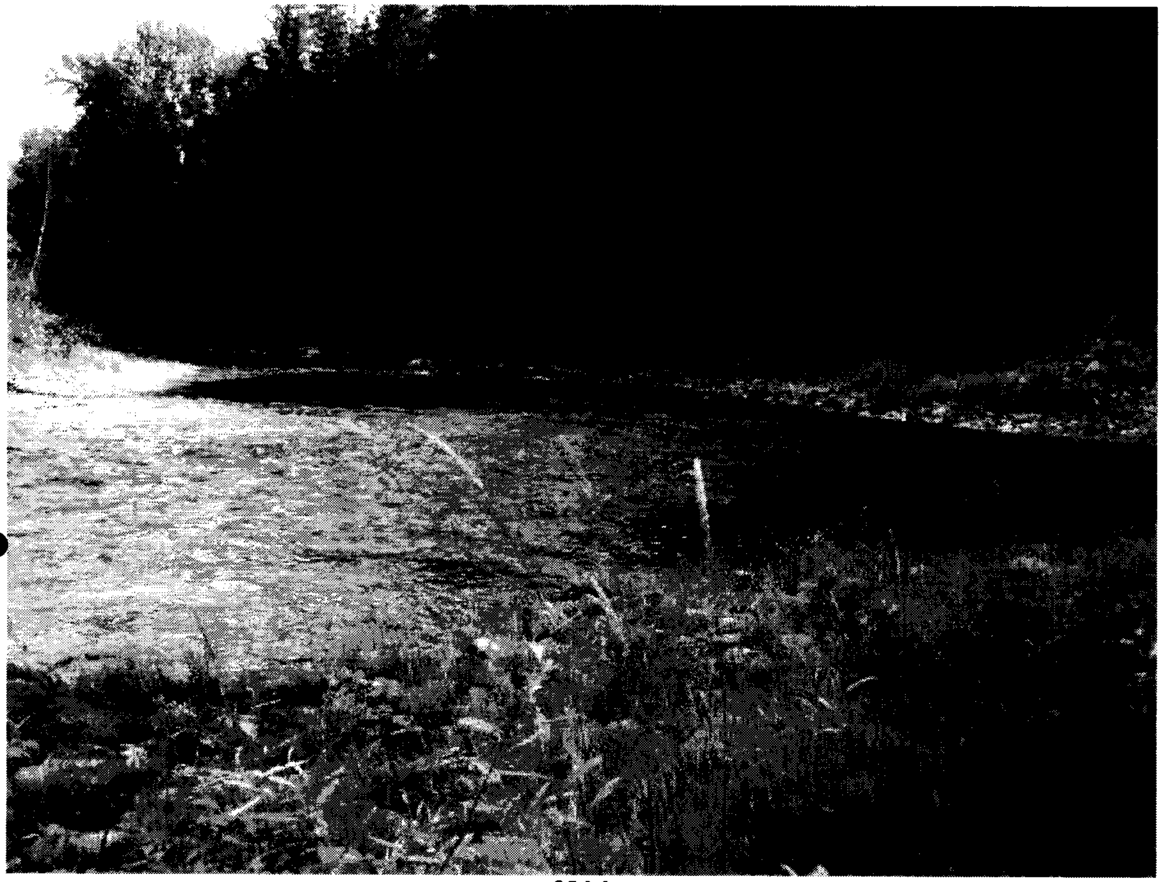
M11
Pool under twin bridges – boat launch. Start at log jam. 176 m long

M12
Run/pocket water near homes. End a little past house. 94 m long.



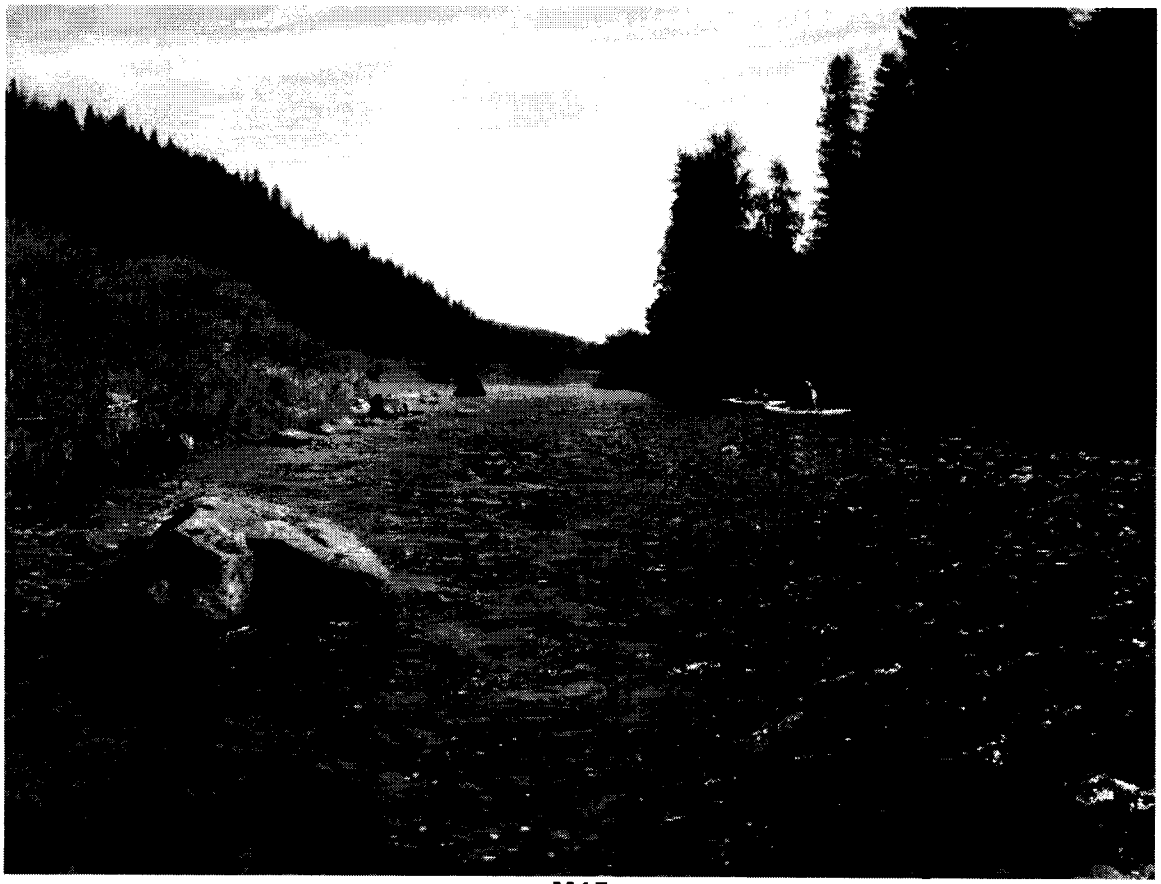
M13

Pool/run by house that uses old road as a deck. Start in riffle. 107 m long.



M14

Swift pool/run on corner. Start at head of pool. 57 m long



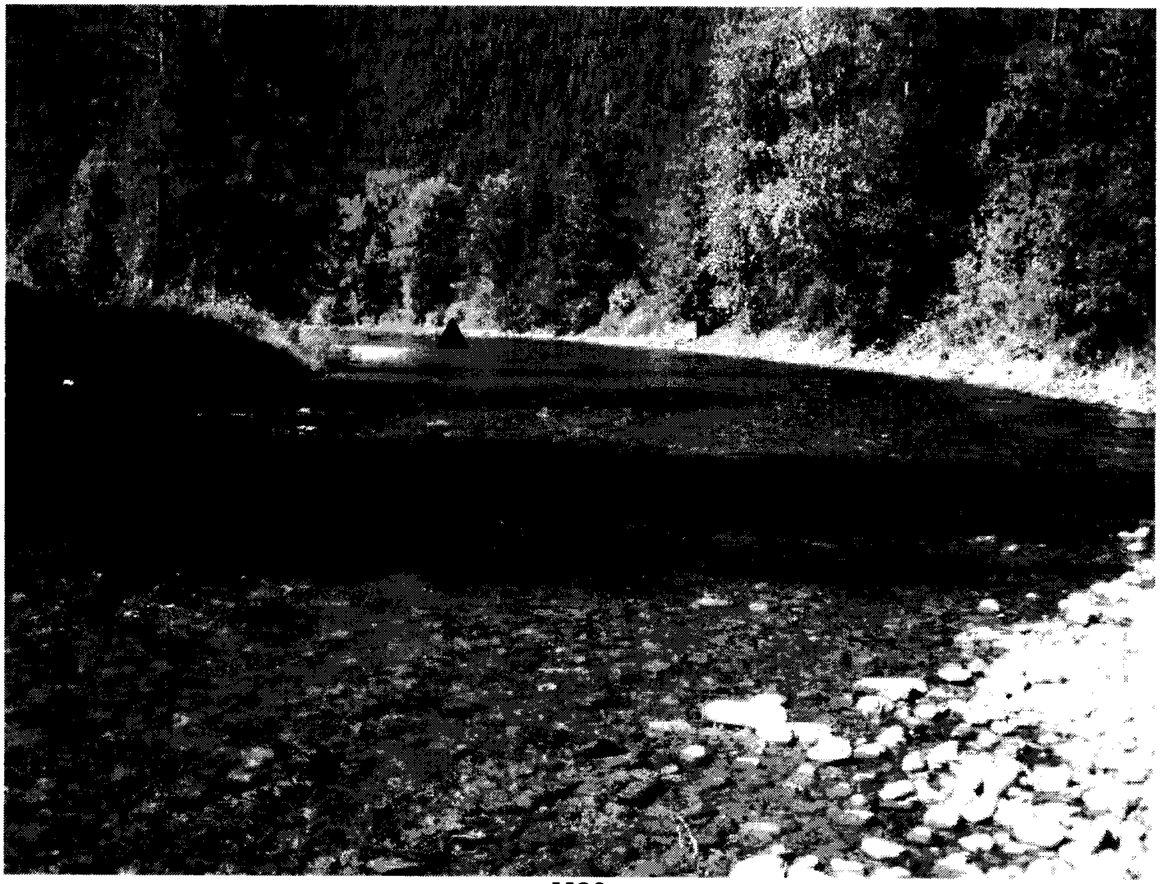
M15
Run along railroad bridge. 132 m long.

M16
Pool from rock bluff to railroad bridge. 125 m long.

M17
Pool from drop structure and under bridge. Start at drop structure. 120 m long.

M18
Pool along log jam. 100 m long.

M19
Big pool with railroad on one side and log house on the other. 145 m long.



M20
150 m below Eastport Bridge. Stop at drop structure. 206 m long.

Appendix C. Data sheet used while conducting snorkel surveys in the Moyie River, Idaho, during 2006.

IDFG Snorkel Data

Stream: ______________________ **Transect Name/Number:** ______________________

Date:________ Time:________ Temperature: ______ Visibility:________ GPS Datum: ____________

Observers:______________________ No. of Snorkelers:______ GPS Coord: (Easting) ____________

(Northing) ____________

Habitat Type: Pool, Riffle, Run, Glide, Pocket Water Max Depth (m): ______ Dominant Cover / % surface area: ____________

Stream Length (m): ________ Stream Width (m): __ ____ ____ ____ ____ ____ ____ ____

Comments: ____

____

____

Length	WCT		RBT		BLT		BRK		MWF		LSS		NPM		Other
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
<3"															
3"-6"															
6"-9"															
9"-12"															
12"-15"															
15"-18"															
18"-21"															
>21"															
Total															

Abbreviations: **WCT** = Westslope Cutthroat Trout; **RBT** = Rainbow Trout; **BLT** = Bull Trout; **BRK** = Brook Trout; **MWF** = Mountain Whitefish
MWF = Mountain Whitefish; **LSS** = Large Scale Sucker; **NPM** = Northern Pike Minnow; **RSS** = Redside Shiner; **LND** = Long Nose Dace.

Cover Types: **LWD** (large woody debris > 4"), **SWD** (small woody debris < 4")' **LS** (large substrate), **UB** (undercut banks), **OC** (ovehead cover)

Panhandle Region 2006 Fishery Management Report

COEUR D'ALENE RIVER BASIN SNORKEL SURVEYS

ABSTRACT

From July 27 to August 3, 2006, a total of 43 transects in the North Fork Coeur d'Alene River and 27 transects in the South Fork Coeur d'Alene River were snorkeled to estimate salmonid abundance and their approximate size distribution. Mean densities of age one and older cutthroat trout were 0.79 fish/100 m^2 in the North Fork Coeur d'Alene River and 0.39 fish/100 m^2 in the South Fork Coeur d'Alene River. Densities of cutthroat trout ≥ 300 mm in length were 0.18 fish/100 m^2 in the North Fork Coeur d'Alene River and 0.02 fish/100 m^2 in the South Fork Coeur d'Alene River and they represented 23% and 6% percent of the cutthroat trout respectively. The North Fork Coeur d'Alene River showed an increasing trend in abundance of cutthroat trout following the decline observed after the 1996 and 1997 flood events and record high densities were observed for the second year in a row in 2006. The North Fork also showed increasing trends in abundance of cutthroat trout ≥ 300 mm and densities observed in 2006 were the second highest ever. No trends in cutthroat trout abundance were available for the South Fork as 2006 was the first year it was snorkeled.

Densities of mountain whitefish were 3.49 fish/100 m^2 in the North Fork Coeur d'Alene River and 0.42 fish/100 m^2 in the South Fork Coeur d'Alene River during 2006. Increasing trends in abundance of mountain whitefish were observed in the North Fork Coeur d'Alene River following the declines observed after the 1996 and 1997 flood events with a record high density being observed in 2006.

In the North Fork Coeur d'Alene River, 279 (0.18 fish/100 m^2) rainbow trout were counted with all being observed in the downstream reaches where harvest is allowed. In the South Fork Coeur d'Alene River, 11 (0.03 fish/100 m^2) rainbow trout were counted and were distributed throughout the river. Rainbow trout were not stocked into any rivers or streams in the Panhandle Region since 2002. Consequently, these fish were either holdovers from earlier stockings or are offspring from natural reproduction.

No brook trout were observed in the North Fork Coeur d'Alene River during 2006 whereas 45 were observed in the South Fork. The presence of brook trout in the South Fork may be attributed to the degraded habitat conditions that occur there.

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Ned Horner
Regional Fisheries Manager

INTRODUCTION

Westslope cutthroat trout are a highly sought after game fish native to northern Idaho attracting anglers from around the United States. The popularity of cutthroat trout stems from their eagerness to take a dry fly, their beautiful appearance and the pristine environment they inhabit. In northern Idaho, the major cutthroat trout fisheries occur in many of the larger rivers and streams that drain the rugged landscape. During 1996, over 60,000 hours of fishing effort was estimated to have occurred on the St. Joe and Coeur d'Alene rivers, two of the more popular rivers for cutthroat trout fishing in the Panhandle Region (Fredericks et al. 1997). Evidence suggests fishing pressure for cutthroat trout has continued to increase in the Panhandle Region (Fredericks et al. 1997).

In the early 1900's, many considered the streams and rivers in northern Idaho to be some of the finest trout streams in America. The local newspaper of St. Maries, Idaho frequently reported catches of seven to nine-pound trout, and trips where anglers caught 50-100 cutthroat trout averaging three to five pounds in a few hours (Rankel 1971). By the 1960's, cutthroat trout abundance had declined in many rivers in the Panhandle and studies were initiated to determine why these declines had occurred and what could be done to restore the fishery (Mallet 1967; Dunn 1968; Rankel 1971; Bowler 1974; Lewynsky 1986). This research found that declines in the fishery were largely a response to over harvest in the St. Joe River and a combination of over harvest, habitat degradation and toxic mine wastes in the Coeur d'Alene River (Rankel 1971; Bowler 1974; Lewynsky 1986; Rabe and Sappington 1970; Mink et al. 1971). As efforts were made to correct the reasons for the decline in the fishery, it was necessary to monitor trends in fish numbers to evaluate how successful recovery efforts were. Transects were set up in the North Fork Coeur d'Alene River in 1973 and have been snorkeled on a regular basis ever since (Bowler 1974). Fish counts in these trend transects were successful in documenting how changes in fishing regulations and/or habitat have influenced cutthroat trout densities.

The history in the South Fork Coeur d'Alene River was quite different than the North Fork. Prior to 1968, unregulated mining practices delivered such high concentrations of heavy metals to the South Fork that it prevented any life from existing in much of the river (Mink et al. 1971). Locals commonly referred to the South Fork as Lead Creek. As heavy metal concentrations dropped the first insects started appearing throughout the South Fork in the early 1970's (Rabe and Flaherty 1974) and it wasn't until the early 1990's that we stated receiving reports that fish were surviving in the lower river. Transects were set up for the first time in 2006 in the South Fork Coeur d'Alene River to help monitor the recovery of this fishery and to evaluate the success of restoration activities.

The long term trend data sets collected from these snorkel transects are and will continue to be very important in documenting how changes in fishing regulations, habitat and weather patterns influence trends in fish populations. To ensure this data is collected in a consistent manner in the future and to increase the ease of locating the snorkel sites, this report has set out to clearly describe techniques used to collect the data, the time when snorkeling should occur and the locations of the transects. Extensive efforts have been made to collect and compile the existing historic data in this report so that in the future one does not have to sort through the raw data. The goal of this report is to evaluate the status of the fishery in the Coeur d'Alene River watershed and assess how changes in fishing regulations, habitat and weather patterns have influenced the fishery.

OBJECTIVES

1. Estimate salmonid density and trends in abundance in snorkeling transects in the Coeur d'Alene River watershed and evaluate how changes in fishing regulations, habitat and weather patterns have influenced the fishery.

2. Describe the methods one should follow when conducting snorkel surveys at established trend sites.

3. Compile existing historic data from past snorkel surveys conducted on the Coeur d'Alene River.

STUDY SITES

The Coeur d'Alene River and its tributaries drain belt series geology with non-glaciated alluvial valleys. The watershed has a dendritic drainage pattern with several major tributaries including the North Fork Coeur d'Alene River (123 km in length; 188,274 hectare drainage), the Little North Fork Coeur d'Alene River (60.29 km in length; 43,857 hectare drainage) and the South Fork Coeur d'Alene River (56 km in length; 77,699 ha drainage). Most 4th order and larger tributaries in the watershed have a stream gradient < 4% and the riparian vegetation mostly consists of red alder *Alnas rubra*, willow *Salix* spp., black cottonwood *Populus trichocarpa*, and redosier dogwood *Cornus sericea* and is often mixed with western red cedar *Thuja plicata* and grand fir *Abies grandis.*

North Fork Coeur d'Alene River

The North Fork and Little North Fork Coeur d'Alene River watersheds are predominately (93%) owned and managed by the U.S. Forest Service. The Forest Service has intensively managed these watersheds for timber harvest over the last 100 years (Strong and Webb 1970). Prior to 1930, the Little North Fork Coeur d'Alene River, Independence Creek and Shoshone Creek were all splash dammed and log drives occurred along the main North Fork Coeur d'Alene River (Strong and Webb 1970). These activities resulted in a straighter less complex river channel as log jams, woody debris, large boulders and sharp channel bends were removed. After 1931, road systems were developed to export logs. Many of these roads were constructed along streams and the riparian areas are now considered the most altered portion of the entire watershed (DEQ 2001). The road density in the watershed averages 5 km/km^2 and is considered the most densely roaded, timbered watershed in the entire Columbia River Basin (Quigley et al. 1996). Much of the floodplain in the lower 40 km of North Fork Coeur d'Alene River is privately owned and has been developed for housing or agriculture. Placer and hard rock mining has occurred in the North Fork Coeur d'Alene River – mainly in the Prichard Creek and Beaver Creek watersheds. The hard rock mining has resulted in elevated heavy metals in the substrates in both of these drainages. Fish from both of these drainages commonly have black tails which may be a stress related symptom to elevated heavy metals. The placer mining in these watersheds has denuded large areas of the floodplains and left large mounds of loose cobble which continue to be eroded back into the stream system.

Thirty-eight snorkeling transects in the North Fork Coeur d'Alene River watershed were initially established in 1973 by selecting sites that were considered good cutthroat trout habitat (Bowler 1974). Twenty-three of these transects were in the North Fork Coeur d'Alene River (85 river km), 10 were in the Little North Fork Coeur d'Alene River (36 river km) and five were in

Tepee Creek (8 river km). Some of the transect locations have been changed over the years as the river has shifted positions and pools have filled in. Modified transect boundaries were selected based on closeness and similarity to original sites, access, and permanence for future study. Transects that have changed locations from their original location in the Coeur d'Alene River basin include TP01, NF17, NF20 and NF23, LNF02, LNF04. During 2002, three additional transects (LNF10, LNF12 and LNF 13) were added into the Little North Fork Coeur d'Alene River in the catch-and-release area bringing the number of transects in this area to five. This was accomplished to better evaluate whether differences in fish densities occurred between the catch-and-release and harvest areas of the Little North Fork Coeur d'Alene River. Two temporary snorkel transects (REHAB1 & REHAB2) were established during 2002 in the upstream portion of Tepee Creek where the U.S. Forest Service had completed some extensive stream restoration in 2001. These sites were added to evaluate how fish densities respond to this restoration over time. This brings the total number of transects that were snorkeled in the Coeur d'Alene basin during 2006 to 43, which spans about 138 km of river (Figure 35). Thirteen sites were on the Little North Fork Coeur d'Alene River; seven were on Tepee Creek and 23 on the North Fork Coeur d'Alene River. Coordinates for the location of each of these transects are displayed in Appendix D and photographs (taken in 2002 through 2004) of each of the samples locations are displayed in Appendix E. These photos not only show transect pictures, but also depict snorkeling boundaries and approximate length of stream that should be snorkeled. Photos of the original transects taken in 1973 can be viewed in DuPont et al. (In Press a), and provide a good comparison of if and how the sites have changed over the years.

The actual names of the North Fork Coeur d'Alene River transects have changed many times since 1973. By 2002, some river reaches had transect numbers that increased as you moved upstream whereas in other reaches the numbers increased as you moved downstream. Because of this confusion, the transect numbers were changed in 2003 so that they all increased from the mouth upstream. This is the same system transects are numbered in the St. Joe River and Little North Fork Clearwater River. Hopefully, this will eliminate confusion and prevent any changes in the numbering system in the future.

South Fork Coeur d'Alene River

The South Fork Coeur d'Alene River watershed is 44% privately owned. This private land occurs primarily in the lower elevations and is mostly a combination of mining operations, home sites, small landowners and timber companies. The private timberland is intensively managed and heavily roaded, similar to what we see in the North Fork Coeur d'Alene River watershed. Mining activities have been intensive over the last century in the South Fork Coeur d'Alene River watershed. Tailing piles occur in many areas along the South Fork and it tributaries resulting in reduced floodplain size and increased sediment delivery to the stream network. Historic mining (both placer and hard rock) and processing activities resulted in high loads of heavy metals being delivered to the South Fork and its tributaries. Heavy metal concentrations were so high in the lower half of the South Fork that it was devoid of life until the 1970's (Mink et al. 1971). Currently, the lower section of the South Fork Coeur d'Alene River floodplain (downstream of Kellogg) is an Environmental Protection Agency Super Fund cleanup site in an effort to improve water quality. These efforts are beginning to pay off as heavy metal concentrations in 2006 were two to three times lower than what was recorded in 1998 (Table 43 and Figure 36) and low densities of fish and insects now occur in the South Fork. The U.S. Forest Service manages approximately 33% of the South Fork Coeur d'Alene River drainage with most of this public land occurring in higher elevations. Interstate 90 parallels much of the South Fork, restricting its access to the historic floodplain.

Twenty-seven snorkel transects were established on the main South Fork Coeur d'Alene River in 2006 by selecting sites that were considered good cutthroat trout habitat (Figure 37). Sites were spread throughout 34 km of river to help determine if habitat, heavy metals or fishing pressure was influencing fish densities. Sites downstream of Canyon Creek (SF1-SF24) were accessed by boat (one man pontoon boats) whereas sites SF25-SF26 were accessed by foot. Coordinates for the location of each of these transects are displayed in Appendix D and photographs (taken in 2002 through 2004) of each of the samples locations are displayed in Appendix F. These photos not only show a picture of sampled transects, but also depict where snorkeling should start and end and the approximate length of stream that should be snorkeled.

METHODS

Field Work

The same snorkeling methods previously described for the Moyie River were used to evaluate trends in fish abundance in the St. Joe River and Coeur d'Alene River. We suggest these techniques be followed when conducting snorkel surveys on any river or large stream in the Panhandle Region to ensure data is collected in a consistent comparable manner. Using repeatable methods is essential to identification of population and fish community changes and evaluation of various regulations, habitat changes and the influence of weather patterns.

Transects on the North Fork Coeur d'Alene River were snorkeled during the first week in August which is the same time period this river has been consistently snorkeled since the start. The South Fork Coeur d'Alene River was snorkeled during the last week of July and future sampling efforts should be during a similar timeframe. We intend to snorkel transects on the South Fork once every three years. Data was recorded on information sheets shown in Appendix G.

Data Analysis

Fish counts for each transect were converted to density (fish/100 m^2) to standardize the data and make it possible to compare counts within the watershed as well as to other watersheds. Average densities of each salmonid species (all sizes) and for cutthroat trout $\geq$ 300 mm were calculated for the entire North Fork Coeur d'Alene River and South Fork Coeur d'Alene River as well as for different stream reaches within each watershed (roadless vs. roaded, catch-and-release vs. limited harvest, upstream vs. downstream etc). These averages were calculated by summing the total number of fish counted in a particular reach of stream and dividing it by the total area snorkeled. It is important to note that this is not the same as calculating an average from the density recorded at each snorkel transect within a particular reach or stream. The densities of these fishes were added to the long-term data set to evaluate trends in abundance (see Appendice E for historic data). This was accomplished by graphing the average fish density over time. Attempts were made to assess why trends were occurring by evaluating when changes in fishing regulations, known climatic events (floods, droughts or extreme cold), habitat improvement projects and factors causing habitat degradation occurred.

To evaluate whether densities of cutthroat trout differed between the different stream reaches in the North Fork and South Fork Coeur d'Alene rivers we conducted an analysis of variance (ANOVA) on the density of fish in each of the transect sites. We used a p-value ≤ 0.10 to denote when a significant difference in density occurred between stream reaches. This value is often used to show significance when evaluating fish and wildlife populations for management purposes (Peterman 1990; Johnson 1999; Anderson et al. 2000). When an ANOVA showed that a significant difference ($p \leq 0.10$) in cutthroat trout density occurred between stream reaches we used Fisher's Least-Significance-Difference Test to evaluate which stream reaches differed significantly. Fisher's Least-Significance-Difference Test was chosen for this analysis as this test tends to maximize the power, which increases that ability to show statistically significant differences with low sample sizes (Milliken and Johnson 1992).

RESULTS

Forty-three transects were snorkeled in the North Fork Coeur d'Alene River watershed on August 1-3, 2006. A total of 1,218 cutthroat trout, 279 rainbow trout, 5,348 mountain whitefish, 1,230 northern pikeminnow and 620 largescale sucker were counted (Table 44). Cutthroat trout were observed in 41 of the 43 transects snorkeled. Densities of cutthroat trout (all size classes) in these transects ranged from 0.00 to 7.39 fish/100 m^2 with an overall average of 0.79 fish/100 m^2 (Table 2). About 23% of the cutthroat trout observed were estimated to be ≥ 300 mm in length and their overall density was calculated to be 0.18 fish/100 m^2.

Twenty-seven transects were snorkeled on the South Fork Coeur d'Alene River on July 27-28, 2006 (Tables 45 and 46). A total of 129 cutthroat trout, 11 rainbow trout, 43 brook trout, 141 mountain whitefish and 10 Chinook salmon were counted (Table 45). Cutthroat trout were observed in 21 of the 27 transects snorkeled. Densities of cutthroat trout (all size classes) in these transects ranged from 0.00 to 9.44 fish/100 m^2 with an overall average of 0.39 fish/100 m^2 (Table 45). A total of eight cutthroat trout ≥ 300 mm (6% of all cutthroat) were observed in all the transects we snorkeled with an overall density of 0.02 fish/100 m^2. Downstream of Canyon Creek, fish (of all species) were commonly observed with blackish tails.

The overall density of cutthroat trout was about twice as high in North Fork Coeur d'Alene River (0.79) as in the South Fork (0.39) (Tables 44 and 45). Analysis of variance (ANOVA) testing indicated that significantly different (p value < 0.001) densities of cutthroat trout occurred between stream reaches in the North Fork Coeur d'Alene River and South Fork Coeur d'Alene River (Figure 38). Fisher's LSD test showed that cutthroat trout densities in the upstream reaches within the within the North Fork (catch-and-release areas) and South Fork (upstream of Canyon Creek) were generally significantly higher than densities in the more downstream reaches (Table 47 and Figure 38). The highest density of cutthroat trout observed in all the reaches we snorkeled was In the South Fork upstream of Canyon Creek (4.8 fish/100 m^2). This reach was represented by shallow (< 1 m deep) riffle habitat (Table 46). Downstream of Canyon Creek, cutthroat trout densities dropped considerably and essentially the farther downstream we snorkeled the lower the cutthroat trout densities became (Table 45 and Figure 38). In fact, between Jackass Creek and Pine Creek (downstream of Kellogg) densities of cutthroat trout were near zero (Figure 38). Habitat conditions in this stream reach were represented by pool habitat with maximum depths between 1.5 and 2.0 m. High amounts of large woody debris were also located in two transects in this reach (Table 46). Densities of cutthroat trout in the South Fork downstream of Canyon Creek were similar to what was observed in the Little North Fork (Figure 38).

When we evaluated only cutthroat trout ≥ 300 mm, ANOVA testing also showed that densities were significantly different (p value < 0.001) between stream reaches (Figure 38). Fisher's LSD test showed that densities in the stream reaches in the catch-and-release areas of the North Fork Coeur d'Alene River tended to be significantly higher than densities in all other stream reaches (Table 47 and Figure 38). Few cutthroat trout ≥ 300 mm were observed in the South Fork.

Transects in the North Fork Coeur d'Alene River watershed have been snorkeled since 1973. Plotting the average density of cutthroat trout in various reaches of this river over time shows how cutthroat trout abundance has changed in response to changes in fishing regulations, extreme climatic events and rainbow trout stocking. Low densities (< 0.15/fish 100 m^2) of cutthroat trout (all sizes) in the North Fork Coeur d'Alene River were observed between 1973 and 1981 (Table 48 and Figure 39). During this period, significant changes in fishing regulations occurred (1975 – 1977) in which the entire Coeur d'Alene River basin changed from essentially a 15 fish limit for cutthroat trout to a 6 fish limit in the lower half of the basin and a 3 fish limit (none < 13 inches – 330 mm) upstream of the Yellow Dog Creek in the North Fork and upstream of Laverne Creek in the Little North Fork (Table 49). Despite these changes, no improvements in cutthroat trout densities were observed. The first improvements in cutthroat trout densities (all sizes) were observed in 1988, and it increased steadily until 1997 when densities were about six times higher than those observed between 1973 and 1981 (Figure 39 and Table 48). This initial increase in cutthroat trout density coincided with significant changes in the fishing regulation in 1986 and 1988 where upstream of Yellow Dog Creek and Laverne Creek it was changed to catch-and-release for cutthroat trout and downstream of these streams one fish > 14 inches (355 mm) could be harvested (Table 49). This same trend was not observed when we evaluated only those cutthroat trout ≥ 300 mm in length (Figure 39 and Table 48). From 1973 to 1981, the observed density of cutthroat trout ≥ 300 mm in length increased from 0.01 fish/100m^2 to 0.05 fish/100m^2. However, from 1981 to 1996 the observed density of cutthroat trout ≥ 300 mm fluctuated but never increased above 0.08 fish/100 m^2 despite the significant changes in fishing regulations. In 1996, about 11% of the cutthroat trout observed were ≥ 300 mm in length.

A noticeable decline in cutthroat trout densities (all sizes and ≥ 300 mm) were observed in 1997 and in 1998 (Figure 39 and Table 48). No changes in fishing regulations occurred around this time. However, during February 1996, the second highest peak flow event since 1950 occurred and was followed in 1997 by the third highest mean annual flow year since 1950 (Figure 40). Following this decline, densities of cutthroat trout (all sizes) increased steadily to the point that record high densities of cutthroat trout (all sizes) were observed in 2005 and 2006. From 1998 to 2002 densities of cutthroat trout ≥ 300 mm in length increased slowly but remained low (< 0.06 fish/100 m^2) and represented about 16% of the cutthroat trout observed (Figure 39 and Table 48). From 2002 to 2005 densities of cutthroat trout ≥ 300 mm increased dramatically to the point where record high counts were observed each succeeding year and about 27% of the cutthroat trout observed in 2005 were ≥ 300 mm in length (Figure 39 and Table 48). Densities observed in 2006 were lower than what was observed in 2005 although they were still the second highest ever recorded. The declines were most pronounced in the limited harvest areas and in the Little North Fork (Table 48).

From 1973 to 2006, there have been three different winters (78-79, 84-85 and 92-93) where the average air temperature in Kellogg, Idaho was < -3.5°C (Figure 41). These unusually cold winters did not coincide with obvious declines in cutthroat trout abundance the following summer.

Trends in cutthroat trout densities have been different for the Little North Fork Coeur d'Alene River. Densities of cutthroat trout (all sizes and ≥ 300 mm) declined from 1973 to 1995 (Figure 39 and Table 48). From 1996 to 2005 densities (all sizes) increased steadily to the point where record high densities were observed in 2005 (0.56 fish/100 m^2). In 2006, a decline (>

50%) in cutthroat trout density was documented. Numbers were similar to those observed prior to 2002. This was the largest single year decline recorded since counts began in 1973. This drop in cutthroat trout density did not coincide with an unusually cold winter or extreme flow event. Densities of cutthroat trout ≥ 300 mm fluctuated near zero from 1994 to 2002, and then increased sharply in 2003 when record high densities (0.07 fish 100/m^2) were observed. These record high densities were broken in 2004 (0.08 fish 100/m^2) and 2005 (0.10 fish 100/m^2) and cutthroat trout ≥ 300 represented about 18% of the fish (Figure 39 and Table 48). In 2006, densities of cutthroat trout ≥ 300 mm declined to levels observed prior to 2003, a single year decline of >50%.

During 2006, an average density of 0.55 cutthroat trout/100 m^2 (all size classes combined) was observed in the rehab sites on Tepee Creek. These densities were up from what was documented in 2005, although cutthroat trout abundance has fluctuated greatly in the rehab area since they were first snorkeled in 2002. Densities of cutthroat trout ≥ 300 mm in 2006 were 0.19 fish/100 m^2, the highest ever recorded. About 35% of the cutthroat trout observed in the rehab sites during 2006 were ≥ 300 mm.

This was the first year snorkel transects were set up in the South Fork Coeur d'Alene River. Average cutthroat trout densities in the South Fork downstream of Canyon Creek were 0.22 fish/100 m^2. We must look prior to 1988 in North Fork to find lower densities lower than were observed in 2006.

Mountain whitefish were observed in 20 of the 43 snorkel transects in the North Fork Coeur d'Alene River basin in 2006. Densities ranged from 0.00 to 18.23 fish/100 m^2 with a mean density of 3.49 fish/100 m^2 (Table 44). Mountain whitefish were observed in 4 of the 27 transects in the South Fork Coeur d'Alene River. Densities ranged from 0.00 to 8.80 fish/100 m^2 with a mean density of 0.42 fish/100 m^2 (Table 45). The highest densities of mountain whitefish were observed in the lower North Fork Coeur d'Alene River, with few observed upstream of Tepee Creek or in the Little North Fork Coeur d'Alene River or upstream of Pine Creek in the South Fork (Tables 44 and 45). The average density of mountain whitefish observed in the North Fork Coeur d'Alene River has fluctuated greatly since 1973 (Table 50 and Figure 42). Low densities of mountain whitefish (1980-81, 1993 and 1997; Figure 42) were observed the year following sever cold temperature conditions (winters of 1978-79, 1984-85, 1992-1993; Figure 41), or extreme flow events (1996 and 1997; Figure 40). Densities of mountain whitefish rebounded within two or three years to densities observed prior to their decline (Figure 42). Mountain whitefish densities have remained at > 2.3 fish/100 m^2 in the North Fork Coeur d'Alene River since its recovery from the floods of 1996 and 1997 and reached a record high in 2005 and 2006.

Rainbow trout were observed in 15 snorkel transects in the North Fork Coeur d'Alene River during 2006 (Table 44). Densities of rainbow trout observed at each transect ranged from 0.00 to 1.24 fish/100 m^2, with an overall average density of 0.18 fish/100 m^2. Densities of rainbow trout increased essentially as you moved downstream with every one of the rainbow trout being observed in the most downstream reaches where harvest was allowed (Table 44). About 19% of the trout observed in all snorkeled transects in the North Fork were rainbow trout, and in the downstream reaches where limited harvest was allowed, 34% of the observed trout were rainbow trout. Of the 279 rainbow trout observed, 54 (19%) were estimated to be ≥ 300 mm in length. Between 1991, and 2006 the average density of rainbow trout has remained relatively constant in the Coeur d'Alene River (Table 51 and Figure 42), despite decreased stocking within the basin (Figure 43). 2003 was the first year no rainbow trout were stocked into any flowing waters in the Panhandle Region. Eleven rainbow trout were observed in the South

Fork and were scattered throughout the entire river (Table 45). Densities of rainbow trout observed at each transect ranged from 0.00 to 0.48 fish/100 m^2, with an overall average density of 0.03 fish/100 m^2. About 6% of the trout observed in the South Fork were rainbow trout.

No brook trout were observed in the North Fork Coeur d'Alene River in 2006. Forty-three brook trout were observed in the South Fork Coeur d'Alene River with all but two being observed downstream of Twomile Creek and upstream of Pine Creek. No brook trout were observed > 300 mm in length and only two were estimated to be > 225 mm in length.

DISCUSSION

Cutthroat Trout

North Fork Coeur d'Alene River

Snorkel surveys in the North Fork Coeur d'Alene River basin first occurred in 1973 when extremely low densities of cutthroat trout were observed (0.20 fish/100 m2). These observations led researches to believe that one of the major factors influencing the fishery was overharvest (Bowler 1974) similar to what had happened in the St. Joe River (Mallet 1967; Dunn 1968; Rankel 1971). A series of changes in the fishing regulations occurred from 1975 to 1977 where the entire river was essentially changed from a 15 fish daily limit to only allowing harvest of three fish > 13 inches upstream of Yellow Dog and Laverne Creek and six fish downstream of these reaches. Despite changes in fishing regulations, from 1973 to 1981 the densities of cutthroat trout declined even further. In 1986, the first catch-and-release regulations for cutthroat trout were implemented in the North Fork Coeur d'Alene River basin and by 1988 it was catch-and-release upstream of Yellow Dog and Laverne Creek and one cutthroat trout > 14 inches could be kept downstream of these reaches. The snorkel sites were next surveyed in 1988 and the density of cutthroat trout (all size classes) in transects on the main North Fork had increased three fold from when it was last snorkeled in 1981. This information shows just how restrictive regulation must become before improvements in a cutthroat trout fishery can occur. Cutthroat trout are considered an easy fish to catch (Trotter 1987) which may be a result of evolving in unproductive waters where aggressive feeding must occur to obtain adequate food supplies (Rieman and Apperson 1989). In addition, Dwyer (1990) found that westslope cutthroat trout were the easiest to catch of three different subspecies of cutthroat trout. Lewynski (1986) found that cutthroat trout are significantly more vulnerable to angling than rainbow trout. When exposed to similar fishing regulations, higher catch rates of cutthroat trout could lead to a dominance of rainbow trout where they occupy the same waters (Lewynski 1986). The aggressive feeding habits that cutthroat trout display may explain why such restrictive fishing regulations must occur to sustain desirable numbers of larger cutthroat trout in heavily fished waters.

From 1988 to 1997 the average cutthroat trout density (all sizes combined) increased steadily in transects on the main North Fork Coeur d'Alene River to the point it was over five times higher than when it was first snorkeled in 1973. Increases in cutthroat trout densities were believed to occur from a combination of more restrictive fishing regulations, improvements in tributary habitat and reductions in heavy metal mining wastes (DuPont et al. In Press a). In 1998, a decline in cutthroat trout densities was observed, and by 2000 the density dropped to 33% lower than was observed in 1997. In all likelihood, the decrease in cutthroat trout density in 1998 was a delayed response to the large flood events that occurred during the winter of 1996 and spring of 1997 and not a factor of changes in fishing pressure, fishing regulations or unusually cold winters. 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; DeVries 2000). Large swings in cutthroat trout densities are not uncommon in Idaho rivers and have even been documented in wilderness rivers (Selway and Middle Fork Salmon) where fishing pressure and habitat degradation are usually not issues (Dan Schill, IDFG, personal communication). Following the floods (post 1998) densities of cutthroat trout increased steadily to the point where consecutive all time highs were observed in 2005 and 2006. The average densities were over 6.5 times higher in 2006 than what was observed in 1973 in snorkel sites on the main North Fork.

A big spike in cutthroat trout density was recorded in 2001 that appeared out of place. Closer evaluation of this data revealed that inexperienced snorkelers collected this data, they skipped several sites on the North Fork Coeur d'Alene River where low densities are typically observed and they did not snorkel the entire length of all transects. For this reason, we believe this data is misleading and is not accurately reported. This shows the importance of using trained personnel and accurate replication of snorkeling transects when conducting these surveys.

Snorkel surveys in transects on the main North Fork Coeur d'Alene River showed quite a different pattern when we evaluated only cutthroat trout ≥ 300 mm in length. Densities increased from 1973 to 1980, but from 1980 to 2002 no significant increase or decrease in density was observed despite significant changes in the fishing regulations. Two consecutive years of decline were observed in 1997 and 1998. This decline was not large (drop of 0.05 fish/100 m^2), although the average density in 1998 was the lowest recorded since 1973. We believe this decline was related to the floods of 1996 and 1997 as was also observed with the smaller fish. Based on telemetry work on cutthroat trout ≥ 300 mm, a combination of factors appeared to play a role in their suppression including, non-compliance with fishing regulations, degraded or loss of cold water refugia, degraded or loss of over-winter habitat, and degraded summer rearing habitat (DuPont et al. In Press b). However, from 2002 to 2005, the density of cutthroat trout ≥ 300 mm increased more than five-fold in the North Fork Coeur d'Alene to the point that they were the highest ever recorded. This increase in density was observed in both limited harvest and catch-and-release areas. Densities of cutthroat trout ≥ 300 mm dropped slightly in 2006 but were still the second highest ever recorded and were still over 15 times higher than was observed in 1973. These findings are very promising and suggest that survival of larger cutthroat trout is improving. Favorable weather patterns and restrictive fishing regulations may help explain why this increase occurred. A series of mild winters (1998-2005) and a lack of flood events may have increased survival of larger adult fish. In fact, the warmest seven consecutive winters on record in Kellogg was from 1998-2005. Future surveys will indicate whether this increase in the number of large cutthroat trout is a temporary or long-term trend and how average or below average winter temperatures will effect cutthroat trout densities.

Declines in densities of cutthroat trout were not observed throughout the North Fork Coeur d'Alene River watershed following unusually cold winters as has been observed in the St. Joe River (DuPont et al. In Press a). However, when we examine cutthroat trout densities in the upstream catch-and-release areas, the two lowest densities recorded (1980 and 1993) occurred following unusually cold winters. These same drops in cutthroat trout abundance were not observed in both years in the limited harvest areas. This may suggest a couple things. First, better overwinter habitat may have occurred in the downstream reaches. Work by DuPont et al. (In Press b) has found more deep, slow pools accompanied by wide floodplains in the downstream transects than the upstream transects. Habitat, characterized by many as good overwinter habitat (Thurow 1976; Lewynsky 1986; Bjornn and Reiser 1991; Hunt and Bjornn 1992; Schmelterling 2001) can be found in all areas. The other factor that may help explain this difference is water temperatures in the higher elevation transects get colder during winter, and consequently, cutthroat trout using these areas may experience higher mortality following unusually cold winters. Others have reported winter to be a major period of fish mortality based largely on the severity of the winter and subsequent losses of stored energy (Reimers 1963; Hunt 1969; Whitworth and Strange 1983). High fish mortality during periods of extreme cold have been attributed to frazil ice (Tack 1938), loss of or destruction of habitat through anchor ice formation and hanging ice dams (Maciolek and Needham 1952; Brown 1999; Brown et al. 2000) and depletion of energy reserves (Cunjack and Power 1986; Shuter and Post 1990). Extended cold periods appear to have the most impact on smaller fish (Shuter and Post 1990; Meyer and Griffith 1997). Shutter and Post (1990) claim that smaller fish tend to be less tolerant of starvation conditions because they exhaust their energy stores sooner. However, following the winter of 1992-93 declines in density of cutthroat trout ≥ 300 mm also occurred although not as pronounced as it was for fish < 300 mm. Often during intense cold periods ice dams form potentially backing up water for miles. When these ice dams break they can scour the river bottom and damage riparian vegetation (Beltaos, 1995). Presumably these types of events would have impacts on all sizes of fish. We're not aware if this type of event happened during the winter of 1992-93.

Restrictive fishing regulations may have also played a role in the increase in cutthroat trout ≥ 300 mm following 2002. However, the first catch-and-release regulations for cutthroat trout in the North Fork Coeur d'Alene River were initiated in 1986. In the St. Joe River where habitat conditions have not appeared to suppress cutthroat trout numbers, appreciable numbers of cutthroat trout ≥ 300 mm were observed shortly after much of the population was protected by catch-and-release regulations (DuPont et al. In Press a). Lewynski (1986) believed one of the possible reasons the abundance of cutthroat trout did not increase from 1973 to 1981 in the North Fork Coeur d'Alene River was because of non compliance with fishing regulations. In the North Fork Coeur d'Alene River, it may have taken a while before the public accepted the changes in fishing regulations. Work by Schill and Kline (1995) found that in the catch-and-release area of the North Fork, compliance with the fishing regulations was high (97% compliance) as early as 1993. However, research conducted in 2003 (> 65% annual mortality; DuPont et al. In Press b) and 2006 (73% of cutthroat trout kept were too small) showed that illegal harvest of cutthroat trout ≥ 300 mm was still extremely high in many of the limited harvest areas, especially downstream of Prichard Creek. Gigliotti and Taylor (1990) found that in waters with low densities of fish and high fishing effort it didn't take a high amount of non-compliance (<15%) to suppress a fishery. We believe the restrictive regulation implemented in 1988 (catch-and-release upstream of Yellow Dog and Laverne creeks and 1 fish > 14 inch daily limit downstream), were adequate to improve the abundance of cutthroat trout ≥ 300 mm in the North Fork. However, a combination of illegal harvest and unfavorable weather patterns (floods) likely prevented any benefits from being expressed until 2002.

Improvements in habitat has also been associated with increases in fish densities (Fausch et al. 1988; Hicks et al. 1991) Following 2002, the density of cutthroat trout ≥ 300 mm in the North Fork Coeur d'Alene improved throughout the basin. For this reason, if habitat improvements were responsible for this increase in fish density it would also be expected to have occurred basin wide. Although the flood events of 1996 and 1997 caused cutthroat trout abundance to decline, floods can also have favorable impacts on fish including increased large woody debris delivery to streams, and increases in pool depth (Swanston 1991). In Jordan Creek, a tributary to the upper North Fork, following the floods of 1996 and 1997 it was found that pool depth actually increased (Ed Lider, U.S. Forest Service, personal communication). It is believed the increased flows of these floods actually scoured out pools and transported excess sediment downstream. In the past (1960-1980's), it was believed that unstable stream banks coupled with an abundance of roads located in riparian areas actually caused more sediment to be delivered to streams in the North Fork basin during floods which caused pools to be filled with sediment. However, over the years the U.S. Forest Service has put a considerable amount of effort into removing problem roads and stabilizing stream banks. If these efforts did reduced sediment input into the North Fork Coeur d'Alene River to the point where sediment delivery was less than sediment export during the floods of 1996-1997, than it is possible pool depth increased throughout the basin following these floods. Most research has shown that pools tend to become shallower over time in managed watersheds, such as the North Fork Coeur d'Alene (Overton et al. 1993; Overton et al. 1995; Wood-Smith and Buffington 1996; Lee et al 1997; Kershner et al. 2004). This does not mean improvements in habitat can't occur in a managed watershed. It just means it is unlikely we will reach conditions found in unmanaged systems.

The highest density of cutthroat trout in the North Fork Coeur d'Alene River has consistently been observed in the catch-and-release (C&R) areas upstream of Yellow Dog Creek. Past snorkel surveys show that similar densities of cutthroat trout <150 mm occur in the limited harvest (LH) area as the C&R area, but the larger the fish we evaluated the fewer we observed in the LH area. This leads us to believe higher mortality rates in the LH area are resulting in significantly lower densities once they reach desirable sizes for fishermen to catch. Similar percentages of pool and run habitat occurred in the C&R areas as the LH areas, although the depths of pools and runs tended to be deeper than in the LH areas (DuPont et al. In Press b). Studies in the St. Joe River (Hunt and Bjornn 1992; Fredericks et al. 2002a) found that cutthroat trout tend to move upstream during summer, likely in search of cooler water temperatures. However, DuPont et al. (In Pres b) found in the Coeur d'Alene River basin that many cutthroat migrated downstream of C&R areas after spawning and did not migrate upstream during warm summer months. In addition, relatively high densities of cutthroat trout (521 to 444 fish/km) were found to occur in the free flowing reach of the Coeur d'Alene River with about half of these fish being > 250 mm (Fredericks et al. 2002 b, 2003). These findings suggest that habitat or upstream migrations towards cooler temperatures can't explain the higher densities of fish in the catch-and-release areas.

It is believed that angling pressure has increased on the Coeur d'Alene River, and it is likely that fishing mortality on cutthroat trout is having an impact on areas where limited harvest is allowed (downstream of Yellow Dog Creek and Laverne Creek). New fishing regulations implemented in 2000 (release all cutthroat trout between 8 and 16 inches (203 mm and 406 mm) where previously fish over 14 inches (356 mm) could be harvested) should limit the impacts that fishing would have on this fishery. However, work conducted by DuPont et al. (In Press b) suggests that high fishing pressure coupled with illegal harvest is suppressing the cutthroat trout fishery in many of the limited harvest areas. On the North Fork Coeur d'Alene River downstream of Prichard Creek, annual exploitation was estimated at 69% for cutthroat trout ≥ 300 mm during 2003 with 75% of these fish being illegally kept (too small to keep) (DuPont et al. In Press b). Stocking of rainbow trout historically provided a harvest fishery in this reach of river. Creel surveys in 2006 indicates illegal harvest is still a problem in the LH area of the North Fork Coeur d'Alene River as 73% of the cutthroat trout caught were between 8 and 16 inches in length (203 mm and 406 mm) (DuPont et al. In Prep).

Exploitation may not be the only reason cutthroat trout densities were lower in the LH area than in the C&R area. Rainbow trout could play a role as the LH area had the lowest cutthroat trout densities (lower North Fork and lower Little North Fork) and the highest densities of rainbow trout during 2006. Rainbow trout represent about 31% of the trout in the LH area and

< 1% in the C&R area. Rainbow trout have been found to displace cutthroat trout in many areas through competition and hybridization (Behnke 1992). Cutthroat trout are known to be hybridizing with rainbow trout in the North Fork Coeur d'Alene River watershed. However, it appears that despite a long history of rainbow trout stocking, there are likely some reproductive isolating mechanisms helping to limit hybridization and introgression between these two species (either pre- or post- isolating mechanisms) in the Coeur d'Alene River basin (DuPont et al. In Press c). Starting in 2003, no rainbow trout were stocked in any free flowing waters in the Panhandle Region of Idaho. Not surprisingly, this cessation of stocking corresponded with in a large decline in the densities of rainbow trout observed during 2003 and has continued to slowly decline through 2006. Cutthroat trout densities on the other hand increased in the LH area from 2003 to 2006 and have outnumbered rainbow trout ever since (Figure 44). We can't say for certain that this increase in cutthroat trout density is due to not stocking rainbow trout because we also observed an increase in cutthroat trout density in C&R areas at the same time suggesting that other factors are playing a role. Harvest may also give an advantage to rainbow trout in the limited harvest areas. Cutthroat trout are considered an easy fish to catch (Trotter 1987) and Lewynski (1986) found that cutthroat trout are significantly more vulnerable to angling than rainbow trout. When exposed to similar fishing regulations, higher catch rates of cutthroat trout could lead to a dominance of rainbow trout where they occupy the same waters (Lewynski 1986). Fishing regulations since 2000 allowed a daily harvest of six rainbow trout of any size whereas only 2 cutthroat trout could be harvested. If anglers comply with fishing regulations, exploitation should not be a reason that leads to a dominance of rainbow trout over cutthroat trout.

Telemetry worked conducted by DuPont et al. (In Press b) in the Coeur d'Alene River watershed found larger cutthroat trout are grouping in areas where colder water occurs during warm summer months. In the LH area of the North Fork, cold water refugia that cutthroat trout utilized during summer was often located in side channels or back water areas. One of these areas where fish concentrated during the heat of the summer was located at snorkel transect NF01-slough. This particular backwater had water temperatures around 2°C cooler than the main river channel when it was snorkeled during 2005. The second highest density of cutthroat trout in all the LH area was observed at this particular site (1.70 fish/100 m^2). The warmer the water temperature, the more the cutthroat trout appear to congregate in this cold water sanctuary. The summer of 2003, was an unusually hot year (water temperatures were 5°C cooler in the slough than the main river), and cutthroat trout densities were 2.34 fish/100 m^2 in this slough - the highest cutthroat trout density of all transects snorkeled at that time. The abundance of this type of habitat has declined over the years due to road building, levee construction, and general development in the floodplain. If this habitat type is important in improving survival of larger cutthroat trout, its decline in abundance may also help explain why fewer cutthroat trout occur in the LH area than the C&R area.

Two temporary snorkel transects (R1 & R2) were established during 2002 in the upstream portion of Tepee Creek where the U.S. Forest Service had completed some extensive stream restoration in 2001. These sites were added to evaluate how fish densities respond to habitat restoration over time. Cutthroat trout densities have fluctuated greatly in these rehabilitation sites since we first started snorkeling them - which may indicate that unstable habitat conditions occur in this reach. Since its creation, some stream channel shifting has occurred. We expect this to continue until willows and other shrubs take hold and begin to stabilize the banks. We did observe the highest densities of cutthroat trout ≥ 300 mm in 2006 suggesting this area is becoming more suitable to larger fish. However, densities of cutthroat trout in the rehabilitated areas are still considerably lower than the average density observed in Tepee Creek or the C&R area.

The cutthroat trout fishery in the Little North Fork Coeur d'Alene River did not follow suit with the North Fork Coeur d'Alene River. In fact, cutthroat trout densities in the Little North Fork were no better in 2006 than they where we were in 1973. In this same time period, cutthroat trout densities increased almost seven fold in the North Fork (they were 27 times higher if we evaluate only cutthroat trout ≥ 300 mm). Poor habitat and illegal harvest may explain for the low densities in the Little North Fork. Splash damming was used to transport wood from the basin prior to 1930 (Strong and Webb 1970). These practices seriously degraded habitat in this watershed including straightened and widened the river channel, removal of large woody debris, loss of pool habitat, and destruction of riparian vegetation. Effects from these practices are still obvious today, especially in the upstream reaches that are protected by catch-and-release. This reach of stream is dominated by riffle habitat. Where pools exist they tend to be shallow in nature and have an absence of large woody debris (DuPont et al. In Press b). The best habitat in the Little North Fork is located in areas where harvest is allowed. This difference in habitat quality helps explain why many of the larger cutthroat trout move downstream into the lower Little North Fork after spawning. Unfortunately, in doing so, these larger fish are more susceptible to fishing exploitation (both legal and illegal). Evidence suggests that illegal harvest is very high in the LH reach of the Little North Fork and may be playing a large role in suppressing the fishery (DuPont et al. In Press c). In the C&R area of the Little North Fork, habitat appears to limit the abundance of cutthroat trout it can support.

South Fork Coeur d'Alene River

This survey was the first year transects were set up and snorkeled in the South Fork Coeur d'Alene River. Cutthroat trout were located throughout the South Fork, although densities tended to be low (< 0.6 fish/100 m^2) except upstream of Canyon Creek (4.3 fish/100 m^2). Essentially, the farther downstream we snorkeled the lower the cutthroat trout densities became. The scarcity of larger cutthroat trout was even more apparent in the South Fork. In the 27 transects we snorkeled, we saw only one cutthroat trout that we believe was > 450 mm in length and only eight (6% of the cutthroat trout) that were ≥ 300 mm in length. As with the smaller cutthroat trout, the highest densities of larger fish were located upstream of Canyon Creek where shallow riffle habitat dominated the water.

Many factors may explain why densities of cutthroat trout were low downstream Canyon Creek, but probably the main reason for these low densities is the elevated heavy metals found in the drainage. Prior to 1971, heavy metal concentrations (cadmium and zinc) were so high that no life existed in the South Fork downstream of Canyon Creek (Ellis 1940; Mink et al. 1971). As heavy metal concentrations dropped, due to development of settling ponds in 1968, insects started appearing in many areas in the South Fork in the early 1970's (Mink et al. 1971), and by the 1990's there were reports that fish were surviving in the river. The density of cutthroat trout we observed in the South Fork correlated closely with heavy metal concentrations where the higher the concentration of the heavy metals the fewer fish we observed (Table 52). Concentration of cadmium, copper, lead and zinc in the South Fork Coeur d'Alene River during 2006 (USEPA 2007) were lower than the LC50 (concentration when 50% of the fish will die after 96 hrs) for rainbow trout reported in Nelson et al. (1991). However, Woodward et al. (1997) found that cutthroat trout will avoid waters with zinc concentrations > 28 µg/L. In 2006, zinc concentrations downstream of Twomile Creek (near transect 19) exceeded 180 µg/L, more than six times the level that cutthroat trout have been found to avoid. Heavy metals have not been surveyed upstream of Twomile Creek since 1998, although we believe they greatly exceed 28 µg/L in 2006 except upstream of Canyon Creek. Zinc concentrations upstream of Canyon Creek in 1998 were at least 3.5 to 7.0 times lower than what was measured downstream. Cutthroat trout densities were 10 to 100 times higher upstream of Canyon Creek than what was observed downstream.

The lowest average density (0.04 fish/100 m^2) of cutthroat trout was observed between Jackass Creek and Pine Creek (downstream of Kellogg) where cutthroat trout weren't observed in four of the six transects we snorkeled. This reach of stream was located in the Superfund Cleanup Site and had the highest concentrations of heavy metals. A considerable amount of rehabilitation has occurred in this reach to reduce heavy metal concentrations. The top layer (top 1-2 m) of substrate in the floodplain; where high concentrations of heavy metal occurred, was removed. Following this removal, substrate was replaced, riparian vegetation was planted, large woody debris and boulders were anchored in the stream channel, pools were created and side channels and backwater areas were constructed. This work was completed in 1999 and explains why this area was still unstable. The instability of this reach also plays a role in the low fish densities observed. Willows and other riparian vegetation were beginning to establish in many areas in this reach, which were helping to stabilize the stream banks. Over time, this reach of stream should become more stable and the riparian vegetation should begin providing shade to maintain lower stream temperatures. Habitat conditions in the transects we snorkeled in this reach actually appeared favorable for cutthroat trout as they were represented by pool habitat with maximum depths between 1.5 and 2.0 m and often high amounts of large woody debris.

The area between Jackass Creek and Pine Creek was not the only section with poor or unstable habitat. Many of the areas we snorkeled (between transects 11-15, and 20-27) were confined and lined with rip-rap to prevent the river from damaging and/or flooding roads and housing developments. Where the river widened (between transects 16 and 19) the stream channel tended to be unstable, and had sparse amounts of riparian vegetation. Drop structures and bank barbs had been placed throughout much of this area (during the mid 1990's) to create deeper pool and run habitat. However, this type of work can have only limited success when compared to its potential as the river has been restricted to less than 10% of its original floodplain in many areas upstream of Jackass Creek.

Water temperatures in the South Fork were found to exceed 20˚C downstream of Jackass Creek and most likely exceeded this temperature downstream of Twomile Creek. The year 2006 was a relatively cool summer when compared to the past seven years; consequently water temperatures were likely cooler. For example, in 2003, water temperatures near the mouth of the South Fork reached around 24˚C whereas when we snorkeled this area in 2006 the water temperature was 21˚C. Much of the South Fork is lined with dark rip-rap which absorbs heat and restricts the growth of shade growing vegetation. Other areas were devoid of riparian vegetation and without the benefit of shade, water temperatures in the South Fork were elevated. Westslope cutthroat trout have been found to avoid or move from stream reaches when maximum water temperatures exceed approximately 22°C (Hunt and Bjronn 1992). Bjornn and Reiser (1991), the USEPA (2003) and Behnke (1992) also reported similar avoidances by salmonids when water temperatures reached approximately 22°C. McMahon et al. (2006) found that the preferred temperature of westlope cutthroat trout was 14.8°C. Similarly, Dwyer and Kramer (1975) reported the activity of cutthroat trout was highest at 15°C and Hickman and Raleigh (1982) stated that 12-15°C was their optimum temperature range. Bell (1986) found the upper lethal temperature for cutthroat trout to be 22.8°C and Behnke and Zarn (1976) reported that cutthroat trout would not persist where temperatures consistently exceed 22°C. Bjornn and Reiser (1991) also suggested that salmonids are placed in life threatening conditions when water temperatures exceed 23-25°C. Laboratory studies have shown that trout reduce and finally cease feeding as water temperatures rise above 22°C (Dickson and Kramer 1971). As water temperatures reach 20-21°C other species may have a competitive advantage over cutthroat trout and may out-compete them for food and/or space (Reeves et al. 1987; DeStaso and Rahel 1994). Over time, as heavy metal concentrations decline and rehabilitation areas have time to mature, we expect riparian vegetation will begin to provide enough shade to help reduce stream temperatures that are more suitable to cutthroat trout. We believe water temperature throughout much of the South Fork often exceeds 22°C during warm summer years. However, these types of temperatures have also been observed in the North Fork Coeur d'Alene River where cutthroat trout densities exceed 1.5 fish/100 m^2 (DuPont et al. In Press b).

Illegal harvest could also be impacting this fishery, especially since it would take little exploitation to negatively influence an already weak population of fish. We did observe people fishing along the river (mostly downstream of Pine Creek), including several groups of young kids. Despite these observations, fishing pressure appeared light and was a fraction of what occurred on the North Fork.

Degraded habitat, elevated water temperatures, and illegal harvest could all play a role in the low cutthroat trout densities in the South Fork. It's our professional opinion that we believe the elevated heavy metals play the biggest role in suppressing this cutthroat trout population. This seems to appear logical given cutthroat trout population was 10 to 100 times higher upstream of Canyon Creek where heavy metal concentrations were low. This same area appeared to have the least desirable habitat as the river was confined between rip-rap banks and was dominated by riffles and shallow water – habitat conditions typically not preferred by cutthroat trout (DuPont et al. In Press a). The coolest water temperature did occur upstream of Canyon Creek; however, water temperatures in transects 20-24 were similar but cutthroat trout densities were about 10 times lower. In addition, the reach of the South Fork downstream of Pine Creek had the most desirable habitat (stable stream channel, wide unconfined floodplain and deep long pools) but some of the lower densities of cutthroat trout. Water temperatures exceeded 20°C in this stretch of river, although cutthroat trout densities were at least five times higher in the North Fork where similar water temperatures occurred. The only real explanation for these low cutthroat trout densities was the elevated heavy metals.

The absence of larger cutthroat trout (≥ 300 mm) could be explained by reasons other than elevated heavy metals. For example, if this population was represented by migratory fish, the adult fish could use the South Fork only as a migratory corridor to and from spawning areas or seasonal habitats. Because larger cutthroat trout were located were upstream of Canyon Creek, it contradicts this theory. We surmise that cutthroat trout mortality is high in areas with elevated heavy metal concentrations and sub-adult fish vacate the area when they become mobile. Whatever the case, we believe large fish will become more abundant in the South Fork as heavy metal concentrations decline. The South Fork certainly has the habitat to support larger fish, as this watershed is larger than Tepee Creek or the North Fork upstream of Tepee Creek where much higher densities of cutthroat trout ≥ 300 mm occur.

One area that could benefit the quickest from stream work in the South Fork is upstream of Canyon Creek. This section of stream had the best water temperatures and lowest levels of heavy metals, but the worst habitat. Upstream of Canyon Creek much of the river has been rip-rapped and confined by the freeway. Despite these habitat limitations this is where the most fish were located. We believe that if efforts were made to create pools or pockets of calmer deeper water this section of river could support a considerable number of cutthroat trout ≥ 300 mm in length. Currently, cutthroat trout ≥ 300 mm in length do occur in this reach but they are limited by habitat. In the couple areas where calm, deeper (> .75 m), pocket water occurred we observed cutthroat trout ≥ 300 mm in length. Currently, pool habitat is almost nonexistent in this reach.

Despite the low densities of cutthroat trout in the South Fork, densities are fairly comparable to those observed in the Little North Fork. In addition, the average density of cutthroat trout observed upstream of Canyon Creek (4.3 fish/100 m^2) exceeded observations in other stream reaches snorkeled in the North Fork or the St. Joe River (DuPont et al. In Press a) despite the relatively poor habitat found in this reach. This leads us to believe that if heavy metal concentrations can be lowered to the point they do not influence survival or cause avoidance behaviors, densities of cutthroat trout could be higher and provide a quality fishery in the South Fork. How long this will take is difficult to determine. History suggests recovery of the North Fork took approximately 25 years. We would expect a similar recovery time in the South Fork (downstream of Canyon Creek) from where it is today (DuPont et al. In Press a). It took the St. Joe River about 20 years to go from an average density of 0.29 cutthroat/100 m^2 to the renowned fishery it is today (DuPont et al. In Press a). However, the issues that the North Fork and St. Joe rivers faced are different than the South Fork. Once heavy metals decline to suitable levels in the South Fork, the fishery could quickly rebound.

Mountain Whitefish

Based on snorkel surveys, the density of mountain whitefish in the North Fork Coeur d'Alene River has fluctuated since 1973. Many of the down years occur immediately after unusually cold winters (1979-1980; 1992-1993) or flood events (1996). Despite drops in density by 75% to 85%, the whitefish population typically bounced back in about three years. Since 2000, the average whitefish density has remained relatively high in the North Fork Coeur d'Alene River and reached all time highs in 2006. Since 1997, we have not experienced extremely cold temperatures or flood events.

Mountain whitefish were almost exclusively located downstream of Pine Creek in the South Fork Coeur d'Alene River. This is the reach of river where stable, deep, long pools were located –habitat similar to where the highest densities of mountain whitefish were located in the North Fork. When we compare the density of mountain whitefish we observed downstream of Pine Creek (1.1 fish/100 m^2) to the reach of the North Fork Coeur d'Alene where it is of similar habitat and size (Yellow Dog Creek to Tepee Creek – 5.0 fish/100 m^2) the density was about five times lower in the South Fork. We surmise lower densities are a factor of elevated heavy metals concentrations.

Rainbow Trout

Rainbow trout were located in only the LH areas in the North Fork Coeur d'Alene River basin and essentially the lower downstream we snorkeled the higher their densities became. About 34% of the trout in the LH area were rainbow trout. Based on snorkel surveys and other work conducted in the Coeur d'Alene River basin, it appears that a natural reproducing rainbow trout population exists in the North Fork Coeur d'Alene downstream of Shoshone Creek and downstream of Laverne Creek in the Little North Fork Coeur d'Alene River. Others have also found introduced rainbow trout to be more abundant in the lower reaches of streams where cutthroat trout occur (Paul and Post 2001; Sloat et al. 2005). Some have suggested that the ability of rainbow trout to survive prolonged exposure to temperatures > 20°C and to grow over a wider range of temperatures helps explain why rainbow trout are often located in the lower reaches of streams and cutthroat trout in the upper reaches (Bear et al. 2005). Where the warmest water temperatures occur in the North Fork (transects 8-13) is not where the highest densities of rainbow trout occurred. Although water temperature certainly influences the distribution of rainbow trout, other factors obviously play a role. The absence of rainbow trout in the upstream reaches in the North Fork basin may have to do with the difference in geomorphology. The further upstream you go in North Fork Coeur d'Alene basin the more canyon-like the topography becomes, the stream gradient steepens, and the floodplain narrows. Cutthroat trout, that spend the summer in the upstream reaches of the North Fork, migrate downstream to areas (often 5-20 km) where the river is slower, deeper and has a wider floodplain to overwinter (DuPont et al. In Press b). Cutthroat trout evolved over thousands of year to develop these migrations to maximize their survival. Consequently, for rainbow trout to survive throughout a year in the upper North Fork they would have to go through a more complex migration than they would in the lower North Fork. Introduced rainbow trout don't have this adaptation and could explain why they don't exist in the upstream reaches. Moller and VanKirk (2003) have found that rainbow trout in the South Fork Snake River appear to have a competitive advantage over Yellowstone cutthroat trout where flows were less flashy (lower peak flows and higher low flows). They speculate these types of flows provide better rearing conditions for first year rainbow trout that occur in the main river. The wider floodplains that occur in the lower reaches of the North Fork Coeur d'Alene River likely moderate flow velocities by dispersing flow across the floodplain during high flow periods and releasing groundwater during low periods. The area with the widest and most intact floodplain occurs downstream of the South Fork Coeur d'Alene River in the Coeur d'Alene River. Rainbow trout represent about 10% of the trout species in this reach of river (DuPont et al. In Prep), whereas they represent over 30% of the trout species upstream of the South Fork. Water temperatures and fishing pressure are lower downstream of the South Fork than upstream. Likely a combination of water temperature, geomorphology and fishing pressure all play a role in the distribution and abundance of rainbow trout in the North Fork Coeur d'Alene River.

Past snorkel surveys indicate that rainbow trout have decreased in the North Fork Coeur d'Alene River, although their decline has been minimal since 2003. The initial decline was likely a response to the cessation of rainbow trout stocking within the Panhandle Region starting in 2003. The current fishing regulations allow six rainbow trout of any size to be harvested from the Coeur d'Alene River. These regulations do not appear to be causing the rainbow trout population to decline in abundance, although they may be keeping the rainbow trout population from increasing. What appears to be happening is these regulations are causing the size of the rainbow trout to decline. Fishermen regularly comment on the decline in size of harvested rainbow trout. Continual monitoring of this fishery should reveal population trends in rainbow trout and their potential impact on cutthroat trout in the lower North Fork and Little North Fork Coeur d'Alene rivers.

In the South Fork Coeur d'Alene River, only eleven rainbow trout were observed and were scattered throughout the entire river. Their abundance did not increase downstream as we observed in the North Fork. This again may be a result of the elevated heavy metals that occur lower in the river system. All of the rainbow trout observed downstream of Canyon Creek were between 225 and 450 mm. This suggests that little natural reproduction is occurring in the main South Fork and that these fish likely migrated in from outside waters.

Brook Trout

Forty-five brook trout were observed in the South Fork Coeur d'Alene River whereas none were observed in the North Fork Coeur d'Alene River during our snorkel surveys. The absence of book trout in the North Fork is likely related to the habitat conditions. The North Fork Coeur d'Alene River watershed is dominated by belt geology. Through weathering and erosional processes, belts break into flat gravel, cobble or boulder type substrates. This geology doesn't form an abundance of sand type particles as is often observed with granite. Brook trout tend to flourish in areas with sandy substrates (granitic watersheds). They have successfully established themselves and displaced cutthroat trout in the Panhandle (DuPont et al. In Press c) in streams with moderate levels of fine substrate. Another reason brook trout may not do well in the North Fork Coeur d'Alene watershed is because of its low elevation. Rain-on-snow events often occur which causes flash flow events and scouring of fine sediments. These rain-on-snow events can cause bedload movement which suffocates or displaces eggs laid by fall spawning fish. It can also fill interstitutial spaces where juvenile fish over-winter. The reason brook trout may be more common in the South Fork is because of all the mining work that has occurred in the basin (both hard rock and placer mining). This mining activity has greatly altered the habitat in the South Fork as well as many of its tributaries and has increased the amounts of fine sediment within the basin. Brook trout have a competitive advantage over cutthroat trout where disturbances occur especially when it increases the amount of fine substrates in streams (Dunham et al. 2002; Shepard 2004). Densities of brook trout were certainly not high in the South Fork and may suggest that these fish are mostly moving downstream from tributaries. The size of the brook trout observed (only two brook trout > 225 mm) helps support this idea.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor cutthroat trout abundance in the North Fork Coeur d'Alene River annually due to its popularity with fishermen.

2. Continue to monitor the fishery in the South Fork Coeur d'Alene River through snorkel surveys. We recommend evaluating the South Fork Coeur d'Alene River on average about every three years due to its low density of fishes and low fishing pressure. As the popularity of this river increases it may be desirable to survey it more frequently.

3. Assess whether rainbow trout are having an impact on cutthroat trout in the North Fork Coeur d'Alene River.

Table 43. Concentrations (µg/L) of dissolved heavy metals in surface water collected from sites on the South Fork Coeur d'Alene River, Idaho (USEPA 2007). Refer to Figure 36 for locations of these sites.

	Cadmium		Copper		Lead		Zinc	
Site	1998	2006	1998	2006	1998	2006	1998	2006
1	4.1	1.4	ND	ND	6.9	2.9	583	230
2	4.9	1.6	2.0	ND	15.8	3.8	579	240
3	3.0	1.2	ND	ND	7.2	3.4	412	181
4	3.0	ND	1.0	ND	17.1	ND	472	ND
5	3.2	ND	ND	ND	6.7	ND	429	ND
6	2.6	ND	0.8	ND	7.9	ND	412	ND
7	2.3	ND	0.8	ND	8.3	ND	369	ND
8	2.0	ND	0.7	ND	9.6	ND	296	ND
9	0.3	ND	0.6	ND	1.1	ND	84	ND

Table 44. Number and density (fish/100 m^2) of salmonids observed while snorkeling transects in the North Fork Coeur d'Alene River watershed, Idaho, during August 1-3, 2006.

Reach	Transect #	Habitat Type	Area (m^2)	Cutthroat trout: Number counted ≥300mm	Cutthroat trout: Number counted all sizes	Cutthroat trout: Density (No./100 m^2)	Rainbow Trout: Number Counted	Rainbow Trout: Density (No./100 m^2)	Brook Trout: Counted	Mountain whitefish: Number Counted	Mountain whitefish: Density (No./100 m^2)
Lower North Fork Coeur d'Alene (Limited Harvest Allowed)	NF-01	Pool	4,612	3	17	0.37	57	1.24	0	600	13.01
	NF-01 (slough)	Pool	1,256	10	15	1.19	6	0.48	0	125	9.96
	NF-02	Pool	9,314	5	23	0.25	23	0.25	0	331	3.55
	NF-03	Pool	8,854	3	35	0.40	57	0.64	0	379	4.28
	NF-04	Pool	10,661	7	33	0.31	12	0.11	0	490	4.60
	NF-05	Pool	6,201	0	34	0.55	26	0.42	0	200	3.23
	NF-06	Pool	7,124	2	36	0.51	15	0.21	0	300	4.21
	NF-07	Pool	6,033	2	58	0.96	28	0.46	0	1100	18.23
	NF-08	Pool	5,405	11	38	0.70	7	0.13	0	70	1.30
	NF-09	Pool	9,555	11	45	0.47	9	0.09	0	31	0.32
	NF-10	Pool/Run	8,323	58	176	2.11	23	0.28	0	500	6.01
	NF-11	Glide	8,385	1	7	0.08	1	0.01	0	0	0.00
	NF-12	Run	6,587	2	7	0.11	0	0.00	0	0	0.00
	NF-13	Run	3,111	3	6	0.19	0	0.00	0	0	0.00
N. F. Cd'A (Catch-and-Release)	NF-14	Pool	3,276	14	74	2.26	0	0.00	0	81	2.47
	NF-15	Pool	2,119	13	77	3.63	0	0.00	0	325	15.34
	NF-16	Run	4,130	6	8	0.19	0	0.00	0	0	0.00
	NF-17	Pool	10,585	28	175	1.65	0	0.00	0	530	5.01
	NF-18	Pool	1,703	17	39	2.29	0	0.00	0	150	8.81
	NF-19	Pool	812	11	60	7.39	0	0.00	0	0	0.00
	NF-20	Pool	1,617	5	19	1.18	0	0.00	0	3	0.19
	NF-21	Pool	1,274	10	34	2.67	0	0.00	0	2	0.16
	NF-22	Pool	1,218	14	41	3.37	0	0.00	0	0	0.00
	NF-23	Pool	452	0	3	0.66	0	0.00	0	0	0.00
Tepee Creek (Catch-and-Release)	TP-01	Pool	1,732	18	40	2.31	0	0.00	0	10	0.58
	TP-02	Riffle/Run	3,138	3	7	0.22	0	0.00	0	0	0.00
	TP-03	Pool	1,230	3	5	0.41	0	0.00	0	0	0.00
	TP-04	Run	1,474	3	10	0.68	0	0.00	0	0	0.00
	TP-05	Pool	1,638	0	30	1.83	0	0.00	0	120	7.33
	TP R1	Pool	1,284	3	14	1.09	0	0.00	0	0	0.00
	TP R2	Pool	1,824	3	3	0.16	0	0.00	0	0	0.00
L.N.F. Cd'A (Limited Harvest Allowed)	LNF-01	Pool	893	0	1	0.11	3	0.34	0	0	0.00
	LNF-02	Run	3,125	2	4	0.13	7	0.22	0	0	0.00
	LNF-03	Pool	2,508	0	0	0.00	0	0.00	0	1	0.04
	LNF-04	Pool/Run	1,054	0	3	0.28	5	0.47	0	0	0.00
	LNF-05	Pool	777	0	1	0.13	0	0.00	0	0	0.00
	LNF-06	Run	1,620	0	1	0.06	0	0.00	0	0	0.00
	LNF-07	Pool	1,643	1	2	0.12	0	0.00	0	0	0.00
	LNF-08	Pool	1,212	1	6	0.50	0	0.00	0	0	0.00
L.N.F. Cd'A (Catch-and-Release)	LNF-09	Run	875	0	0	0.00	0	0.00	0	0	0.00
	LNF-10	Pool/Run	1,595	3	22	1.38	0	0.00	0	0	0.00
	LNF-11	Pool	1,580	0	1	0.06	0	0.00	0	0	0.00
	LNF-12	Pool	819	1	3	0.37	0	0.00	0	0	0.00
	LNF-13	Run	680	0	5	0.74	0	0.00	0	0	0.00
Total	43 sites	--	153,306	277	1,218	0.79	279	0.18	0	5,348	3.49

Table 45. Number and density (fish/100 m^2) of salmonids observed while snorkeling transects in the South Fork Coeur d'Alene River watershed, Idaho, during July 27-28, 2006.

Reach	Transect	Area (m^2)	Cutthroat trout: Number counted ≥300mm	Cutthroat trout: Number counted All sizes	Cutthroat trout: Density (No./100 m^2)	Rainbow Trout: Number Counted	Rainbow Trout: Density (No./100 m^2)	Brook: Number Counted	Brook: Density (No./100 m^2)	Mountain whitefish: Number Counted	Mountain whitefish: Density (No./100 m^2)
Pine Creek to CdA River	SF1	3,827	2	5	0.13	1	0.03	0	0.00	20	0.52
	SF2	3,096	0	1	0.03	1	0.03	0	0.00	0	0.00
	SF3	2,063	1	3	0.15	1	0.05	1	0.05	30	1.45
	SF4	3,223	2	2	0.06	0	0.00	0	0.00	0	0.00
	SF5	1,011	0	3	0.30	0	0.00	0	0.00	89	8.80
Jackass Creek to Pine Creek	SF6	2,117	0	1	0.05	1	0.05	0	0.00	2	0.09
	SF7	1,275	0	2	0.16	0	0.00	4	0.31	0	0.00
	SF8	1,485	0	0	0.00	1	0.07	0	0.00	0	0.00
	SF9	955	0	0	0.00	0	0.00	0	0.00	0	0.00
	SF10	765	0	0	0.00	0	0.00	0	0.00	0	0.00
	SF11	1,260	0	0	0.00	0	0.00	1	0.08	0	0.00
Twomile Creek to Jackass Creek	SF12	1,525	0	12	0.79	0	0.00	11	0.72	0	0.00
	SF13	669	0	8	1.20	0	0.00	6	0.90	0	0.00
	SF14	1,075	0	3	0.28	0	0.00	3	0.28	0	0.00
	SF15	1,448	0	3	0.21	0	0.00	6	0.41	0	0.00
	SF16	988	0	1	0.10	0	0.00	3	0.30	0	0.00
	SF17	676	1	5	0.74	0	0.00	2	0.30	0	0.00
	SF18	814	0	2	0.25	1	0.12	2	0.25	0	0.00
	SF19	1,037	0	4	0.39	0	0.00	3	0.29	0	0.00
Canyon Creek to Twomile Creek	SF20	708	0	4	0.56	2	0.28	0	0.00	0	0.00
	SF21	445	1	8	1.80	0	0.00	1	0.22	0	0.00
	SF22	780	0	0	0.00	0	0.00	0	0.00	0	0.00
	SF23	454	0	3	0.66	0	0.00	0	0.00	0	0.00
	SF24	369	0	0	0.00	0	0.00	0	0.00	0	0.00
Upstream of Canyon Creek	SF25	360	1	34	9.44	0	0.00	0	0.00	0	0.00
	SF26	602	0	14	2.33	1	0.17	0	0.00	0	0.00
	SF27	416	0	11	2.64	2	0.48	0	0.00	0	0.00
Total	27 sites	33,442	8	129	0.39	11	0.03	43	0.13	141	0.42

Table 46. Characteristics of transects snorkeled in the South Fork Coeur d'Alene River watershed, Idaho, during July 27-28, 2006.

Reach	Transect 2006	Date snorkeled	Time snorkeled	Temp (°C)	Visibility (m)	Habitat Type	Max Depth (m)	Dominant Cover	Percent Cover	Length (m)	Average width(m)	Area (m^2)
Pine Creek to CdA River	SF1	7/27/2006	16:36	21.0	6.4	Pool	3.0	UB	15	205	18. 7	3,827
	SF2	7/27/2006	16:10	20.5	6.4	Pool	2.5	LS	15	180	17.2	3,096
	SF3	7/27/2006	15:55	20.0	6.4	Pool	2.0	LWD	15	95	21.7	2,063
	SF4	7/27/2006	15:37	19.0	7.0	Run	1.0	UB	10	160	20.1	3,223
	SF5	7/27/2006	15:10	21.0	8.0	Pool	1.0	UB	5	64	15.8	1,011
Jackass Creek to Pine Creek	SF6	7/27/2006	14:30	21.0	8.0	Run	1.7	UB	5	145	14.6	2,117
	SF7	7/27/2006	14:00	21.0	8.0	Pool	1.7	LWD	30	75	17.0	1,275
	SF8	7/27/2006	13:40	19.0	9.0	Pool	2.0	UB	10	116	12.8	1,485
	SF9	7/27/2006	13:00	19.0	9.0	Pool	2.0	LS	35	62	15.4	955
	SF10	7/27/2006	11:45	17.5	10.0	Pool	1.5	LWD	30	75	10.2	765
	SF11	7/27/2006	11:30	18.0	10.0	Run	1.8	LS	20	90	14	1,260
Twomile Creek to Jackass Creek	SF12	7/27/2006	10:43	15.5	12.0	Run	1.8	LS	40	123	12.4	1,525
	SF13	7/27/2006	10:16	15.0	12.0	Pool/Run	1.9	LS	70	44	15.2	669
	SF14	7/27/2006	9:50	14.5	12.0	Pool	1.8	LS	10	56	19.2	1,075
	SF15	7/27/2006	9:04	13.5	12.0	Pool	2.0	LS	20	102	14.2	1,448
	SF16	7/28/2006	12:55	19.0	10.0	Run	1.2	UB	5	65	15.2	988
	SF17	7/28/2006	12:43	19.0	10.0	Pool	1.8	LS	35	65	10.4	676
	SF18	7/28/2006	11:31	17.5	10.0	Pool	1.2	LS	5	55	14.8	814
	SF19	7/28/2006	10:55	17.0	10.0	Pool/Riff/Run	1.5	LS	30	102	10.2	1,037
Canyon Creek to Twomile Creek	SF20	7/28/2006	10:25	15.0	10.0	Riff/Run	1.5	LS		60	11.8	708
	SF21	7/28/2006	10:00	15.0	10.0	Pool	1.9	LS		39	11.4	445
	SF22	7/28/2006	9:34	14.0	10.0	Run	1.0	LS	50	75	10.4	780
	SF23	7/28/2006	9:15	13.0	10.0	Pool	1.8	LS	20	27	16.8	454
	SF24	7/28/2006	8:58	13.5	10.0	Run	1.2	LWD	30	26	14.2	369
Upstream of Canyon Creek	SF25	7/28/2006	14:55	18.0	12.0	Riffle	1.0	LS	20	40	9.0	360
	SF26	7/28/2006	14:28	17.0	12.0	Riffle	0.7	LS	20	56	10.8	602
	SF27	7/28/2006	14:07	16.0	12.0	Riffle	0.7	LS	15	40	10.0	416

Table 47. Fishers Least-Significance-Difference Test matrices showing pair wise comparison probabilities of cutthroat trout densities (all sizes and ≥ 300 mm) between seven stream reaches in the North Fork Coeur d'Alene River watershed, Idaho, and five in the South Fork Coeur d'Alene River, Idaho during 2006. Shaded cells indicate which stream reaches had significantly different ($p \leq 0.10$) cutthroat trout densities. Stream reaches labeled by bold text occurred in catch-and-release areas.

All sizes	SF-Prich	Prich-YD	**YD-Tepee**	**Tepee-JC**	LNF lower	**LNF upper**	**Tepee**	CdA River	Pine Cr	Jackass Cr	Twomile Cr	Canyon Cr
SF-Prich	1.000											
Prichard-YD	0.921	1.000										
YD-Tepee	0.032	0.064	1.000									
Tepee-JC	0.000	0.002	0.167	1.000								
LNF lower	0.545	0.529	0.008	0.000	1.000							
LNF upper	0.979	0.910	0.050	0.001	0.614	1.000						
Tepee	0.407	0.509	0.226	0.011	0.176	0.440	1.000					
CdA-Pine	0.562	0.541	0.015	0.000	0.962	0.618	0.206	1.000				
Pine-Jackass	0.444	0.438	0.008	0.000	0.837	0.511	0.146	0.890	1.000			
Jackass-Two Mi	0.957	0.884	0.029	0.000	0.581	0.984	0.381	0.594	0.474	1.000		
Twomile-Canyon	0.909	0.989	0.066	0.002	0.519	0.899	0.518	0.532	0.430	0.872	1.000	
Up of Canyon	0.000	0.000	0.002	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

≥ 300 mm	SF-Prich	Prich-YD	**YD-Tepee**	**Tepee-JC**	LNF lower	**LNF upper**	**Tepee**	CdA River	Pine Cr	Jackass Cr	Twomile Cr	Canyon Cr
SF-Prich	1.000											
Prichard-YD	0.404	1.000										
YD-Tepee	0.003	0.044	1.000									
Tepee-JC	0.000	0.001	0.119	1.000								
LNF lower	0.639	0.215	0.001	0.000	1.000							
LNF upper	0.891	0.382	0.005	0.000	0.784	1.000						
Tepee	0.076	0.386	0.239	0.007	0.030	0.085	1.000					
CdA-Pine	0.715	0.281	0.003	0.000	0.964	0.837	0.055	1.000				
Pine-Jackass	0.521	0.177	0.001	0.000	0.835	0.657	0.026	0.819	1.000			
Jackass-Two Mi	0.595	0.196	0.001	0.000	0.950	0.742	0.027	0.920	0.880	1.000		
Twomile-Canyon	0.784	0.319	0.003	0.000	0.891	0.902	0.065	0.934	0.753	0.848	1.000	
Up of Canyon	0.932	0.566	0.022	0.000	0.666	0.852	0.188	0.716	0.567	0.633	0.770	1.000

Table 48. Average density (fish/100 m^2) of cutthroat trout (all sizes and only fish ≥ 300 mm) counted in reaches of the North Fork Coeur d'Alene River (N.F. Cd'A), Little North Fork Coeur d'Alene River (L.N.F. Cd'A), and Tepee Creek, Idaho, during snorkel evaluations from 1973 to 2006.

	All sizes of cutthroat trout																	
River section	**1973**	**1980**	**1981**	**1988**	**1991**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
N.F. Cd'A - S. F. Cd'A to Prichard Cr.	0.06	0.02	0.02	0.05	0.18	0.56	0.31	0.47	0.51	0.35	0.32	0.41	--	0.28	0.41	0.60	0.65	0.49
N.F. Cd'A - Prichard Cr to Yellowdog Cr.	0.05	0.00	0.02	0.02	0.14	0.08	0.28	0.19	0.06	0.44	0.41	0.13	--	0.49	0.30	0.33	0.66	0.67
N.F. Cd'A - Yellowdog Cr to Tepee Cr.	0.24	0.31	0.28	1.10	1.18	0.35	1.70	1.57	1.71	1.70	0.63	0.63	--	0.54	0.78	0.88	1.38	1.71
N.F. Cd'A - Tepee Cr. to Jordan Cr.	1.48	0.68	0.74	0.46	0.11	0.27	1.31	0.46	1.17	1.87	1.18	1.49	1.02	2.40	1.22	1.27	1.78	2.92
L.N.F. Cda - Mouth to Laverne Cr.	0.33	0.04	0.02	0.10	0.09	0.18	0.03	0.04	0.12	0.22	0.39	0.36	0.28	0.13	0.30	0.22	0.21	0.14
L.N.F. Cda - Laverne Cr. to Deception Cr.	0.79	1.03	1.95	0.90	0.66	0.03	0.47	0.22	0.90	0.00	0.65	0.79	0.12	0.98	0.69	0.97	1.35	0.56
Tepee Creek	0.00	0.14	0.43	0.12	0.24	0.19	0.12	0.13	0.02	0.45	1.24	0.25	0.24	0.84	0.44	0.85	0.54	1.00
Entire N.F. Cd'A River	0.13	0.10	0.11	0.33	0.32	0.35	0.54	0.53	0.63	0.69	0.44	0.38	--	0.43	0.47	0.58	0.82	0.86
Entire L.N.F. Cd'A River	0.38	0.15	0.24	0.27	0.20	0.15	0.13	0.09	0.35	0.17	0.45	0.45	0.25	0.31	0.39	0.44	0.56	0.27
All Transects	0.20	0.11	0.14	0.31	0.30	0.31	0.43	0.42	0.50	0.57	0.49	0.38	--	0.44	0.46	0.58	0.76	0.800
All limited harvest areas	0.10	0.02	0.02	0.04	0.15	0.32	0.25	0.31	0.28	0.35	0.36	0.28	--	0.29	0.36	0.45	0.59	0.51
All catch-and-release areas	0.51	0.41	0.53	0.81	0.76	0.25	0.94	0.72	0.90	1.08	0.89	0.65	--	0.89	0.73	0.92	1.23	1.56
Tepee Creek Rehab Area	--	--	--	--	--	--	--	--	--	--	--	--	--	0.87	0.00	1.09	0.09	0.55

	Cutthroat trout ≥ 300 mm																	
River section	**1973**	**1980**	**1981**	**1988**	**1991**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
N.F. Cd'A - S. F. Cd'A to Prichard Cr.	0.00	0.02	0.01	0.01	0.01	0.08	0.01	0.01	0.04	0.00	0.00	0.01	--	0.01	0.10	0.13	0.13	0.07
N.F. Cd'A - Prichard Cr to Yellowdog Cr.	0.00	0.00	0.00	0.01	0.03	0.02	0.04	0.01	0.01	0.01	0.03	0.01	--	0.04	0.09	0.09	0.24	0.21
N.F. Cd'A - Yellowdog Cr to Tepee Cr.	0.02	0.12	0.04	0.08	0.13	0.04	0.31	0.07	0.14	0.11	0.02	0.07	--	0.12	0.21	0.25	0.52	0.36
N.F. Cd'A - Tepee Cr. to Jordan Cr.	0.07	0.35	0.20	0.23	0.06	0.23	0.37	0.29	0.30	0.21	0.18	0.38	0.09	0.44	0.24	0.43	0.69	0.74
L.N.F. Cda - Mouth to Laverne Cr.	0.02	0.02	0.00	0.05	0.05	0.06	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00	0.05	0.04	0.08	0.03
L.N.F. Cda - Laverne Cr. to Deception Cr.	0.18	0.37	0.18	0.09	0.00	0.03	0.00	0.00	0.05	0.00	0.00	0.06	0.00	0.11	0.15	0.18	0.16	0.07
Tepee Creek	0.00	0.03	0.43	0.06	0.18	0.08	0.09	0.09	0.00	0.08	0.08	0.05	0.04	0.22	0.16	0.34	0.05	0.29
Entire N.F. Cd'A River	0.01	0.05	0.02	0.04	0.04	0.06	0.08	0.03	0.07	0.03	0.02	0.04	--	0.05	0.12	0.15	0.24	0.19
Entire L.N.F. Cd'A River	0.03	0.05	0.02	0.06	0.04	0.06	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.02	0.07	0.08	0.10	0.04
All Transects	0.01	0.05	0.04	0.05	0.04	0.06	0.06	0.03	0.06	0.03	0.02	0.04	--	0.06	0.12	0.15	0.21	0.18
All limited harvest areas	0.00	0.01	0.01	0.01	0.02	0.06	0.02	0.01	0.02	0.00	0.01	0.02	--	0.01	0.09	0.10	0.15	0.11
All catch-and-release areas	0.04	0.17	0.15	0.10	0.11	0.07	0.20	0.10	0.12	0.10	0.06	0.11	--	0.18	0.19	0.28	0.37	0.36
Tepee Creek Rehab Area	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.00	0.04	0.04	0.19

Table 49. History of fishing regulations for cutthroat trout in the St. Joe River and Coeur d'Alene River, Idaho from 1941 to 2006.

	St. Joe River		
Year	CdA Lake to N.F. St Joe	N.F. St. Joe to Prospector Cr.	Prospector Cr. to headwaters
1941-1945	15 lbs plus 1 fish - not to exceed 25 fish		
1946-1950	10 lbs plus 1 fish - not to exceed 20 fish		
1951-1954	7 lbs plus 1 fish - not to exceed 20 fish		
1955-1970	7 lbs plus 1 fish - not to exceed 15 fish		
1971	7 lbs plus 1 fish - not to exceed 15 fish		3 fish, none < 13 inches
1972-1975	7 lbs plus 1 fish - not to exceed 10 fish		3 fish, none < 13 inches
1976	10 fish, only 5 > 12 inches and 2 > 18 inches		3 fish, none < 13 inches
1977-1987	6 fish, only 2 > 16 inches		3 fish, none < 13 inches
1988-1999	1 fish, none < 14 inches		Catch-and-release
2000-2006	2 fish, none between 8"-16"	Catch-and-release	

	Coeur d'Alene River		
Year	CdA Lake to Yellow Dog Creek (Includes South Fork)	Yellow Dog Creek to headwaters	Laverne Creek to headwaters (LNF CdA)
1941-1945	15 lbs plus 1 fish - not to exceed 25 fish		
1946-1950	10 lbs plus 1 fish - not to exceed 20 fish		
1951-1954	7 lbs plus 1 fish - not to exceed 20 fish		
1955-1971	7 lbs plus 1 fish - not to exceed 15 fish		
1972-1974	7 lbs plus 1 fish - not to exceed 10 fish		
1975	7 lbs plus 1 fish - not to exceed 10 fish	3 fish, none < 13 inches	
1976	10 fish, only 5 > 12 inches & 2 > 18 inches	3 fish, none < 13 inches	
1977-1985	6 fish, only 2 > 16 inches	3 fish, none < 13 inches	
1986-1987	6 fish, only 2 > 16 inches	Catch-and-release	3 fish, none < 13 inches
1988-1999	1 fish, none < 14 inches	Catch-and-release	
2000-2006	2 fish, none between 8"-16"	Catch-and-release	

Table 50. Average density (fish/100 m^2) of all size classes of mountain whitefish counted in reaches of the North Fork Coeur d'Alene River (N.F. Cd'A), Little North Fork Coeur d'Alene River (L.N.F. Cd'A), and Tepee Creek, Idaho, during snorkel evaluations from 1973 to 2006.

River section	1973	1980	1981	1988	1991	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006
N.F. Cd'A - S. F. Cd'A to Prichard Cr.	0.75	1.47	0.18	3.09	6.59	0.45	2.42	2.53	5.54	0.69	1.05	7.38	4.36	2.91	6.46	4.90	5.49	6.05
N.F. Cd'A - Prichard Cr to Yellowdog Cr.	0.46	0.02	0.12	0.03	1.25	0.29	0.65	0.11	1.13	0.56	0.58	0.23	0.20	0.32	0.83	0.73	2.04	1.48
N.F. Cd'A - Yellowdog Cr to Tepee Cr.	3.19	1.18	1.71	1.09	5.52	1.07	2.60	1.65	5.05	1.45	3.57	2.90	4.00	2.13	2.98	3.16	4.43	4.98
N.F. Cd'A - Tepee Cr. to Jordan Cr.	0.00	0.00	0.00	0.11	0.00	0.00	1.33	2.41	1.12	0.00	2.80	0.13	0.97	0.65	0.14	0.60	0.00	0.09
L.N.F. Cda - Mouth to Laverne Cr.	0.00	0.35	0.00	0.00	0.00	0.06	0.00	0.00	2.68	0.00	0.20	0.36	1.09	0.91	0.04	0.01	0.19	0.01
L.N.F. Cda - Laverne Cr. to Deception Cr.	0.59	0.01	0.12	0.03	0.00	0.00	0.00	0.00	1.88	0.00	0.02	0.00	0.04	0.03	0.00	0.00	0.00	0.00
Tepee Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	1.04	0.43	1.41
Entire N.F. Cd'A River	1.00	0.80	0.39	1.21	4.07	0.46	1.86	1.70	3.52	0.72	1.35	3.46	3.43	2.33	3.95	3.06	4.21	4.26
Entire L.N.F. Cd'A River	0.52	0.01	0.11	0.02	0.00	0.00	0.00	0.00	1.34	0.00	0.02	0.00	0.03	0.02	0.03	0.01	0.13	0.01
All Transects	0.87	0.65	0.33	0.96	3.18	0.37	1.35	1.26	3.03	0.52	1.00	2.78	2.49	1.85	3.18	2.52	3.40	3.56
All limited harvest areas	0.60	0.63	0.15	1.12	3.29	0.32	1.42	1.37	3.28	0.51	0.70	3.21	2.59	2.02	3.70	2.74	3.75	3.81
All catch-and-release areas	1.77	0.71	0.95	0.64	2.86	0.52	1.14	0.97	2.61	0.53	1.93	1.53	2.20	1.35	1.73	1.93	2.43	2.91
Tepee Creek Rehab Area	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	0.00	0.00

Table 51. Average density (fish/100 m^2) of all size classes of rainbow trout counted in reaches of the North Fork Coeur d'Alene River (N.F. Cd'A), Little North Fork Coeur d'Alene River (L.N.F. Cd'A), and Tepee Creek, Idaho, during snorkel evaluations from 1973 to 2006.

River section	1973	1980	1981	1988	1991	1993	1994	1995	1996	1997	1998	2000	2001	2002	2003	2004	2005	2006
N.F. Cd'A - S. F. Cd'A to Prichard Cr.	0.35	0.45	0.59	3.15	0.22	0.04	0.16	0.61	0.50	0.75	0.42	1.06	0.76	0.52	0.46	0.48	0.39	0.39
N.F. Cd'A - Prichard Cr to Yellowdog Cr.	0.48	0.12	0.46	0.14	0.20	0.01	0.08	0.14	0.02	0.12	0.06	0.03	0.11	0.00	0.01	0.08	0.06	0.09
N.F. Cd'A - Yellowdog Cr to Tepee Cr.	0.03	0.21	0.34	0.03	0.04	0.00	0.00	0.02	0.25	0.01	0.01	0.01	0.14	0.00	0.00	0.00	0.00	0.00
N.F. Cd'A - Tepee Cr. to Jordan Cr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
L.N.F. Cda - Mouth to Laverne Cr.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.09	0.17	0.12
L.N.F. Cda - Laverne Cr. to Deception Cr.	1.39	0.55	1.25	1.60	0.99	0.22	0.45	0.02	0.09	0.24	0.54	0.35	0.18	0.46	0.02	0.02	0.00	0.00
Tepee Creek	0.12	0.06	0.18	0.05	0.03	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00
Entire N.F. Cd'A River	0.33	0.26	0.47	1.00	0.17	0.02	0.11	0.37	0.25	0.40	0.24	0.43	0.50	0.34	0.23	0.22	0.22	0.22
Entire L.N.F. Cd'A River	1.25	0.49	1.13	1.27	0.80	0.18	0.34	0.02	0.24	0.19	0.43	0.28	0.15	0.39	0.21	0.07	0.11	0.08
All Transects	0.46	0.29	0.56	0.99	0.27	0.04	0.14	0.28	0.22	0.32	0.27	0.38	0.39	0.33	0.21	0.19	0.19	0.19
All limited harvest areas	0.59	0.34	0.66	1.49	0.35	0.05	0.19	0.37	0.25	0.46	0.35	0.51	0.51	0.43	0.29	0.29	0.27	0.26
All catch-and-release areas	0.03	0.12	0.21	0.02	0.03	0.00	0.00	0.01	0.16	0.00	0.00	0.00	0.06	0.02	0.00	0.00	0.00	0.00
Tepee Creek Rehab Area	--	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	0.00	0.00

Table 52. Comparisons of average cutthroat trout densities (fish/100 m2) collected in 2006 with average dissolved heavy metal concentrations collected during 1998 and 2006 in different reaches of the South Fork Coeur d'Alene River, Idaho.

	Cutthroat	Heavy metal concentrations (µg/L)							
	trout	Cadmium		Copper		Lead		Zinc	
River reach	density	1998	2006	1998	2006	1998	2006	1998	2006
CdA River to Pine Cr	0.13	4.1	1.4	NA	NA	6.9	2.9	583.0	230
Pine Cr to Jackass Cr	0.04	4.9	1.6	2.0	NA	15.8	3.8	578.7	240
Jackass Cr. to Twomile Cr.	0.50	3.1	1.2	1.0	NA	10.3	3.4	437.6	181
Twomile Cr. to Canyon Cr.	0.60	2.3	NA	0.8	NA	8.6	NA	359.0	NA
Upstream of Canyon	4.80	0.3	NA	0.6	NA	1.1	NA	83.5	NA

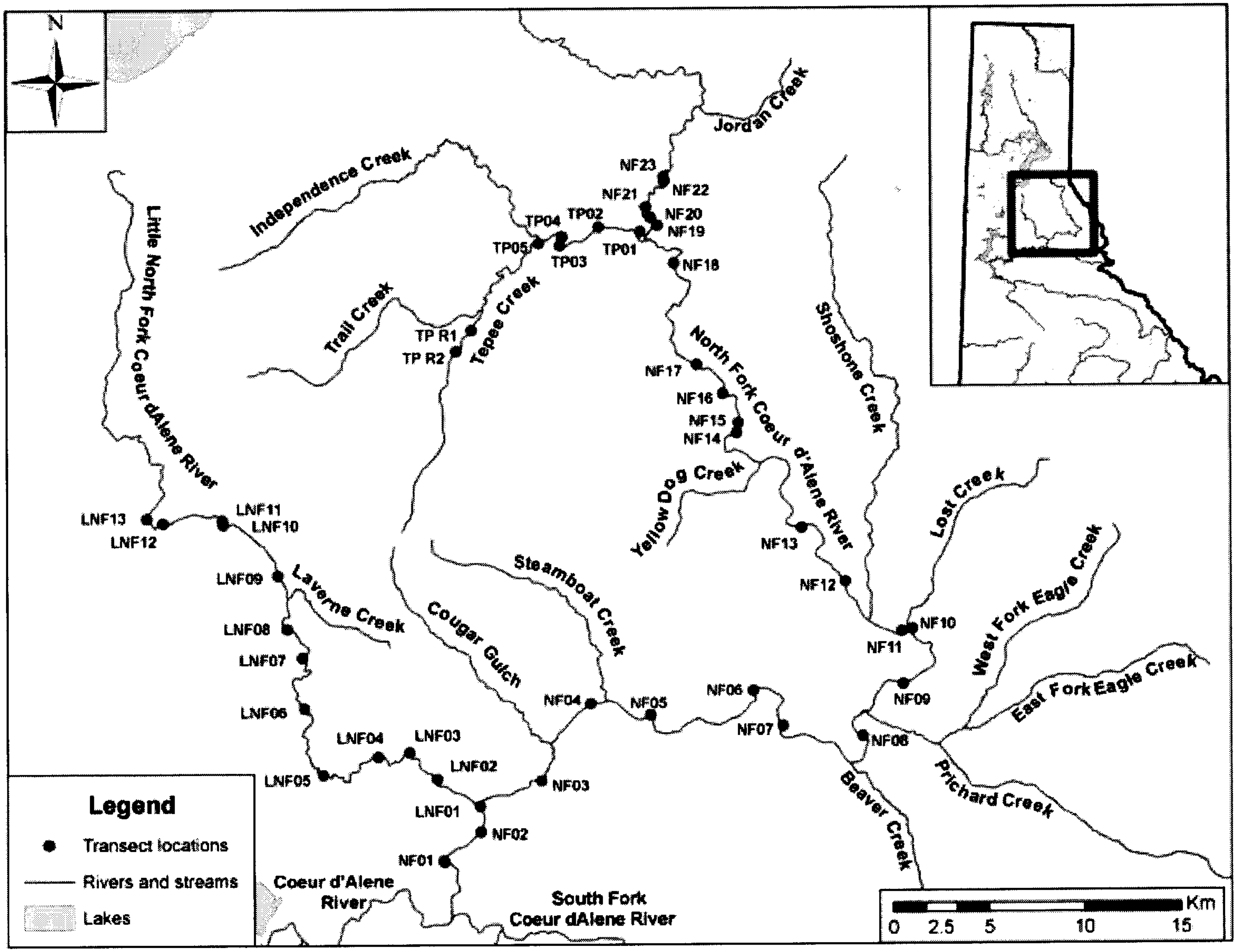


Figure 35. Location of 43 transects snorkeled in the North Fork Coeur d'Alene River watershed, Idaho, during August 1-3, 2006.

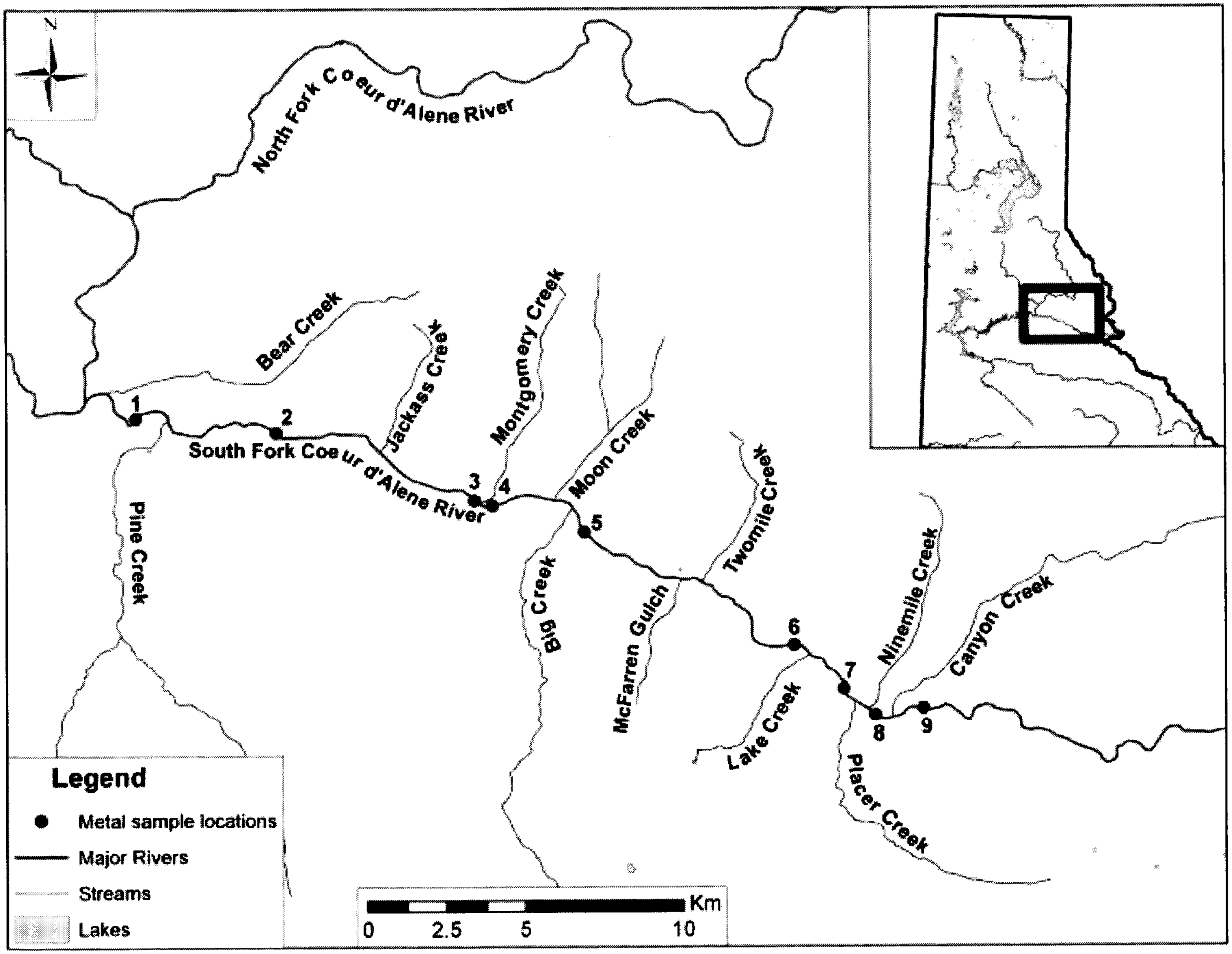


Figure 36. Sample locations for heavy metals in the South Fork Coeur d'Alene River, Idaho, that are displayed in Table 1.

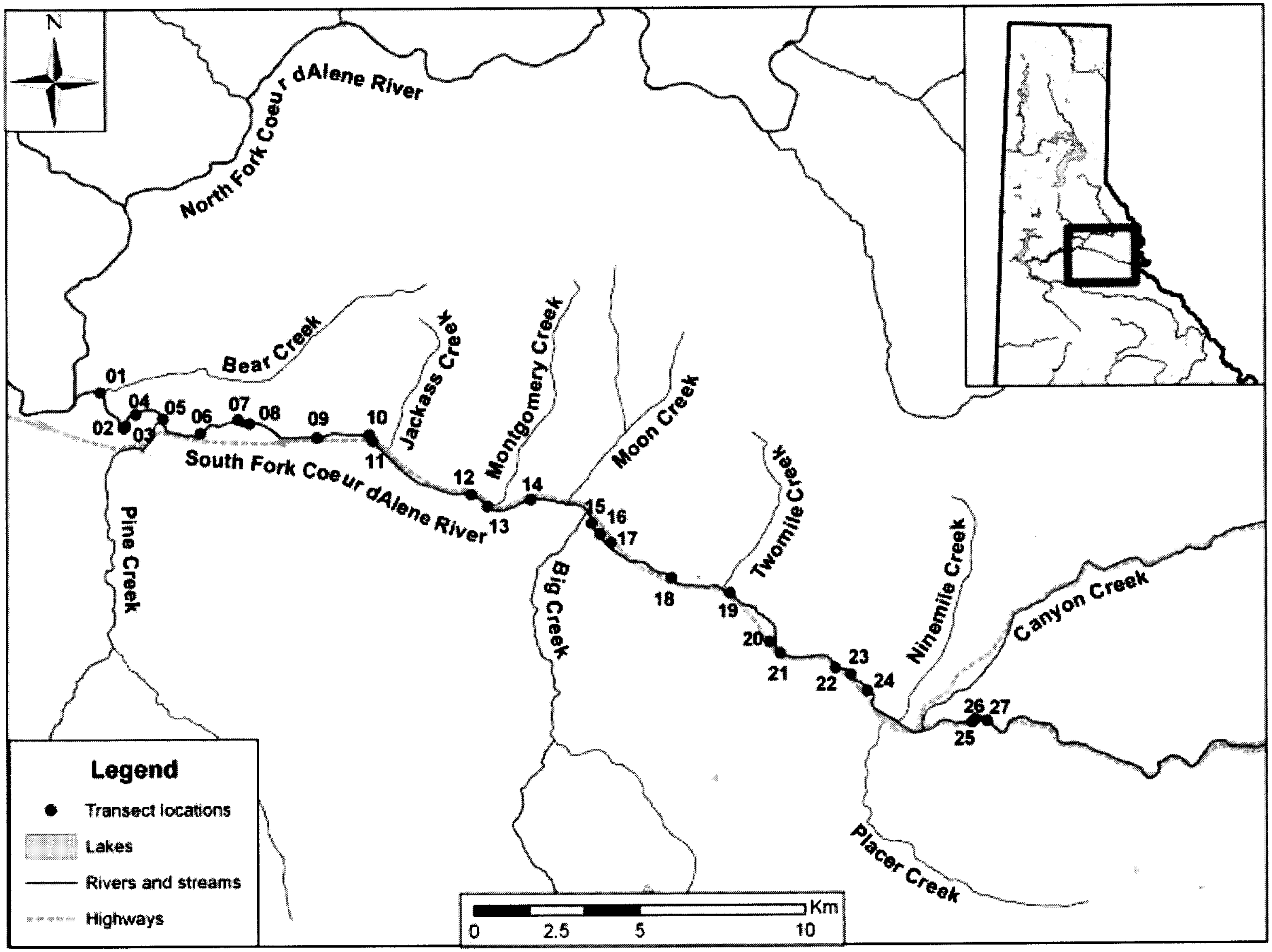
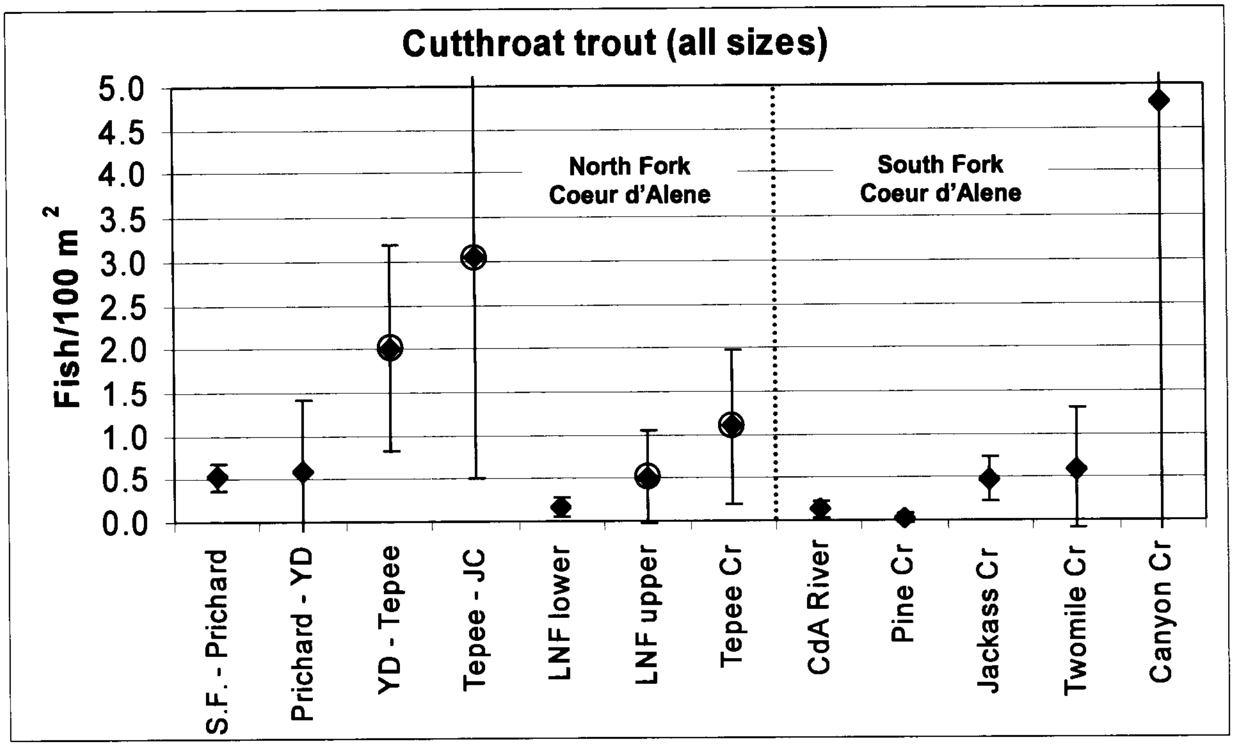


Figure 37. Location of 27 transects snorkeled on the South Fork Coeur d'Alene River, Idaho, during July 27-28, 2006.



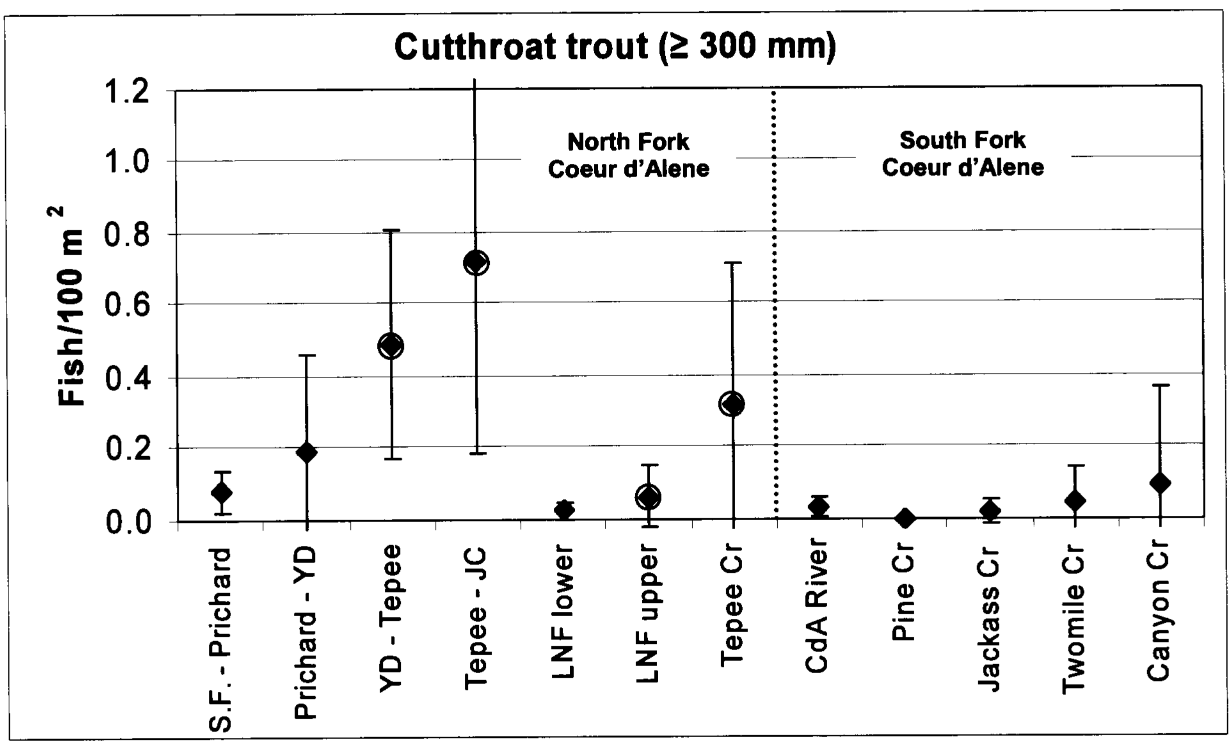
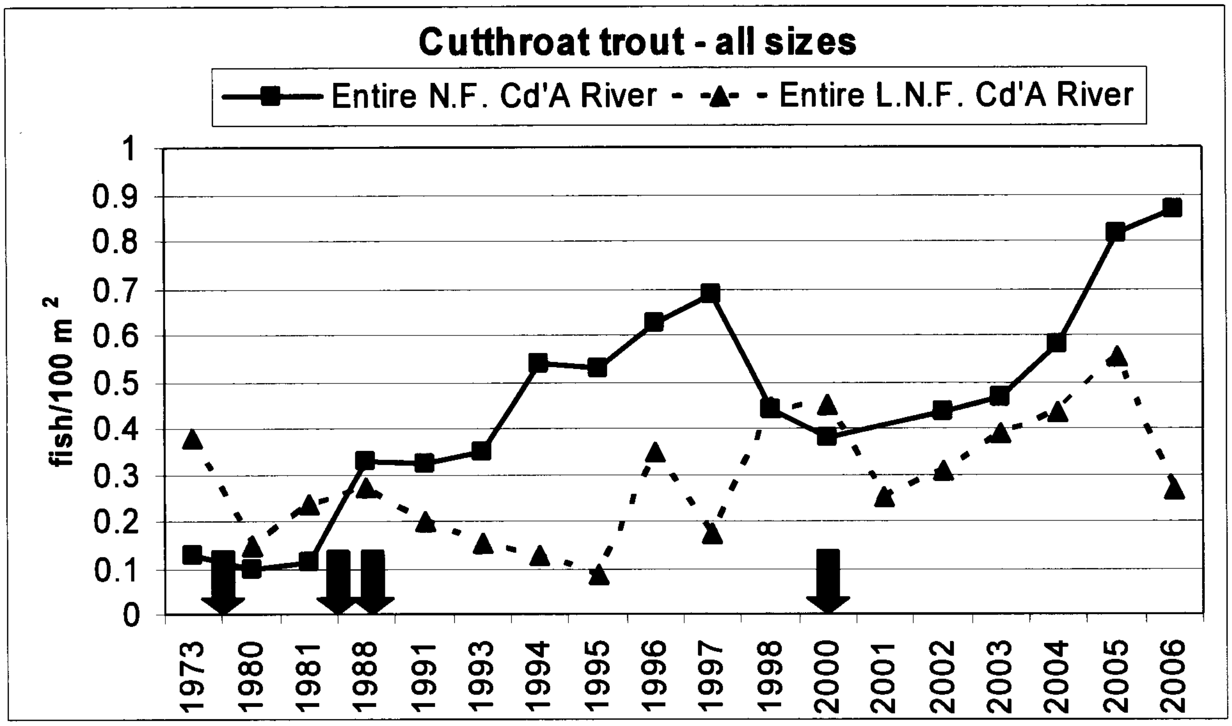


Figure 38. The average cutthroat trout density and 90% confidence intervals (all sizes and only fish ≥ 300 mm) determined from snorkeling transects in seven reaches in the North Fork Coeur d'Alene River and five reaches in the South Fork Coeur d'Alene River Idaho, during 2006. Stream reaches symbolized with circles around diamonds occurred in the catch-and-release areas.



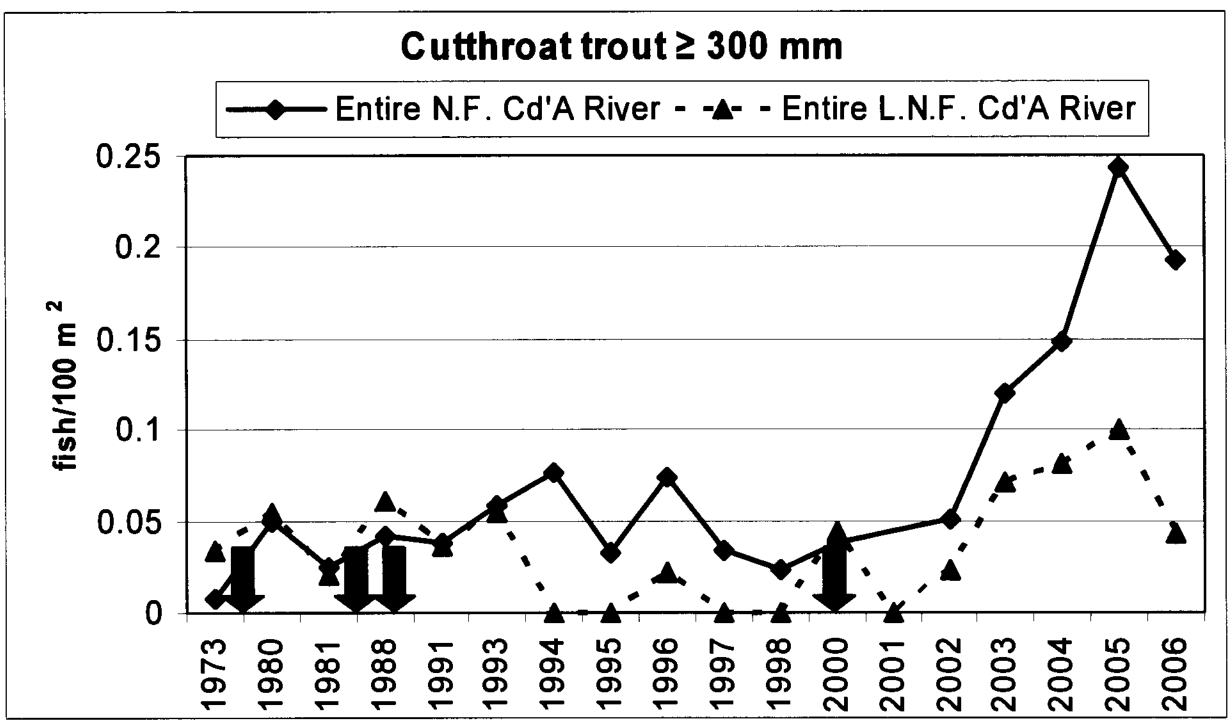


Figure 39. The average density (fish/100 m^2) of all size classes of cutthroat trout and cutthroat trout ≥ 300 mm observed while snorkeling transects in the North Fork Coeur d'Alene River (N.F. Cd'A) and Little North Fork Coeur d'Alene River (L.N.F. Cd'A), Idaho, from 1973 to 2006. Arrows signify when significant changes occurred in the cutthroat trout fishing regulations. Refer to Table 48 to see how the regulations changed on these particular dates.

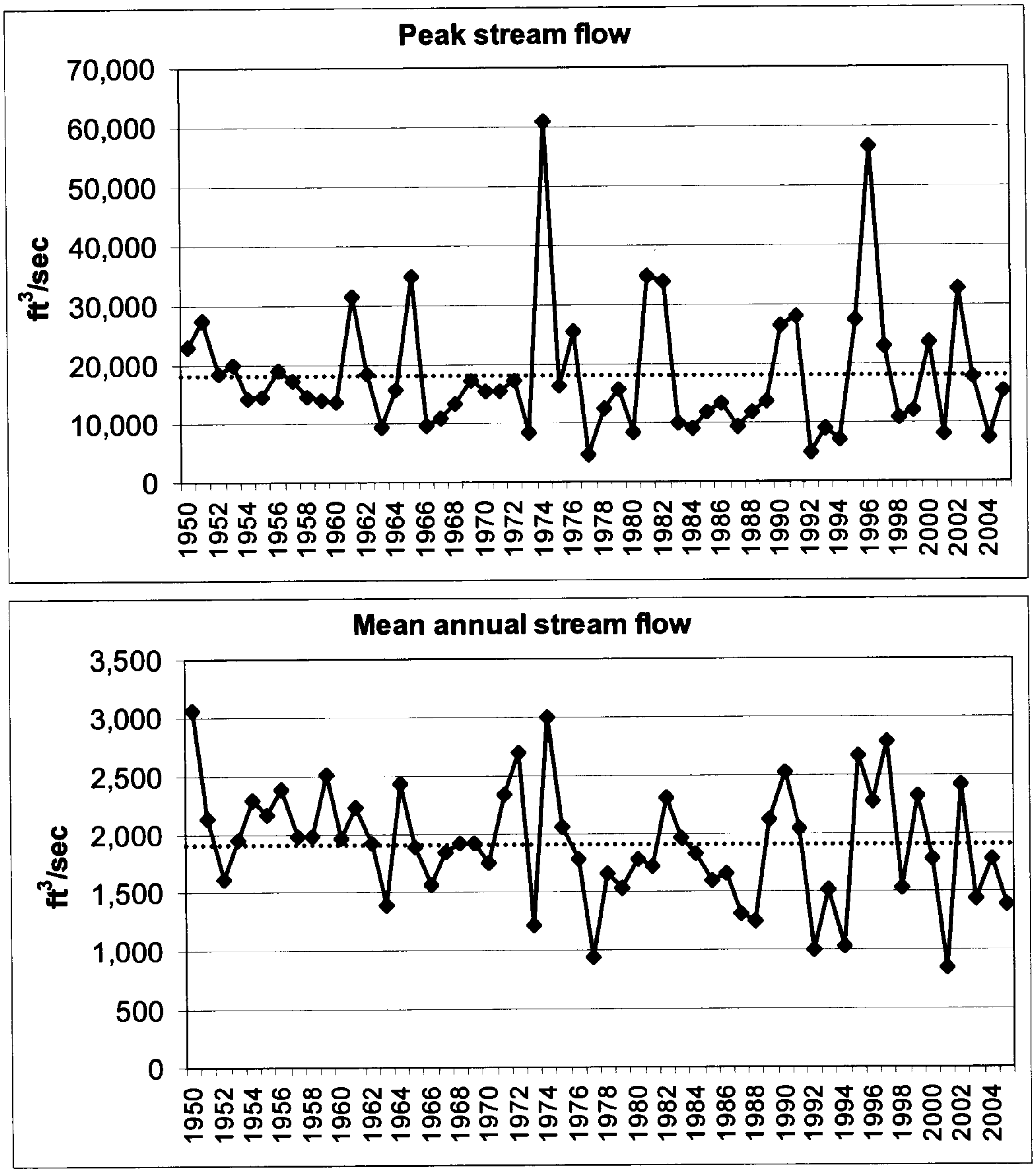


Figure 40. The peak stream flow and mean annual stream flow documented by USGS for the North Fork Coeur d'Alene River, Idaho, at Enaville from 1950 to 2005. The dashed line indicates the average flow since 1950.

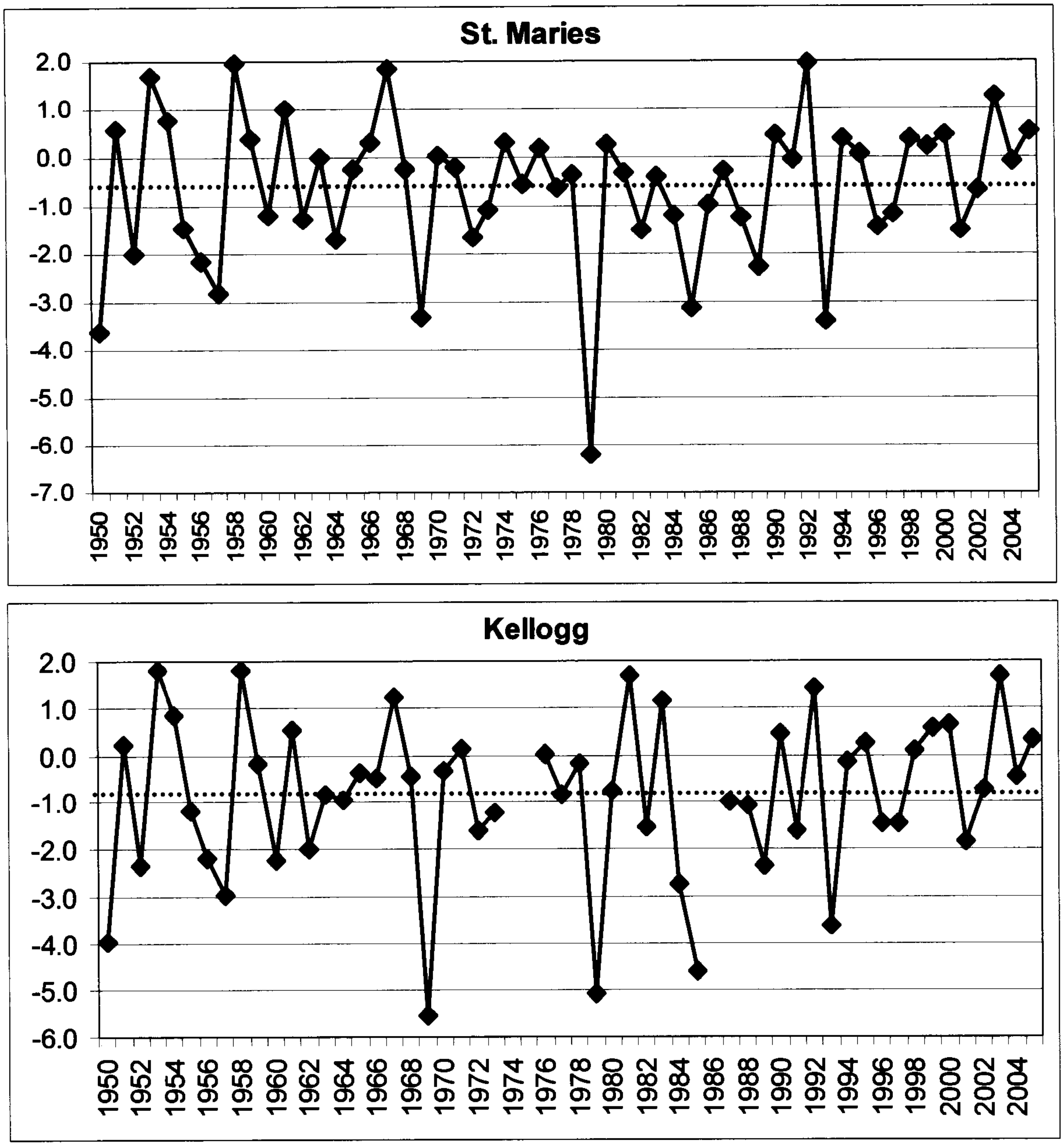


Figure 41. Average air temperature (°C) during winter (Dec-Feb) from 1950 to 2005 in St. Maries and Kellogg, Idaho. The dotted line represents the average since 1950.

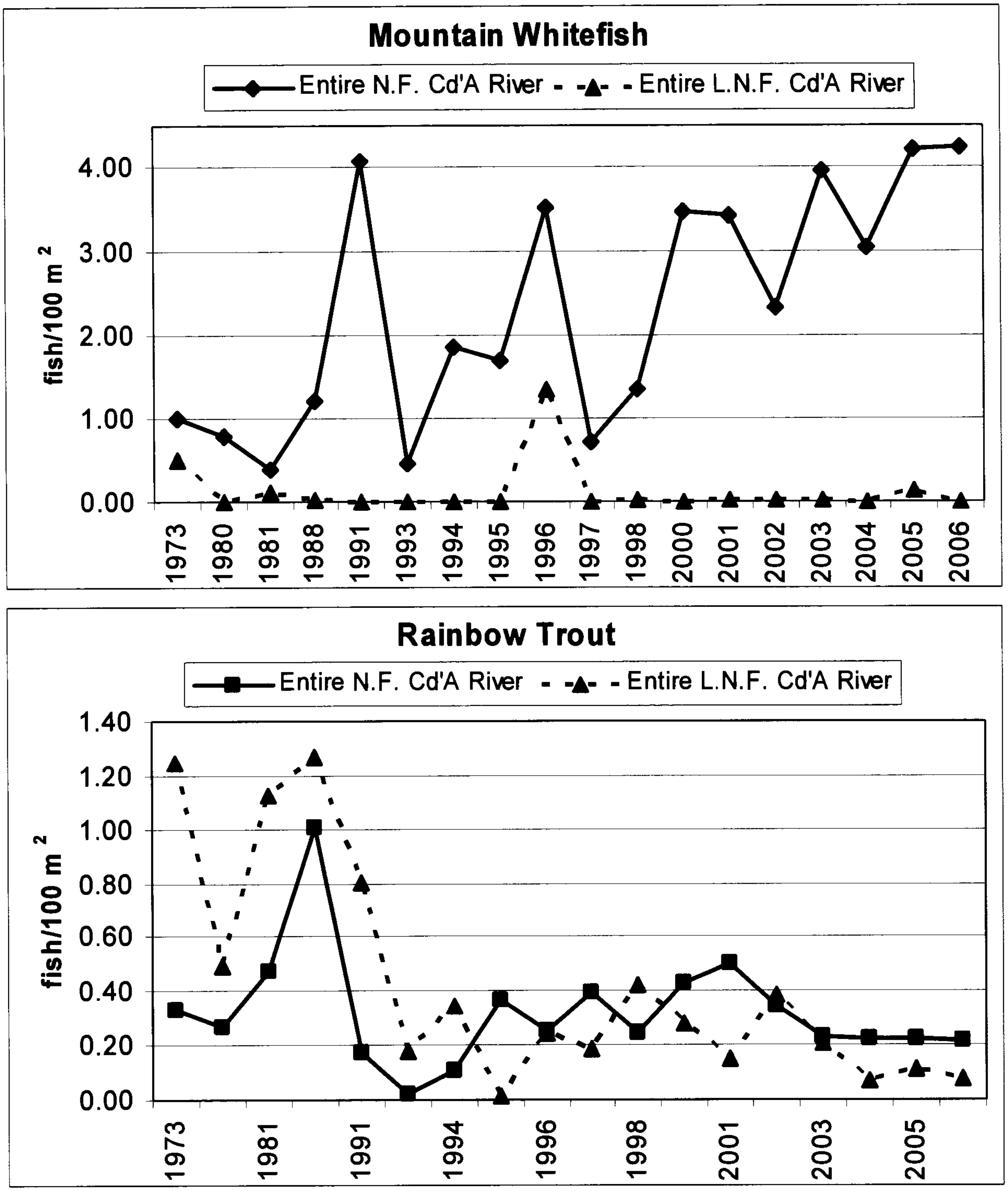


Figure 42. The average density (fish/100 m^2) of mountain whitefish and rainbow trout observed while snorkeling the North Fork Coeur d'Alene River (N.F. Cd'A) and Little North Fork Coeur d'Alene River (L.N.F. Cd'A), Idaho, from 1973 to 2006.

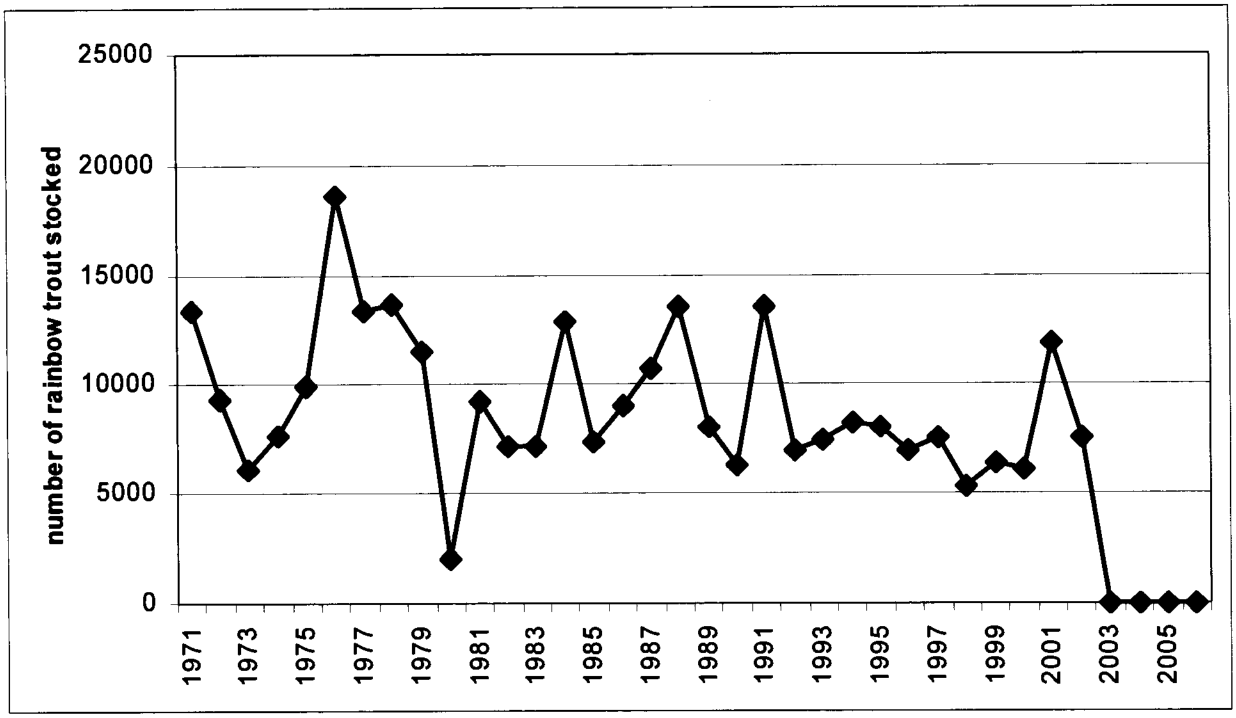


Figure 43. The number of rainbow trout > 6 inches (152 mm) in length stocked in the Coeur d'Alene River basin between 1968 and 2006.

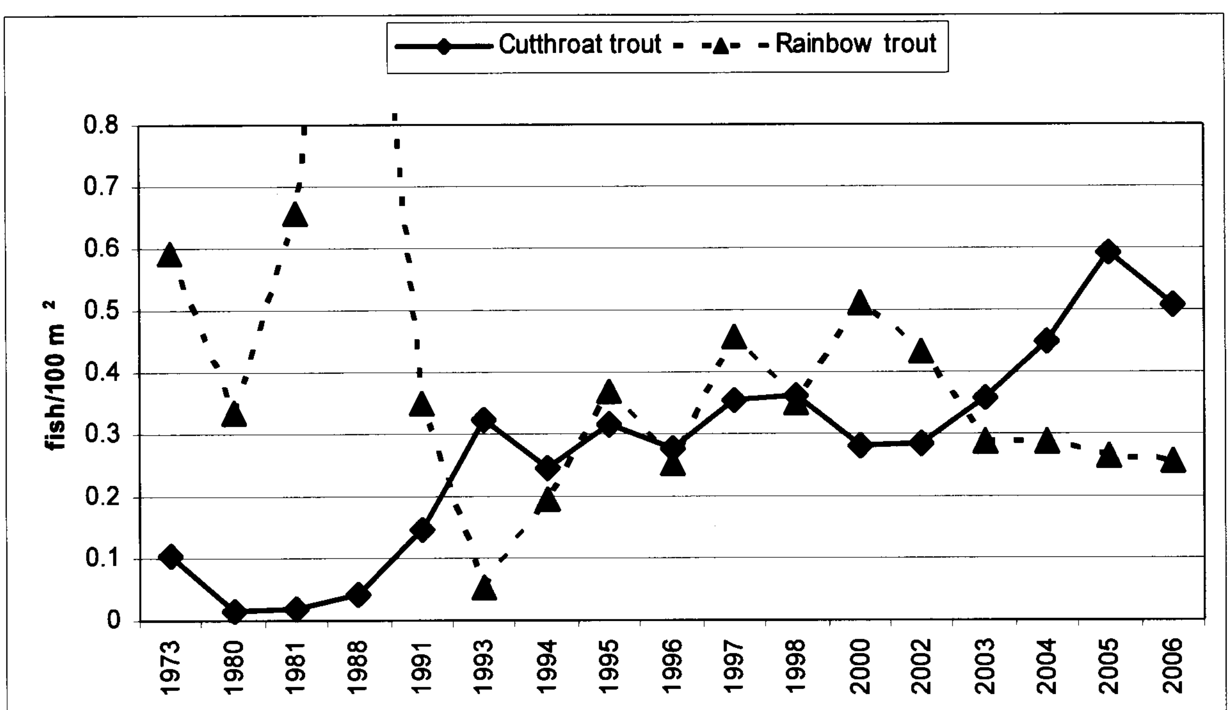


Figure 44. The average densities of all sizes of cutthroat trout and rainbow trout observed when snorkeling transects occurring in limited harvest areas of the Coeur d'Alene River watershed (downstream of Yellow Dog Creek in the North Fork and downstream of Laverne Creek in the Little North Fork), Idaho from 1973 to 2006.

Appendix D. Global Position System coordinates for snorkel sites in the North Fork Coeur d'Alene River and South Fork Coeur d'Alene River, Idaho. Coordinates are in Latitude and Longitude (decimal degrees) and the map datum is WGS 84.

North Fork Coeur d'Alene River			
Transect	**Latitude**	**Longitude**	**Elevation (ft)**
NF01	47.5834313096	-116.263508093	2160
NF01(slough)	47.5839027664	-116.264033691	2160
NF02	47.5980975390	-116.239150740	2175
NF03	47.6230913690	-116.197393280	2198
NF04	47.6602863990	-116.164915750	2230
NF05	47.6555075390	-116.122508930	2250
NF06	47.6683620290	-116.051353870	2290
NF07	47.6517464090	-116.030235580	2322
NF08	47.6476927346	-115.974008062	2375
NF09	47.6731529590	-115.947287090	2415
NF10	47.6994508330	-115.941997337	2455
NF11	47.6981889689	-115.948838883	2462
NF12	47.7210683064	-115.988983228	2495
NF13	47.7460557290	-116.020762020	2540
NF14	47.7902211490	-116.067433880	2638
NF15	47.7950221390	-116.066453620	2644
NF16	47.8086489290	-116.077928940	2665
NF17	47.8221527690	-116.096722760	2688
NF18	47.8698222390	-116.114066010	2765
NF19	47.8874945590	-116.126008880	2803
NF20	47.8911150318	-116.131135122	2818
NF21	47.8959927190	-116.134283240	2845
NF22	47.9084303790	-116.122064190	2893
NF23	47.9104295490	-116.122662990	2900
LNF01	47.6102457690	-116.240224130	2175
LNF02	47.6223549569	-116.270057576	2202
LNF03	47.6346269590	-116.290432570	2222
LNF04	47.6322947790	-116.312127450	2243
LNF05	47.6230192806	-116.349840873	2283
LNF06	47.6542351663	-116.364287453	2352
LNF07	47.6784352613	-116.366764331	2420
LNF08	47.6919056990	-116.378035280	2470
LNF09	47.7170544290	-116.385589630	2520
LNF10	47.7403984490	-116.423973130	2622
LNF11	47.7423587290	-116.424672940	2628
LNF12	47.7402961383	-116.466309514	2717
LNF13	47.7422381090	-116.477646150	2748
TP01	47.8844407890	-116.138037080	2805
TP02	47.8860222790	-116.167622010	2836
TP03	47.8769626190	-116.194171360	2869
TP04	47.8810230590	-116.192663280	2872
TP05	47.8775494390	-116.208969770	2885
TP R1	47.8357018590	-116.254984330	3010
TP R2	47.8255609290	-116.264991310	3037

Appendix D. Continued.

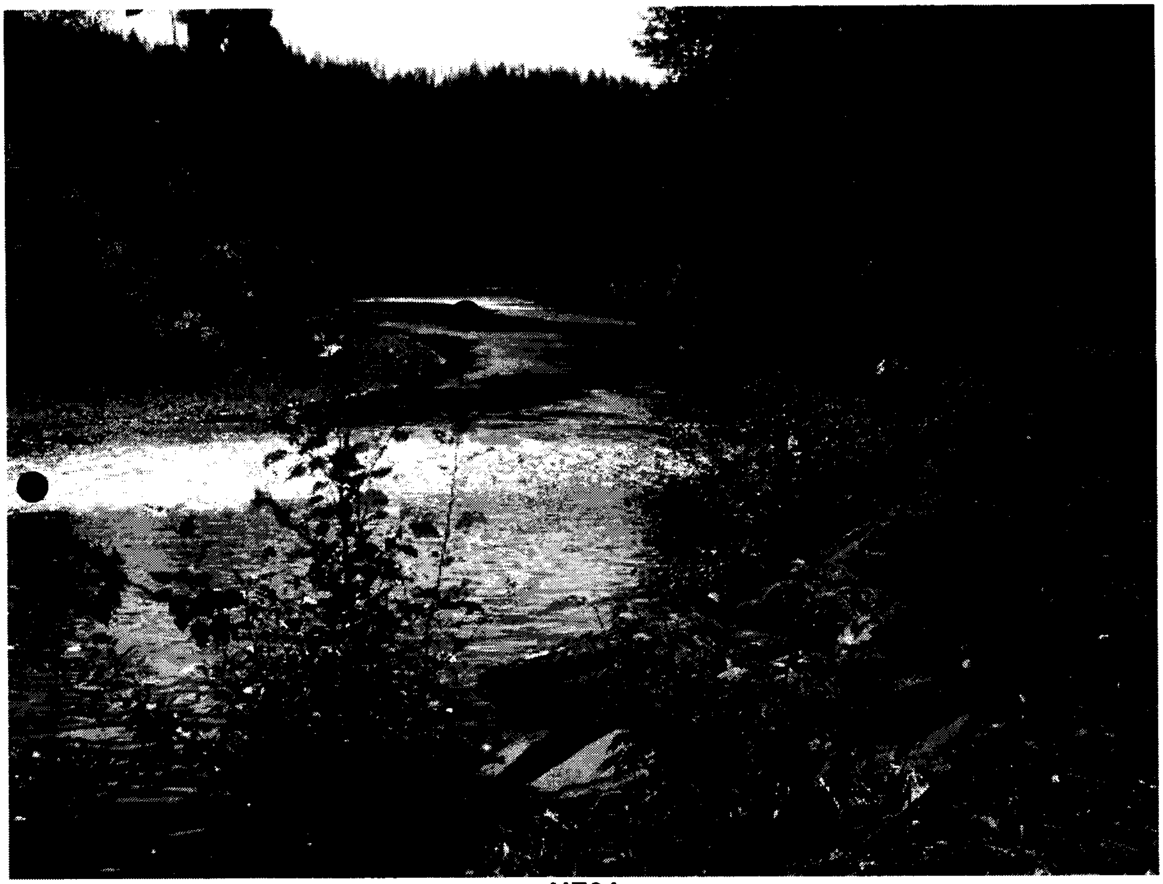
South Fork Coeur d'Alene River

Transect	Latitude	Longitude	Elevation (ft)
SF1	47.5592133900	-116.247758290	
SF2	47.5496723500	-116.237895890	
SF3	47.5502465900	-116.237121230	
SF4	47.5535237500	-116.233150810	
SF5	47.5524677100	-116.222372020	
SF6	47.5487773300	-116.207227680	
SF7	47.5528322400	-116.192158020	
SF8	47.5516821600	-116.187535240	
SF9	47.5483938600	-116.160379800	
SF10	47.5495761300	-116.139348930	
SF11	47.5477134200	-116.137865420	
SF12	47.5338806800	-116.098002340	
SF13	47.5307577500	-116.091441330	
SF14	47.5328645400	-116.074268730	
SF15	47.5267376200	-116.049528460	
SF16	47.5239268300	-116.046095650	
SF17	47.5216817400	-116.041622730	
SF18	47.5124098500	-116.016842140	
SF19	47.5086478000	-115.993364430	
SF20	47.4955191400	-115.976831540	
SF21	47.4924461600	-115.972468260	
SF22	47.4887020500	-115.950475150	
SF23	47.4869770600	-115.944034660	
SF24	47.4826046303	-115.936985862	
SF25	47.4744633169	-115.894944801	
SF26	47.4751924416	-115.893637589	
SF27	47.4748760882	-115.888988216	

Appendix E. Photographs depicting locations of transects, starting (green dot) and stopping (red dot) points and approximate distance of stream to snorkeled in the North Fork Coeur d'Alene River, Idaho. These photos were taken in 2002 - 2004.

North Fork Coeur d'Alene River Snorkel Transects - 2006

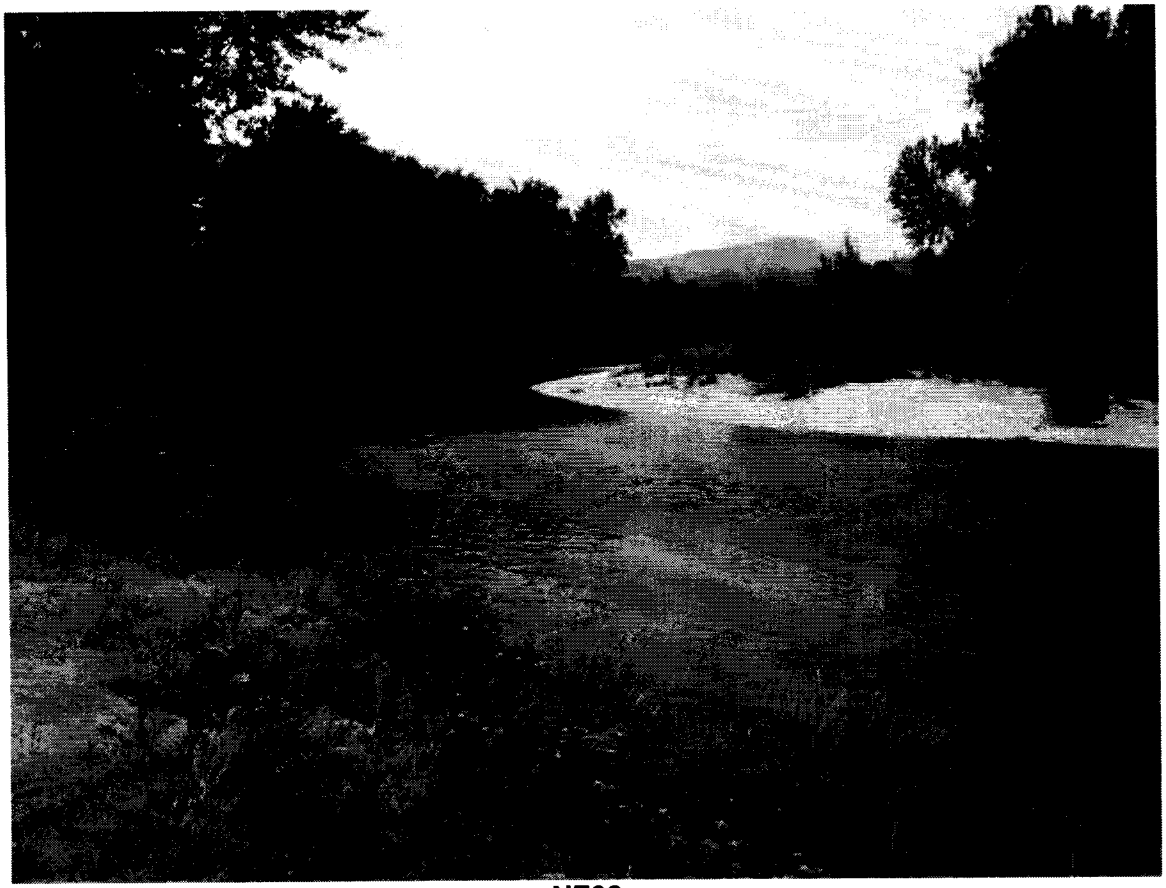
NF01 Slough
80 m



NF01

Freeman Eddy - Access from West Side Road about 1.5 miles upstream from steel bridge. 150 m

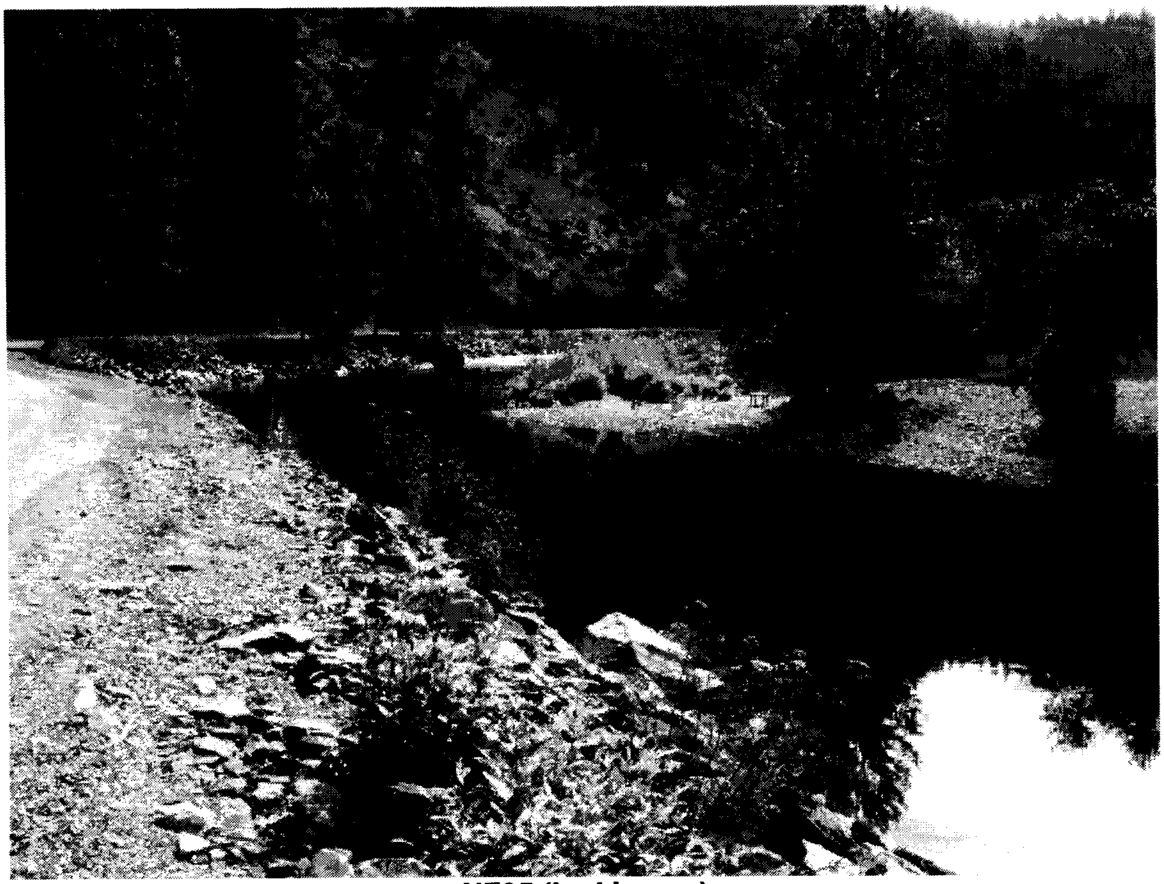
NF02
Accessed from East side road about 2.7 miles below N. Fork Bridge. 191 m



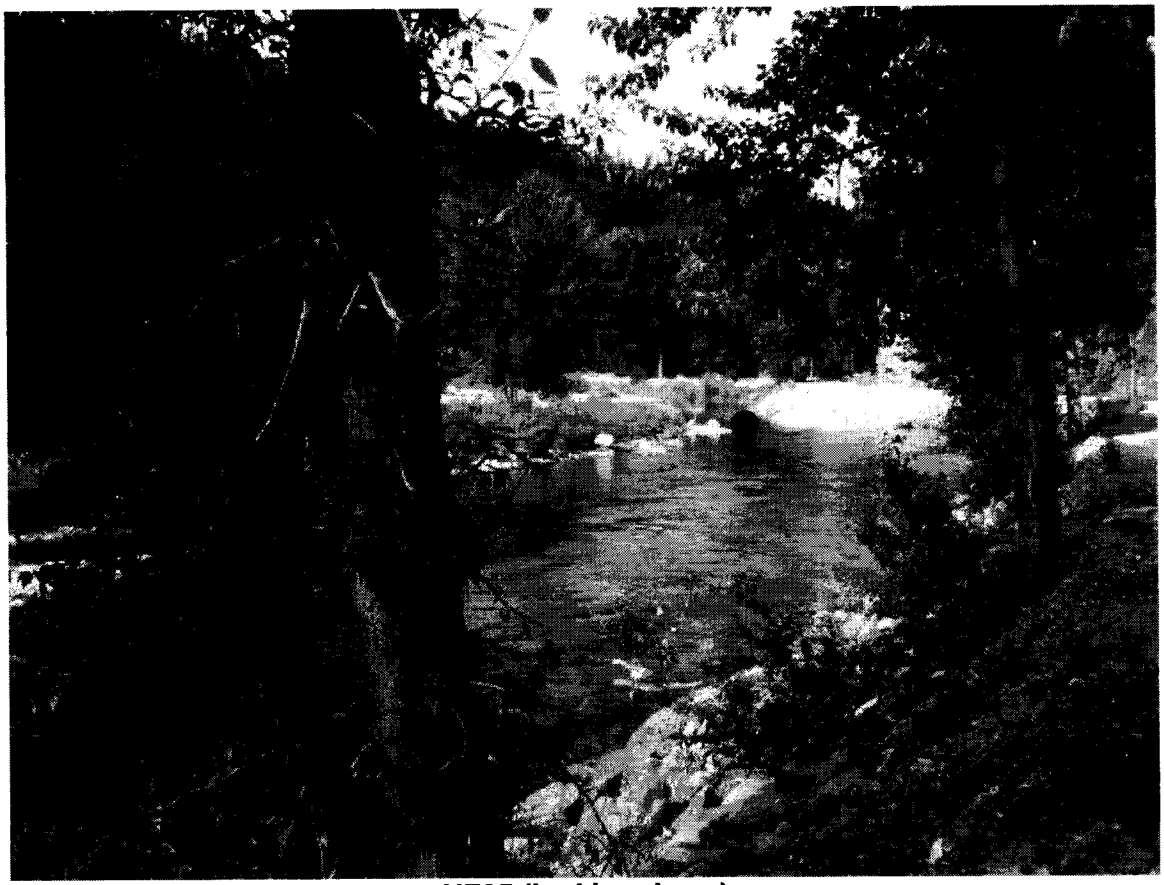
NF03
Deadman's Eddy - Accessed from East Side Road about 0.1 miles above Thomas Ck. 230 m

NF04

Simmons Draw - Accessed from West Side Road about 0.5 miles below Steamboat Ck. 205 m

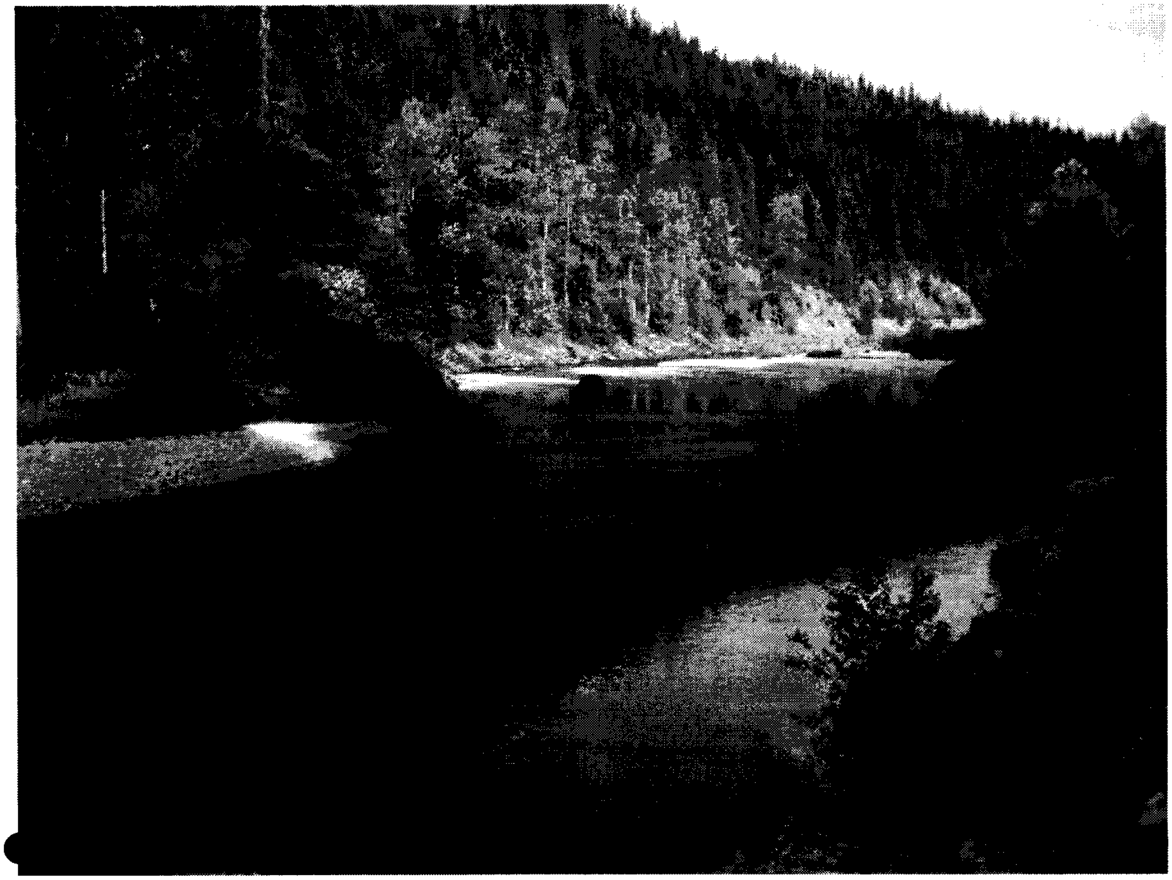


NF05 (looking up)



NF05 (looking down)
Castle Rock - Accessed from West Side Road about 1.6 miles below Silver Creek.
250 m

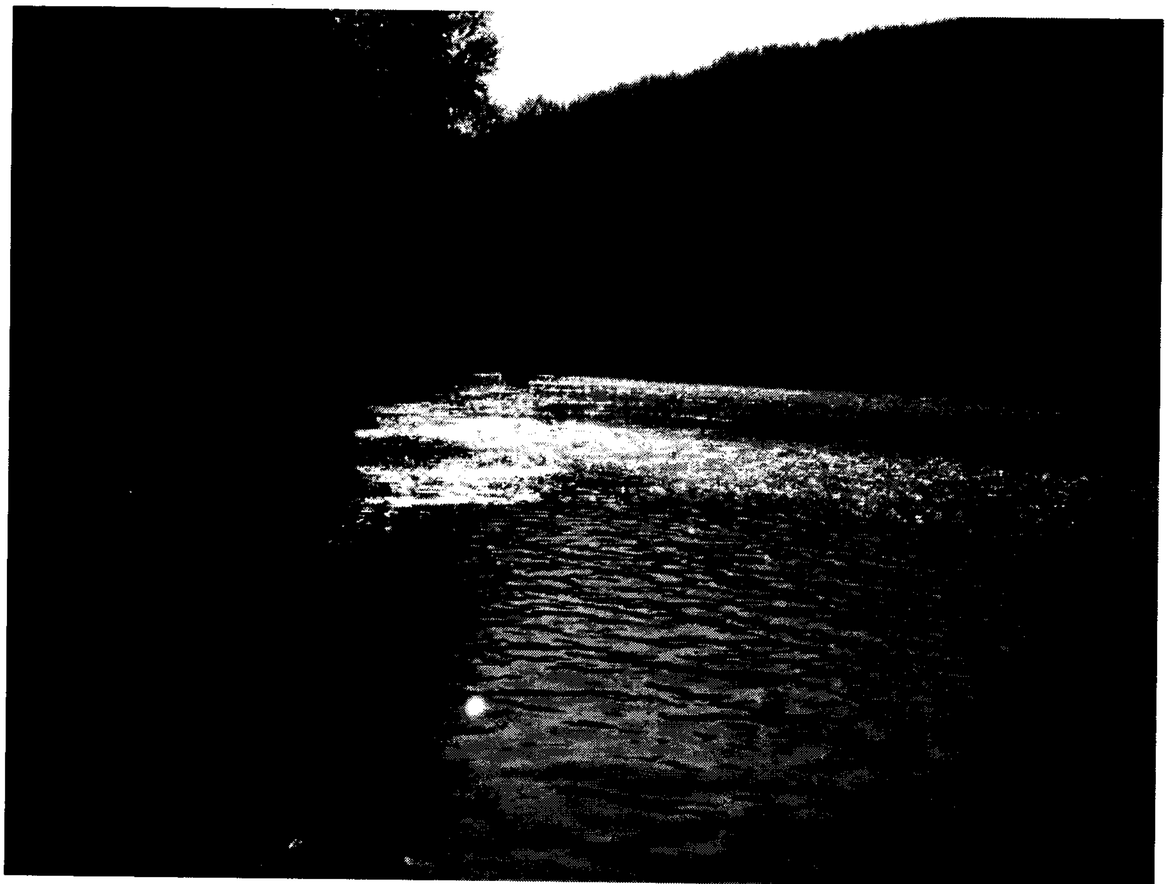
NF06
Accessed from West Side Road about 0.7 miles below Brown Ck. 172 m



NF07

The Rock – Accessed from West Side Road just downstream of Steel Bridge. 181 m

NF08
Prichard Bridge - 1 mile below Prichard Creek. 138 m



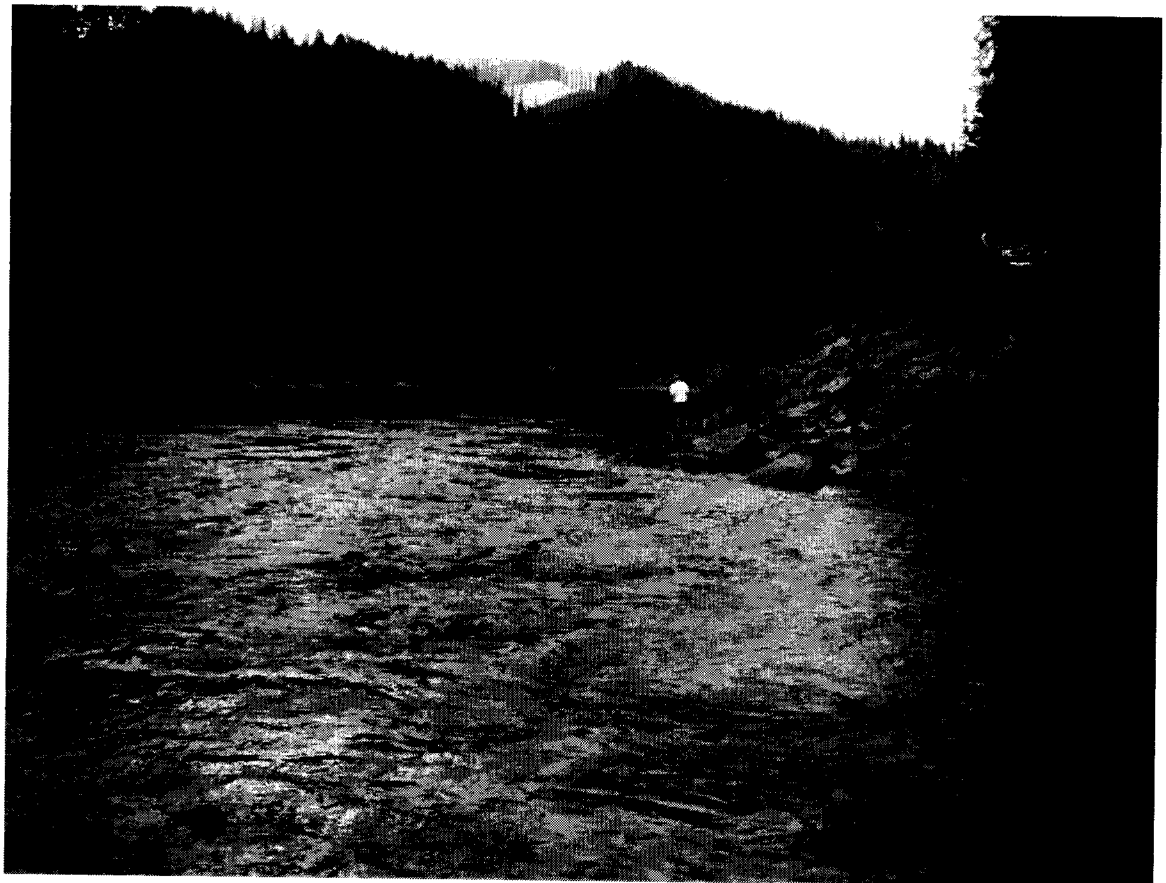
NF09
3 miles below Lost Creek Bridge. 155 m

NF10
About 200 m downstream from the confluence with Lost Creek. 273 m

NF11

0.4 miles above Lost Creek Bridge. Starts at big flat rock in middle of river. 230 m

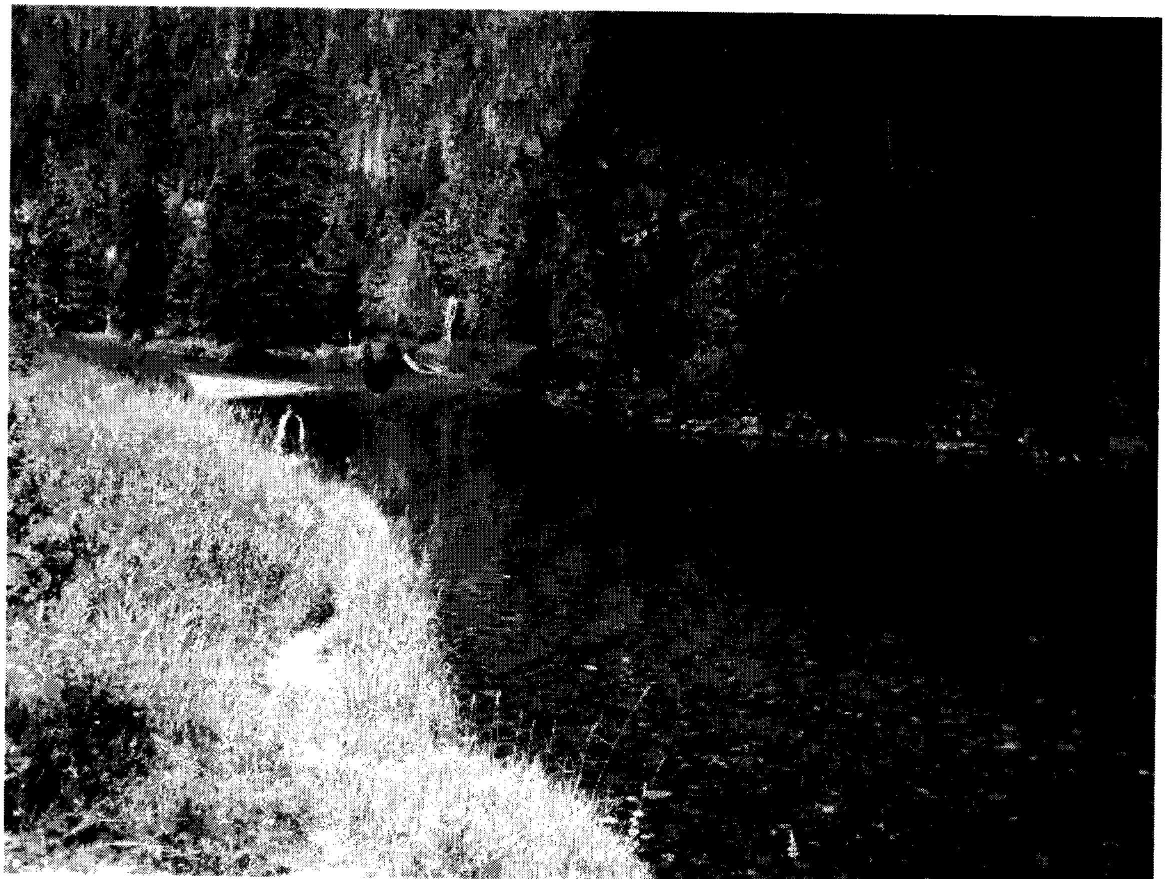
NF12
About 1.6 miles upstream of Shoshone Creek. 202 m



NF13
4 miles above Shoshone Ck. just below Devil's Elbow. 89 m

North Fork Coeur d'Alene River
Beginning of Catch and Release Section

NF14
1 mile below Flat Creek just above bridge. 134 m



NF15
0.6 miles below Flat Creek. 73 m

NF16
0.6 miles above Flat Creek and 1.5 miles below Big Hank Meadow. 175 m

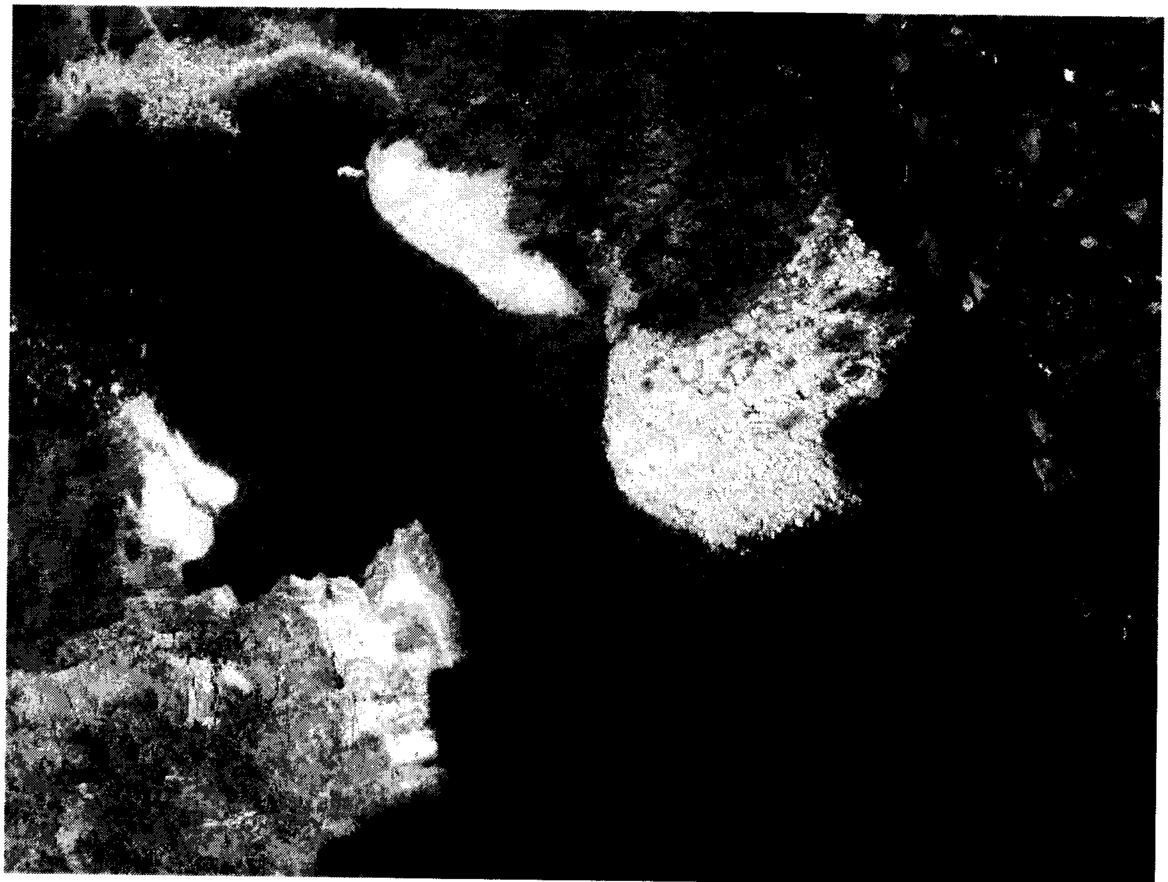
NF17
Big Hank Meadow (New Site in 2002 - River shifted) 291 m.

NF18

Just below Cinnamon Ck. Walk down from pullout below creek. 82 m

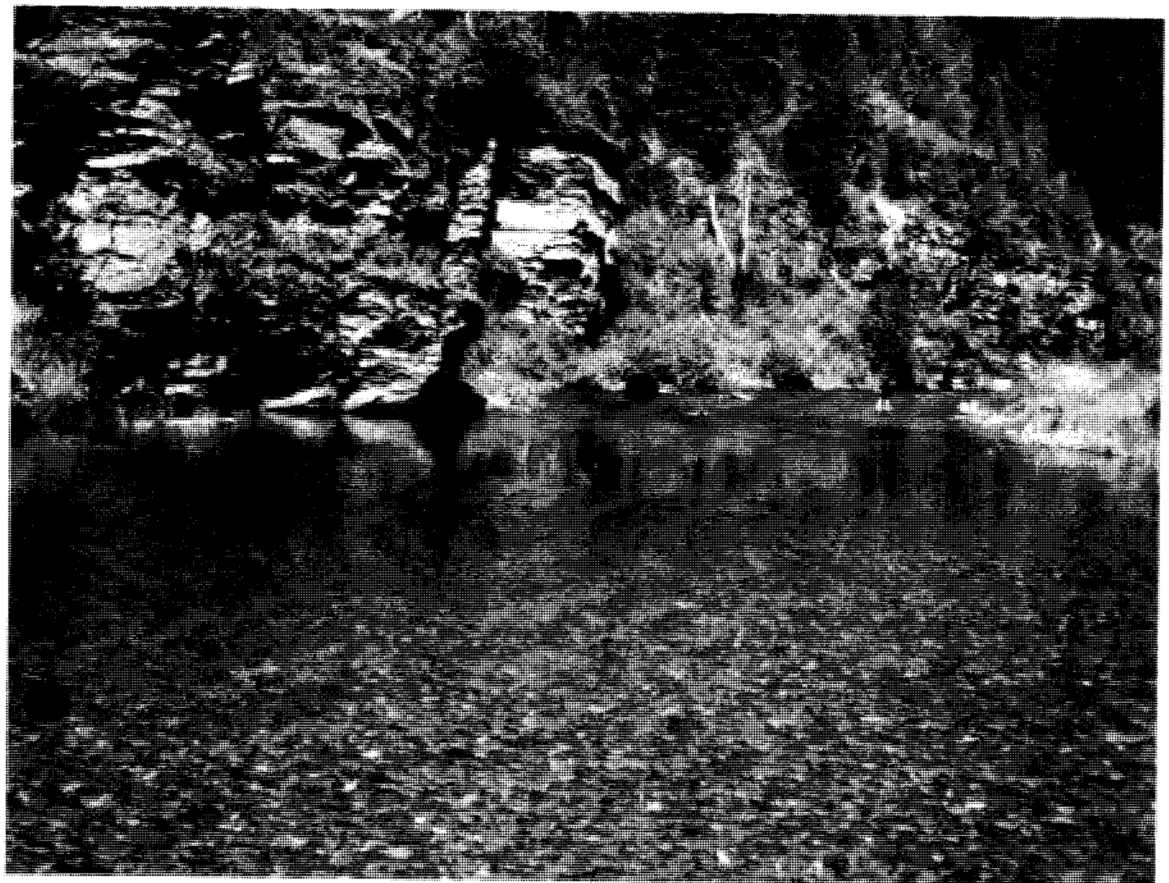
NF19
At section where stream splits about 0.5 miles up from bridge. 70 m

NF20
Upstream of site NF19 by about 300 m. 65 m

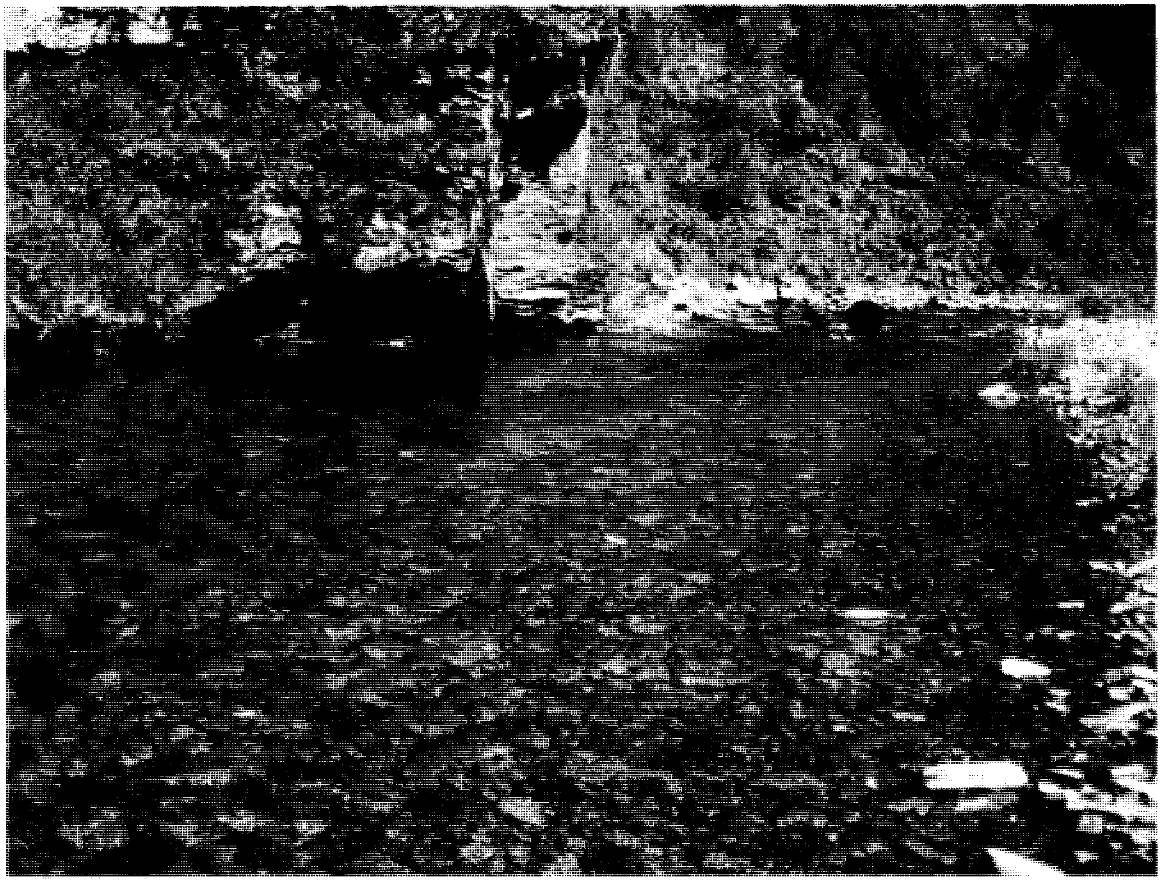


NF 21 (from above)

NF21
About 1.6 miles upstream from bridge in roadless area. 41 m



NF22
Roadless area about 3 miles up from bridge. 55 m

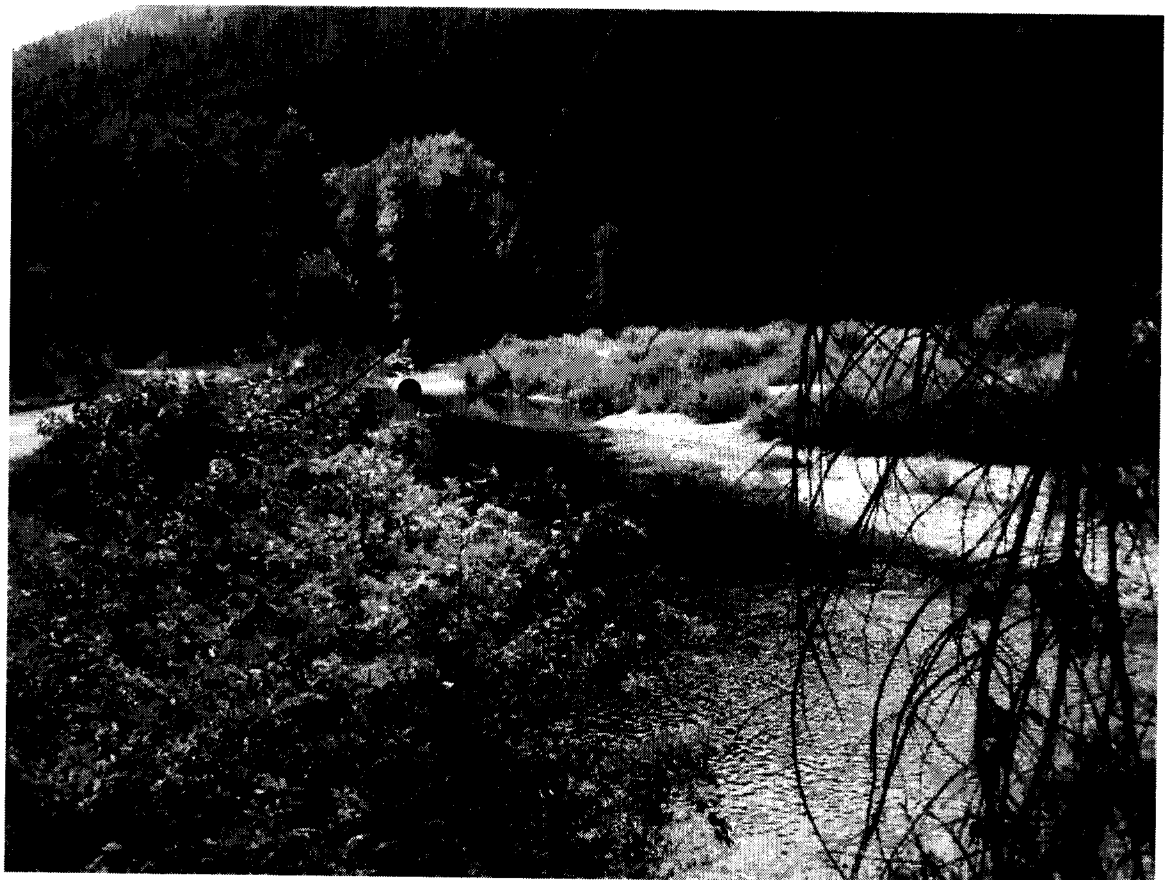


NF23

About 3.1 miles upstream from bridge in roadless area. New site in 2002 - Moved downstream 75m due to pool filling. 38 m

Little North Fork Coeur d'Alene River

LNF01
Just above bridge at mouth of Little North Fork. 66 m

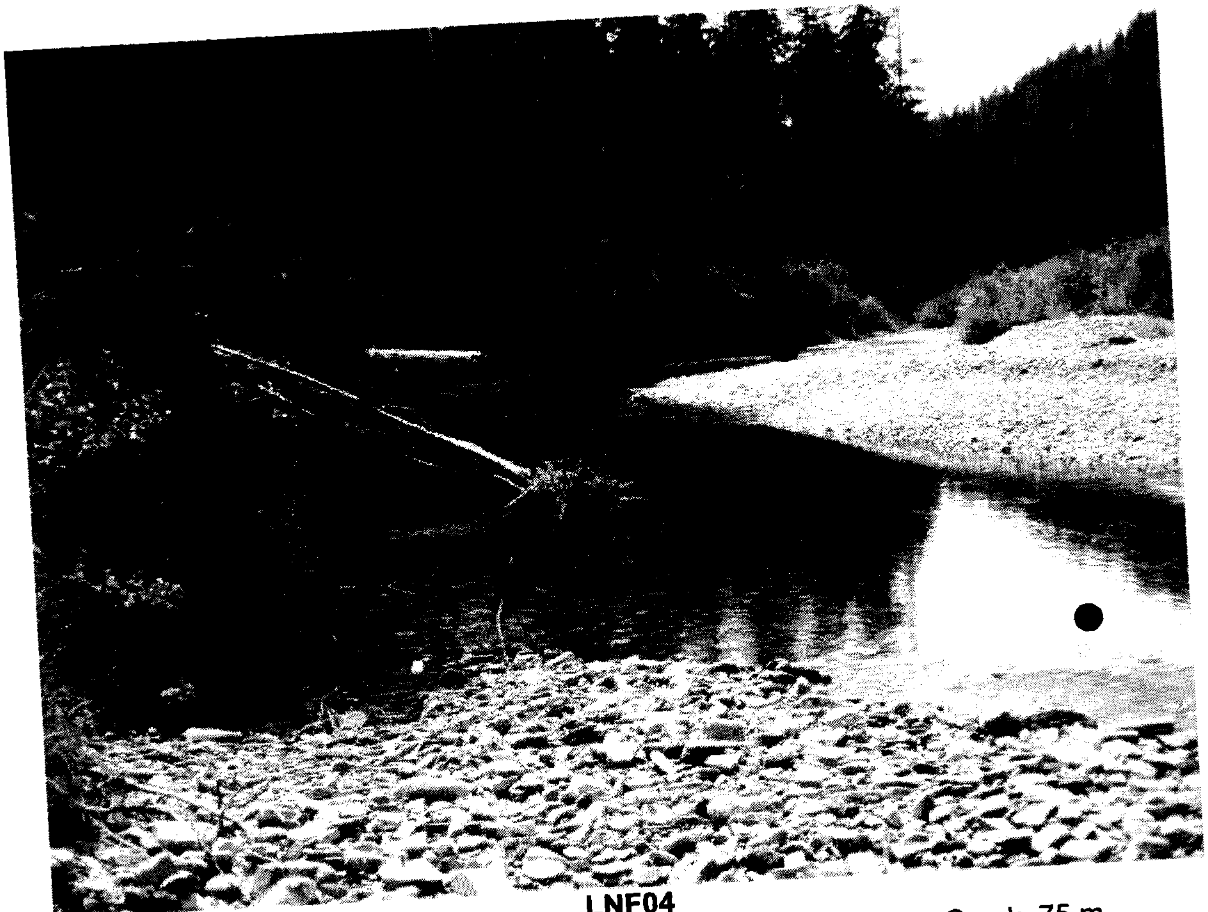


LNF02 (looking downstream)

LNF02 (looking upstream)
1.0 mile below Bumblebee Campground Road. 128 m

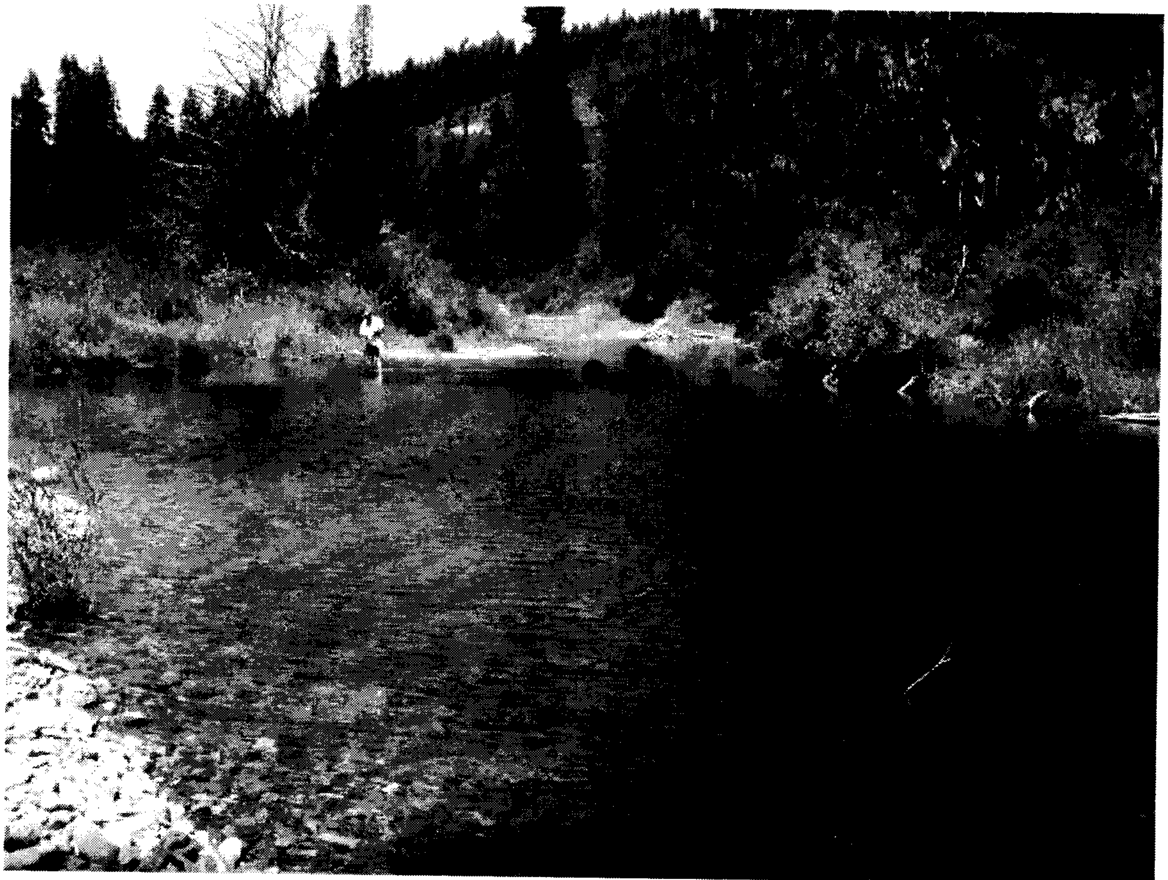
LNF03

0.6 miles above Bumblebee Campground Rd. just below Little Bumblebee Ck 90 m



LNF04
0.8 miles below LNF6 and 1.2 miles above Little Bumblebee Creek. 75 m

LNF05



LNF05 (looking up side channel)
200 m downstream of old Owl Creek turnoff (old dirt road). Just upstream from Little Tepee Creek. 130 m

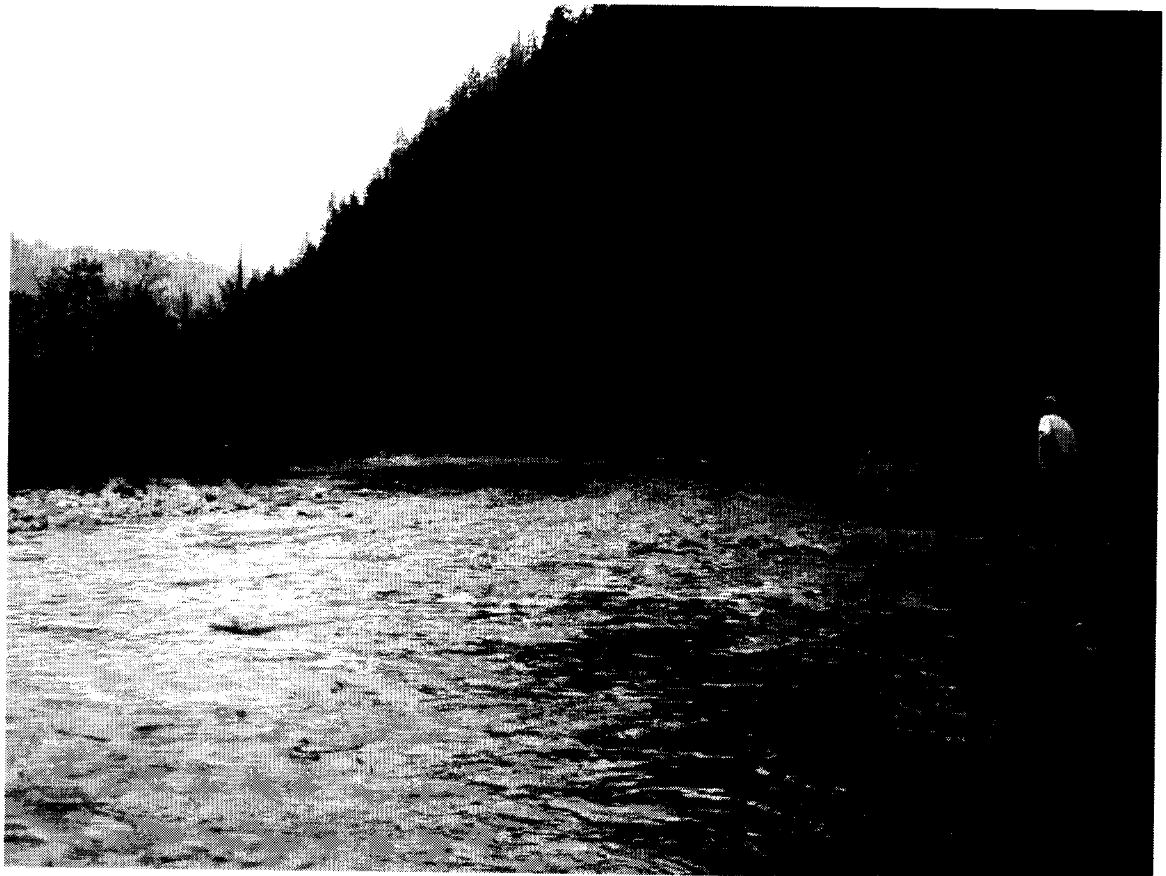
LNF06

Take F.S. road 413 to Breakwater bridge. 71 m.

LNF07

About 2.5 miles below Laverne Ck. Hike about 250 m down from road. 91 m

LNF08
1.2 miles below Laverne Creek Bridge. 152 m


LNF09
0.1 miles below Lieberg Creek. 41 m

LNF10
Old Splash Dam Historical Site (pullout with interpretive sign). 110 m

LNF11
0.1 miles below Bootjack Creek culvert – 250 m upstream from splash-dam. 90 m

LNF12
Confluence of Skookum Creek – 0.25 miles downstream of F.S. road 612. 66 m

LNF13

Take pull out 0.4mi upstream from F.S. road 612. Transect begins at flat rock to tail end of run.

50 m

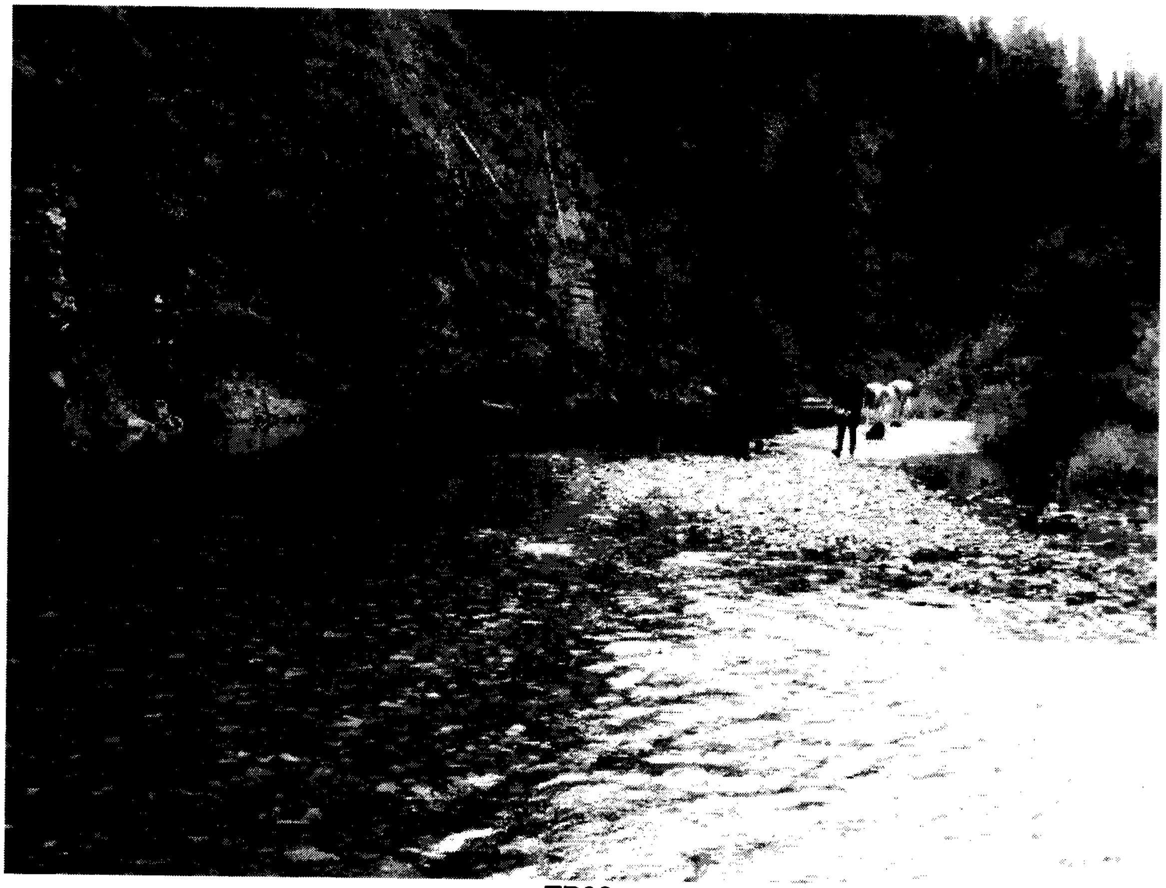
Tepee Creek

TP01

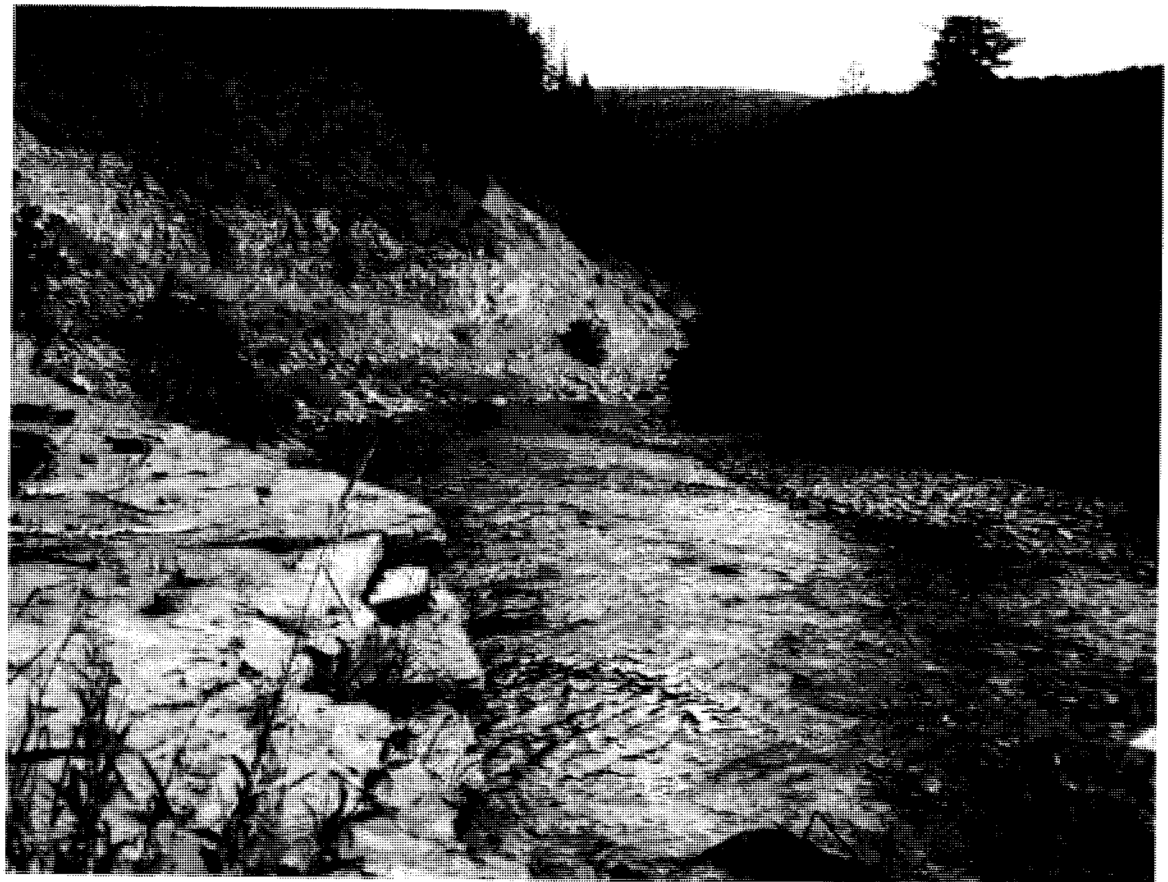
Accessed through private property – near mouth of TP Creek beside where trailers are usually parked. 100 m

TP02 (Looking upstream)

TP02 (Looking downstream)
Winton Creek enters the middle of this site. 225 m

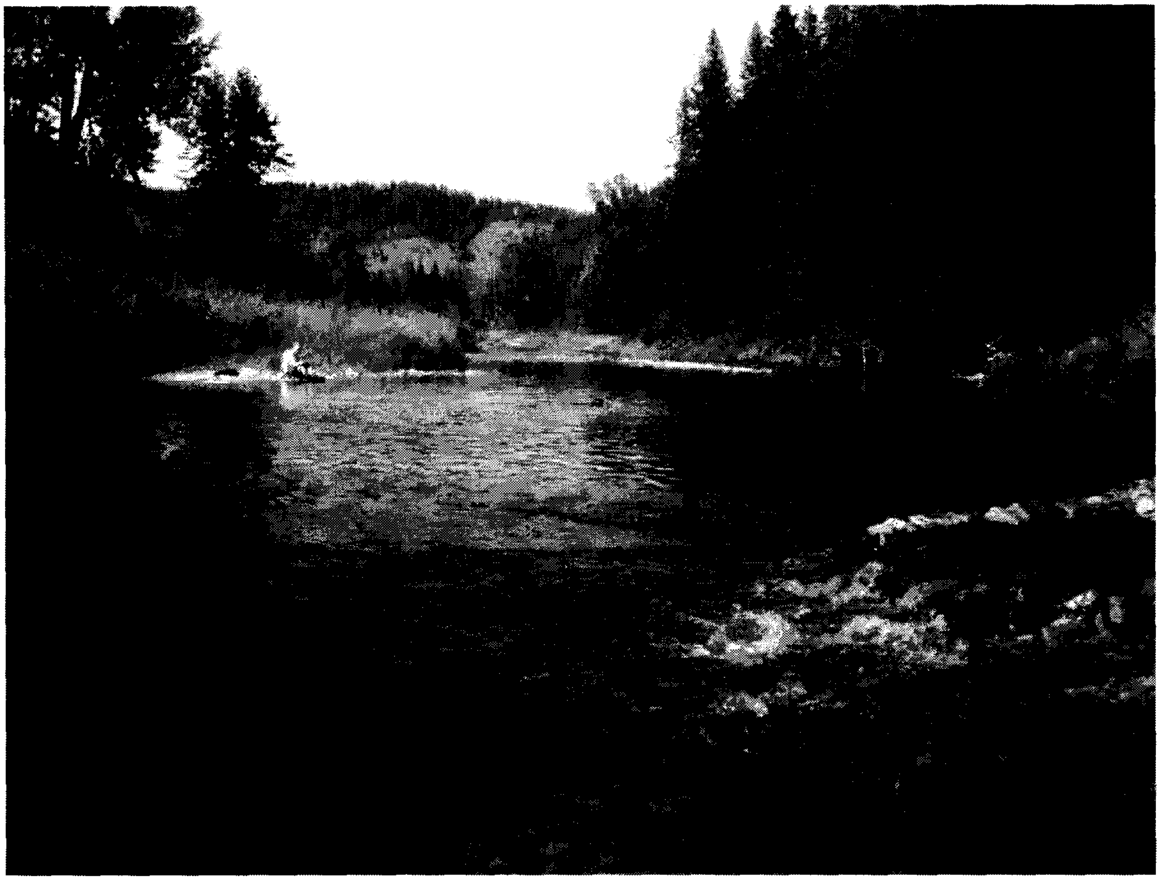


TP03
About 0.2 miles upstream from Plant Creek. 90 m



TP04

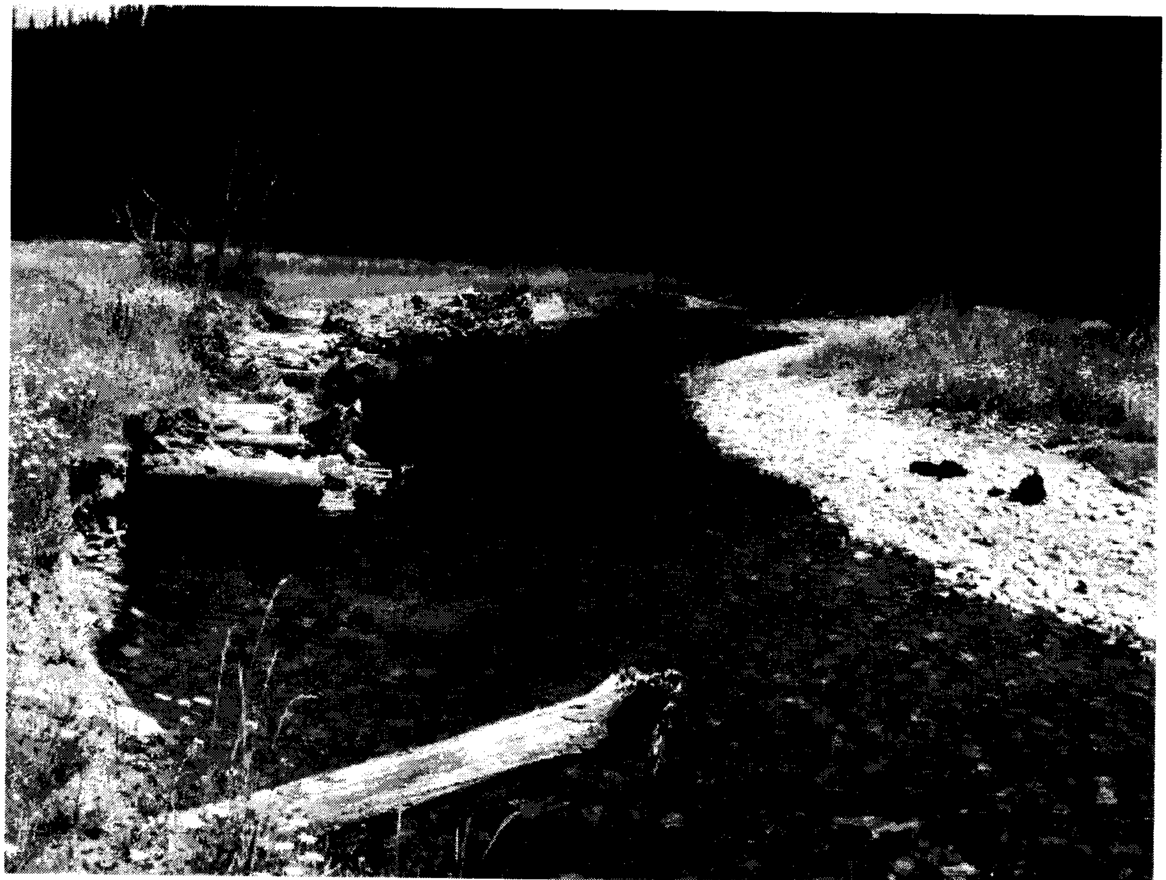
About 1.0 road mile downstream from Independence Creek. 112 m



TP05
Confluence of Independence Creek and Tepee Creek. 60 m.

TP R1

New Site. Hike upstream from bridge above airport and snorkel first two meander bends with roots on bank (rehab area). 150 m



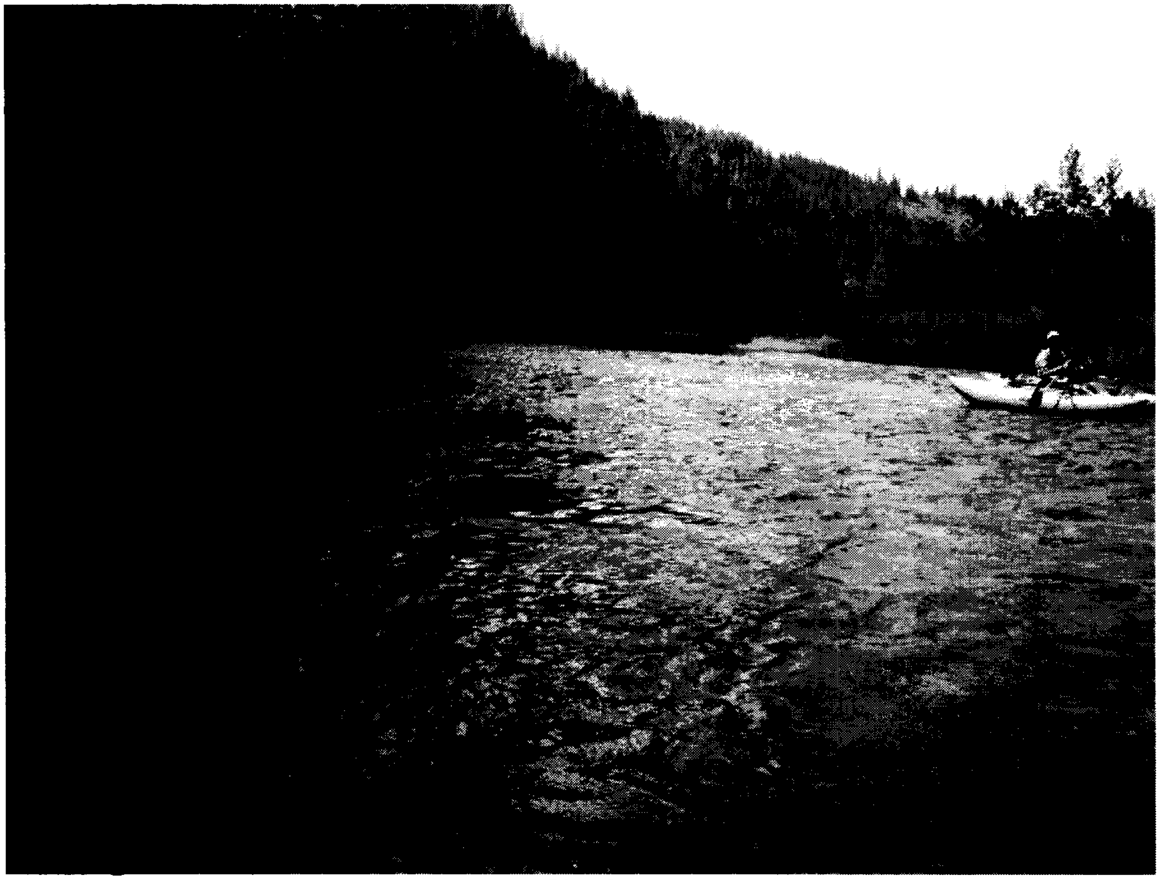
TP R2

New Site. Snorkel the two most upstream meander bends with rootwads (of the rehab area). Access this transect from the bridge at upstream end of the rehab area. 150 m

Appendix F. Photographs depicting locations of transects, starting (green dot) and stopping (red dot) points and approximate distance of stream to snorkel in the South Fork Coeur d'Alene River, Idaho. These photos were taken in 2006.


Site 1 (looking down from top of transect)
Bear Creek confluence – 205 m long


Site 1 (looking down from Bear Creek)
205 m long

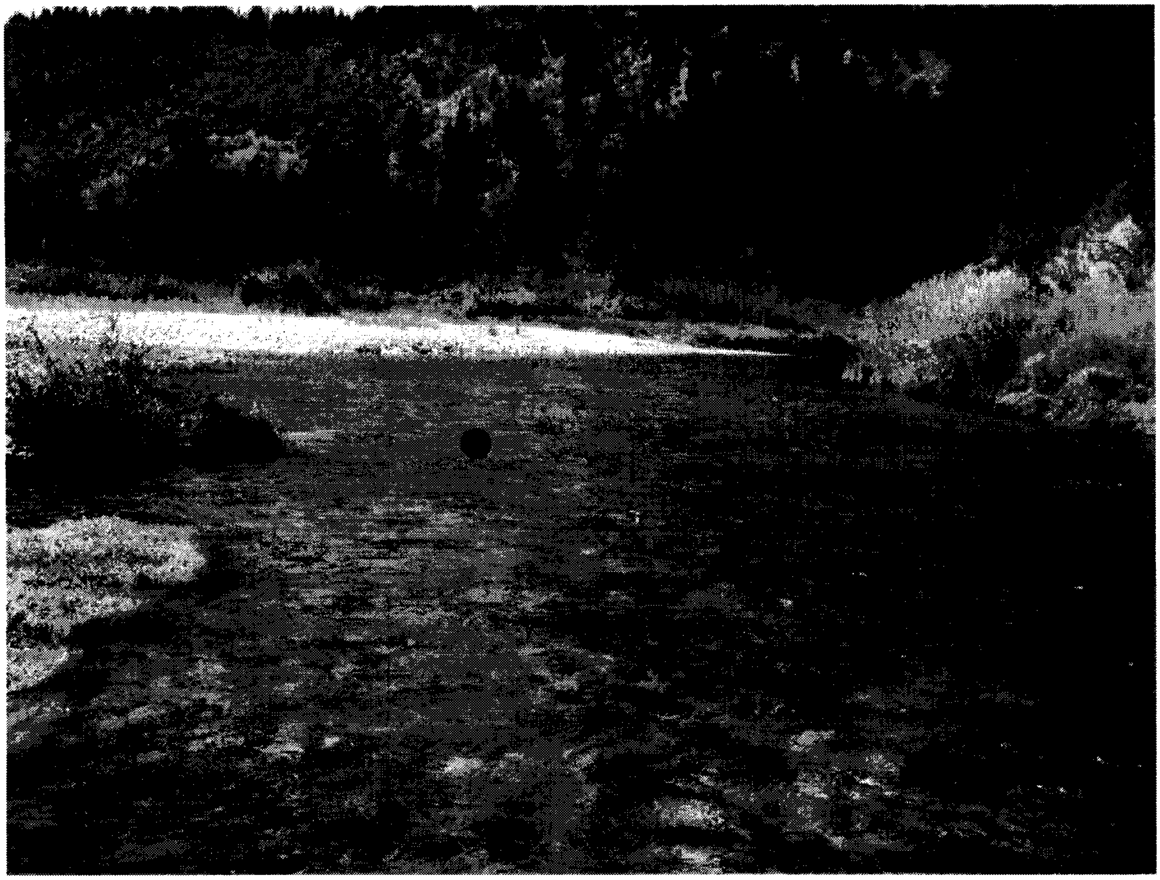


Site 2
180 m long

Site 3 (looking upstream from old bridge crossing)
100 m downstream from bike bridge

Site 3 (looking downstream from old bridge crossing)
95 m long

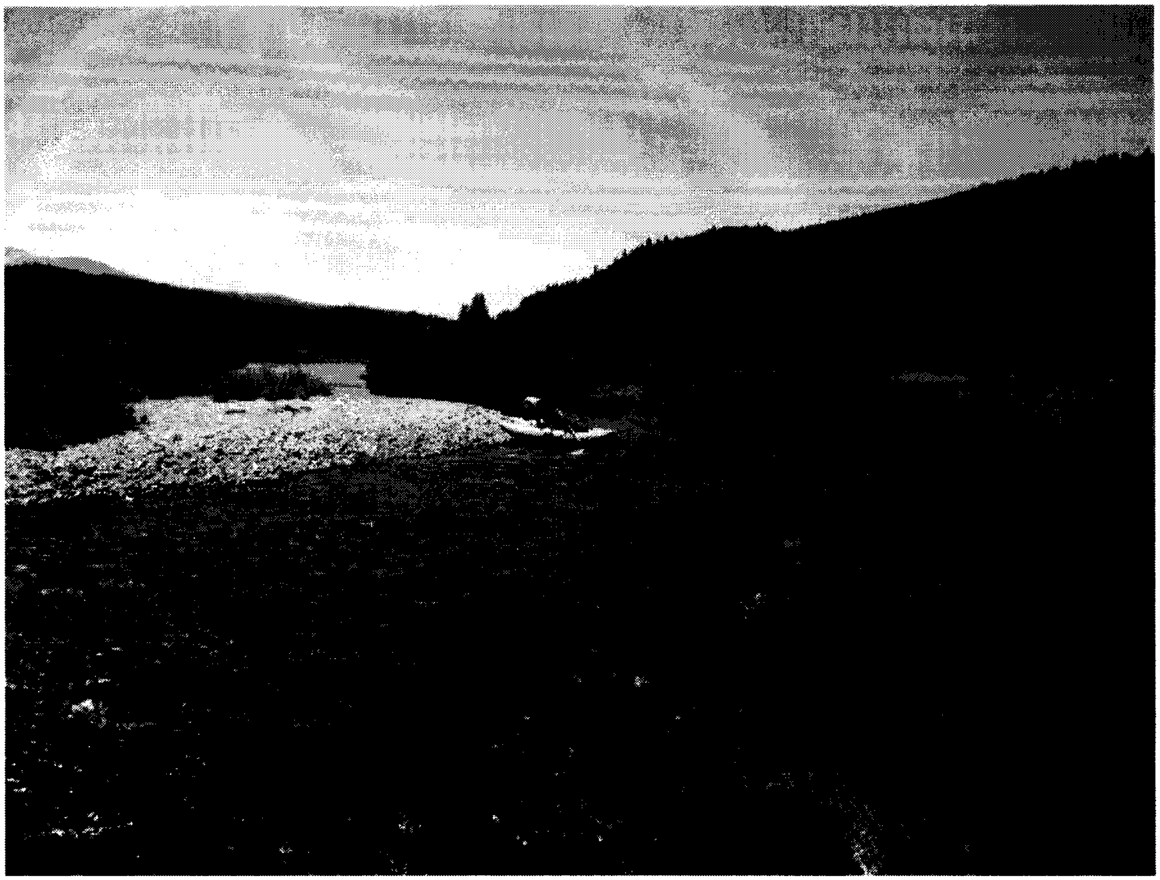
Site 4
160 m long



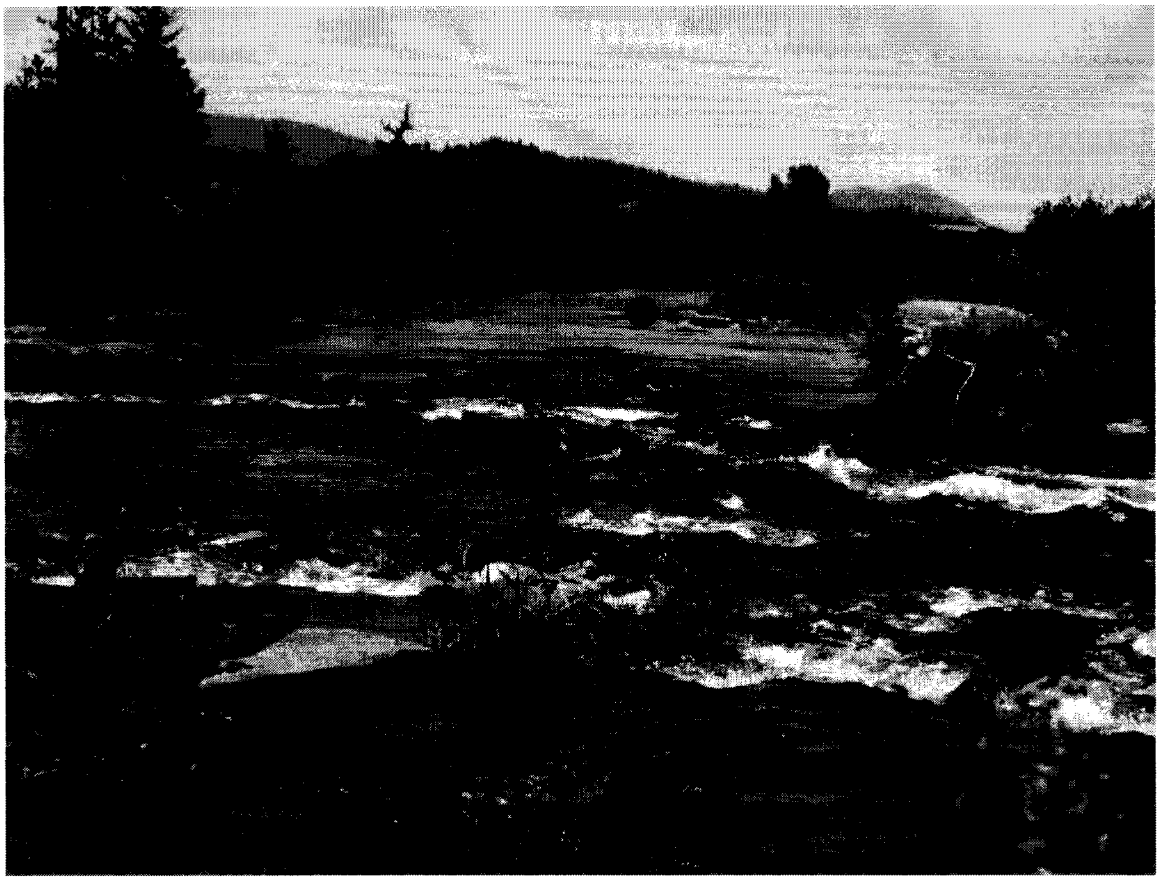
Site 5
Pine Creek confluence – 64 m long

Site 6
145 m long

Site 7
75 m long

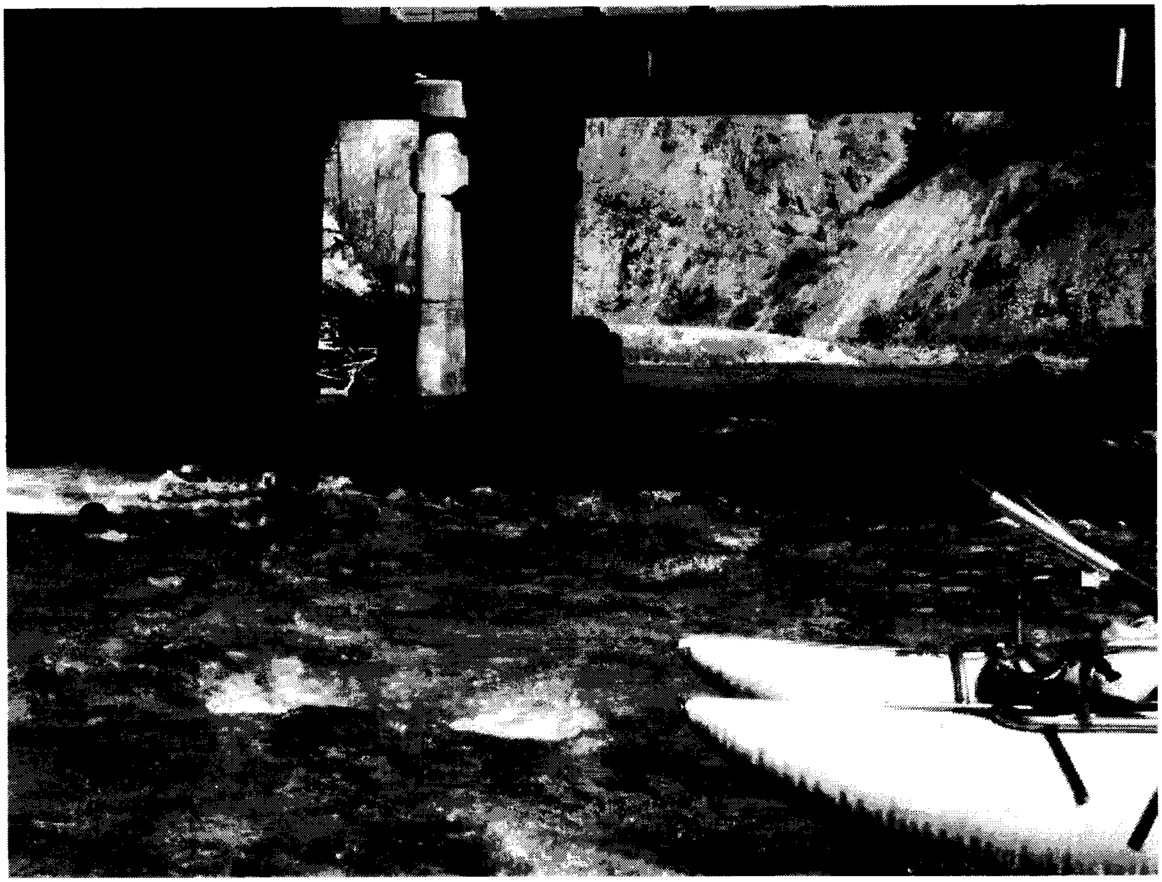


Site 8
116 m long

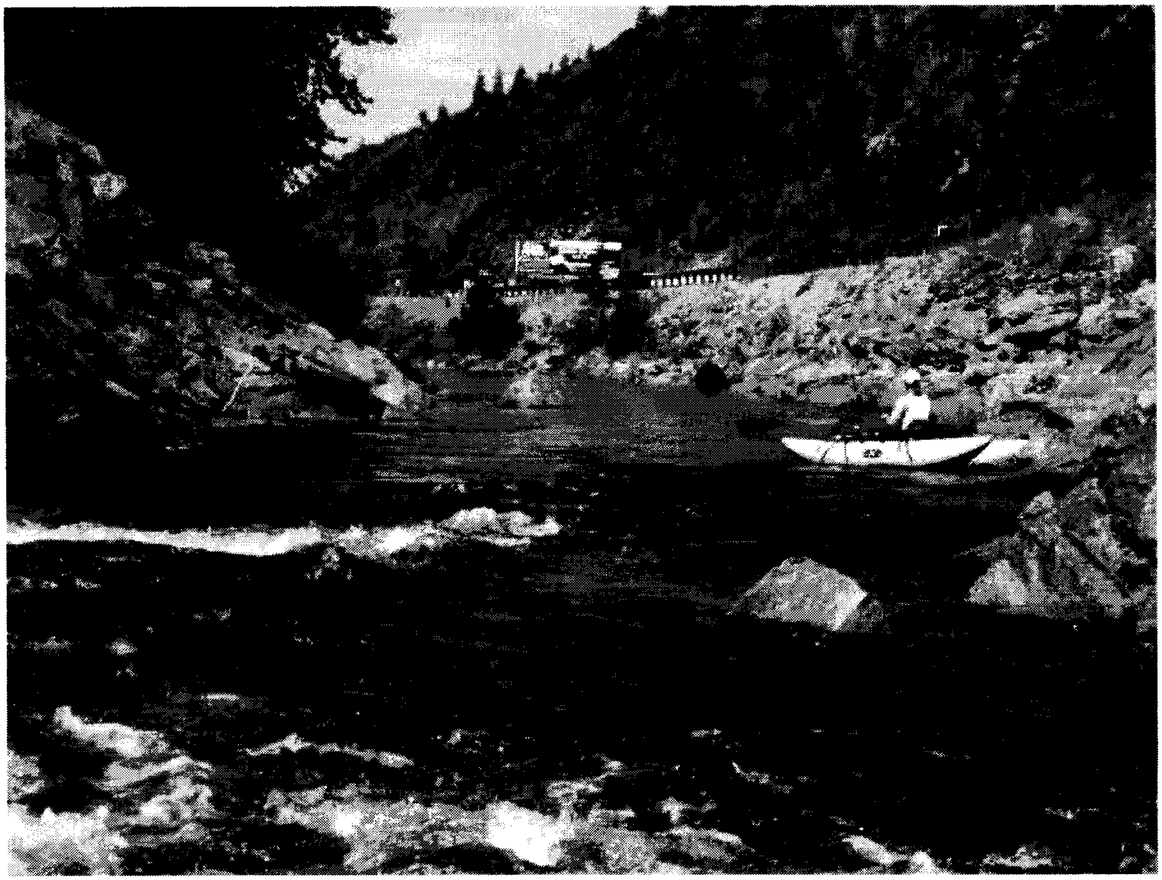


Site 9
62 m long


Site 10
75 m long

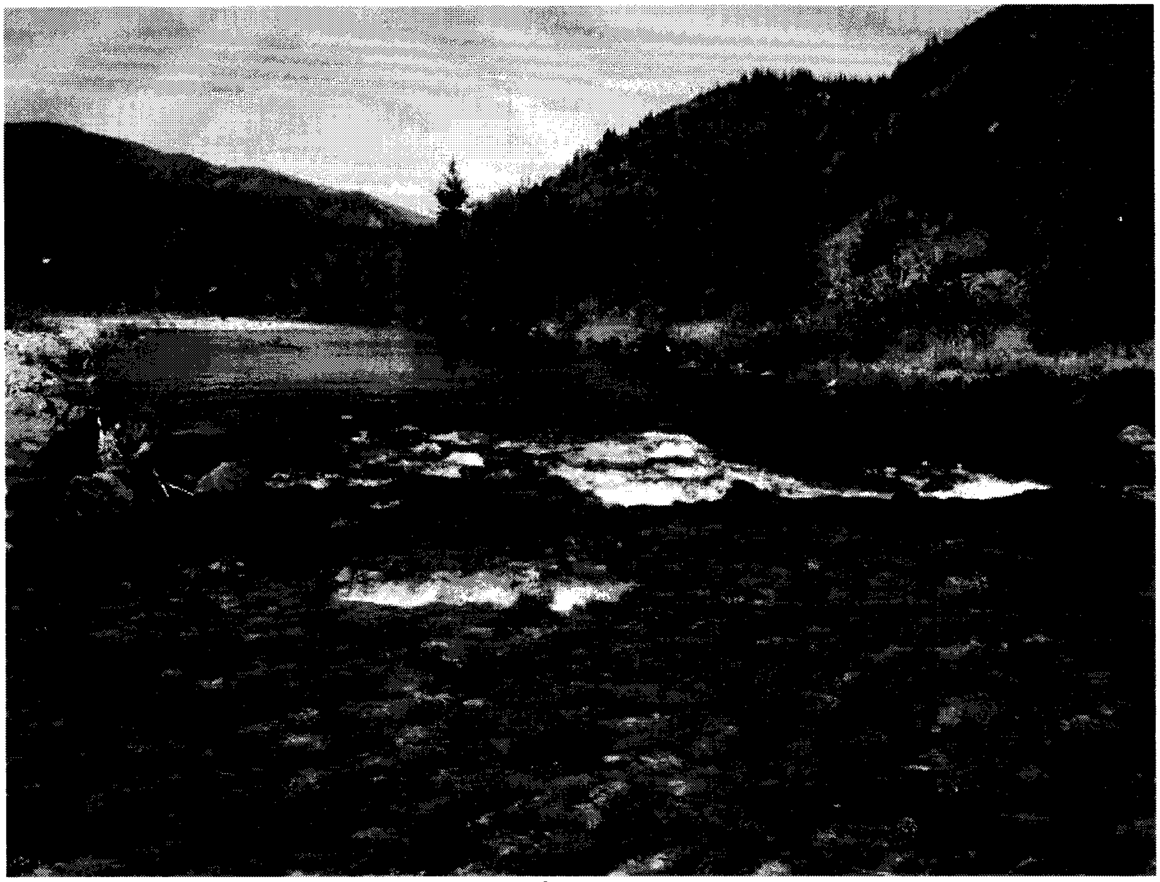


Site 11
Under freeway bridge – 90 m long

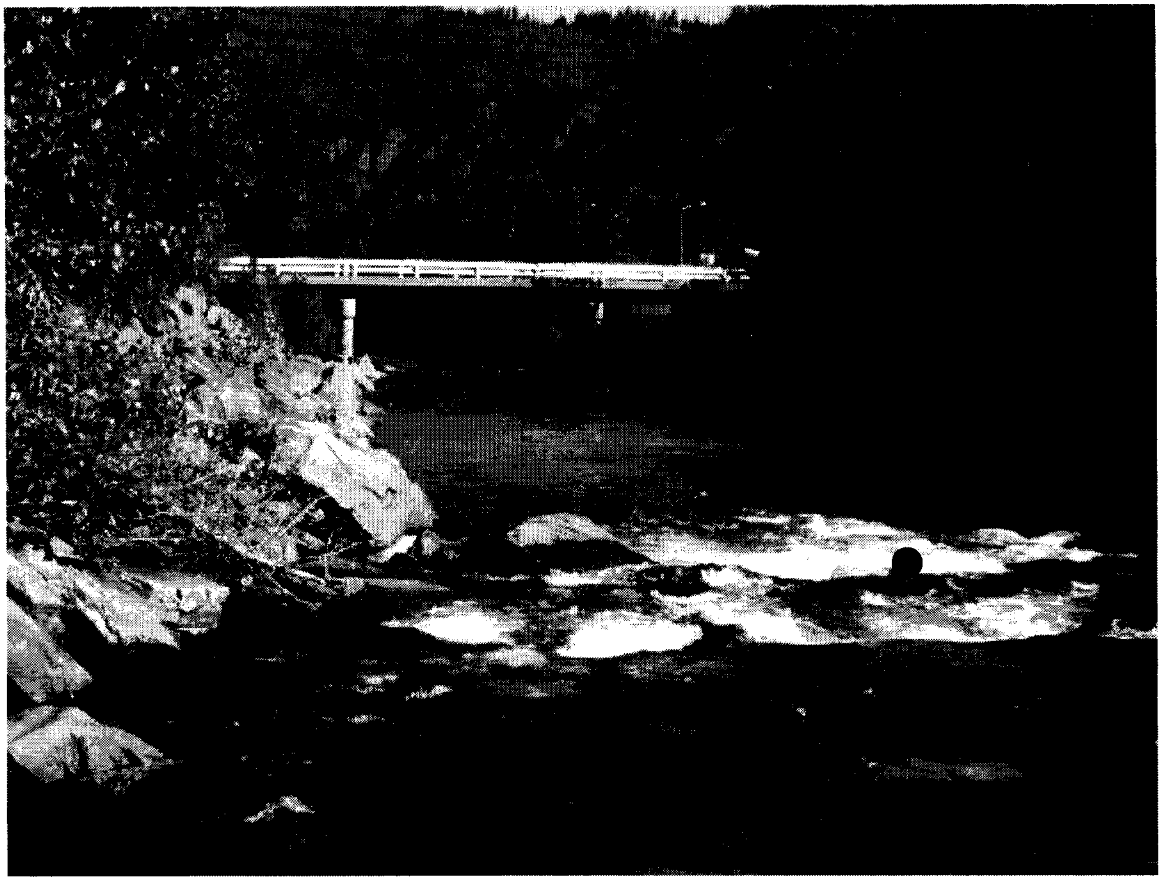


Site 12
123 m long

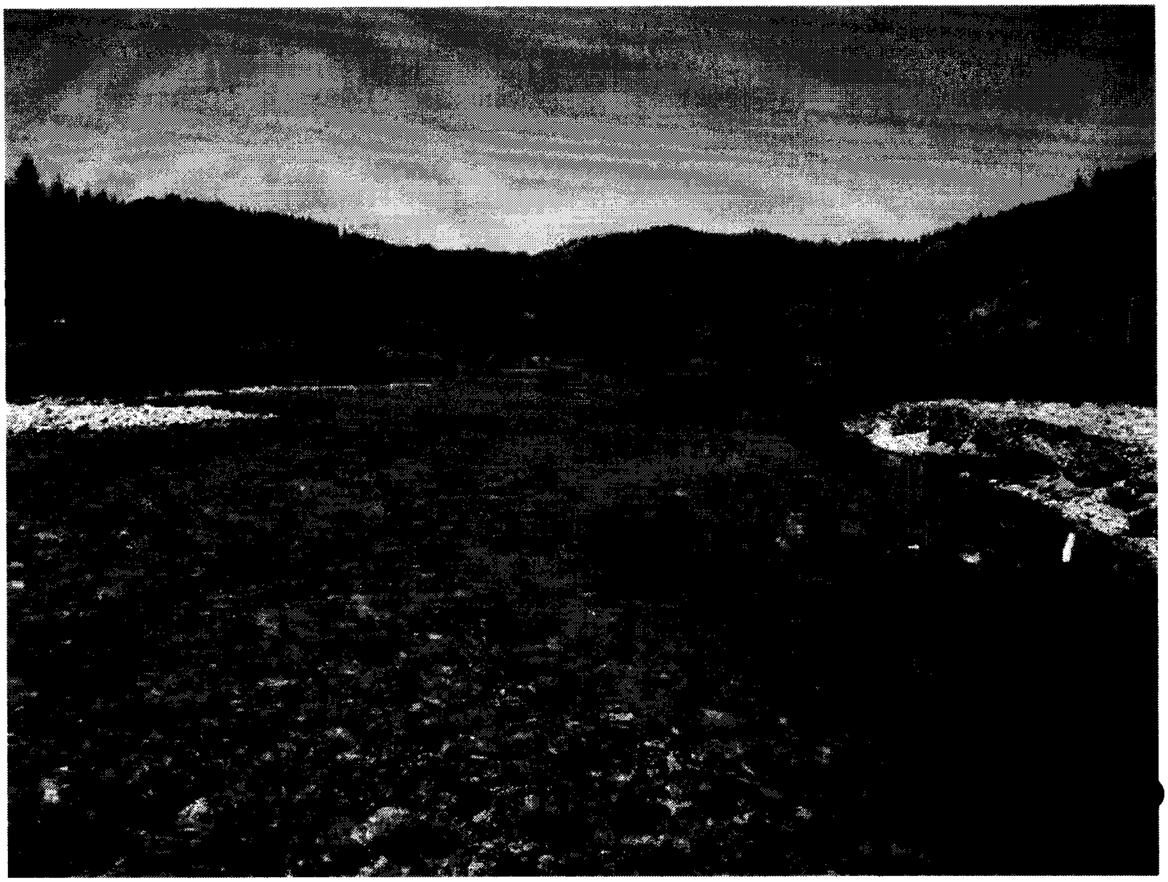

Site 13
Past steep drop – 44 m long



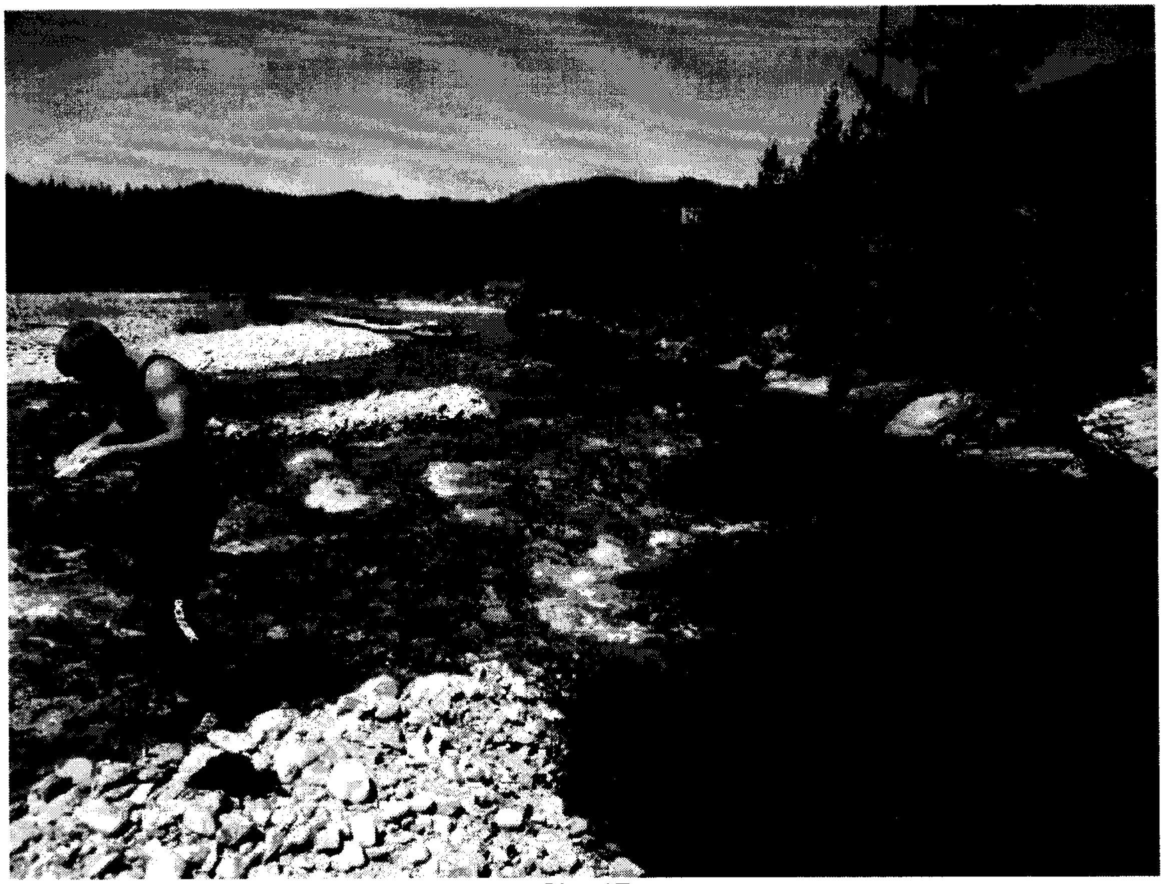
Site 14
56 m long



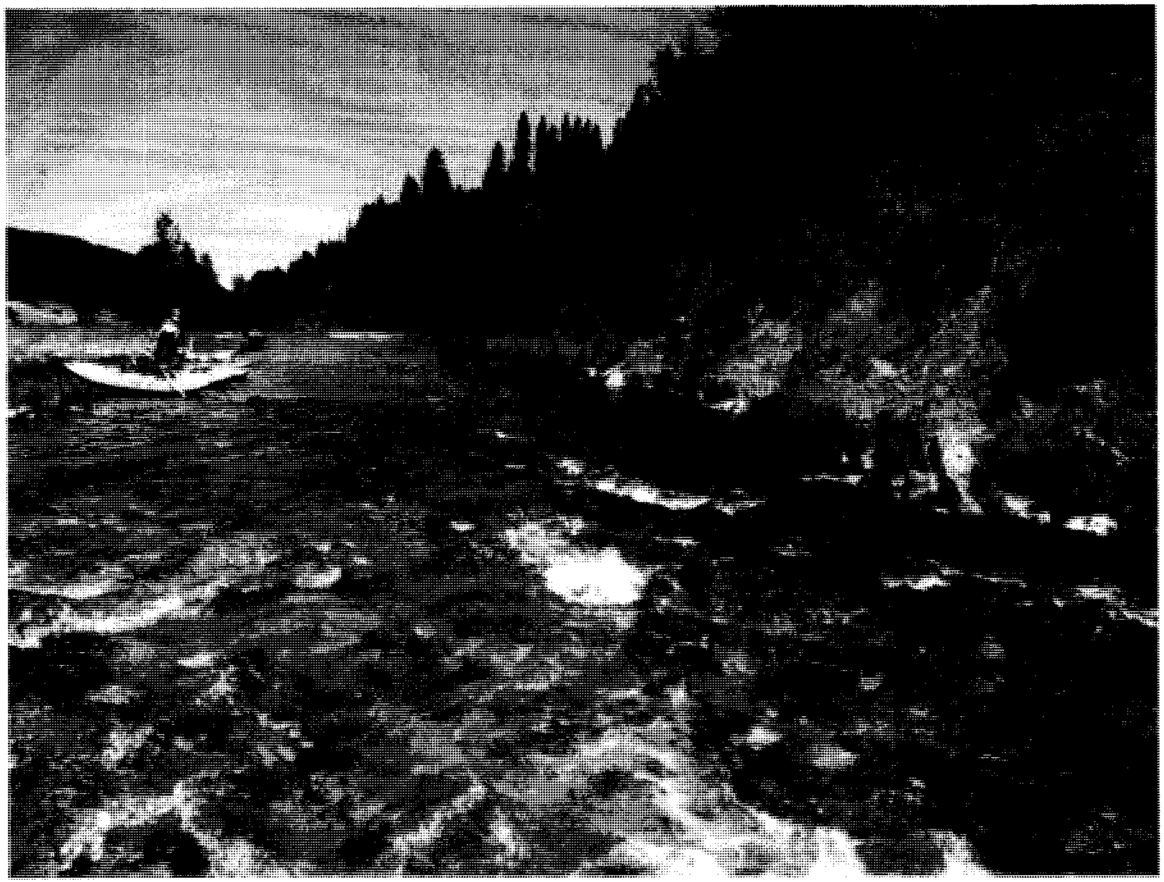
Site 15
Snorkel past Big Creek bridge - 103 m long



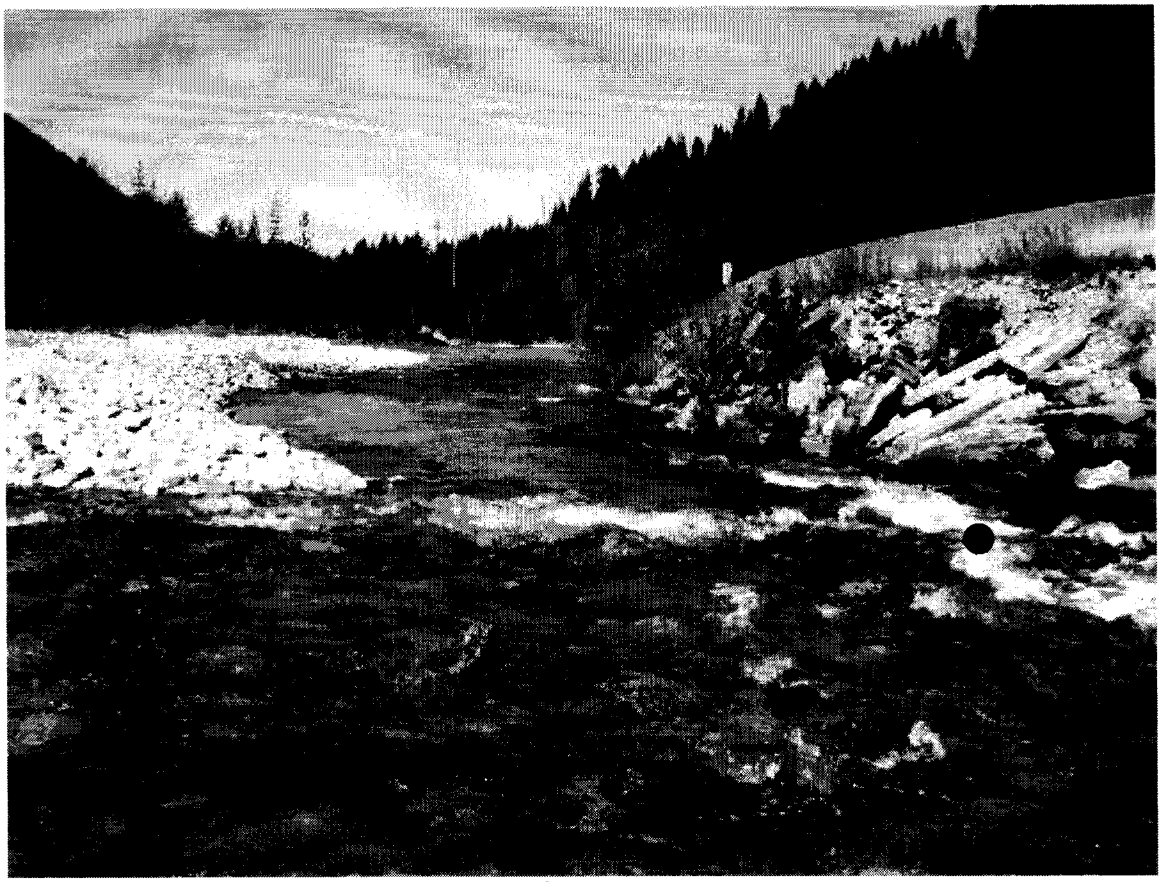
Site 16
65 m long



Site 17
65 m long



Site 18
55 m long

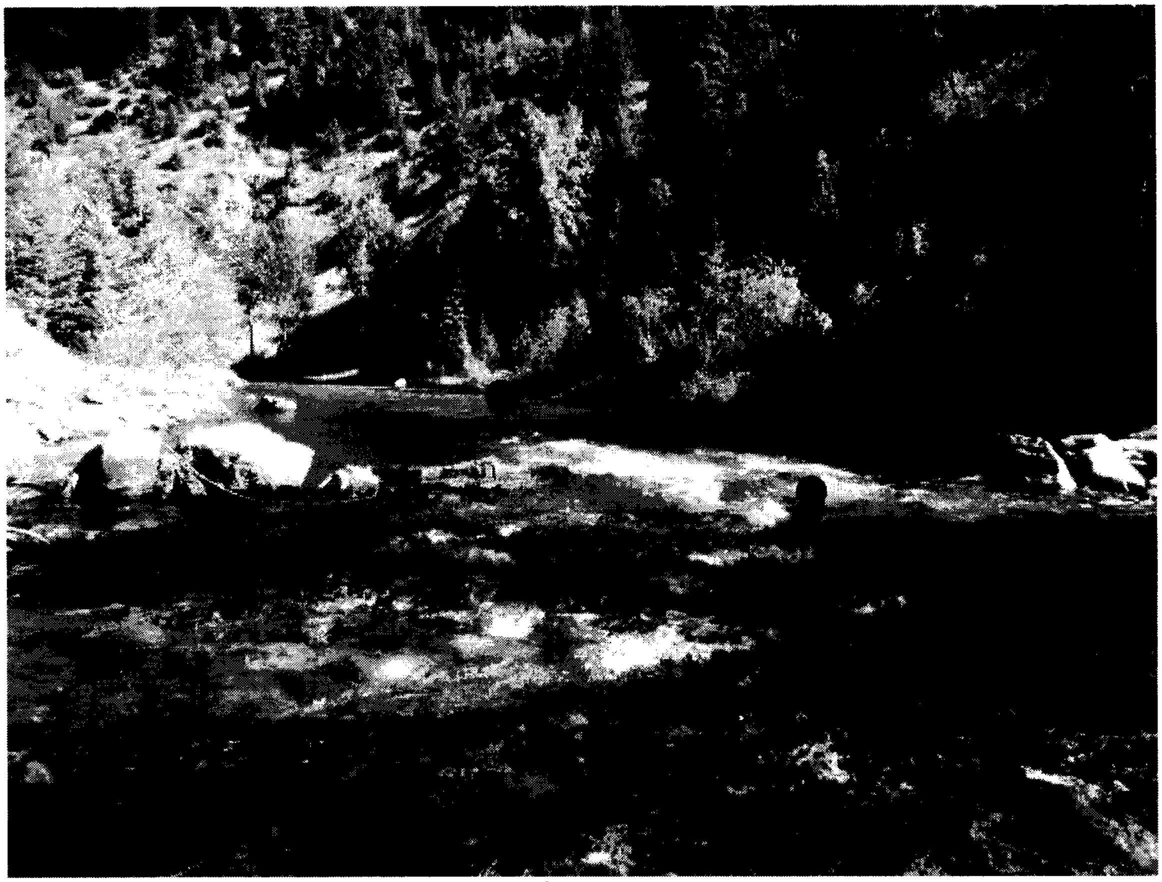


Site 19
Snorkel both pools – 102 m

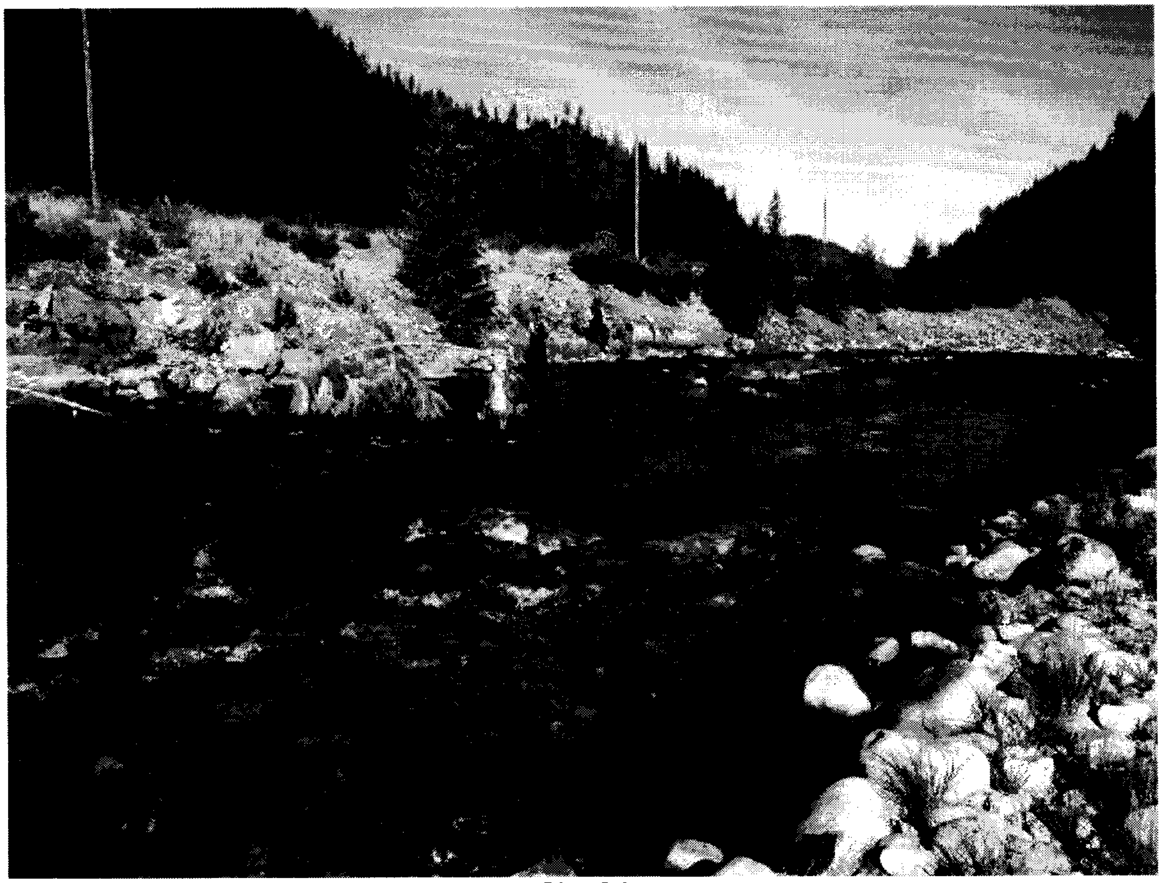
Site 20
Snorkel to culvert – 60 m long

Site 21
39 m long

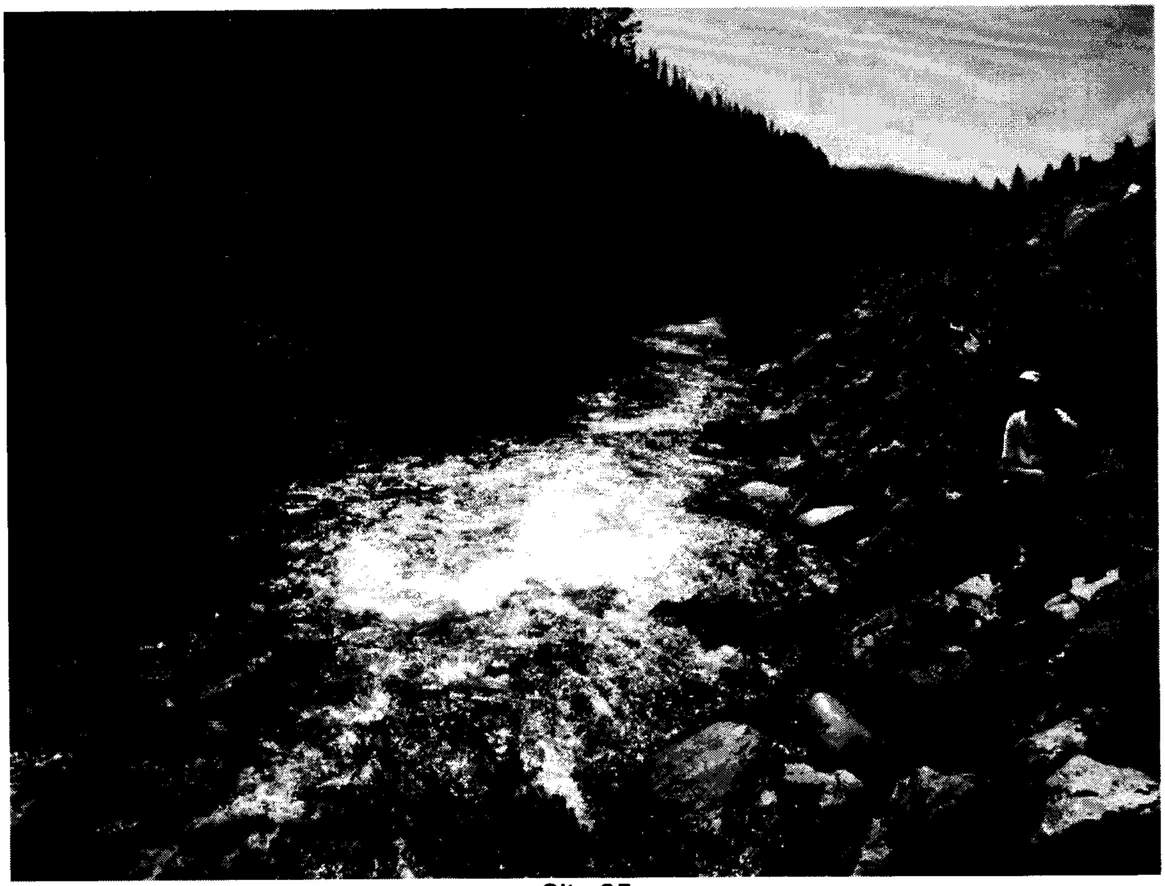
Site 22
Pocket water just past freeway bridge – 75 m long



Site 23
27 m long



Site 24
Snorkel around old stump – 26 m long



Site 25
Below freeway bridge about 150 m – 40 m long


Site 26
Under freeway bridge, stop at Watson Gulch - 56 m long


Site 27
Start at Dexter Creek - 40 m long

Appendix G. Data sheet used when collecting information during snorkel surveys in the St. Joe River and Coeur d'Alene River, Idaho, during 2006.

IDFG Snorkel Data

Stream: ____________________ **Transect Name/Number:** ____________________

Date:__________ Time:__________ Temperature: ______ Visibility:__________ GPS Datum: ______________

Observers:______________________________ No. of Snorkelers:_______ GPS Coord: (Easting) ______________

(Northing) ______________

Habitat Type: Pool, Riffle, Run, Glide, Pocket Water Max Depth (m): ______ Dominant Cover / % surface area: ______________

Stream Length (m): __________ Stream Width (m): __ ____ ____ ____ ____ ____ ____ ____

Comments: ____

Length	WCT		RBT		BLT		BRK		MWF		LSS		NPM		Other
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
<3"															
3"-6"															
6"-9"															
9"-12"															
12"-15"															
15"-18"															
18"-21"															
>21"															
Total															

Abbreviations: **WCT** = Westslope Cutthroat Trout; **RBT** = Rainbow Trout; **BLT** = Bull Trout; **BRK** = Brook Trout; **MWF** = Mountain Whitefish **MWF** = Mountain Whitefish; **LSS** = Large Scale Sucker; **NPM** = Northern Pike Minnow; **RSS** = Redside Shiner; **LND** = Long Nose Dace.

Cover Types: **LWD** (large woody debris > 4"), **SWD** (small woody debris < 4")' **LS** (large substrate), **UB** (undercut banks), **OC** (ovehead cover)

CUTTHROAT TROUT POPULATION AND EXPLOITATION ESTIMATES IN THE COEUR D'ALENE AND NORTH FORK COEUR D'ALENE RIVERS

ABSTRACT

Through electrofishing, we conducted a Petersen mark-and-recapture population estimate on cutthroat trout and mountain whitefish in the Coeur d'Alene River and North Fork Coeur d'Alene River during the spring of 2006. We collected a total of 2,086 fishes in the Coeur d'Alene River and 1,398 fishes in the North Fork Coeur d'Alene River. Mountain whitefish were the most common fish caught in both the Coeur d'Alene River (65%) and North Fork Coeur d'Alene River (82%) and cutthroat trout were the second most abundant species sampled in both systems. Rainbow trout represented 10% of the trout species in the Coeur d'Alene River and 38% in the North Fork Coeur d'Alene River. Cutthroat trout and rainbow trout tended to be larger in the Coeur d'Alene River than the North Fork Coeur d'Alene River. Our mark-and-recapture efforts resulted in a density estimate of 523 cutthroat trout/km in the Coeur d'Alene River. This density is similar to what was documented in 1999 and 2000 before changes in the fishing regulations occurred. Not enough cutthroat trout were recaptured in the North Fork Coeur d'Alene River to conduct a population estimate. Mountain whitefish density estimates were 942 fish/km in the Coeur d'Alene River and 484 fish/km in the North Fork Coeur d'Alene River.

While electrofishing the Coeur d'Alene River and lower North Fork Coeur d'Alene River, all rainbow trout and rainbow/cutthroat hybrids ≥ 250 mm and cutthroat trout ≥ 400 mm (legal sized fish) were marked with Floy tags to evaluate exploitation. We calculated that annual exploitation for rainbow trout and cutthroat trout in the Coeur d'Alene River was about 27% and 58% respectively. We received tag returns only for rainbow trout from the North Fork Coeur d'Alene River, and the annual exploitation was calculated to be about 11%. Based on angler surveys of 163 different people on the Coeur d'Alene River and North Fork Coeur d'Alene River, 73% of the cutthroat trout they harvested were between 200 and 400 mm (illegal size to keep). We calculated that the annual exploitation rate on cutthroat trout 300-400 mm in length (illegal harvest) was 43% in the Coeur d'Alene River. Angler interviews found that 53% of anglers did not know what the regulations were for cutthroat trout and 48% of the anglers did not have rulers with them.

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INTRODUCTION

Westslope cutthroat trout are a highly sought after game fish native to northern Idaho attracting anglers from around the United States. The popularity of cutthroat trout stems from their eagerness to take a dry fly, their beautiful appearance and the pristine environment they inhabit. In northern Idaho, the major cutthroat trout fisheries occur in many of the larger rivers and streams that drain the rugged landscape. One of these rivers, the Coeur d'Alene River, was considered by many to be one of the finest trout streams in American In the late 1800s and early 1900s. Captain John Mullan reported that fish were observed by the thousands in pools of the Coeur d'Alene River (Near the Cataldo Mission) and provided enough fish to sustain a village of 300 Indians (Ellis 1940). The abundance of trout in the Coeur d'Alene River supported a commercial fishery and steam ships which ran the river featured trout on their dinner menus (Rabe and Flaherty 1974). Colonel Wallace, reported catching 247 trout in one day in one of the tributaries (Rabe and Flaherty 1974). The local newspaper of St. Maries, Idaho frequently reported catches of seven to nine-pound trout, and trips where anglers caught 50-100 cutthroat trout averaging three to five pounds in a few hours (Rankel 1971).

The abundance of cutthroat trout in the Coeur d'Alene River (downstream of the South Fork) changed abruptly after gold and silver was discovered in the South Fork Coeur d'Alene watershed in 1883. The ensuing unregulated mining practices that occurred in this basin resulted in such high concentrations of heavy metals being delivered to the South Fork Coeur d'Alene that it created toxic conditions all the way to Lake Coeur d'Alene. In 1932 Ellis (1940) described the Coeur d'Alene River as being devoid of life. Settling ponds were built along the South Fork Coeur d'Alene River in 1968 and in 1973 the discharge of toxic metals became regulated by the U.S. Environmental Protection Agency. These actions resulted in decreased concentrations of heavy metals, and insects started appearing throughout the Coeur d'Alene River in the early 1970's (Rabe and Flaherty 1974). A thriving fishery now occurs in the Coeur d'Alene River, although many of the fish still have blackened tails, believed to be caused by still elevated heavy metal concentrations. Work conducted in 1999 (Fredericks et al. 2002) and 2000 (Fredericks et al. 2003) found that cutthroat trout densities in the Coeur d'Alene River were around 500 fish/km, which approached densities (780 fish/km) that occurred in some of the popular fishing reaches in the St. Joe River (Nelson et al. 1997).

Water quality in North Fork Coeur d'Alene River was not impacted by elevated heavy metal concentrations. However, by the 1960s cutthroat trout abundance had declined considerably and studies were initiated to determine why these declines had occurred and what could be done to restore the fishery (Bowler 1974; Lewynsky 1986). This research found that declines in the cutthroat trout fishery in the North Fork Coeur d'Alene River watershed were a result of over harvest, and habitat degradation (Bowler 1974; Lewynsky 1986). As efforts were made to correct these impacts, snorkel surveys were initiated to monitor trends in fish numbers and to evaluate how successful recovery efforts were. Snorkel surveys indicated that the density of cutthroat trout was increasing steadily to the point where record high densities were observed in 2005 (DuPont et al. In Press b).

Despite improvement in the cutthroat trout fishery in the Coeur d'Alene and North Fork Coeur d'Alene rivers there are still concerns. Fishing regulations in the Coeur d'Alene River (downstream of the South Fork) were changed in 2000 from a July 1 opener to opening on Saturday of Memorial weekend (general stream season) and 2 cutthroat trout, none between 8 (203 mm) and 16 inches (406 mm), could be harvested where previously 1 cutthroat trout greater than 14 inches (356 mm) could be harvested. Some had concerns that these changes would allow excess harvest of large adfluvial cutthroat trout that utilized this system. Research in 2004 (DuPont et al. In Press a) suggested that illegal harvest of cutthroat trout was suppressing the fishery in the lower North Fork Coeur d'Alene River. Continued monitoring of these rivers is necessary to evaluate what impacts the new regulations, exploitation, and illegal harvest are having on the cutthroat trout fishery. This study specifically set out to accomplish the following objectives.

OBJECTIVES

1. Conduct population estimates on salmonids in the Coeur d'Alene River and lower North Fork Coeur d'Alene River.
2. Evaluate exploitation by anglers on cutthroat trout and rainbow trout in the Coeur d'Alene River and lower North Fork Coeur d'Alene River.
3. Evaluate compliance with the fishing regulations in the Coeur d'Alene River and lower North Fork Coeur d'Alene River.

STUDY SITES

Mark-and-recapture and exploitation studies occurred in a 5.1 km reach of the Coeur d'Alene River (bike path bridge at Cataldo downstream to the Cataldo Mission Boat Ramp) and a 15.4 km reach on the lower North Fork Coeur d'Alene River (Graham Creek Campground downstream to the Little North Fork Coeur d'Alene River) (Figure 45). The Coeur d'Alene River is about 55 km from the town of Coeur d'Alene. The river can be characterized as low gradient (<2%), seventh and sixth order streams with wide floodplains. The riparian vegetation mostly consists of red alder, willow, black cottonwood, and redosier dogwood with scattered western red cedar and grand fir. The lower North Fork Coeur d'Alene River has roads that parallel the channel on both sides, whereas the Coeur d'Alene River reach has access by foot, only. The land along both of these reaches of river is predominately privately owned with development (clearing, levying, homes, and roads) being common along both reaches.

METHODS

Population Estimates

In 2006, we conducted mark-and-recapture electrofishing runs to estimate the abundance of salmonids in the Coeur d'Alene River and lower North Fork Coeur d'Alene River. On the Coeur d'Alene River, two jet boat mounted electrofishing units captured fishes along each shoreline during the night. Two marking runs occurred on consecutive nights (May 24 and 25) and the recapture run was conducted on the night of June 1. Due to boat problems, only one boat was used during the recapture run. On the lower North Fork Coeur d'Alene River, fishes were captured using a single drift boat mounted electrofishing unit. Three marking runs occurred on consecutive days (June 13-15) with the recapture runs occurring on June 22 and 23. Attempts were made to capture all fish seen while electrofishing, and all captured fish were identified to species and measured to the nearest millimeter. All salmonids were either marked with a caudal tail punch, or an orange Floy T-bar tag was inserted below the dorsal fin. We used a Petersen estimate (Ricker 1975) to calculate the population size (N) for all salmonids species where three or more fish were recaptured. Because studies in 1999 (Fredericks et al. 2002) and

2000 (Fredericks et al. 2003) combined cutthroat trout and cutthroat trout/rainbow trout hybrids together into one population estimate, we did the same for comparison purposes. We recognize that the Petersen estimate tends to overestimate the true population size and its recommended to use the adjusted Petersen estimate (Ricker 1975). However, because the studies in 1999 (Fredericks et al. 2002) and 2000 (Fredericks et al. 2003) used a Petersen estimate, we felt it was necessary to do the same to allow for direct comparisons. The Petersen estimate is as follow:

$$N = \frac{MC}{R}$$

with a sampling variance of:

$$V(N) = \frac{M^2 C(C-R)}{R^3}$$

Where:

M = the number of marked fish,
C = catch or sample taken from the population, and
R = number of recaptured marks in the sample

The Peterson estimate operates under the following assumptions:

1. Marked fish did not lose their marks.
2. Marked fish were not overlooked when recaptured.
3. Marked and Unmarked fish were equally vulnerable during recapture runs (non learning behavior).
4 Marked fish must redistribute in the population when released.
5 The population was closed (no movement in or out of study area)
6 No mortality occurred during the estimate.

Exploitation Estimates

While electrofishing the Coeur d'Alene River and lower North Fork Coeur d'Alene River, all rainbow trout and rainbow/cutthroat hybrids ≥ 250 mm and cutthroat trout ≥ 400 mm (legal sized fish) were inserted with Floy tags to evaluate exploitation. To increase the number of tagged fish we also captured and tagged rainbow trout and cutthroat trout while fishing the North Fork Coeur d'Alene River on June 20, 21 and 24. Floy tags were marked with "IDFG", a reward value (non-reward, $10, $50, $100, and $200) and a phone number for anglers to call to report information about the fish captured and to receive their reward. These tags were generally applied at rates of 77%, 7%, 8%, 4%, and 4% respectively. The different reward values were used to estimate angler reporting rates based upon the high-reward methodology (Pollock et al. 2001). Tag reporting rate (λ), or angler compliance, was estimated as the relative return rate of non-rewards tags to the return rate of high-rewards tags (both $100 and $200 dollar tags were returned at similar rates and were considered high-reward tags; Butts et al. 2007):

$$\lambda = \frac{R_t N_r}{R_r N_t}$$

where R_t is the number of non-reward tags returned, N_t is the number of non-reward tags released, R_r is the number of high-reward tags returned, and N_r is the number of high-reward tags released (Butts et al. 2007).

To assess tag loss (Tag_l), about half the fish had two Floy tags inserted. When anglers returned their tags they were asked if one or two tags were attached to the fish. The tag loss rate (Tag_{lr}) was calculated by dividing the number of double tagged fish that were reported by anglers as having one tag by the total number of reported fish that were actually doubled tagged. Data from our study were pooled with other tag return data from around the state to calculate tag loss by species across the state (Butts et al. 2007). To calculate the actual number of rainbow trout and cutthroat trout that were lost from the data pool because they had lost their tag (for single tagged fish) or both of their tags (for double tagged fish) we used the following formula:

$$Tag_l = (Tag_{lr}S)+(Tag_{lr}^2D)$$

where S = the number of fish single tagged and D = the number of fish double tagged.

The unadjusted exploitation rate (u) was calculated according to Ricker (1975) as the number of fish with non-reward tags caught by anglers that were harvested (R_h), divided by the number of fish released with non-reward tags (N_t). Adjustments were made to the exploitation estimate (u') based on angler compliance, tag loss, and tag mortality (Tag_m) using the following formula.

$$u' = \frac{R_h/(N_t - Tag_l)}{\lambda(1 - Tag_m)}$$

where the terms are defined as before. Tagging mortality (Tag_m) was unknown but was suggested by Butts et al. (2007) to be about 15% for salmonids.

To calculate annual exploitation we used only those tag returns from fish caught through June, 2007 – a one year period. We assessed when these fish were captured (on a weekly basis) to assess how seasonal closures could influence exploitation. We compared length frequencies of the fish tagged to the fish caught and harvested by anglers to evaluate if anglers were effective at catching all sizes of fish and if they were selective in the size of fish they harvested.

Cutthroat Trout Illegal Harvest

To evaluate illegal harvest on cutthroat trout in the limited harvest areas of the Coeur d'Alene River and lower North Fork Coeur d'Alene River, all anglers encountered by conservation officers during routine patrols were surveyed to determine how many and what size of fish they had caught (see Appendix H for survey sheet). This survey also asked questions to help determine why anglers may not have complied with the fishing regulations. Using this survey, we were able to determine the percent of fish caught that were harvested, the size of fish harvested and the percent of fish harvested that were illegally kept (between 200 and 400 mm in length). Through algebra, we calculated the annual exploitation rate of cutthroat trout between 300 and 400 mm (illegal harvest) using the known exploitation rate of legal sized fish (≥ 400 mm). We used a 300 mm cutoff because past research indicated cutthroat trout ≥

300 mm had high mortality rates (DuPont et al. In Press a). The algebra we used to calculate the rate of illegal harvests is as follows:

$$u_{300} = \frac{u' N_{E400}(N_{A300} / N_{A400})}{N_{E300}}$$

Where:

- u_{300} is the annual exploitation rate of cutthroat trout between 300 and 400 mm.
- u' is the adjusted exploitation rate of legal sized cutthroat trout (≥ 400 mm)
- N_{E400} is the number of cutthroat trout ≥ 400 mm sampled through electrofishing.
- N_{E300} is the number of cutthroat trout between 300 and 400 mm sampled through electrofishing.
- N_{A400} is the number of cutthroat trout ≥ 400 mm that were harvested by anglers based on the creel survey.
- N_{A300} is the number of cutthroat trout between 300 and 400 mm that were harvested by anglers based on the creel survey.

RESULTS

Population Estimate

We collected a total of 2,086 fishes in the Coeur d'Alene River and 1,398 fishes in the North Fork Coeur d'Alene River during electrofishing efforts in 2006. Mountain whitefish were the most common fish caught in both the Coeur d'Alene River (65%) and North Fork Coeur d'Alene River (82%), and cutthroat trout were the second most abundant species sampled in both systems (Table 52). Rainbow trout represented 10% of the trout species in the Coeur d'Alene River and 38% in the North Fork Coeur d'Alene River. Cutthroat trout and rainbow trout tended to be larger in the Coeur d'Alene River than the North Fork Coeur d'Alene River (Tables 52 and 2, Figure 46). This was partially due to the abundance of fish < 200 mm being sampled from the North Fork Coeur d'Alene River (Figure 46). In the Coeur d'Alene River, cutthroat trout were larger on average in 1999 and rainbow trout and mountain whitefish were larger on average in 2006 (Table 53 and Figure 47).

Our mark-and-recapture efforts resulted in a population estimate of 2,667 cutthroat trout ≥ 115 mm (includes cutthroat trout x rainbow trout hybrids) or 523 fish/km in the Coeur d'Alene River. About 31% of the cutthroat trout were ≥ 300 mm in length and 7% were ≥ 400 mm (approximate legal size to keep). The 2006 density and size distribution is similar to observations reported in 1999 and 2000 (Figures 48 and Table 54). Not enough cutthroat trout were recaptured in the North Fork Coeur d'Alene River to conduct a population estimate. About 29% of the cutthroat trout were ≥ 300 mm and 2% were ≥ 400 mm.

Our mark-and-recapture efforts resulted in a population estimate of 4,804 mountain whitefish ≥ 115 mm or 942 fish/km in the 5.1 km reach of the Coeur d'Alene River. About 27% of the mountain whitefish were ≥ 300 mm in length. This density is lower than what was reported in 1999 (1,649 fish/km) and 2000 (1,867 fish/km), although the average size was larger (Table 53 and Figure 49). Our mark-and-recapture efforts resulted in a population estimate of 7,456 mountain whitefish ≥ 115 mm in a 15.4 km reach of the North Fork Coeur d'Alene River, which calculates to a density of 484 fish/km. This density is about half of what was observed in the Coeur d'Alene River in 2006, although the average size was larger (Figure 49 and Table 53).

During 2006, one brook trout was sampled in the Coeur d'Alene River versus 8 in 1999 and 30 in 2000. Two brook trout were sampled in the North Fork Coeur d'Alene River in 2006.

Exploitation

We Floy-tagged 17 cutthroat trout and 52 rainbow trout (includes rainbow/cutthroat hybrids) in the Coeur d'Alene River and 2 cutthroat trout and 38 rainbow trout (includes rainbow/cutthroat hybrids) in the North Fork Coeur d'Alene River during the spring of 2006 (Table 56). Over a one year period, 2 (12%) of the cutthroat trout and 7 (13%) of the rainbow trout that were tagged in the Coeur d'Alene River were reported as being captured, and 5 (13%) rainbow trout and no cutthroat trout that were tagged in the North Fork Coeur d'Alene River were reported as being captured (Table 56).

By comparing return rates for the of the high dollar reward tags ($100 and $200) to the non-reward tags we calculated that angler compliance (percent of time anglers return non-reward tags) was about 48% for rainbow trout and cutthroat trout combined (Table 57). When we corrected for angler compliance rates, fish mortality rates (15%) and statewide tag loss rates (17.7% for rainbow trout and cutthroat trout), we calculated that 31% to 42% of the tagged rainbow trout and 58% of the cutthroat trout from the Coeur d'Alene River were caught over a one year period depending on whether we used high reward tags (assume 100% angler compliance) or non-reward tags (Table 58). For the North Fork Coeur d'Alene River, we calculated that between 32% and 49% of the rainbow trout were caught and no tags were returned from cutthroat trout (Table 58). Using non-reward tags and correcting for angler compliance, tag loss rates, and fish mortality; we calculated that annual exploitation (June 2006 to June 2007) for rainbow trout and cutthroat trout in the Coeur d'Alene River was about 27% and 58% respectively (Table 59). For the North Fork Coeur d'Alene River, we received tag returns only for rainbow trout; and the adjusted annual exploitation was calculated to be about 11% (Table 59).

Most (93%) of the rainbow trout and cutthroat trout were reported as being caught between May and August in the Coeur d'Alene River and North Fork Coeur d'Alene River (Figure 50). Three (21%) of the fish were caught and harvested between March and May when trout harvest is not allowed. The size distribution of rainbow trout and rainbow/cutthroat hybrids that were caught were similar to the size distribution that were tagged, indicating angler's fishing techniques are equally effective in catching all sizes of fish (Figure 51). Not enough tagged cutthroat trout (2) were reported to evaluate this for cutthroat trout.

Cutthroat Trout Illegal Harvest

Based on angler surveys of 163 different people on the Coeur d'Alene River and North Fork Coeur d'Alene River, they fished 329 hours and caught 259 trout (0.8 trout/hour) (Table 60). About 94% of the trout caught were cutthroat trout (143) and 6% were rainbow trout (11) or rainbow/cutthroat hybrids (4). Of the 143 cutthroat trout caught 11 (8%) were harvested. Eight (73%) of harvested cutthroat trout were between 200 and 400 mm (illegal size to keep) (Figure 52). Four of the illegally harvested cutthroat trout were between 350 and 400 mm and the other four were between 250 and 350 mm (Figure 52).

For every legal cutthroat trout harvested (≥ 400 mm), four illegal fish were kept 300-400 mm in length. Based on these rates and a known exploitation rate (0.57%) on cutthroat trout ≥

400 mm, we calculated that the annual exploitation rate on cutthroat trout 300-400 mm (all illegal) was 43%.

Angler Interviews found that 53% of anglers did not know the regulations for cutthroat trout, and 48% of the anglers did not have rulers with them. The eight illegal cutthroat trout were harvested by five anglers. Three of these anglers were unaware of the regulations and none of them had rulers. About half of the anglers interviewed were fly fishers, and the other half used bait or spinning gear (Table 61). All the harvested cutthroat trout were caught by anglers using either bait or spinning gear.

DISCUSSION

Cutthroat Trout

Estimated density of cutthroat trout in the Coeur d'Alene River (523 fish/km) in 2006 was similar to what was documented in 1999 (526 fish/km) and 2000 (440 fish/km), indicating that changing the season opener (changed from a July 1 to memorial weekend opener) and limit (changed from one cutthroat trout greater than 14 inches (356 mm) to a 2-fish slot limit - none between 8 (203 mm) and 16 inches (406 mm)) in 2000 did not have a negative effect on this fishery. The size distribution of cutthroat trout also remained relatively consistent between the years. Previously, conservation officers expressed concerns that opening the season earlier would put adfluvial cutthroat trout at risk as they would be concentrated and vulnerable to exploitation (Fredericks et al. 2002). We have since learned that relatively low percentage (9%) of cutthroat trout which utilize the free flowing section of the Coeur d'Alene River during May are adfluvial fish (DuPont et al. In Press a). In addition, Coeur d'Alene River cutthroat trout seldom move outside of the free flowing river except during spawning migration (DuPont et al. In Press a). These findings help explain why an earlier stream opener did not appear to effect the abundance or size distribution of cutthroat trout in the Coeur d'Alene River.

Exploitation rates (we re-evaluated the 1999 and 2000 data using the same correction factors as we did in 2006) of cutthroat trout appeared to be higher in 2006 (58%) than in 1999 (48%) and 2000 (47%). However, the low number of fish tagged and returned in 2006 make this data somewhat questionable. Around 0.5% of the cutthroat trout were of legal size (≥ 406 mm), which made it difficult to tag a large number of cutthroat trout. Based on this knowledge, we can't conclude that annual exploitation on legal sized fish has change since 2000, and very likely has remained relatively constant at around 50%. Regardless of whether exploitation has increased, annual exploitation rates around 50% are considered high. A 50% exploitation rate will cause cropping of cutthroat trout once they reach legal size (≥ 406 mm). This may explain why, despite the high growth rates, cutthroat trout in the Coeur d'Alene River experience (Lewynsky 1986); few fish (5%) which exceed 406 mm (legal size). Illegal harvest also helps explain why few cutthroat trout reach legal size. Our data suggests that once cutthroat trout reach 250 mm, illegal harvest becomes an issue, and for cutthroat trout 300-400 mm we calculated that annual exploitation was 43%. Findings from a telemetry study in 2003-2004 suggested that annual exploitation on cutthroat trout ≥ 300 mm was 30% in the Coeur d'Alene River and 69% in the lower North Fork Coeur d'Alene River (DuPont et al. In Press a). Gigliotti and Taylor (1990) found that in waters with low densities of fish and high fishing effort it didn't take a high amount of non-compliance (15%) to suppress a fishery.

Cutthroat trout appear to grow faster in the Coeur d'Alene River system than any other river in the Panhandle Region (Lewynsky 1986; Apperson et al. 1988). In addition, work by

DuPont et al. (In Press a) found that water temperatures and habitat quality are considered good in the Coeur d'Alene River. To truly reap the benefits of the high growth rates of cutthroat trout and good habitat, efforts must be made to decrease illegal harvest. Our work suggests the reason person kept illegal sized fish was because they did not know the regulations and they did not have rulers to measure the fish they kept. One way to combat this is through increased education. Currently, few if any fish regulation signs can be read while driving along any of the main roads on the Coeur d'Alene River or North Fork Coeur d'Alene River. Putting up signs on all major access point to the Coeur d'Alene River should significantly increase angler awareness of the regulations. Increased enforcement on the river should also help improve public awareness. Michaelson (1983) found that where illegal harvest was suppressing a fishery in a lake it took only a year after enforcement was significantly increased to see substantial improvements in the fishery. However, conservation officers have indicated that rarely do they talk with the same angler more than once on the river, indicating a high volume of anglers fish the river on an inconsistent basis. With this type of clientele, we would suspect enforcement would be less effective at educating the public. Increased enforcement should reduce illegal harvest from those who intentionally violate the rules. Our surveys were not effective at estimating this, as these surveys were conducted during routine patrols (uniformed officers in marked cars). Those who intentionally violate the rules likely watch for IDFG officers and either hide any illegal fish they may have or hide themselves when they see an officer approaching. Because we were not effective at estimating this, we believe illegal harvest was higher than we reported.

The abundance of cutthroat trout ≥ 406 mm could also be improved by making the regulations more restrictive. Based on our officer survey, none of anglers we surveyed kept more than one legal sized fish. This suggests that reducing the limit from two to one fish would make little difference in the number of legal fish harvested. Another option would be to change the size of fish that could be harvested. To maximum survival and their potential size, catch-and-release regulations could be implemented. These are purely social issues as the cutthroat trout population in the Coeur d'Alene River appears to be healthy and in no jeopardy of collapsing from overharvest. Ultimately, anglers will have to decide whether it is more important to them to have more big cutthroat trout but fewer harvest opportunities, or fewer big fish but some opportunity to harvest fish. What is intriguing is that cutthroat trout that occur in the Coeur d'Alene River rarely leave the 13 km free flowing reach (DuPont et al. In Press a). Consequently, here is an example where implementing more restrictive fishing regulations in a relatively short reach of river has the potential to increase the size structure of a fishery.

Based on snorkel surveys, cutthroat trout densities have about doubled in the North Fork Coeur d'Alene River between 2000 and 2006 (DuPont et al. In Press c). This begs the question, why would cutthroat trout densities increase in the North Fork Coeur d'Alene River, but not in the Coeur d'Alene River? Unfortunately we do not have comparable data to evaluate how cutthroat trout densities actually differ between the two rivers. DuPont et al. (In Press a) found that cutthroat trout that utilize the Coeur d'Alene River tend to spawn in tributaries that have more degraded habitat than tributaries that fish from the North Fork Coeur d'Alene River spawn in. It's possible these degraded habitat conditions are limiting recruitment to the Coeur d'Alene River. The Coeur d'Alene River has heavy metal concentrations that are much higher than occur in the North Fork Coeur d'Alene River (Ott and Clark 2003; USEPA 2004). Although these heavy metal concentrations are not lethal to cutthroat trout, Woodward et al. (1997) found that cutthroat trout in controlled lab studies will avoid waters with heavy metal concentrations similar to what occurs in the Coeur d'Alene River. No studies have been conducted to evaluate whether these heavy metal concentrations will reduce long term survival of fish. Many of the fish in the Coeur d'Alene River we sampled had blackened tails, which is often an indicator of stress.

Telemetry work suggests these heavy metal concentrations are restricting immigration of cutthroat trout from the North Fork Coeur d'Alene River basin into the Coeur d'Alene River (DuPont et al. In Press a). We are not certain whether tributary conditions or heavy metals can explain the difference in population growth between the two rivers, but it gives us something to consider if this trend continues.

Not enough marked cutthroat trout were recaptured (one fish) in the North Fork Coeur d'Alene River to calculate a population estimate. So, unfortunately we were not able to compare fish densities between the two populations. During the recapture runs, we often observed tagged cutthroat trout swimming away from the boat before they could be captured. It appeared that these fish had learned to avoid the drift boat from their previous experience, which is a violation of one of the assumptions when conducting a mark-and-recapture population estimate (marked and unmarked fish should be equally vulnerable during recapture runs). With night electrofishing, we believe fish would be less able to detect the presence of the drift boat making marked fish equally vulnerable to capture to unmarked fish during the recapture runs. Reynolds (1996) suggests using different techniques when marking and recapturing fish to avoid these types of problems. In the future, we suggest night electrofishing or utilizing different recapture techniques such as snorkeling or angling when conducting population estimates in the North Fork Coeur d'Alene River.

Comparisons of cutthroat trout relative abundance between the North Fork Coeur d'Alene River (8%) and Coeur d'Alene River (16%) suggests cutthroat trout densities were higher in the Coeur d'Alene River. The dominance of mountain whitefish sampled in the North Fork Coeur d'Alene River can't explain the lower relative abundance estimate of cutthroat trout because the population estimate of mountain whitefish was 2.8 times lower in the North Fork Coeur d'Alene River (484 fish/km) than the Coeur d'Alene River (942 fish/km). In fact, through algebra (known relative abundance of cutthroat and mountain whitefish in both systems, a known population estimate of whitefish in both systems, and a known cutthroat trout population estimate in the Coeur d'Alene River) we calculated a density of 110 cutthroat trout/km in the North Fork Coeur d'Alene River (Densities in the Coeur d'Alene River were estimated to be 523 fish/km). Granted this is very rough, but it gives us some idea of the differences in cutthroat trout abundance between these two systems.

Another difference between the cutthroat trout populations in the Coeur d'Alene River and North Fork Coeur d'Alene River is their sizes. The most noticeable difference was the number of legal sized fish that were sampled in the two systems. Over 7% of the cutthroat trout in the Coeur d'Alene River were ≥ 400 mm whereas less than 2% were ≥ 400 mm in the North Fork Coeur d'Alene River. The most plausible explanation for this is exploitation is higher in the North Fork Coeur d'Alene River. Unfortunately, we were not able to evaluate exploitation in the North Fork Coeur d'Alene due to the low number (2) of cutthroat trout we tagged. We believe fishing pressure is higher along the North Fork Coeur d'Alene River due to accessibility – a road parallels both sides of the river. In addition, telemetry work in 2003-2004 found that annual exploitation on cutthroat trout ≥ 300 mm was about 69% in the North Fork Coeur d'Alene River and 30% on the Coeur d'Alene River (DuPont et al. In Press a). Despite this, we must also consider that our sampling technique (daytime electrofishing) in the North Fork Coeur d'Alene may have biased our results. Often while sampling the North Fork we observed large cutthroat trout swimming away from the boat to avoid capture. Larger fish were likely better at avoiding capture due to their faster swimming speed. We suspect this is less of an issue when night electrofishing.

Differences in habitat between the Coeur d'Alene River and North Fork Coeur d'Alene River could also help explain why cutthroat trout were larger and higher densities occurred in the Coeur d'Alene River. Work by DuPont et al. (In Press a) found that summer water temperatures in the Coeur d'Alene River were more suitable for cutthroat trout and more deep pool habitat was available which cutthroat trout also prefer.

Rainbow Trout

We were unable to evaluate the population abundance of rainbow trout in either the Coeur d'Alene River or North Fork Coeur d'Alene River due to an insufficient number of recaptures. However, the relative abundance of rainbow trout was about 2% of the entire electrofishing catch in the Coeur d'Alene River and 6% of the catch in the North Fork Coeur d'Alene River. When compared to other trout, rainbow trout represented 10% of the catch in the Coeur d'Alene River and 38% of the catch in the North Fork Coeur d'Alene River. Rainbow trout in the Coeur d'Alene River represented 2% of the trout catch in 1999, 8% in 2000 and 10% in 2006. Although these relative abundances suggest the rainbow trout population is expanding in the Coeur d'Alene River, we believe these differences are too small to make this assessment. Snorkel surveys in the lower North Fork Coeur d'Alene River show that the density of rainbow trout has declined from 1.06 fish/100 m^2 to 0.39 fish/100 m^2 between 2000 and 2006 (DuPont et al. In Press c). The main explanations for this is, rainbow stocking ended in 2002. Rainbow trout densities dropped the year after stocking ended, but appears to have stabilized since (DuPont et al. In Press c).

Notably absent from the Coeur d'Alene River catch were the smaller rainbow trout. About 12% of the rainbow trout sampled in the Coeur d'Alene River were < 200 mm, whereas 65% of the rainbow trout in the North Fork Coeur d'Alene River were < 200 mm. We know little about the spawning behavior of rainbow trout in the Coeur d'Alene River to explain for the lower abundance of fish < 200 mm. The length frequency of rainbow trout collected from the Kootenai River (Walters 2004) was similar (the Kootenai River had a few more fish < 200 mm) to what was observed in the Coeur d'Alene River. In the Kootenai River, it appears that most rainbow trout recruit to the river from the surrounding tributaries at age 1 and 2 (Walters 2004). This may suggest that most rainbow trout do not recruit to the Coeur d'Alene River until they reach two years of age, whereas in the North Fork Coeur d'Alene River most appear to recruit at one year of age or earlier.

Based on rainbow trout length frequencies, it appears few exceeded 400 mm in length in either the Coeur d'Alene River or North Fork Coeur d'Alene River. Anglers used to report catching large rainbow (>500 mm) and have indicated this size of fish has become rare in recent years. Work by Lewynky (1986) supports this as 11% of the rainbow trout he used for aging in 1981 were > 500 mm in length. None of the rainbow trout caught in 1999, 2000 or 2006 were > 500 mm. This suggests that that angler harvest is having an impact on the size of rainbow trout in the Coeur d'Alene River and North Fork Coeur d'Alene River. The average size of rainbow trout were larger in 2006 (288 mm) than in 1999 (263 mm) and 2000 (255 mm).

Exploitation of rainbow trout was calculated to be 27% in the Coeur d'Alene River and 10% in the North Fork Coeur d'Alene River. Low tag returns (7 in Coeur d'Alene River and 5 in North Fork Coeur d'Alene River) make this information somewhat questionable, although it does indicate rainbow trout exploitation is relatively low. This lower exploitation may be because rainbow trout are more difficult to catch than cutthroat trout. Based on our officer creel data, about 4% of the trout that were reported as being caught were rainbow trout, whereas they represented 38% of the trout species available to harvest. On the other hand, anglers harvested about 36% of the rainbow trout caught, whereas they harvested about 4% of the cutthroat trout they caught (most were illegal sized). Lewynsky (1986) also found that rainbow trout were significantly more difficult to catch than cutthroat trout and related it to differences in feeding behaviors. The aggressive feeding habits that westslope cutthroat trout display make them vulnerable to even less experienced fishermen and helps indicate why anglers are able to exploit cutthroat trout at a higher rate than rainbow trout. Lewynsky (1986) suggested where cutthroat trout and rainbow trout occur together, more restrictive regulations must be put on the cutthroat trout to help prevent rainbow trout from dominating in abundance.

Mountain Whitefish

Mountain whitefish densities were about twice as high in the Coeur d'Alene River in 1999 (1,649 fish/km) and 2000 (1,867 fish/km) as was estimated in 2006 (942 fish/km). Interestingly, with less effort (one of the boats didn't work one day) over twice as many mountain whitefish were caught in 2006 (1,355) as in 1999 (300) or 2000 (641). Explanations for this discrepancy could be there was higher mortality on tagged fish in 1999 and 2000, or efforts were not made to net all mountain whitefish during those years. According to those involved in 1999 and 2000, they attempted to sample all fish they observed, and they don't recall an unusually high mortality rate. Variation in flows can't explain for the difference as they were similar between the years. Mountain whitefish densities have been steadily increasing on the North Fork Coeur d'Alene River between 1999 and 2006 based on snorkel surveys (DuPont et al. In Press c), whereas they are decreasing in the Coeur d'Alene River based on this data.

The mountain whitefish population estimate in the North Fork Coeur d'Alene River was 7,456 fish in 15.4 km of river. This converts to a density estimate of 484 fish/km, which is about half of what was estimated for the Coeur d'Alene River (942 fish/km). We question the findings in the North Fork Coeur d'Alene River as through snorkeling in this same reach of river we observed over 2,500 mountain whitefish in 1.2 km of river. The reason we believe the population estimate was low was because we were only effective at capturing mountain whitefish in shallow water (we used day electrofishing in the North Fork Coeur d'Alene River). When floating through pools and deeper runs, we would often see numerous fish that were not affected by the electrofishing unit. We do not believe that sufficient mixing of marked fish occurred between shallow habitats and deeper habitats in the time between our marking and recapture runs. As a result, this estimate approximated the number of mountain whitefish in the North Fork Coeur d'Alene River that utilized shallower habitat. Based on snorkel surveys, mountain whitefish densities are 2 to 10 times higher in pools and deeper runs than habitat that is less than 2 m deep (DuPont et al. In Press c). At night we suspect many mountain whitefish would move out of deeper waters to feed in shallower areas where they would be more susceptible to electrofishing. Consequently, we believe night electrofishing would be a more effective technique in estimating mountain whitefish density as we did in the Coeur d'Alene River.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor cutthroat trout abundance in the Coeur d'Alene River and North Fork Coeur d'Alene River using mark recapture techniques approximately every five years.

2. Electrofish at night or utilizing different recapture techniques such as snorkeling or angling when conducting population estimates in the North Fork Coeur d'Alene River.

3. Increase angler awareness of the fishing regulations, through improved placements of signs, increased enforcement, and presentation to the public to reduce illegal harvest of cutthroat trout from the Coeur d'Alene River and North Fork Coeur d'Alene River.

4. Evaluate public demand for increased abundance and size distribution of cutthroat trout in the Coeur d'Alene River through more restrictive regulations.

Table 52. Percent composition of fishes collected through electrofishing a 5.1 km reach of the Coeur d'Alene River and 15.4 km reach on the North Fork Coeur d'Alene River, Idaho, in 2006.

Coeur d'Alene River

Species	Number captured	Mean length (mm)	Maximum length (mm)	Minimum length (mm)	Percent composition
Mountain whitefish	1,355	262	423	48	65%
Cutthroat trout	334	254	437	115	16%
Largescale sucker	125	263	631	64	6%
Longnose sucker	113	300	443	71	5%
Northern pikeminnow	49	275	518	149	2%
Rainbow trout	41	288	415	122	2%
Cutthroat/rainbow hybrids	26	301	477	123	1%
Chinook	17	88	216	62	1%
Redside shiner	9	110	124	68	0%
Tench	6	219	231	178	0%
Pumpkinseed	4	57	79	42	0%
Brown bullhead	3	150	199	115	0%
Brook trout	1	328	328	328	0%
Kokanee	1	352	352	352	0%
Largemouth bass	1	232	232	232	0%
Yellow perch	1	130	130	130	0%
Total	2,086				100%

North Fork Coeur d'Alene River

Species	Number captured	Mean length (mm)	Maximum length (mm)	Minimum length (mm)	Percent composition
Mountain whitefish	1,144	288	440	124	82%
Cutthroat trout	110	233	464	127	8%
Rainbow trout	77	193	395	80	6%
Cutthroat/rainbow hybrids	14	215	380	107	1%
Northern pikeminnow	13	187	457	86	1%
Largescale sucker	10	220	545	75	1%
Shorthead sculpin	9	63	77	54	1%
Longnose dace	9	114	160	76	1%
Longnose sucker	4	143	210	93	0%
Torrent sculpin	3	95	119	75	0%
Brook trout	2	322	324	319	0%
Chinook	1	86	86	86	0%
Redside shiner	1	100	100	100	0%
Kokanee	1	245	245	245	0%
Total	1,398				100%

Table 53. Comparison of average lengths of cutthroat trout, rainbow trout and mountain whitefish collected in the Coeur d'Alene River (CdA), and lower North Fork Coeur d'Alene River (NF), Idaho, through electrofishing during 1999, 2000 and 2006.

	Cutthroat trout	Rainbow trout	Mountain whitefish
CdA 1999	267	263	220
CdA 2000	252	255	252
CdA 2006	254	288	262
NF 2006	233	193	288

Table 54. Percent of cutthroat trout in the Coeur d'Alene River (CdA) and North Fork Coeur d'Alene River (NF), Idaho, sampled through electrofishing during 1999, 2000 and 2006 that were ≥ 300 mm and ≥ 400 mm.

Size	**CdA 1999**	**CdA 2000**	**CdA 2006**	**NF 2006**
≥ 300 mm	0.43	0.38	0.31	0.29
≥ 400 mm	0.04	0.05	0.07	0.02

Table 55. Number of rainbow trout (included rainbow/cutthroat hybrids) and cutthroat trout that were Floy-tagged in the Coeur d'Alene River and North Fork Coeur d'Alene River, Idaho, during the spring of 2006.

Coeur d'Alene River

Reward Value	Rainbow	Cutthroat	Total tagged
0	41	9	50
$10	3	3	6
$50	4	2	6
$100	2	0	2
$200	2	1	3
All tags	52	15	67

North Fork Coeur d'Alene River

Reward Value	Rainbow	Cutthroat	Total tagged
0	25	2	27
$10	5	0	5
$50	3	0	3
$100	3	0	3
$200	2	0	2
All tags	38	2	40

Table 56. Number of rainbow trout (includes rainbow/cutthroat hybrids) and cutthroat trout that were Floy-tagged in the Coeur d'Alene River and North Fork Coeur d'Alene River, Idaho, during the spring of 2006 that anglers reported harvesting or catching and releasing over a one year period.

Coeur d'Alene River

	Harvested						Caught and released					
Species	$0	$10	$50	$100	$200	Total	$0	$10	$50	$100	$200	Total
Rainbow	4	0	0	0	0	4	2	0	0	1	0	3
Cutthroat	2	0	0	0	0	2	0	0	0	0	0	0

North Fork Coeur d'Alene River

	Harvested						Caught and released					
Species	$0	$10	$50	$100	$200	Total	$0	$10	$50	$100	$200	Total
Rainbow	1	0	0	0	0	1	2	0	0	1	1	4
Cutthroat	0	0	0	0	0	0	0	0	0	0	0	0

Table 57. Angler compliance rates for rainbow trout and cutthroat trout combined on the Coeur d'Alene River and North Fork Coeur d'Alene River, Idaho, based on the number of fish initially tagged (N) and reported as being caught (R), for both high reward ($100 and $200) and non-reward tags.

High Reward			Non-reward			Angler
N	R	%	N	R	%	Compliance
10	3	0.300	77	11	0.143	0.476

Table 58. Catch, release and harvest rates of rainbow trout (RBT) and cutthroat trout (WCT) from the Coeur d'Alene River and North Fork Coeur d'Alene River, Idaho, between June, 2006 and June, 2007, based on high reward tags ($100 and $200 tags) and non reward tags and corrected for angler compliance, tag loss and fish mortality.

Coeur d'Alene River

Fate of	RBT		WCT	
tagged fish	High $	Non-reward	High $	Non-reward
Caught	0.305	0.421	NA	0.582
Released	1.000	0.333	NA	0.000
Harvested	0.000	0.667	NA	1.000

North Fork Coeur d'Alene River

Fate of	RBT		WCT	
tagged fish	High $	Non-reward	High $	Non-reward
Caught	0.489	0.319	NA	NA
Released	1.000	0.667	NA	NA
Harvested	0.000	0.333	NA	NA

Table 59. Annual exploitation rates of rainbow trout (RBT) and cutthroat trout (WCT) from the Coeur d'Alene River and North Fork Coeur d'Alene River, Idaho, between June 2006 and June 2007 calculated using the number of non-reward fish that were tagged and harvested by anglers, angler compliance rates, tag loss rates and fish mortality rates reported in the table below.

Coeur d'Alene River

	Non-rewward fish		Angler	Tag loss	Fish	Exploitation	
Species	Tagged	Harvested	compliance	rate	mortality	Unadjusted	Adjusted
RBT	41	5	0.476	0.120	0.15	0.122	0.274
WCT	9	2	0.476	0.048	0.15	0.222	0.577

North Fork Coeur d'Alene River

	Non-rewward fish		Angler	Tag loss	Fish	Exploitation	
Species	Tagged	Harvested	compliance	rate	mortality	Unadjusted	Adjusted
RBT	25	1	0.476	0.060	0.15	0.040	0.105
WCT	2	0	0.476	0.031	0.15	--	--

Table 60. The number of fishes caught and harvested in the Coeur d'Alene River and lower North Fork Coeur d'Alene River, Idaho, based on routine patrol surveys conducted by conservation officers in 2006. The bull trout catch was not verified.

	Coeur d'Alene River		NF Coeur d'Alene River		Total	
Species	Caught	Harvested	Caught	Harvested	Caught	Harvested
cutthroat trout	8	3	235	8	243	11
rainbow trout			11	4	11	4
cutthroat x rainbow			4		4	
bull trout			1		1	
mountain whitefish			2		2	

Table 61. The number of cutthroat trout harvested (all and illegal sizes only) by different gear types in comparison to the number of anglers that used these gear types in the Coeur d'Alene River and lower North Fork Coeur d'Alene River, Idaho, based on routine patrol surveys conducted by conservation officers in 2006.

	Bait	Spin	Fly	Total
Number of anglers	58	26	79	163
Cutthroat harvested	8	3	0	11
Illegal Harvest	6	2	0	8

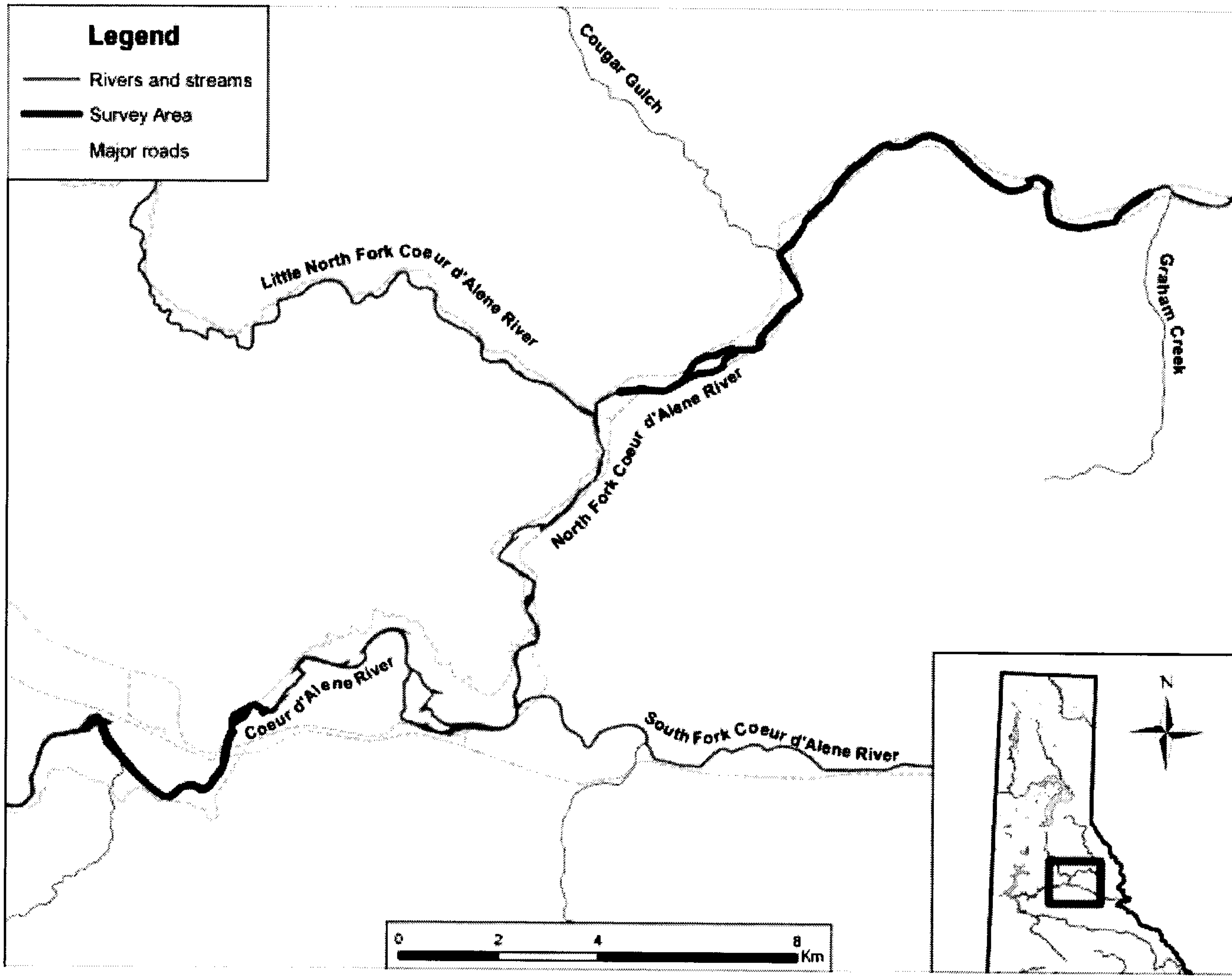
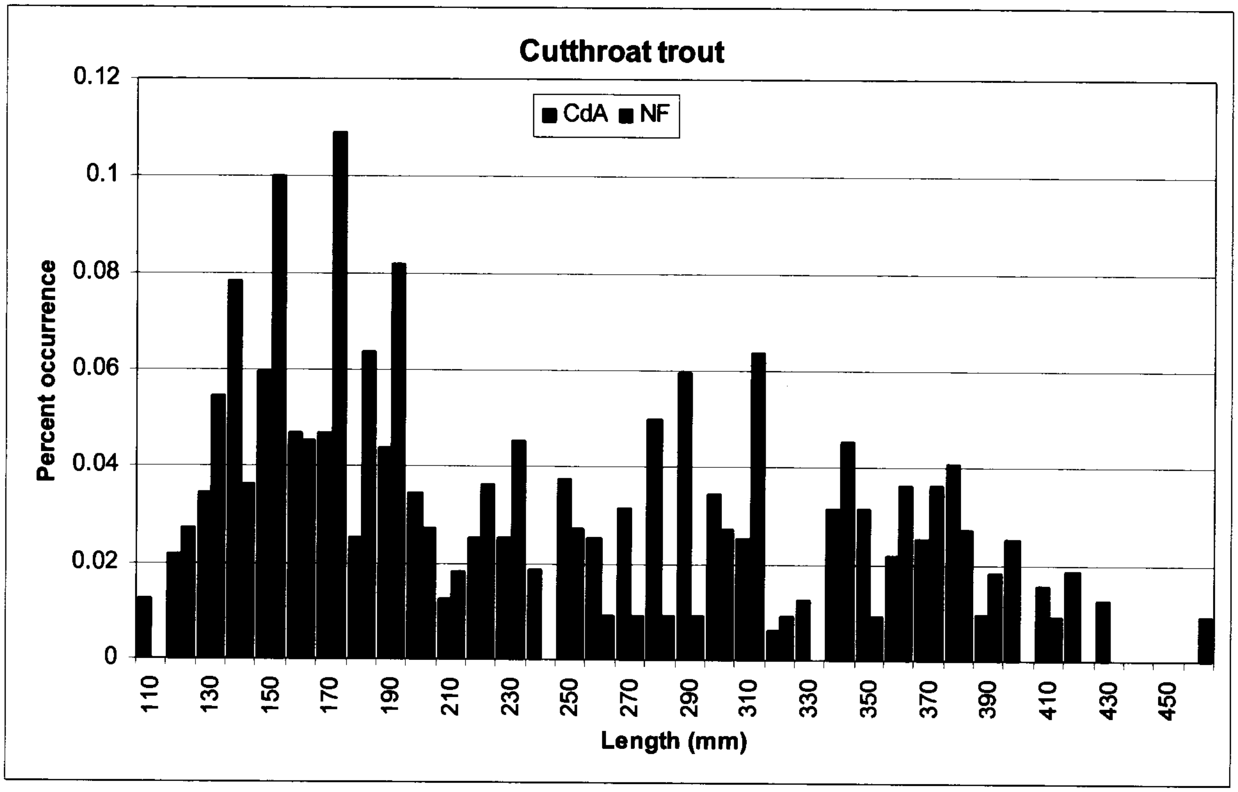


Figure 45. Location of electrofishing transects used to evaluate the fisheries in the Coeur d'Alene River and lower North Fork Coeur d'Alene River, Idaho, during 2006.



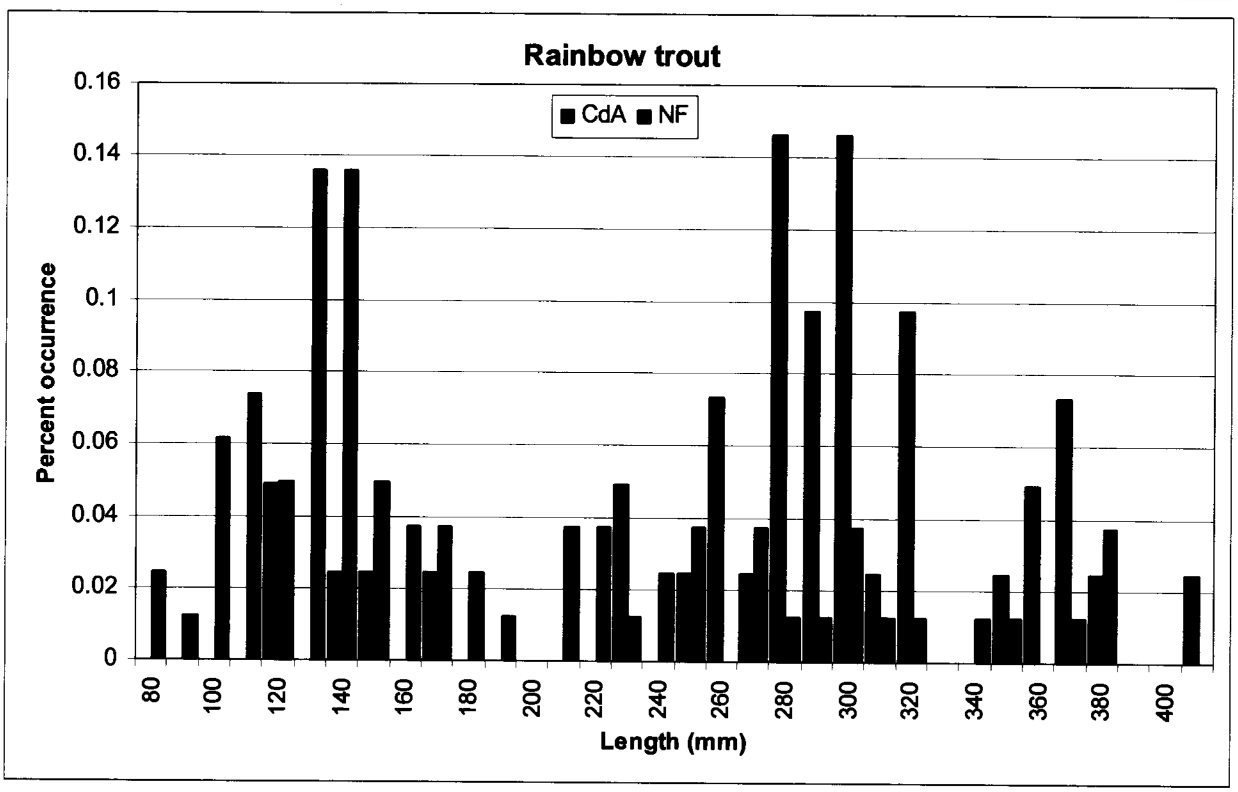


Figure 46. Length frequency histogram depicting the sizes of cutthroat trout and rainbow trout sampled from the Coeur d'Alene River (CdA) and North Fork Coeur d'Alene River (NF), Idaho, during the spring of 2006.

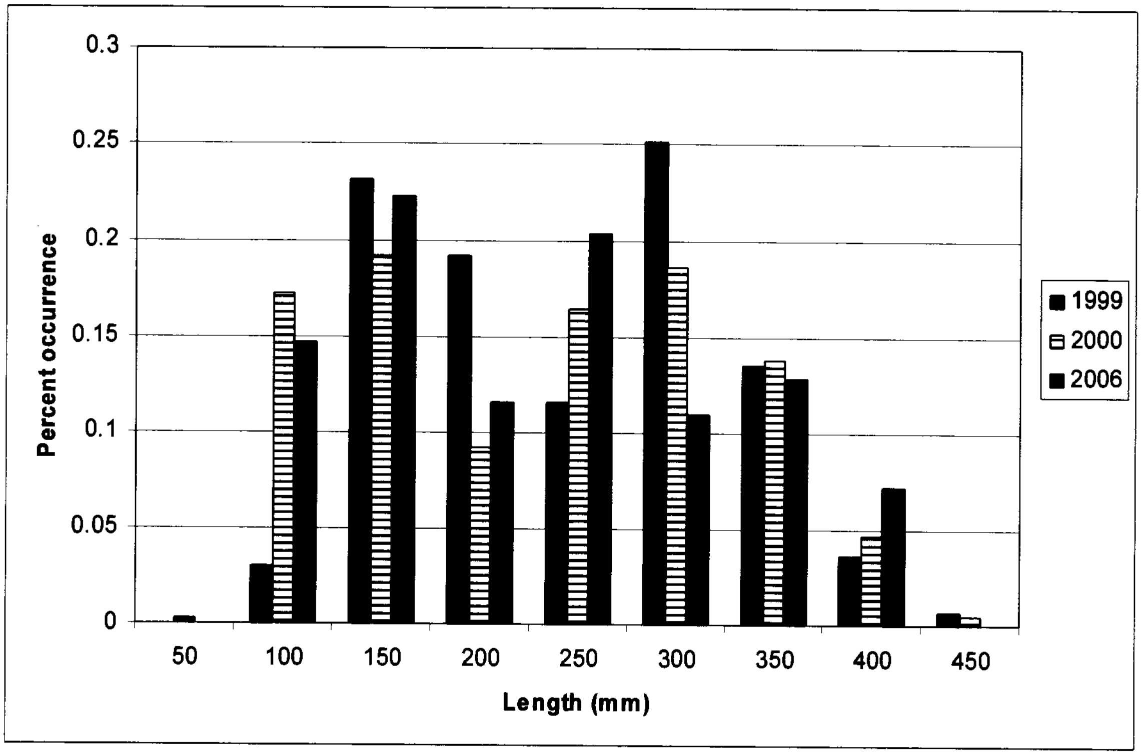


Figure 47. Length frequency histogram depicting the sizes of cutthroat trout captured while electrofishing the Coeur d'Alene River, Idaho, during 1999, 2000, and 2006.

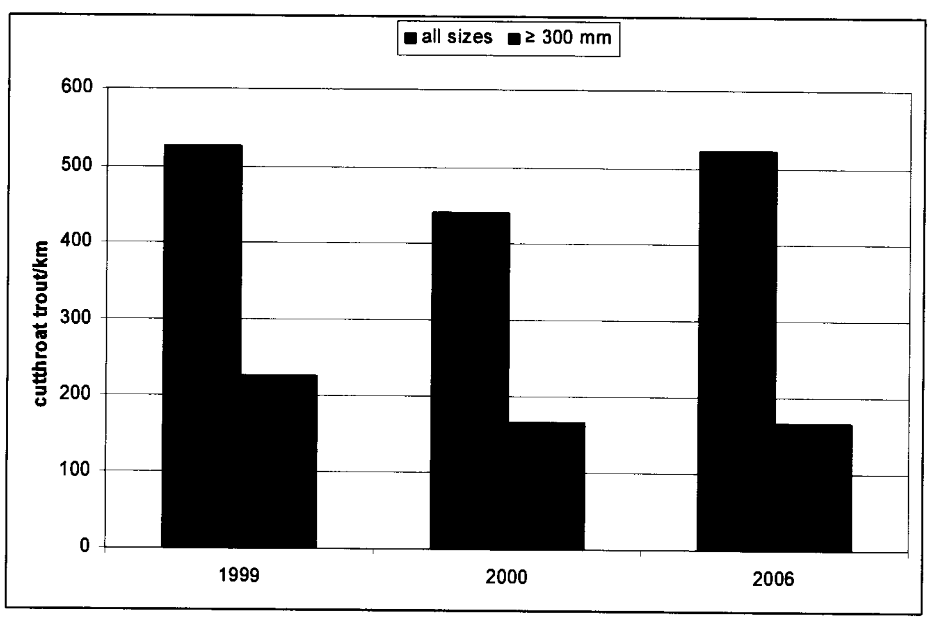


Figure 48. Densities of cutthroat trout (includes cutthroat/rainbow hybrids) in the Coeur d'Alene River, Idaho, determined from mark-and-recapture population estimates during 1999, 2000 and 2006.

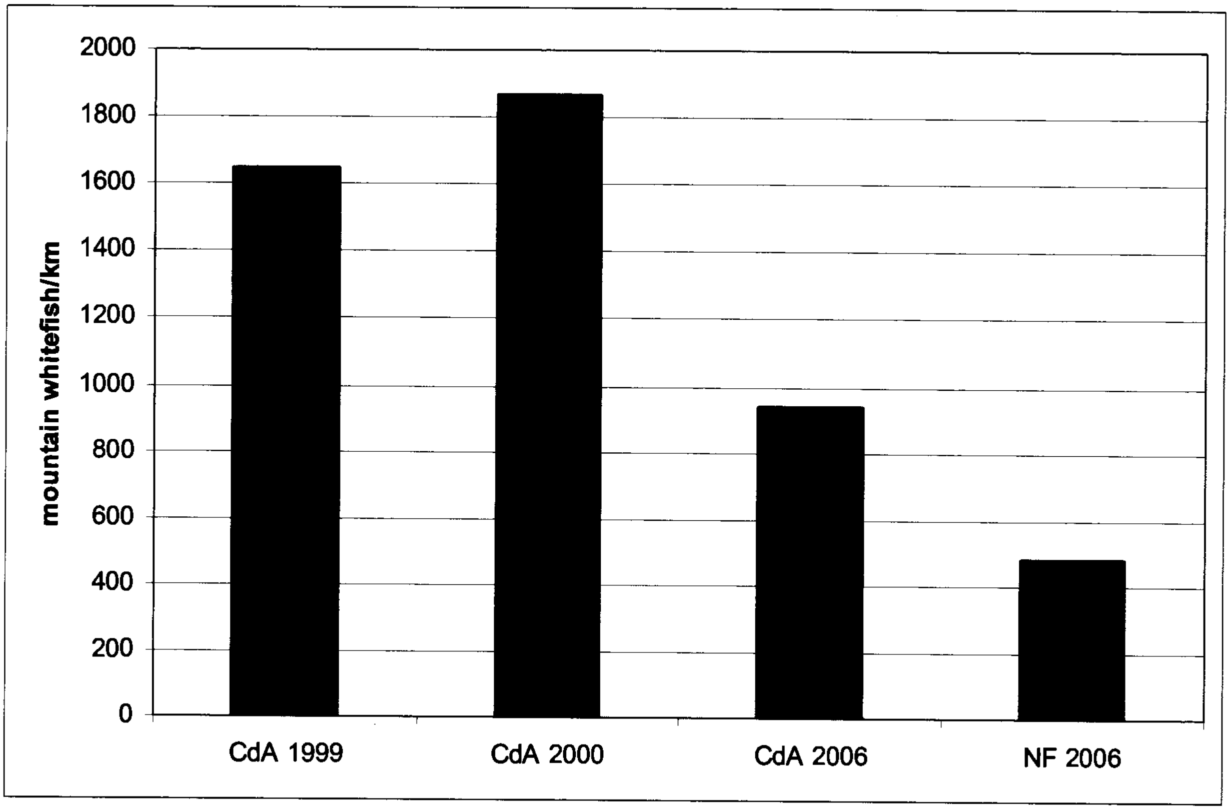


Figure 49. Densities of mountain whitefish in the Coeur d'Alene River (CdA), and lower North Fork Coeur d'Alene River (NF), Idaho, as determined from mark-and-recapture population estimates during 1999, 2000 and 2006.

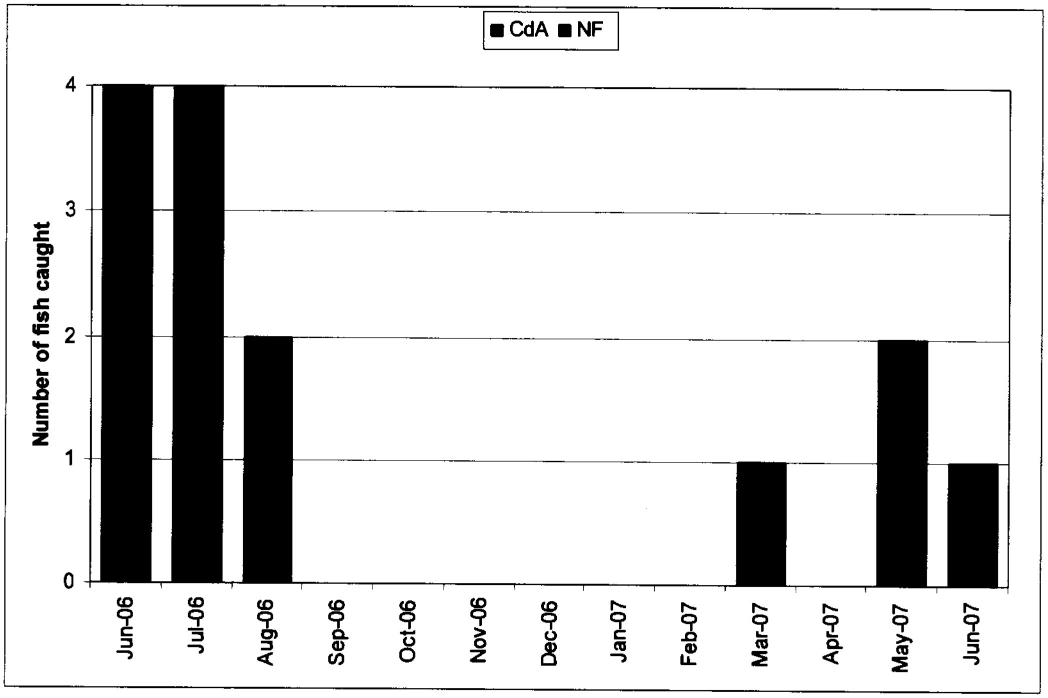


Figure 50. The number of Floy-tagged rainbow trout, cutthroat trout and rainbow/cutthroat trout hybrids reported as being caught on a monthly basis from the Coeur d'Alene River (CdA) and North Fork Coeur d'Alene River (NF), Idaho, from June 2006 to June 2007.

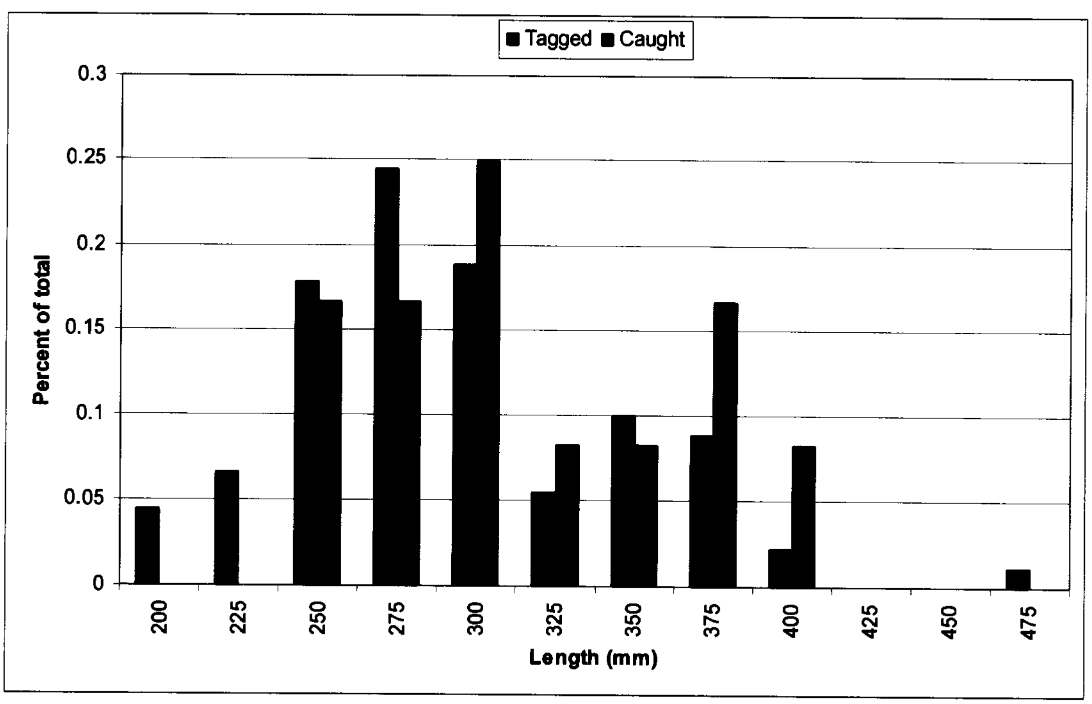


Figure 51. A comparison of length frequencies of rainbow trout and rainbow/cutthroat hybrids from the Coeur d'Alene River and North Fork Coeur d'Alene River, Idaho, that were tagged to those caught by anglers.

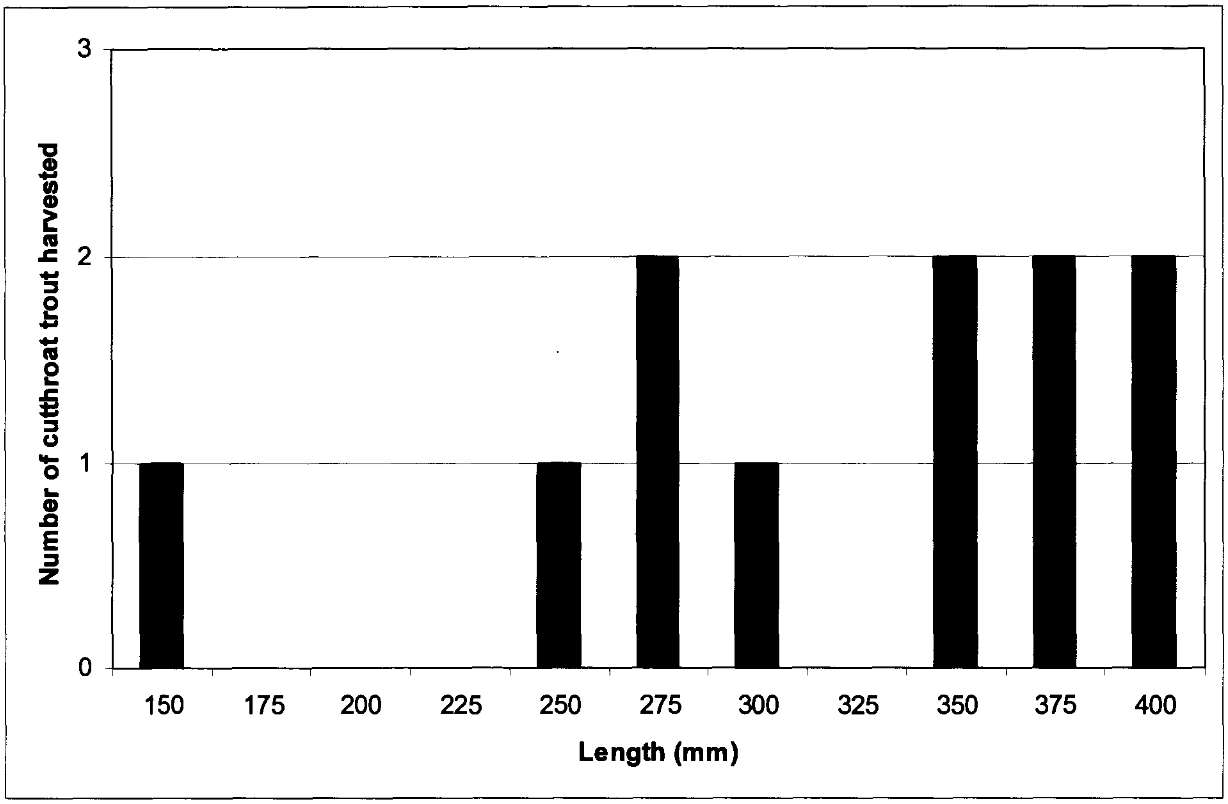


Figure 52. Number and size (mm) of cutthroat trout kept from the Coeur d'Alene River and North Fork Coeur d'Alene River, Idaho, as determined by creel surveys during 2006.

Appendix H. Data sheets used by conservation officers when interviewing anglers during 2006 on the Coeur d'Alene River and lower North Fork Coeur d'Alene River, Idaho.

Angler Survey Form

Creel Clerk:____________________

River and Reach:____ **Date:**_________

GPS Cord. (ddd.ddddd - WGS 84)		No. of people	Time fished	Trip complete	Fish kept		Number Released	Knows regs?	Ruler present	Boat or shore	Fishing gear	Comments
Northing	Easting				Species	Length						

WCT = cutthroat trout; RBT = rainbow trout; HYB = rainbow x cutthroat hybrid; MWF = mountain whitefish; BRK = brook trout

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