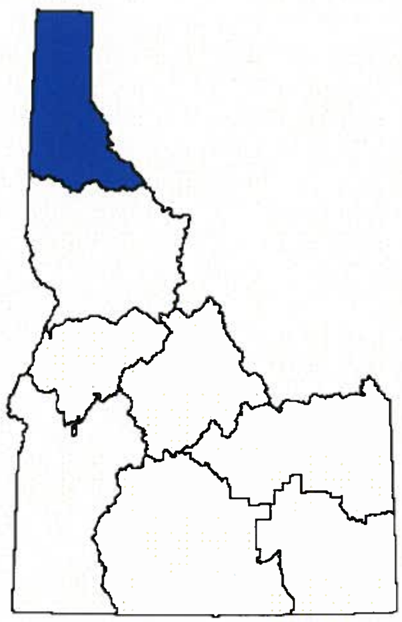
FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME
FISHERY MANAGEMENT ANNUAL REPORT

Virgil Moore, Director



PANHANDLE REGION

2012

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Table of Contents

Page

CHAPTER 1: COEUR D'ALENE LAKE FISHERY INVESTIGATIONS

CHAPTER 2: PRIEST LAKE INVESTIGATIONS

CHAPTER 3: UPPER PRIEST LAKE AND THOROFARE LAKE TROUT CONTROL

CHAPTER 4: SPIRIT LAKE KOKANEE

CHAPTER 5 - HIGH MOUNTAIN LAKE SURVEYS

CHAPTER 6 - EXPLOITATION OF HATCHERY TROUT IN LOWLAND LAKES

CHAPTER 7: EVALUATION OF CHANNEL CATFISH POPULATIONS IN FIVE NORTHERN IDAHO LAKES

CHAPTER 8: TROUT SURVEYS IN THE COEUR D'ALENE, ST. JOE AND LITTLE NORTH FORK CLEARWATER RIVERS

CHAPTER 9: BULL TROUT REDD COUNTS

CHAPTER 1: COEUR D'ALENE LAKE FISHERY INVESTIGATIONS

ABSTRACT

Coeur d'Alene Lake provides one of Idaho's most popular kokanee *Oncorhynchus nerka* fisheries and one of its best fisheries for resident Chinook salmon *O. tshawytscha*. However between 1997 and 2008 adult kokanee density declined to critically low levels (generally < 10/ha) forcing the closure of the kokanee fishery during the fall season to protect spawning fish and requiring a reduced creel limit of six kokanee/day. Steady improvements in kokanee abundance were documented in 2009, 2010, and 2011, due in part to management efforts to reduce predation. Our surveys during 2012 showed the combined total of age-1 to age-3 kokanee declined with a corresponding increase in their length at maturity to 279 mm. This adult length met the objective for the lake of keeping kokanee between 250 mm and 280 mm. We stocked 20,000 fingerling Chinook salmon into Coeur d'Alene Lake for the fourth straight year during 2012. All fish were marked with an adipose fin clip and a coded wire tag. No tagged Chinook salmon were recorded during fishing derbies held on the lake, even though salmon stocked in 2009 would be age-3 and should surpass the 660 mm minimum used in some derbies. Numbers of Chinook salmon redds declined to a total of 94 and no redds were destroyed in 2012.

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INTRODUCTION

Kokanee *Oncorhynchus nerka* are one of the most popular sport fish species in the Panhandle Region. Populations have been established in all the larger lakes, and several of the smaller lakes, even when annual stocking is needed to support their populations. Kokanee first established in Lake Pend Oreille in the 1930's by emigrating down the Clark Fork River 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 and 1940's. Self-sustaining populations were soon established and kokanee fisheries typically supported 50% to 90% of the angling effort in the large northern Idaho lakes. The Lake Whatcom stock of kokanee are described as "late spawners" typically spawning from November through early January on shoreline gravel rather than in tributary streams.

The kokanee fishery in Coeur d'Alene Lake peaked in 1979 with 578,000 fish harvested and remained at 120,000 to 239,000 kokanee harvested during the 1980's (Rieman and LaBolle 1980; Fredericks et al. 1997). Fall Chinook salmon *O. tshawytscha* were introduced into Coeur d'Alene Lake in 1982 as a biological tool to reduce kokanee abundance and increase their size at harvest. Fall Chinook salmon were chosen as the preferred predator for a variety of reasons: their relatively short and semelparous life cycle compared to other species (lake trout *Salvelinus namaycush*, Kamloops rainbow trout *O. mykiss*, walleye *Stizostedion vitreum*, brown trout *Salmo trutta*); ability to manage the predators numbers; and the benefit provided by a Chinook salmon fishery. Chinook salmon have established a naturally reproducing population by spawning in the Coeur d'Alene and St. Joe river systems. Both naturally produced and hatchery stocked Chinook salmon are used to achieve the desired density of these predators.

Adult kokanee densities dropped below the desired range of 30 to 50 fish/ha during the high run-off year of 1996. Based on trawling, age-3 kokanee densities were below 10 fish/ha in 8 of the 11 years between 1997 and 2008, and were at 3 fish/ha in 2006, 2007 and 2008. Our concern was that Chinook salmon predation was impacting, rather than benefiting, the kokanee fishery. Efforts to improve the predator-prey balance included not stocking Chinook salmon in 2007 and 2008, attempting to limit wild Chinook salmon spawning to 100 redds, reducing the kokanee limit to 6 fish, and closing the kokanee fishery during the fall season to limit the harvest of spawning fish. In 2009, 2010 and 2011, we documented a very pronounced increase in the kokanee population as adult abundance increased to 35, 52, and 80 adults/ha, respectively. This report covers IDFG's efforts to monitor kokanee and Chinook salmon in 2012, and manage both populations to improve the sport fishery in Coeur d'Alene Lake.

OBJECTIVES

IDFG objectives for the management of Coeur d'Alene Lake are to manage "for a kokanee yield fishery and limited Chinook salmon trophy fishery" (IDFG 2007). Chinook stocking was geared towards achieving kokanee densities that would allow kokanee to grow to an adult size of 250 mm to 280 mm (IDFG 2007). Chinook salmon management direction is for greater catches of 1.5-9 kg fish rather than fewer but larger fish (11+ kg) (IDFG 2007).

STUDY AREA

Coeur d'Alene Lake is located in northern Idaho near the town of Coeur d'Alene. It is a natural lake of 12,742 ha with 9,648 ha of pelagic habitat used by kokanee. The native sportfish within the lake are bull trout *Salvelinus confluentus*, westslope cutthroat trout *Oncorhynchus clarkii lewisi*, and mountain whitefish *Prosopium williamsoni*. Introduced fish species include kokanee, Chinook salmon, rainbow trout *O. mykiss*, brook trout *Salvelinus fontinalis*, largemouth bass *Micropterus salmoides*, smallmouth bass *Micropterus dolomieu*, pumpkinseed *Lepomis gibbosus*, bluegill *Lepomis macrochirus*, green sunfish *Lepomis cyanellus*, yellow perch *Perca flavescens*, black crappie *Pomoxis nigromaculatus*, brown bullhead *Ameiurus nebulosus*, black bullhead *A. melas*, channel catfish *Ictalurus punctatus*, and northern pike *Esox lucius*.

METHODS

Kokanee Estimates by Hydroacoustics

We conducted a lake-wide, mobile, hydroacoustic survey on Coeur d'Alene Lake to monitor the kokanee population. This was the fifth hydroacoustic survey done on this lake. The survey was conducted on the nights of July 9 and 10, 2012. We used a Simrad EK60 split-beam, scientific echosounder with a 120 kHz transducer to estimate kokanee abundance. Ping rate was set at 0.3 s/ping. A pole-mounted transducer was located 0.52 m below the surface, off the port side of the boat, and pointed downward. The echosounder was calibrated prior to the survey using a 23 mm copper calibration sphere to set the gain and to adjust for signal attenuation to the sides of the acoustic axis. We used Simrad's ER60 software to determine, and input, the calibration settings.

The lake was divided into three sections for this survey (Figure 1). We followed a uniformly spaced, zigzag pattern of 21 transects traveling from shoreline to shoreline (Figure 1). The zigzag pattern was used to maximize the number of transects that could be completed in one night. Also, this pattern follows the general rule of using a triangular design (zigzags) when the transect length is less than twice the transect spacing (Simmonds and MacLennan 2005). The starting point of the first transect in each section was originally chosen randomly, but the same transects have been followed each year. Boat speed was approximately 1.3 m/s at the northern end of the lake and 2.2 m/s in the remainder of the lake (boat speed did not affect our calculations of fish density).

We determined kokanee abundance using echo integration techniques. SonarData's Echoview software, version 5.2, was used to view and analyze the collected data. A box was drawn around the kokanee layer on each of the echograms and integrated to obtain the nautical area scattering coefficient (NASC) and analyzed to obtain the mean target strength of all returned echoes. This integration accounted for fish that were too close together to detect as a single target (MacLennan and Simmonds 1992). Densities were then calculated by the equation:

$$\text{Density (fish/ha)} = (\text{NASC} / 4\pi 10^{TS/10})\ 0.00292$$

where:

NASC is the total backscattering in m^2/nautical mile^2, and
TS is the mean target strength in dB for the area sampled.

We calculated a density estimate of fry directly from the echograms. First a total kokanee density for all fish was calculated by echo integration. Then a virtual echogram was built of the corrected target strengths. The percentage of fish between -60 dB and -50 dB on the echogram was then multiplied by the total kokanee density.

Ninety percent confidence intervals were calculated for the estimates of fry and older age classes of kokanee. Since we had small sample sizes from a contagious distribution, density estimates were transformed (logx+1), and an error bound calculated by the method for stratified systematic sampling. Error bounds were antilogged and placed around the arithmetic means (Elliott 1983).

Unlike past years, no trawling was conducted in 2012. We therefore could not estimate the abundance of older age groups of kokanee based on their percentage in the trawl catch. A total estimate of kokanee in age groups 1, 2 and 3 was calculated based on the percentage of targets between -50 and -33 dB times the total kokanee density estimate.

Kokanee Lengths and Adult Ages

We measured adult kokanee each year in the spawning season to see if their length meets the objectives for the lake. During 2012, a single gill net was set for 10 minutes near the Higgins Point boat ramp on December 3. The monofilament gill net was 91 m long with 50 mm bar mesh.

A sample of adult kokanee was aged by examination of their otoliths. Otoliths were extracted from the kokanee and immediately placed in a drop of water on a microscope slide. Bright light was focused below the whole otolith to show growth rings.

Chinook Salmon Stocking Tests

During 2009, 2010, 2011 and 2012 we stocked Chinook salmon during June and September as a test to determine the best stocking strategy. Eggs from Tule Fall Chinook salmon were obtained from the Big Creek Hatchery located 16 miles east of Astoria, Oregon. Eggs were hatched at Cabinet Gorge Fish Hatchery and reared to size at the Nampa Fish Hatchery before being transported to Coeur d'Alene Lake. All of the salmon fingerlings were given an adipose fin clip and had a coded wire tag inserted into their snout. About 10,000 fingerling Chinook salmon were stocked in each of the two months (Table 1). All of the Chinook salmon were released at the Mineral Ridge boat ramp in Wolf Lodge Bay at the northeastern side of the lake. Size at release varied with the date of release, i.e. larger fingerlings were stocked in September than in June. The test was therefore to compare the survival rate of smaller Chinook salmon stocked in June to that of larger fish stocked in September.

Chinook Salmon Redd Counts

Each year since 1990, we monitored the spawning of wild Chinook salmon in tributaries to Coeur d'Alene Lake. During 2012 we floated the main spawning sections of the Coeur d'Alene and St. Joe rivers using canoes. The Coeur d'Alene River was first floated on September 20, 2012. All redds encountered in the section from the South Fork Coeur d'Alene River to Cataldo were marked by placing a handful of white quartz gravel in the redd and mapping its location. We later mapped redds on September 28 from the Little North Fork Coeur d'Alene River to the South Fork Coeur d'Alene River. On October 2, 2012, we remapped redds from the South Fork Coeur d'Alene River to Cataldo noting the presence of new redds. Lastly the St. Joe River was surveyed from Calder to St. Joe City on October 3 and 4, 2012.

We estimated the natural smolt production from the redd counts by assuming an estimate of 4,000 eggs per redd and a mean egg-to-smolt survival of 10%. No redds were destroyed in 2012 as had been done in some previous years when redd abundance exceeded 100 redds.

RESULTS

Kokanee Estimates by Hydroacoustics

We estimated 12,772,100 kokanee fry (1,324 fry/ha) in Coeur d'Alene Lake with a 90% confidence interval of -24% to +31%. We also estimated the lake contained 6,546,700 kokanee of ages 1 to 3 kokanee (679/ha) with a 90% confidence interval from -16% to +19%. Total abundance was 19,318,800 kokanee (2,002/ha) (Tables 2 and 3).

The highest densities of kokanee fry were found at the northern end of the lake in Wolf Lodge and Cougar bays (Table 2). Most of the kokanee spawning was believed to occur along road fills at the northern end of the lake, and it appeared that most of the fry remained in this section during mid-summer. Lower densities of fry were found in the middle and southern sections. Density of kokanee between the ages of 1 and 3 was also highest in the northern section of the lake, with density just over 970 kokanee/ha (Table 2).

Target strengths of kokanee at the northern end of Coeur d'Alene Lake formed a bimodal distribution (Figure 2). We split fry from older age classes of kokanee at a target strength of -50 dB based on this distribution. We used this decibel level to separate kokanee fry from older age classes in each section of the lake.

Kokanee Lengths and Adult Ages

Mean length of male kokanee during the spawning season was 283 mm (n=122), and female kokanee averaged 274 mm (n=6) (Figure 3). Male kokanee ranged from 255 mm to 346 mm and female kokanee ranged from 256 mm to 288 mm. Mean lengths were slightly longer than the last two years (Figure 4).

Thirty seven kokanee from the spawning run were aged. Thirty six were found to be age-3, and one, a 311 mm male, was thought to be age-4.

Chinook Salmon Redd Counts

The number of Chinook salmon redds counted in the Coeur d'Alene and St. Joe Rivers declined in 2012. We found 94 redds; down from 134 redds the previous year (Table 4). The most heavily used section for spawning was the in the Coeur d'Alene River between the South Fork Coeur d'Alene River and Cataldo (Table 4); (Figures 5 and 6). The trend in wild Chinook salmon spawning since the flood year of 1996 appeared to be increasing in a linear fashion, but 2012 showed a marked decline (Figure 5).

We did not attempt to destroy any of the Chinook salmon redds, and therefore estimated roughly 53,600 smolts would be produced naturally along with the 20,400 that were stocked (Table 5).

Chinook Salmon Stocking Tests

No Chinook salmon with coded wire tags were turned in by anglers during 2012. Also, during the "Big One Chinook Derby" and the "Members-Only Derby" none of the weigh masters reported seeing any Chinook salmon with adipose fin clips even though they were personally contacted by IDFG and instructed to watch for them.

DISCUSSION

Kokanee Population Estimates

Kokanee abundance in Coeur d'Alene Lake appeared to be meeting the objectives established for the lake (see Objectives section of this report). The statewide fisheries management plan stated that an "adjustment in the 25 fish limit for kokanee and reductions in Chinook stocking will be necessary to recover this fishery" (IDFG 2007) Both of these adjustments were made. There was no stocking of Chinook salmon in 2007 and 2008. After these dates, Chinook salmon stocking between 2009 and 2012 was kept at a moderately low level of about 20,000 salmon annually. Additional management efforts also included: digging up any Chinook salmon redds if more than 100 were created, closing the kokanee fishery during some fall seasons to protect kokanee spawners, and reducing the kokanee bag limit to 15 kokanee/person/day. With a lag time of 2 years after a reduction in Chinook salmon stocking, adult kokanee abundance increased greatly from an estimated 4 kokanee/ha in 2008 to 165 kokanee/ha in 2011 (based on the hydroacoustic estimate). The kokanee population and its fishery appeared to be fully recovered by 2012.

The next step is to maintain balance between both kokanee and Chinook salmon to the benefit of both fisheries. The original reason for putting Chinook salmon in Coeur d'Alene Lake was to increase kokanee sizes making them more desirable to anglers. During the rather long time span from 1979 to 1995 the average adult kokanee size was below 250 mm in most years (Figure 4). Chinook salmon stocking began in 1982, but failed to affect kokanee sizes very much until after the 1996 flood year. The desire was to keep kokanee between 250 mm and 280 mm to have somewhat larger fish but to still have fairly high densities of kokanee with good catch rates, high yield and good forage for Chinook salmon (IDFG 2007). Kokanee have met this desirable size range for the last 4 years (Figure 3). It appears the moderate stocking of 20,000 Chinook salmon along with the current level of natural reproduction was just about right to "balance" these fisheries. In other words, we currently appear to be maintaining the desired balance and can see the improvement in the resulting fisheries.

Maintaining kokanee sizes and densities in the desired range will likely be difficult. Annual changes in wild Chinook salmon abundance, losses from the lake of both kokanee and Chinook salmon, and changes in lake productivity are a few of the variables that affect the balance in the lake. Maintaining balance will be dependent on anticipating changes and making quick adjustments. Unfortunately in 2012, there was no mid-water trawling conducted to determine abundance and sizes of individual age classes of kokanee. It therefore becomes more of an imperative to trawl in 2013 and take corrective actions if needed. We recommend trawling be conducted on an annual basis.

We continued a test comparing the spring and fall stocking of Chinook salmon in 2012. As in the past two years, none of the hatchery Chinook salmon were recorded in the fishery. During 2012, the salmon stocked in 2009 were age-3 and should have recruited to the fishery. This coming year all age classes of salmon in the lake will have a marked hatchery component.

We recommend continuing to monitor derbies to obtain Chinook salmon samples and determine the proportion of the catch that originated from each stocking.

We recommend a moderate stocking of 20,000 Chinook salmon in 2013. Holding stocking at a moderate level was advised given the past success with this level of stocking, and the lack of information on the upcoming year classes of kokanee.

MANAGEMENT RECOMMENDATIONS

1. Sample the harvest of Chinook salmon in 2013 to look for adipose clipped fish and evaluate the two stocking strategies.

2. Stock a limited number of about 20,000 Chinook salmon in 2013. Salmon should be marked to determine the proportion of hatchery fish in the harvest.

3. Closely monitor the kokanee population by trawling and hydroacoustics and adjust Chinook salmon stocking to maintain balance between the two species.

Table 1. List of tagged Chinook salmon stocked in Coeur d'Alene Lake between 2009 and 2012 as a test to determine the best month and size for stocking.

Date stocked	Number of Chinook salmon stocked	Tag code	Fin clip	Mean length at stocking (total length in mm)	Mean weight (g)
6/3/09	10,570	10-63-70,10-74-04	Adipose	135	28
6/3/09	127	none	Adipose		
9/9/09	10,936	10-92-71	Adipose	180	65
9/9/09	617	none	Adipose		
6/21/10	10,300	10-90-70, 10-91-71	Adipose	150	40
9/15/10	10,121	10-34-80,10-8- 72	Adipose	194	87
6/27/11	10,000	10-48-73 and 10-34-27	Adipose	178	28
10/4/11	10,132	10-01-53	Adipose	171	57
6/25/12	10,148	10/96/77 and 10/97/77	Adipose	150	35
9/19 /12	10,220	10-1-53	Adipose	205	88

Table 2. Kokanee population estimates in each section of Coeur d'Alene Lake based on hydroacoustic sampling on July 9, 2012.

Section	Fry density (fry/ha)	Fry abundance	Age 1-3 density (fish/ha)	Age 1-3 abundance	Total
1 Northern	4,060	8,676,800	970	2,079,000	10,755,800
2 Middle	600	3,460,700	557	3,211,700	6,672,400
3 Southern	363	634,600	719	1,256,000	1,890,600
Lake-wide mean	1,324	-	679	-	-
Total		12,772,100		6,546,700	19,318,800

Table 3. Estimated abundance of kokanee made by hydroacoustic surveys with age classes split by trawl percentages for Coeur d'Alene Lake, Idaho, from 2008-2012. To follow a particular year class of kokanee, read right one column and up one row.

Sampling year	Age class					Total	Age 3/ha
	Age-0	Age-1	Age-2	Age-3	Age 1 to 3		
2012[a]	12,772,000	-	-	-	6,547,000	19,319,000	-
2011	10,847,000	2,610,000	2,868,000	1,596,000	7,074,000	17,921,000	165
2010	4,025,000	3,089,000	3,042,000	923,000	7,054,000	11,079,000	96
2009	3,574,000	2,467,000	3,738,000	592,000	6,797,000	10,371,000	61
2008	10,479,000	3,572,000	1,650,000	39,200	5,261,200	15,740,000	4

[a] No trawling was conducted in 2012 to partition kokanee year classes.

Table 4. Chinook salmon redd counts in the Coeur d'Alene (Cd'A) River drainage, St. Joe River and Wolf Lodge Creek, Idaho, 1990-20012.

	Coeur d'Alene River								St. Joe River					Wolf Lodge Creek	
Date	Cataldo Mission to S.F. Cd'A River	South Fork Cd'A to L.N.F. Cd'A River	L.N.F. Cd'A to Steamboat Creek	Steamboat Creek to Steel Bridge	Steel Bridge to Beaver Creek	South Fork Cd'A River	Little North Fork Cd'A River	Coeur d'Alene River Subtotal	St. Joe City to Calder	Calder to Huckleberry Campground	Huckleberry Campground to Marble Creek	Marble Creek to Avery	St. Joe River Subtotal	Wolf Lodge Creek	Total
1990	41	10	-	-	-	-	-	51	4	3	3	0	10	--	66
1991	11	0	2	-	-	-	-	13	0	1	0	0	1	-	14
1992	29	5	3	1	-	-	-	21	18	1	2	0	21	-	63
1993	80	11	6	0	-	-	-	97	20	4	0	0	24	-	121
1994	82	14	1	0	0	13	0	110	6	0	1	1	8	-	118
1995	45	14	1	2	0	-	2	64	1	0	0	0	1	-	65
1996	54	13	13	0	0	4	0	84	59	5	7	0	71	-	155
1997	18	5	6	3	1	0	0	33	20	2	2	0	24	-	57
1998	11	3	1	0	0	0	0	15	3	1	0	2	6	4	25
1999	7	5	0	0	0	0	0	12	0	0	0	0	0	5	17
2000	16	20	3	0	0	5	1	45	5	0	0	0	5	3	53
2001	18	13	2	1	0	4	0	38	21	15	-	-	36	4	78
2002	14	10	6	0	0	3	0	33	14	4	0	0	18	0	51
2003	27	17	2	0	0	5	0	51	15	9	3	0	27	0	78
2004	24	36	4	2	0	4	1	71	15	3	0	0	18	1	90
2005	30	7	3	0	0	8	1	49	7	3	0	0	10	1	60
2006	30	80	14	7	0	10	0	141	15	1	0	0	16	-	157
2007	63	20	4	1	0	13	0	101	23	4	0	0	26	-	127
2008	79	6	1	2	0	4	0	92	13	3	1	0	17	-	109
2009	70	23	1	0	0	13	0	107	9	1	0	0	10	-	117
2010	71	16	7	9	0	8	0	112	20	0	2	0	22	-	134
2011	79[a]	12[a]	5	0	0	17	2	115	-	-	-	-	-	-	134[b]
2012[a]	65	7	-	-	-	13	-	85	9	-	-	-	9	-	94

[a] Redds counted by ground survey.
[b] Total based on a proportion of the previous 5 years.

Table 5. Number of Chinook salmon stocked and estimated number of naturally produced Chinook salmon entering Coeur d'Alene Lake, Idaho, 1982-2012. The number of Chinook salmon redds is the number left undisturbed 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
2007	0				100	40,000	40,000
2008	0				65	26,000	26,000
2009	21,500	Big Creek	Nampa	Adipose + coded wire tag	100	40,000	61,500
2010	20,421	Big Creek	Nampa	Adipose + coded wire tag	100	40,000	60,421
2011	20,132	Big Creek	Nampa	Adipose + coded wire tag	134	53,600	73,700
2012	20,368	Big Creek	Nampa	Adipose + coded wire tag	134	53,600	74,000

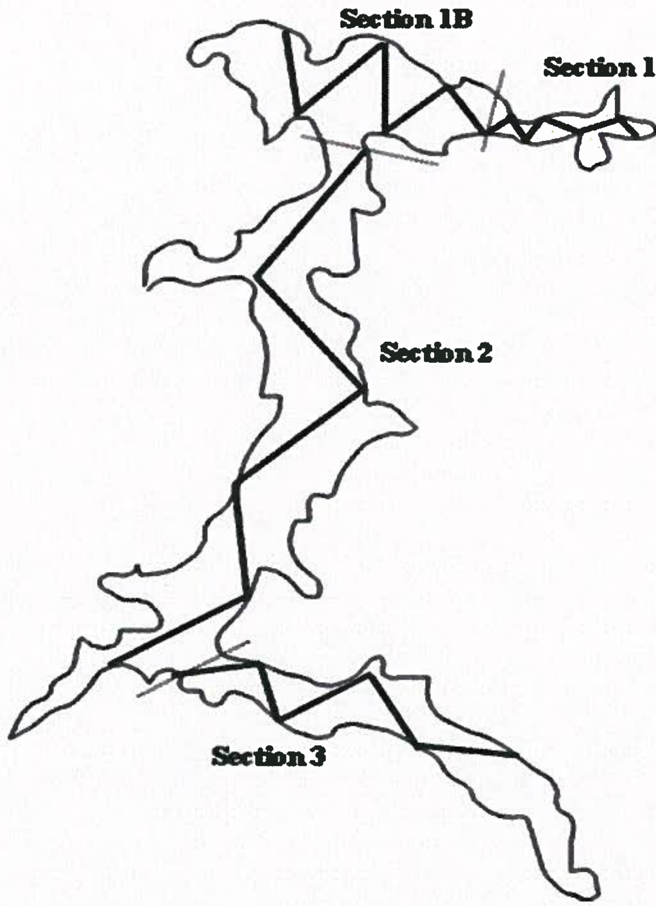

Figure 1. Location of 21 hydroacoustic transects in three sections of Coeur d'Alene Lake, Idaho, used to estimate kokanee population abundance in 2012.

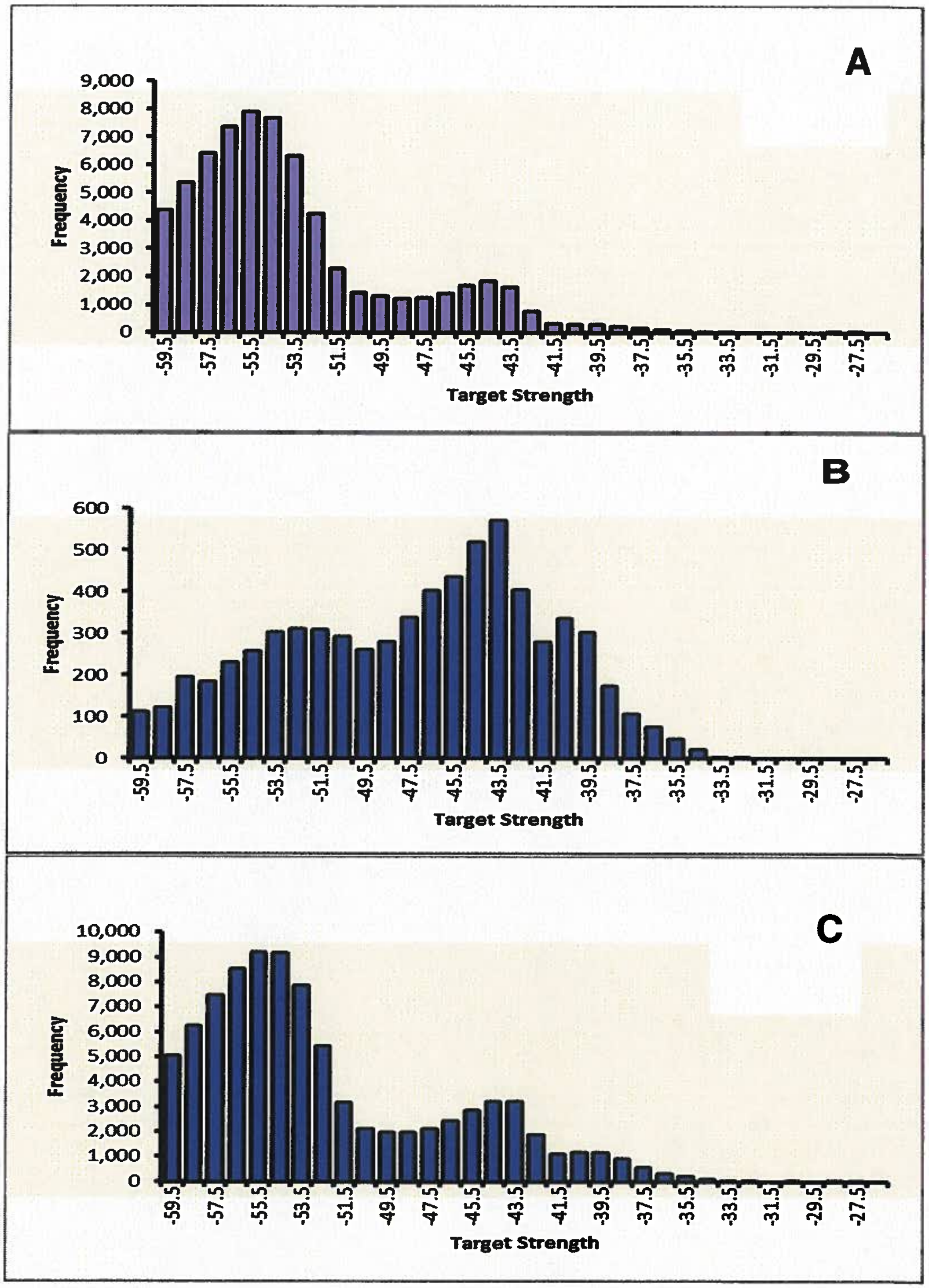

Figure 2. Target strength-frequency distribution of fish within the kokanee layer in Coeur d'Alene Lake during 2012. Plots are of each single returned echo from a single fish. Fry were defined as targets between -60 dB and -50 dB, and older age classes of kokanee as targets between -50 dB and -33 dB. Graphs are for the northern section (A), the southern section (B) and all targets lake-wide (C).

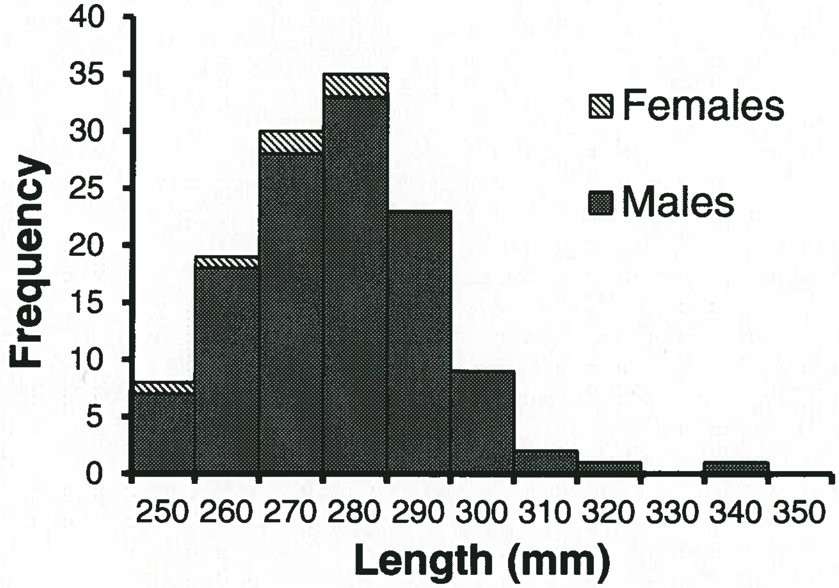

Figure 3. Length-frequency distribution of kokanee gillnetted on December 3, 2012 in Coeur d'Alene Lake.

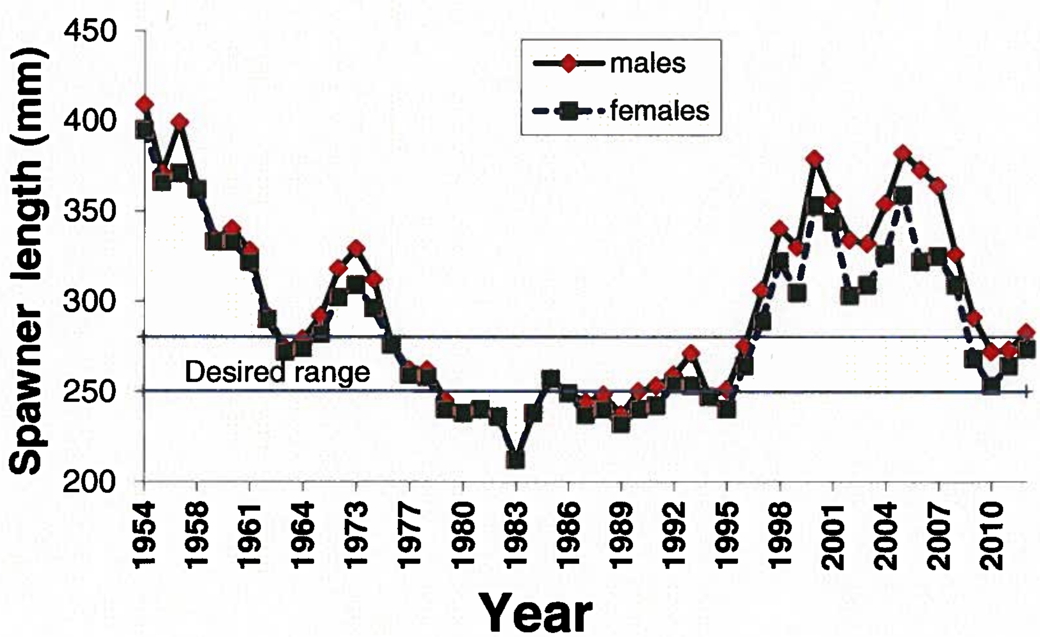

Figure 4. Mean total length of mature male and female kokanee in Coeur d'Alene Lake, Idaho, from 1954 to 2012. Years where mean lengths were identical between sexes were a result of averaging male and female lengths together. Horizontal lines depict a desired range between 250 mm and 280 mm.

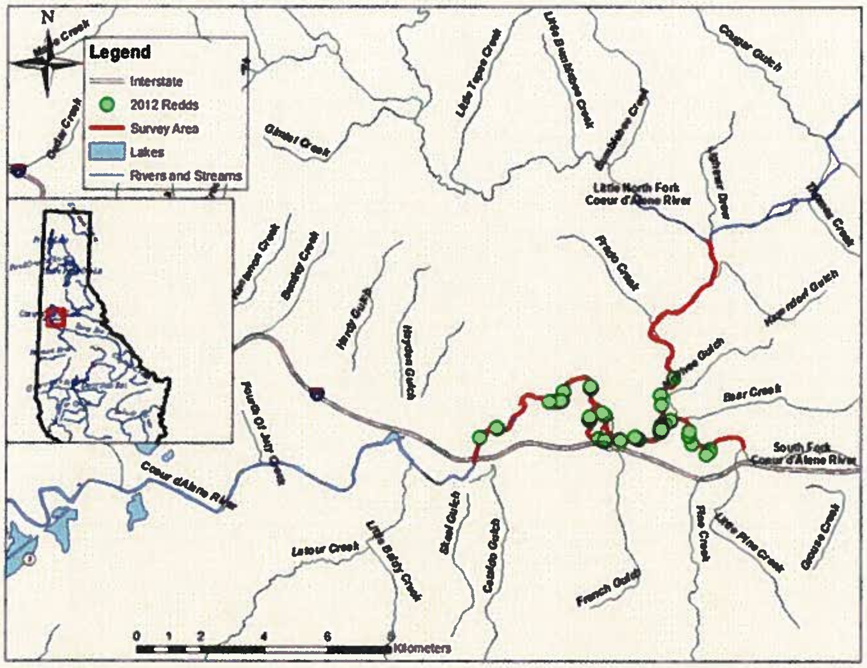

Figure 5. Location of Chinook salmon redds in the Coeur d'Alene River drainage during 2012. Circles denote locations where one or more redds were located.

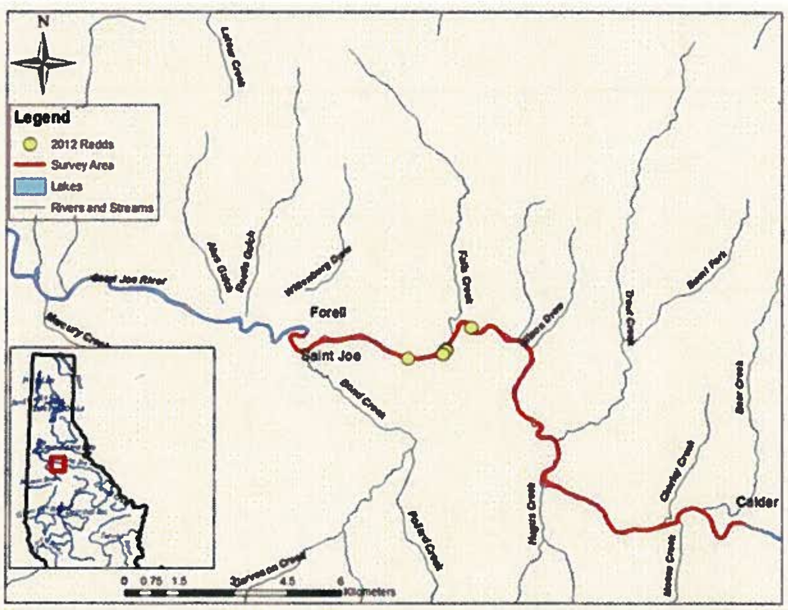

Figure 6. Location of Chinook salmon redds in the St. Joe River drainage during 2012. Circles denote sites where one or more redds were found.

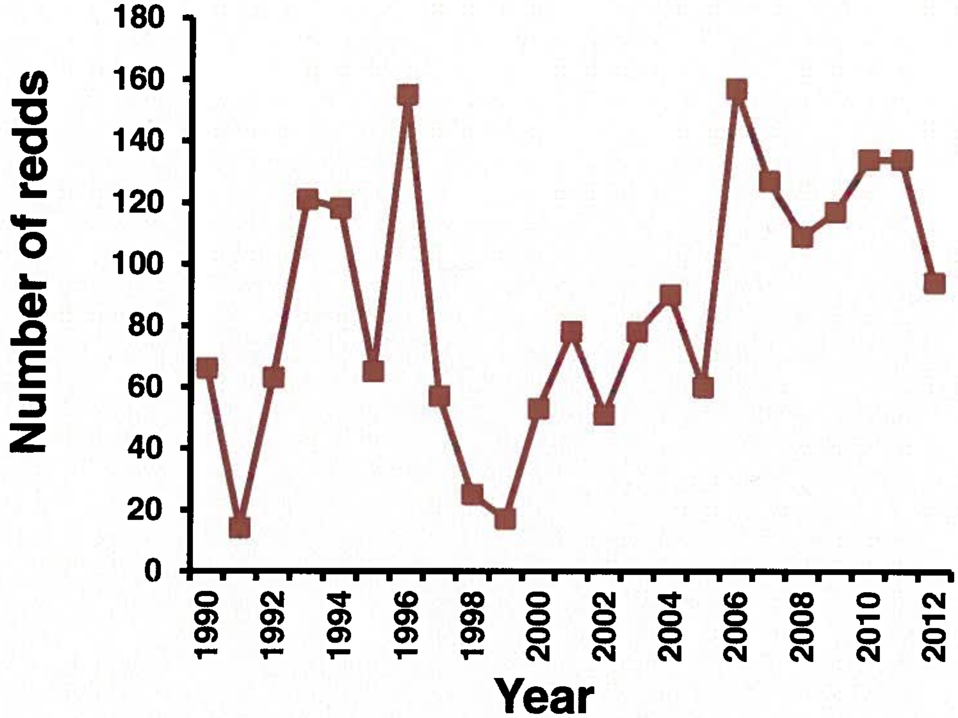

Figure 7. Numbers of Chinook salmon redds counted in tributaries to Coeur d'Alene Lake, Idaho, between 1990 and 2012.

CHAPTER 2: PRIEST LAKE INVESTIGATIONS

ABSTRACT

We examined the kokanee population in Priest Lake during 2012 using hydroacoustics, shore counts of kokanee spawners, and gillnetting during the kokanee spawning season. Using hydroacoustics we estimated only 29 kokanee fry/ha and 13 kokanee ages 1 to 4/ha as an average for the lake. These densities were indicative of a very low kokanee population. Visual counts of kokanee spawners reached a record high of 27,200 kokanee seen along five shoreline spawning areas and indicated an increasing population. Spawning kokanee were primarily age-3, with some age-4 kokanee and an occasional age-2 fish.

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INTRODUCTION

During 2012 the kokanee population in Priest Lake was investigated mainly to assess the current population status. The kokanee fishery opened in 2011 when the fishing rules changed to a 15 kokanee/day limit as a general rule for the Panhandle Region. Anglers began harvesting some rather large kokanee from the lake. Our counts of kokanee spawning along the shoreline during the fall of 2011 showed a pronounced increase. This report is a summary of our efforts to examine the kokanee population to look for trends.

STUDY AREA

Priest Lake is located in Idaho's panhandle about 28 km south of the Canadian border. Surface area of the lake is 9,446 ha with 8,190 ha of open water habitat greater than 12 m deep.

The main fishery in the lake for the last three decades has been lake trout *Salvelinus namaycush* with a smaller catch-and-release fishery for westslope cutthroat trout *Oncorhynchus clarkii lewisi.* Historically the fishery was primarily for westslope cutthroat trout and bull trout *S. confluentus*. During 2011 the fishery for kokanee *O. nerka* reopened and was gaining interest among anglers interested in catching large fish. A survey in 2003 estimated that anglers spent $3.6 million while making 20,000 fishing trips to the lake (IDFG 2003). A more recent survey in 2011 estimated anglers spent $5.9 million and the number of trips stayed the same at 20,000 (IDFG, unpublished data).

OBJECTIVES

The Idaho Department of Fish and Game (IDFG) is currently developing a new 6 year fish management plan. Objectives for Priest Lake will include collecting information that will help to decide whether or not the lake can be managed for more emphasis on native species including cutthroat trout and bull trout (IDFG in press b). If the decision is made to suppress lake trout, then the kokanee population may have a chance to increase. Studies in this report were designed to gather some background information on the kokanee population.

METHODS

For this study we recalculated the area of pelagic habitat in Priest Lake. All previous work we reviewed used an area of 5,050.66 ha, which seemed to be an underestimation of pelagic habitat. First, we estimated the total area of the lake at 9,445.8 ha based on the IDFG Geographic Information System (GIS). Then we calculated the proportion of the lake that was deeper than the 12 m contour by measuring a bathometric map of the lake with a compensating polar planimeter. On the map we found that 86.71% of the area of the lake was deeper than the 12 m contour. We then multiplied the area of the lake (9,445.8 ha) times the proportion of deep water (86.71%) to estimate the lake contained 8,190 ha of pelagic habitat usable by kokanee. This area was 62% larger than the estimate of pelagic habitat used in previous studies dating back to the late 1970s. Investigators who wish to compare kokanee abundance estimates in this report to previous data should correct for this change in lake area.

We conducted a lake-wide, mobile, hydroacoustic survey on Priest Lake to monitor the kokanee population.. The survey was conducted on the nights of August 28 and 29, 2012. We used a Simrad EK60 split-beam, scientific echosounder with a 120 kHz transducer to estimate kokanee abundance. Ping rate was set at 0.3 to 0.5 s/ping. A pole-mounted transducer was located 0.52 m below the surface, off the port side of the boat, and pointed downward. The echosounder was calibrated prior to the survey using a 23 mm copper calibration sphere to set the gain and to adjust for signal attenuation to the sides of the acoustic axis. We used Simrad's ER60 software to determine, and input, the calibration settings.

We followed a uniformly spaced, zigzag pattern of 15 transects stretching from shoreline to shoreline (Figure 1). The zigzag pattern was used to maximize the number of transects that could be completed in one night. The pattern followed the general rule of using a triangular design (zigzags) when the transect length was less than twice the transect spacing (Simmonds and MacLennan 2005). The starting point of the first transect at the northern end of the lake was chosen randomly. Boat speed was approximately 1.3 m/s, which was idling speed (650 revolutions/min) for the boat.

We determined kokanee abundance using echo integration techniques. SonarData's Echoview software, version 5.2, was used to view and analyze the collected data. A box was drawn around the kokanee layer on each of the echograms and integrated to obtain the nautical area scattering coefficient (NASC) and analyzed to obtain the mean target strength of all returned echoes. This integration accounted for fish that were too close together to detect as a single target (MacLennan and Simmonds 1992). Densities were then calculated by the equation:

$$\text{Density (fish/ha)} = (\text{NASC} / 4\pi 10^{TS/10})\ 0.00292$$

where:

NASC is the total backscattering in m^2/nautical mile^2, and
TS is the mean target strength in dB for the area sampled.

All fish in the pelagic layer between 10 m and 23 m were considered to be kokanee based on past trawling work. We calculated a density estimate of fry directly from the echograms. First a total kokanee density for all fish was calculated by echo integration. Then a virtual echogram was built of the corrected target strengths. We then multiplied the total kokanee density estimate on each transect by the percentage of small targets between -60 dB and -45 dB thought to be fry.

No trawling was conducted on Priest Lake in 2012. Therefore we could not estimate the abundance of individual age groups based on their percentage in the trawl catch. A total combined estimate of kokanee in age groups 1, 2, 3 and 4 was calculated based on the percentage of targets that were over -45 dB. Large targets were not excluded from the analysis since kokanee in Priest Lake were known to exceed 440 mm in our collection of spawning kokanee this year.

Ninety percent confidence intervals were calculated for the estimates of fry and older age classes of kokanee. The entire lake was considered to be one section; no stratification by area. Since we had small sample sizes from a clumped (contagious) distribution, density estimates were transformed ($\log_{10}$ x+1), and an error bound calculated using a Student's t distribution. Error bounds were anti-logged and placed around the arithmetic means (Elliott 1983). Arithmetic means were used since it was thought to be an unbiased estimate of the true population mean and would be consistent with methodology used on Spirit and Coeur d'Alene lakes.

We sampled spawning kokanee in Priest Lake to obtain size, sex, and age class information. A gill net was set for 20 min near the Priest Lake State Park boat ramp at Indian Creek on November 7, 2012. The monofilament gill net was 91 m long with 50 mm bar mesh. We aged the kokanee by examining their freshly removed, whole otoliths under a light microscope and counting annuli. Sexes were determined by examining the fish's external and internal characteristics.

RESULTS

We estimated Priest Lake contained 29 kokanee fry/ha (-28% to +39%, 90% confidence limits) and 13 kokanee ages 1 to 4/ha (-37% to +57%, 90% confidence limits) (Table 1). These values were expanded using a lake area of 8,190 ha of pelagic habitat. This yielded a population estimate of kokanee of 241,000 fry and 110,000 kokanee ages 1 to 4.

Target strengths of kokanee during the hydroacoustic survey showed the typical bimodal distribution of a kokanee population (Figure 2). Target strengths, however, were larger than typical for most kokanee populations, which was expected given the large size of the fish. Based on the bimodal distribution, we split kokanee fry from older age classes at -45 dB.

The hydroacoustic survey on Priest Lake showed two distinct layers of fish (Figure 3). A pelagic layer, thought to be kokanee, existed between 10 and 23 m. A second benthic layer of fish was found at depths around 50 m. This benthic layer was not found in Coeur d'Alene Lake (Figure 4), and was likely a mixture of lake trout and pygmy whitefish (Maiolie and Fredericks, in press a).

Counts of kokanee spawning along five shoreline sites were at a record high (Table 2). We counted a total of 27,200 kokanee in 2012. Estimates were 7,995 at Copper Bay, 14,570 at Hunt Creek, 3,135 at Cavanaugh Bay, 830 at Indian Creek, and 665 at Huckleberry Bay (Table 2). Although not part of the standardized survey, an additional 130 kokanee were seen near the Grandview Resort and 26 at the Outlet Bay Campground.

We collected 201 kokanee in our gill net sample of spawners. Sizes ranged from 295 mm to 441 mm. Spawners were found to include three age classes, ages 2, 3, and 4 (Figure 5). The largest and smallest kokanee were males (Figure 6).

DISCUSSION

Kokanee densities in Priest Lake were very low in our hydroacoustic survey. The estimate of 29 fry/ha in Priest Lake was only a fraction of the estimate of 1,300 fry/ha in Coeur d'Alene Lake or 2,200 fry/ha in Spirit Lake (see those chapters in this report). The estimate of age 1-4 kokanee was also quite low. We found 13 age 1-4 kokanee/ha in Priest Lake compared to a mean density of 2,100/ha in Spirit Lake and 680/ha in Coeur d'Alene Lake.

The low density of kokanee in Priest Lake does not appear similar to the population structure in Coeur d'Alene Lake when kokanee were at their lowest. In 2008 Coeur d'Alene Lake had adult kokanee densities of only 4 kokanee/ha by hydroacoustics. However, kokanee fry abundance was over 1,000 fry/ha that year. Fry numbers were still strong but mortality, likely in the form of Chinook salmon predation, reduced the number of adult kokanee. Priest Lake, on the other hand, had both low numbers of fry and low numbers of age 1 to 4 kokanee. Priest Lake would be expected to have only 1 to 3 adults/ha considering normal survival rates and the hydroacoustic estimate of 13 age 1-4 kokanee/ha.

The kokanee population in Priest Lake did not appear to be in the midst of a rapid resurgence based on the hydroacoustic survey. Kokanee in Coeur d'Alene Lake had high survival rates of 58% for the cohort that matured in 2011 (Maiolie and Fredericks, in press b). This cohort grew up under conditions of low Chinook salmon predation and had the highest survival seen in the lake in 15 years. At this rate fry densities of 29 fry/ha in Priest Lake would produce about 6 adults/ha. This density should still be considered a rather weak year class of adults and does not show a strong resurgence in the population within the next generation. If the objective remains to have a limited harvest fishery, close attention should be paid to the numbers of kokanee being harvested so as not to overly reduce kokanee egg deposition.

Kokanee spawner counts seemed to show a different perspective. During 2012 the count of kokanee spawners was 27,200 fish seen on the shoreline during a single day. This was a marked increase from the 1,000 to 3,000 spawners seen in most years before 2010, and suggests a rapid expansion in the kokanee population. Not all spawners were expected to be counted. If we optimistically estimate that half of the spawning kokanee were seen in the count, adult densities would have been about 7 adults/ha. This density is still very low compared to other kokanee fisheries in large lakes in the Panhandle Region. An expanded spawner count of 7 fish/ha appeared high in comparison to the results of the hydroacoustic survey. The kokanee population was estimated to have 13 age 1-4 kokanee/ha. If survival rates were typical and stable, there would not be 7 adults/ha in the population. Possibly the spawner count in 2012 indicated a single good year class of kokanee and future year classes will be lower. Or, possibly the hydroacoustic survey missed significant portions of the kokanee population. Confidence limits on kokanee were rather wide, but we did not find areas of the lake with unusually high densities suggesting the survey underrepresented better areas of the lake. The other possibility was that kokanee were missed by being near the lake's surface. The surface temperature was 18.5°C at the time of the survey on August 28; warm enough that kokanee would avoid the upper epilimnion. Temperature dropped to 9.7°C at the 12 m depth, which was a more suitable temperature for kokanee and possibly shallow enough that some kokanee could have avoided the oncoming hydroacoustic boat. Future hydroacoustic surveys should be carefully timed to occur at the peak of summer thermal stratification. We also suggest conducting a passive drift (motor shut off) during future hydroacoustic surveys to determine the shallowest depths of kokanee.

The spawner counts indicated kokanee in Priest Lake expanded 10 fold in the last decade. The hydroacoustic survey indicated that the kokanee population was still very low. The two findings were not mutually exclusive and may have shown a representative picture of the status of the kokanee population. We recommend periodic monitoring of the kokanee population to see if the population is expanding and if fishing rules need to be modified.

MANAGEMENT RECOMMENDATIONS

1. Calculate the exploitation rate of kokanee in Priest Lake to determine if angler harvest is excessive. This could be accomplished by a creel survey and a kokanee population estimate based on trawling and hydroacoustics.

2. Monitor the total mortality rate of kokanee in Priest Lake to determine the extent of predation. Such monitoring would be expected to show the changes in mortality if a lake trout removal project is initiated.

3. Determine if the kokanee population is truly increasing as suggested by the increasing spawner counts. This could be determined by annual trawling and hydroacoustic surveys.

4. If kokanee numbers are increasing, determine if it is due to declines in lake trout abundance. A direct mark-and-recapture population estimate on lake trout would accomplish this task and would be preferable to examining the fishery by a creel survey.

Table 1. Results of a hydroacoustic survey on Priest Lake during the nights of August 28 and 29, 2012. Transect locations are shown in Figure 1. Mean size of fish was based on Love's equation (Love 1971).

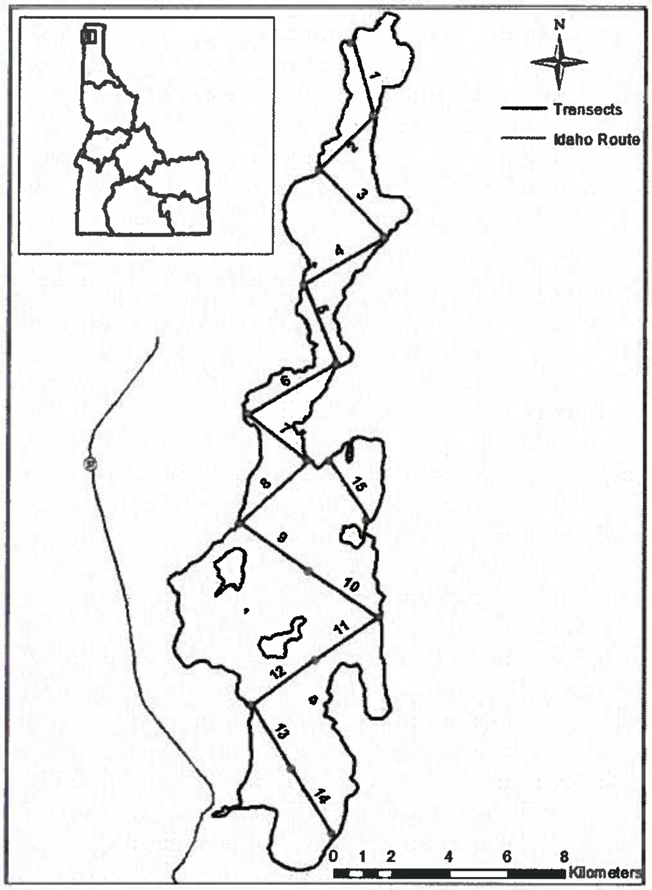
Transect number	Depths analyzed (m)	Number single targets	NASC (m^2/nautical $mile^2$)	Mean TS (dB)	Total density (fish/ha)	Percent fry	Fry density (fish/ha)	Percent age 1-4	Age 1-4 density (fish/ha)	Mean size (mm)
1	10-23	23	18.0	-37	21	52%	11	48%	10	253
2	10-23	8	12.1	-35	9	50%	4	50%	4	327
3	10-23	16	6.4	-39	11	62%	7	38%	4	203
4	10-23	54	26.6	-39	51	67%	34	33%	17	195
5	10-23	16	2.2	-48	31	81%	25	19%	6	69
6	10-23	28	6.2	-46	55	93%	51	7%	4	88
7	10-23	15	0.8	-52	32	100%	32	0%	0	40
8	10-23	54	14.0	-41	42	61%	26	39%	16	154
9	10-23	57	28.6	-41	81	68%	56	32%	26	159
10	10-23	42	49.3	-38	72	52%	38	48%	34	225
11	10-23	27	21.0	-41	59	81%	48	19%	11	160
12	10-23	18	6.8	-46	57	83%	47	17%	9	90
13	10-23	17	17.5	-39	35	53%	18	47%	16	192
14	10-23	6	10.9	-42	38	67%	26	33%	13	142
15	10-23	28	21.5	-40	50	39%	20	61%	30	176
Mean			16.1	-41	43		**29**		**13**	165

Table 2. Visual counts of kokanee spawners along the shoreline of Priest Lake 2001-2012.

YEAR

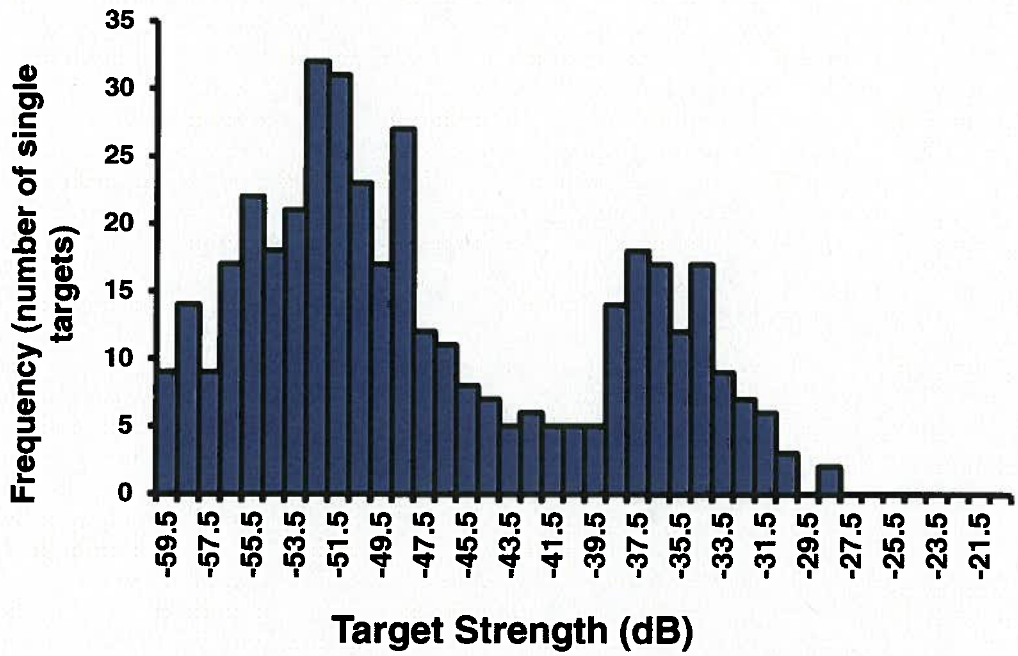
Location	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Copper Bay	588	549	1,237	1,584	906	1,288	308	223	400	37	750	7,995
Cavanaugh Bay	523	921	933	1,673	916	972	463	346	550	331	1,340	3,135
Huckleberry Bay	200	49	38	359	120	43	38	0	37	18	90	665
Indian Creek Bay	222	0	0	441	58	0	40	27	15	49	1,050	830
Hunt Creek Mouth	232	306	624	2,060	2,961	842	1,296	884	1,635	1,410	16,103	14,570
Total	1,765	1,825	2,832	6,117	4,961	3,145	2,145	1,480	2,637	1,845	19,333	27,195

Figure 1. Map of Priest Lake showing the location of transects used in a hydroacoustic survey of the lake in 2012. List adjacent to the figure gives the starting and ending point of each transect.



Transect number	Location
1	48° 44.105 N x 116° 51.216 W 48° 42.752 N x 116° 50.490 W
2	48° 42.752 N x 116° 50.490 W 48° 41.685 N x 116° 51.965 W
3	48° 41.685 N x 116° 51.965 W 48° 40.469 N x 116° 50.052 W
4	48° 40.469 N x 116° 50.052 W 48° 39.509 N x 116° 52.258 W
5	48° 39.509 N x 116° 52.258 W 48° 38.042 N x 116° 51.267 W
6	48° 38.042 N x 116° 51.267 W 48° 37.034 N x 116° 53.687 W
7	48° 37.034 N x 116° 53.687 W 48° 36.185 N x 116° 51.942 W
8	48° 36.185 N x 116° 51.942 W 48° 34.963 N x 116° 53.804 W
9	48° 34.963 N x 116° 53.804 W 48° 34.112 N x 116° 51.784 W
10	48° 34.112 N x 116° 51.784 W 48° 33.288 N x 116° 49.723 W
11	48° 33.288 N x 116° 49.723 W 48° 32.423 N x 116° 51.475 W
12	48° 32.423 N x 116° 51.475 W 48° 31.535 N x 116° 53.247 W
13	48° 31.535 N x 116° 53.247 W 48° 30.357 N x 116° 52.023 W
14	48° 30.357 N x 116° 52.023 W 48° 29.169 N x 116° 50.815 W
15	48° 36.208 N x 116° 51.323 W 48° 35.115 N x 116° 50.215 W

Figure 2. Target strength-frequency distribution of all singe targets recorded in Priest Lake on August 28 and 29, 2012. A single target is a single returned echo off of a single fish. Kokanee fry were split from older age classes at a target strength of -45 dB.



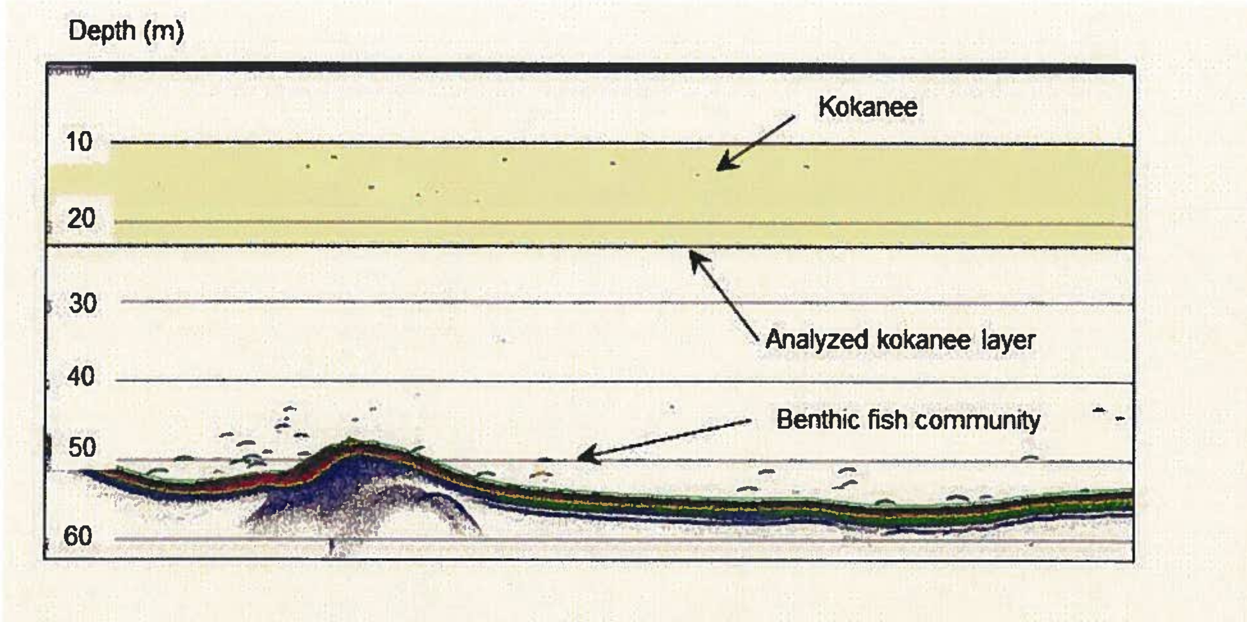


Figure 3. Section of an echogram from Priest Lake during the August 2012 hydroacoustic survey. Area from the depths of 10 m to 23 m was analyzed to calculate kokanee densities.

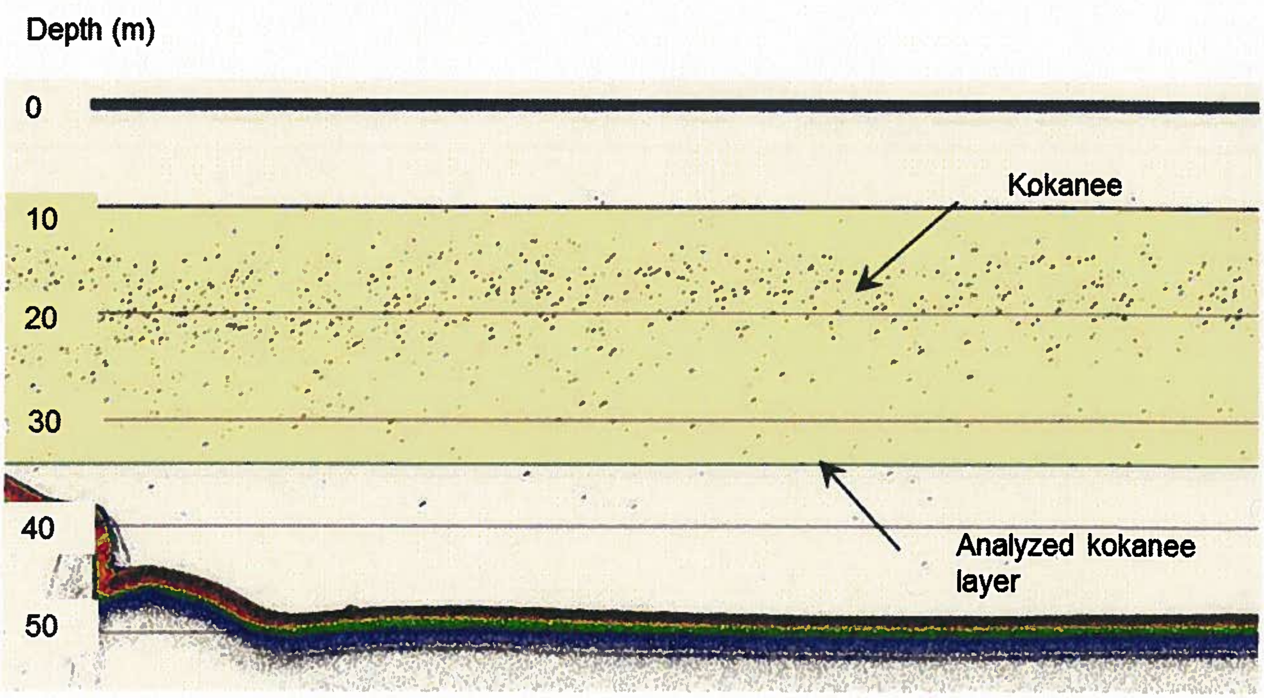


Figure 4. Echogram from the 2012 hydroacoustic survey on Coeur d'Alene Lake for comparison to Figure 3.

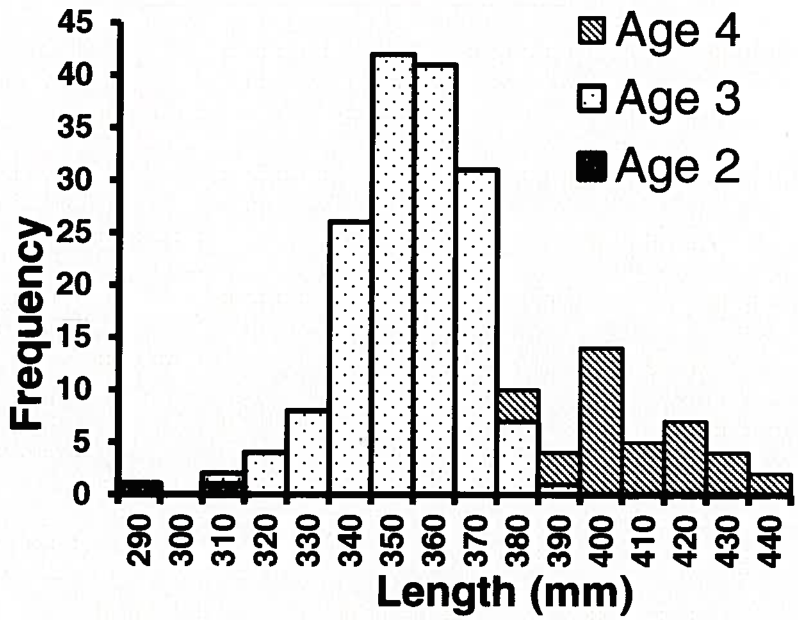


Figure 5. Length frequency distribution of kokanee spawners collected on the shoreline of Priest Lake on November 7, 2012.

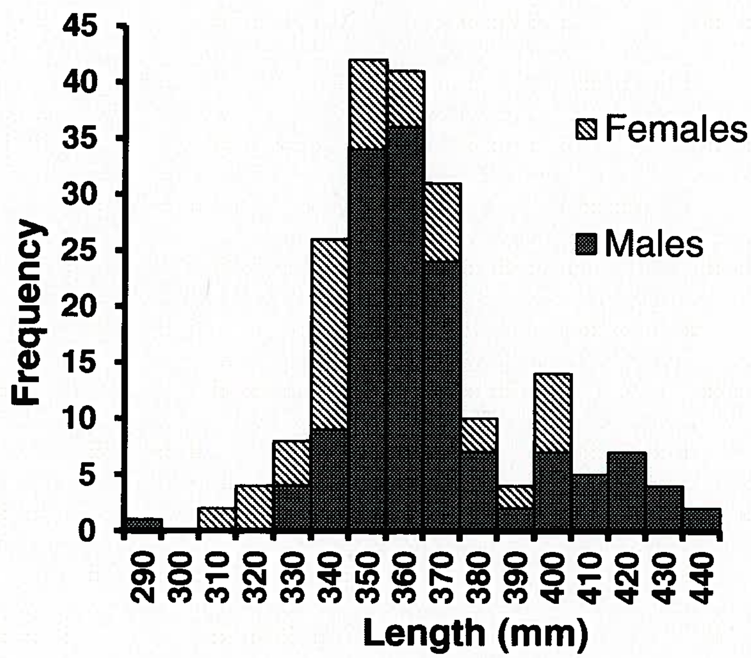


Figure 6. Length-frequency distribution of kokanee collected during the spawning season in Priest Lake showing the sizes of each sex of fish.

CHAPTER 3: UPPER PRIEST LAKE AND THOROFARE LAKE TROUT CONTROL

ABSTRACT

Upper Priest Lake is being managed for the protection of native species. We therefore have been attempting to remove non-native lake trout *Salvelinus namaycush* from the lake to avoid interspecies competition and predation. A private contractor was hired to gill net and remove as many lake trout as possible during a one week period from May 21 through May 28, 2012. We fished an average of 6,035 m net/day for the 8 days. A total of 5,355 lake trout were caught and removed. Based on a Leslie Depletion Model we estimated the lake trout population at the beginning of the effort to be 7,354 fish, which suggested we removed approximately 73% of the population. Number of lake trout removed seemed high considering that a similarly high percentage of the population has been removed for the last five years. Immigration into the lake is possible through the Thorofare that connects Upper Priest Lake to Priest Lake. In an attempt to reduce immigration, we hired a private contractor to operate trapnets in the Thorofare from September 21 through November 19, 2012. Trap nets were placed approximately 200 m and 300 m upstream of Priest Lake. We caught 305 lake trout and four bull trout *Salvelinus confluentus* during this effort. Lake trout movement through the Thorofare increased as surface water temperatures neared 11°C. Peak movement was observed from November 2 through November 13 when 186 (61%) of all lake trout were captured.

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INTRODUCTION

Historically native bull trout *Salvelinus confluentus* 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 population ensued (Mauser et al. 1988). The bull trout population in Upper Priest Lake was considered severely depressed while the population in Priest Lake was considered functionally extinct (DuPont et al. 2007).

Native westslope cutthroat trout *Oncorhynchus clarkii lewisi* were also historically abundant in Priest Lake and Upper Priest Lakes with 30 fish limits common in the 1940's (Mauser et al. 1988). Over harvest, interspecific competition, predation and degradation of spawning habitat all led to the decline of cutthroat trout in the Priest Lakes. Cutthroat trout were closed to harvest in 1988.

In Upper Priest Lake the non-native lake trout *Salvelinus namaycush* population has grown rapidly during the past 30 years. Lake trout often suppress other native and non-native species through predation and/or competition (Donald and Alger 1993; Fredenberg 2002, Hansen et al. 2008.) Lake trout were not documented in Upper Priest Lake until the mid-1980s at which time they were thought to have migrated from Priest Lake (Mauser 1986). In 1998 the lake trout population in Upper Priest Lake was estimated at 859 fish (Fredericks and Vernard 2001). In an effort to reduce threats to dwindling bull trout and cutthroat trout populations, the Idaho Department of Fish and Game (IDFG) has been using gill nets to reduce lake trout abundance in Upper Priest Lake since 1998. Between 150 and 5,000 lake trout have been removed nearly every year from Upper Priest Lake (Fredericks et al. 2013). The netting efforts demonstrated that Upper Priest Lake is not a closed system. Some immigration occurs through the Thorofare from Priest Lake. Between natural recruitment and immigration, Upper Priest Lake appears to be recolonized by the following year. This report covers our efforts in 2012 to net and remove lake trout from Upper Priest Lake.

OBJECTIVES

The Idaho Department of Fish and Game's main objective for Upper Priest Lake is to "restore native fish populations" (Idaho Department of Fish and Game 2007). It is our intent to recover populations of bull trout and cutthroat trout, and maintain the population of pygmy whitefish *Coregonus coulteri* that were native to this lake.

STUDY SITE

Upper Priest Lake is located approximately 21 kilometers (km) south of the Idaho-British Columbia border in the northwest corner of the Idaho Panhandle. It is a glacial lake that has roughly 13 km of shoreline, a surface area of 566 hectares (ha), a maximum depth of approximately 31 meters (m) and a maximum recorded temperature of 21 °C. The lake is bathtub shaped with steep walls and a flat bottom. Upper Priest and Priest lakes are held at 743 m elevation from the end of spring run off until mid-October using a small dam located at the outlet of Priest Lake. Upper Priest Lake is connected to Priest Lake by a channel known as the Thorofare. The Thorofare is roughly 3.2 km long, 70 m wide, and 1.5-3 m deep at summer pool. At low pool the depth of the Thorofare at its outlet is < 0.15 m blocking almost all boat traffic (IDFG 2007).

METHODS

Lake Trout Removal from Upper Priest Lake

We contracted Hickey Brothers Research, LLC of Baileys Harbor, Wisconsin to use gill nets to remove lake trout from Upper Priest Lake in 2012 using their 36 foot commercial gill net boat. Funding for this contract was provided by the U.S. Fish and Wildlife Service (USFWS). Gill nets used in Upper Priest Lake were 91 m long and ranged in height from 1.5 to 2.2 m. Multiple panels of graded mesh sizes ranging from 44 mm to 89 mm were randomly arranged in each net. Individual gill nets were tied together end to end to create a continuous net spanning 3,017 m.

Gill nets were fished from May 21-28, 2012. Nets were set throughout the lake and were moved based on catch rates at a particular site and on 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 fished from around 0500 to 1900 and averaged 10.2 hrs of soak time daily. Nets were set on the lake bottom at depths ranging from 10 to 31 m. A concerted effort was made to avert incidental bull trout captures by avoiding areas known to hold concentrations of bull trout.

Thorofare Netting Evaluation

With funding from USFWS, Kalispel Tribe of Idaho, and U. S. Forest Service (USFS), IDFG contracted with Hickey Brothers Research, LLC in 2012 to continue evaluation of commercial trap nets to minimize lake trout movement into Upper Priest Lake from Priest Lake. From September 21 through November 19, 2012, we used trap nets to capture fish in the Thorofare.

Because the trap net leads were designed to span the entire width of the Thorofare, posing navigation obstacles to boaters, an 8-10 meter wide section of float line was submerged to create a passage-way near the thalweg to allow boat traffic movement. Large signs alerted boaters well in advance that research nets were ahead. Multiple orange floats spaced 6 m apart were attached to the top of the leads to help boaters recognize and avoid the trap nets. Additionally, signs with arrows and the words "boat passage" guided boaters through the passage way.

Trap nets were placed in the Thorofare approximately 200 m and 300 m upstream of Priest Lake. These sites were selected due to their narrow width, relatively flat streambeds and lack of debris. Leads constructed of thick 200 mm mesh extended from the trap net to the shoreline on each side, and extended from the bottom to the surface. These visible leads divert fish into an enclosure called the heart. The heart has wings or net sections that form a V-shape and are supported by floats and anchors. Once inside the heart, fish swam through a tunnel and became trapped in a boxlike receptacle called a pot (Figure 1). Fish trapped in the pot remain alive, until it was raised up to the boat where lake trout were dipped out with a long handled net and removed. Captured lake trout were enumerated, measured for total length (TL), and examined for stage of sexual maturity. Captured bull trout and cutthroat trout were measured and transported away from the net site before release.

RESULTS

Lake Trout Removal from Upper Priest Lake

During our eight day effort we averaged 6,035 m net/day and caught and removed a total of 5,355 lake trout. Daily catch of lake trout ranged from 316 to 1,205 fish. Lake trout lengths ranged from 195-915 mm with a mean total length of 284 mm (Figure 2).

Catch rates of lake trout varied among locations and days. Catch rates were generally higher along shorelines and lower in deeper mid-lake sets. Daily catch was higher at the start of the effort and greatly declined over the 8 days (Figure 3).

Using a Leslie Depletion Model (Ricker 1975) we estimated the lake trout population was 7,354 fish at the beginning of the effort (Figure 4). Assuming equal catchability of all lake trout, our removal efficiency would be approximately 73%.

Catch per unit effort (CPUE) was compared among the years 2009, 2011 and 2012 as these years allowed comparisons between two of the mesh sizes (63 mm and 75 mm). CPUE decreased from 0.76 to 0.52 fish/100 m of net/10 hours from 2009 to 2012 (Figure 5). Relative length-frequency plots showed no consistent pattern with regard to the length of fish captured in the 63 mm and 75 mm mesh nets in the years 2009, 2010, 2011 and 2012.

A total of 25 bull trout were captured and 24 were released (Figure 6). Bull trout ranged from 225-740 mm with a mean length of 322 mm. Other species caught included 138 longnose sucker *Catostomus catostomus*, 7 largescale sucker *C. macrocheilus*, 114 northern pikeminnow *Ptychocheilus oregonensis*, 47 peamouth chub *Mylocheilus caurinus*, and 14 kokanee salmon *Oncorhynchus nerka.*

Thorofare Netting Evaluation

We caught 305 lake trout and four bull trout during the 2012 trap netting effort. Lake trout ranged from 435-1110 mm (TL) (Figure 7); 82% were sexually mature and 50% (181) were females. Four bull trout were captured ranging from 380-720 mm. We also captured 38 cutthroat trout ranging from 260-490 mm (Table 1). Other species caught include kokanee salmon, smallmouth bass *Micropterus dolomieu*, rainbow trout *Oncorhynchus mykiss,* mountain whitefish *Prosopium williamsoni,* tench *Tinca tinca,* northern pikeminnow, largescale and longnose suckers, and peamouth chub. A total of 563 fish were captured (Table 1).

Lake trout movement through the Thorofare increased as surface water temperatures cooled to 11°C (Table 4). This observation was consistent with our 2011 data as well as other studies that suggested lake trout begin to arrive at spawning sites when surface water temperatures near 12°C (Fredericks et al. 2013; Dux 2005; Gunn 1995). Peak movement was observed from November 2 through November 13 when 186 (61%) lake trout were captured. In 2010 we reported lake trout catch was at its highest from October 12 through October 26 and in 2011 between October 12 and October 31. Lake trout spawning migration appeared to begin in mid to late-October when water temperatures approached 11°C and likely ended in early to mid-November based on an average spawning duration for lake trout of 2-3 weeks (MacLean et al. 1981).

Trap nets were removed on November 19, 2012, two weeks later than in 2011. In 2012 we were able to extend our survey into mid-November as we secured permission from two landowners to use their docks and beach as access sites. In previous years netting needed to end because water levels in the Thorofare dropped eliminating access for boats.

DISCUSSION

Lake Trout Removal from Upper Priest Lake

In 2012 we captured and removed 5,355 lake trout from Upper Priest Lake and using a Leslie Depletion Model estimated that this removal represented 73% of the lake trout population. The past six years of lake trout removal demonstrated that we were effective at removing a significant portion of the lake trout population, but that Upper Priest Lake was re-populated annually by mature fish from Priest Lake, as well as juvenile fish recruiting to the population from within Upper Priest Lake. In recent years it appeared the lake trout population was increasing (Table 2). This may be a bit misleading, however, since smaller mesh gill nets were used and therefore the population estimate included smaller fish.

In 2012 we captured and removed more lake trout than any other year; however, this may have been at least partially a function of gill net mesh size. Mean length of lake trout removed from Upper Priest Lake in 2007 was 421 mm TL and has decreased each year (Table 2 and Figure 8). Mean length of lake trout removed in 2012 was 284 mm TL. In 2010 we included 50 mm mesh and 2011 we included 50 mm and 44 mm mesh whereas in previous years our smallest mesh size was 63 mm . Of the 5,355 lake trout captured in 2012, 35% (1,889) were captured in 50 mm mesh and 46% (2,447) were captured in 44 mm mesh (Table 3). It should also be noted that the two small mesh sizes combined accounted for 68% of the total lake trout catch and only 43% of our netting effort. The length frequency histogram in Figure 8 illustrates the increased catch of juvenile lake trout in 2012 as compared to 2007. CPUE has decreased in the 63 mm and 75 mm meshes from 2009 to 2012 suggesting that there may be fewer larger fish within the population.

A total of 25 bull trout were captured in 2012, down from 41 captured in 2011 but above the six year average of 22 bull trout since commercial removal of lake trout began in 2007. Bull trout ranged from 160 to 915 mm. The 160 mm bull trout is the smallest collected in our gill nets during the past 6 years. Eighteen of the bull trout collected (44%) in 2011 were ≤ 305 mm compared to 32% in 2010. This again was likely a function of using smaller mesh sizes. Bull trout redd counts in the Upper Priest Lake drainage were at a six year high in 2012 though Kendall Tau b analysis of bull trout redd counts from 1996-2012 indicated that there has been no significant increase in the number of redds counted ($p=0.93$) (Rieman and Myers 1997); (Table 2).

Thorofare Netting Evaluation

Results of this study continue to indicate the Thorofare is a passage corridor for lake trout as well as westslope cutthroat trout, bull trout, mountain whitefish, and other species. These results are consistent with other studies suggesting extensive fish movement between the lakes, especially in the fall (Fredericks 1999; Fredericks and Vernard 2001). A total blocking of fish movement between the lakes could be detrimental to native fish, and any migration barrier will have to be evaluated relative to negative impacts to several species.

A seasonal passive fish barrier, such as large trap nets, may be a temporary means of minimizing lake trout immigration through the Thorofare. Fredericks and Vernard (2001) reported lake trout movement through the Thorofare is greatest during October and November, coinciding with the timing of spawning. Trap nets set at either end of the Thorofare from September through mid- November could significantly reduce movement of lake trout while not barring native fish migrations. It was our observation that boat traffic was greatly reduced during the fall months, and this project demonstrated that trap nets could be effectively used to block fall migrations of lake trout through a low gradient river channel, while with proper signage, still provide passage for watercraft.

MANAGEMENT RECOMMENDATIONS

1. Continue annual gill netting on Upper Priest Lake as an attempt to reduce lake trout abundance.

2. Continue to investigate methods to minimize lake trout immigration from Priest Lake through the Thorofare to increase effectiveness of annual suppression efforts.

Table 1. Length ranges, mean total lengths and total number of fish caught in trap nets set in the Priest Lake Thorofare to block the passage of lake trout between September 21 and November 19, 2012.

Species	N	Length Range (mm)	Mean Total Length (mm)
Lake trout	305	435-1110	585
Bull trout	4	380-720	470
Westslope cutthroat	38	260-490	387
Kokanee salmon	84	40-450	356
Smallmouth bass	2	300-305	302
Rainbow trout	1	N/A	500
Mountain whitefish	48		
Tench	37		
Northern pikeminnow	21		
Largescale sucker	16		
Longnose sucker	4		
Peamouth chub	3		

Table 2. Results of gillnetting for lake trout removal in Upper Priest Lake along with the bull trout redd counts within the drainage during concurrent years.

	Lake Trout			Bull Trout		
	Lake Trout Removed	Estimated Population	Mean Total Length (mm)	Bull Trout Caught	Mean Total Length (mm)	Upper Priest River Redd Counts
2007	1,982	2,307	421	7	588	7
2008	2,207	2,278	390	13	511	22
2009	1,353	1,348	388	22	408	34
2010	2,551	3,346	310	22	358	42
2011	4,996	5,967	307	41	372	31
2012	5,355	7,354	284	25	321	52

Table 3. Number of lake trout captured in each gill net mesh size in Upper Priest Lake, Idaho from May 21 through May 28, 2012.

Mesh Size (in.)	Number Captured	Effort (m)	Mean Length (TL mm)	Range (mm)	% of Catch	% of Effort
44mm (1.75")	2447	13167	258	195-750	45.70	27.27
50mm (2")	1889	13167	281	200-775	35.28	27.27
56mm (2.25")	276	4389	326	245-710	5.15	9.09
63mm (2.5")	669	13167	348	222-915	12.49	27.27
75mm (3")	74	4389	514	300-788	1.38	9.09
Total:	5355	48280	-	-	100.00	100.00

Table 4. Total number of lake trout captured by date, water temperature (°C) and sex during the netting in the Priest Lake Thorofare in 2012.

Date	Water Temperature	N	Males	Females
9/21/2012	15.5	0	-	-
9/24/2012	15.5	0	-	-
9/27/2012	14.5	0	-	-
10/1/2012	13.9	0	0	0
10/5/2012	10.6	3	2	1
10/9/2012	10.3	1	0	1
10/11/2012	12.8	13	5	8
10/15/2012	12.2	16	7	9
10/18/2012	10.8	25	8	17
10/22/2012	8.9	26	7	19
10/25/2012	8.5	13	6	7
10/29/2012	7.9	14	6	8
11/2/2012	-	73	35	38
11/5/2012	-	50	20	30
11/9/2012	5.6	34	11	23
11/13/2012	-	29	13	16
11/19/2012	-	8	4	4
TOTAL		305	124	181

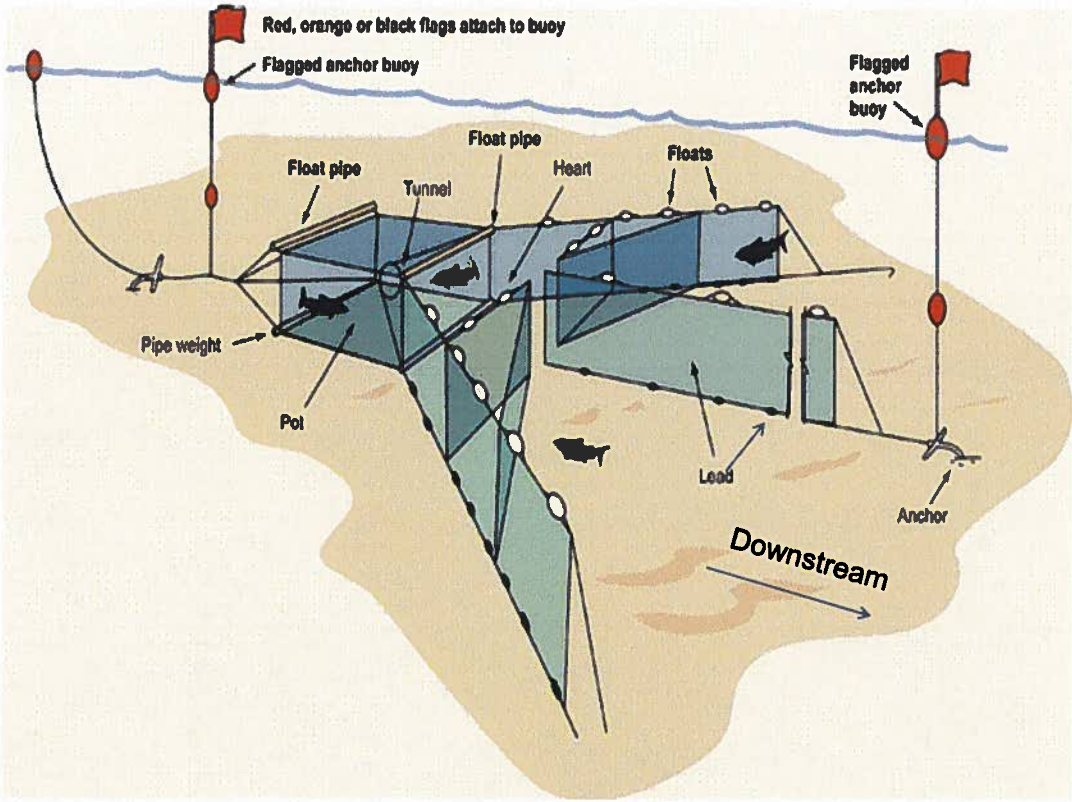

Figure 1. Illustration of a trap net used in the Priest Lake Thorofare. Image redrawn from one provided by the University of Wisconsin Sea Grant Advisory Services.

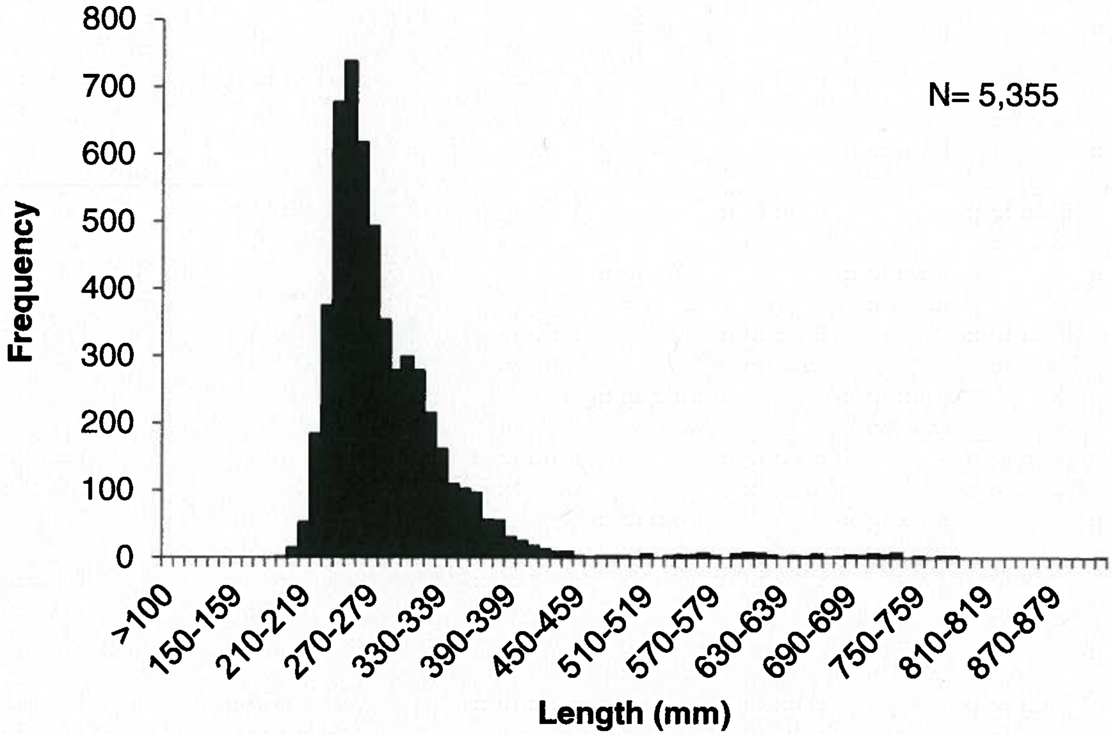

Figure 2. Length frequency of lake trout caught in gill nets in Upper Priest Lake, Idaho, from May 21 through May 28, 2012.

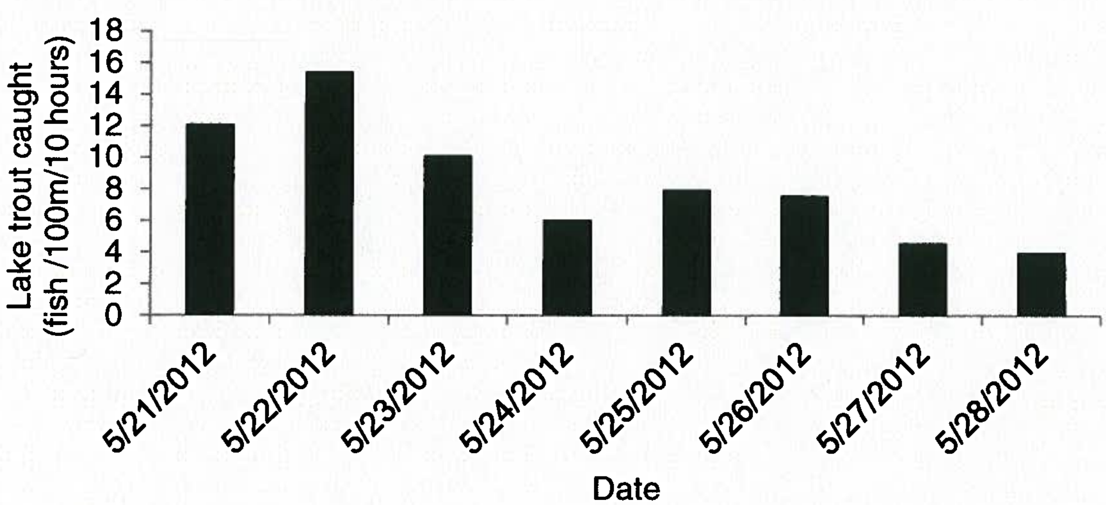

Figure 3. Catch-per-unit-effort (CPUE) of lake trout caught per day over 8 days of sampling by gill nets in Upper Priest Lake, Idaho from May 21 through May 28, 2012.

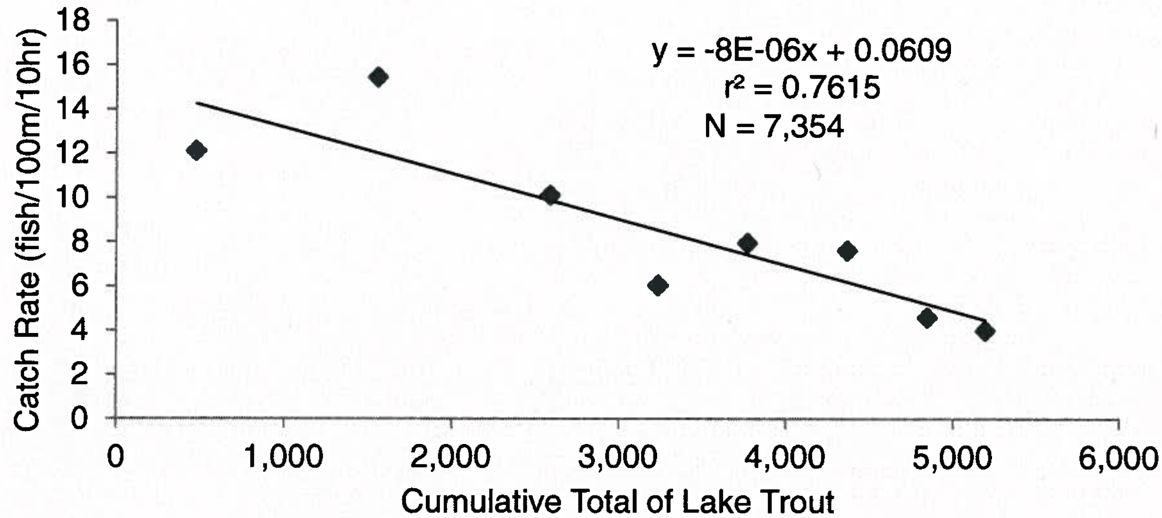

Figure 4. Leslie Depletion Model (Ricker 1975) abundance estimate for lake trout captured by gill nets in Upper Priest Lake, Idaho from May 21 through May 28, 2012.

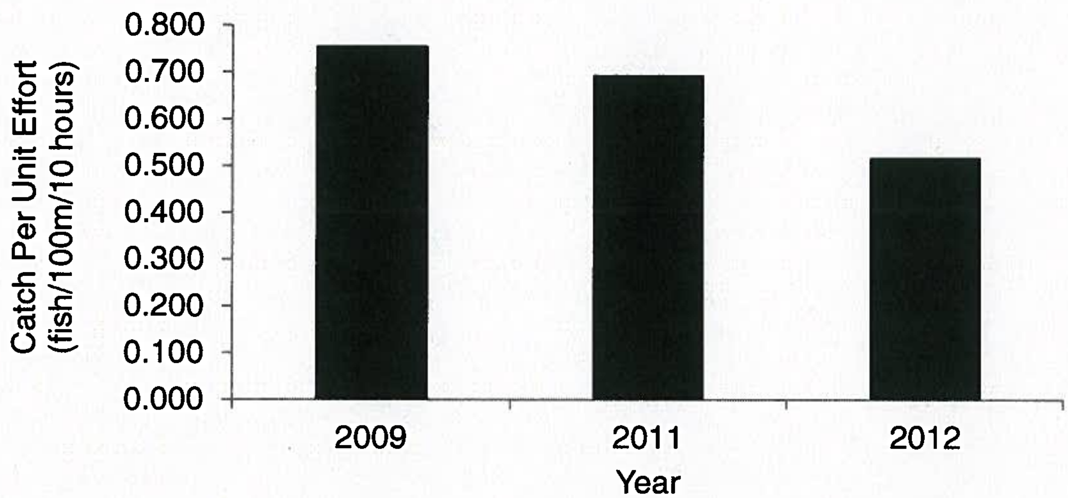

Figure 5. Catch per unit effort (fish/100m/10 hours) of lake trout captured in 6 and 7.6cm mesh gill nets in 2009, 2011 and 2012 in Upper Priest Lake, Idaho.

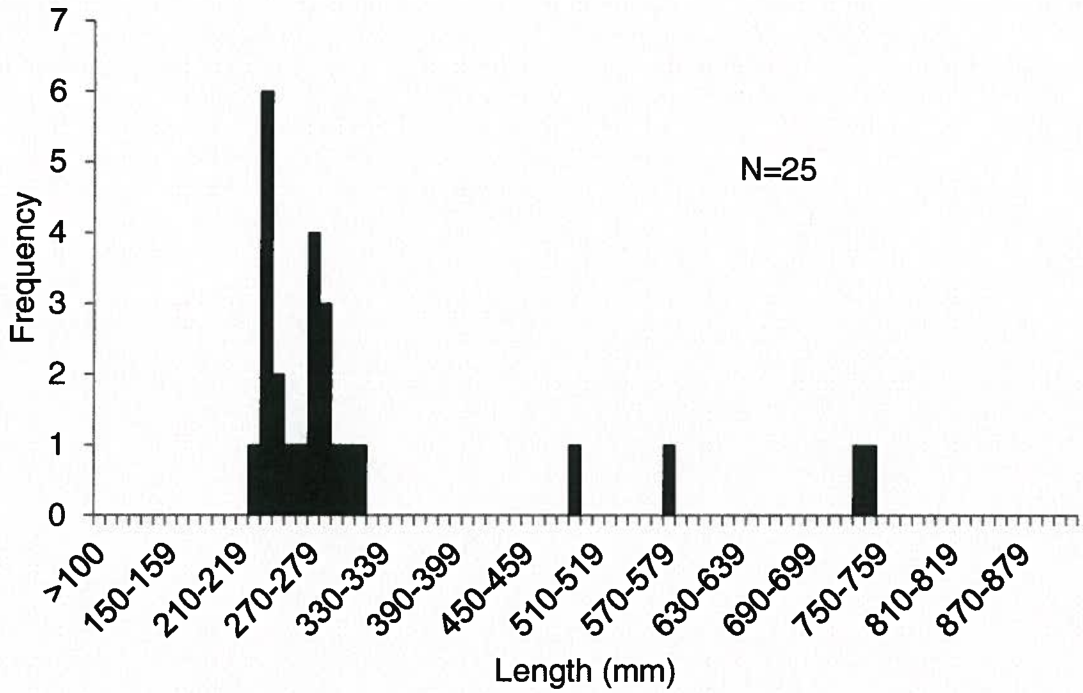

Figure 6. Length frequency of bull trout caught in gill nets in Upper Priest Lake, Idaho, from May 21 through May 28, 2012.

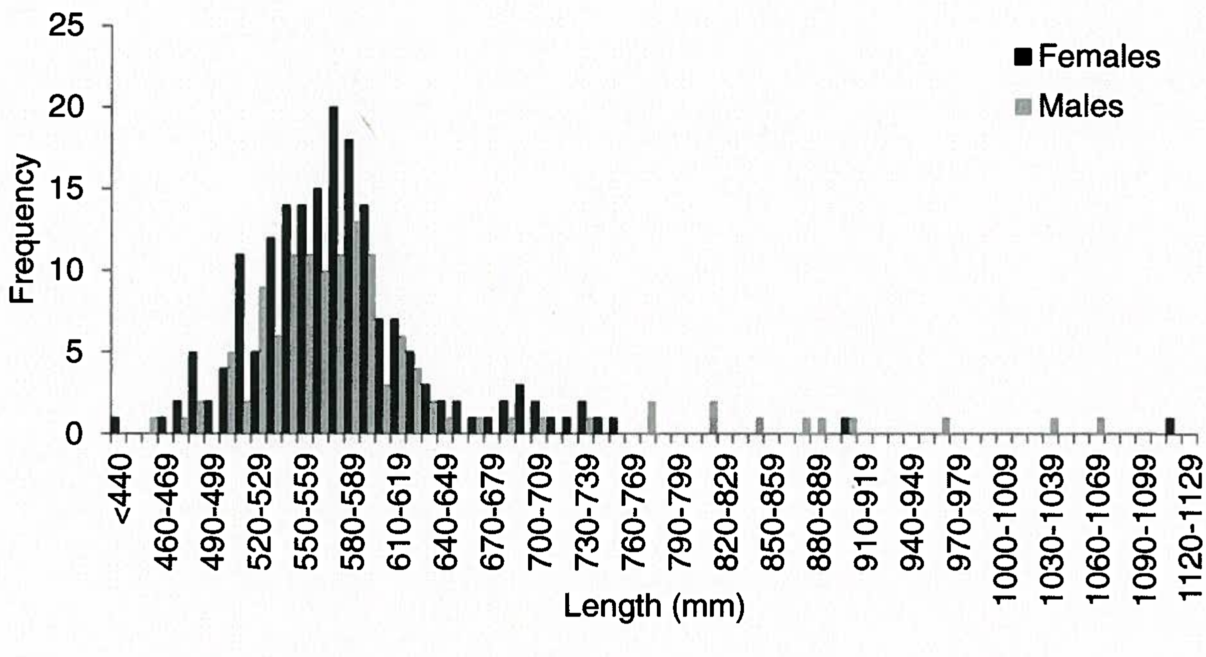

Figure 7. Length frequency of lake trout caught in trap nets during the Priest Lake Thorofare netting evaluation September 21-November 19, 2012.

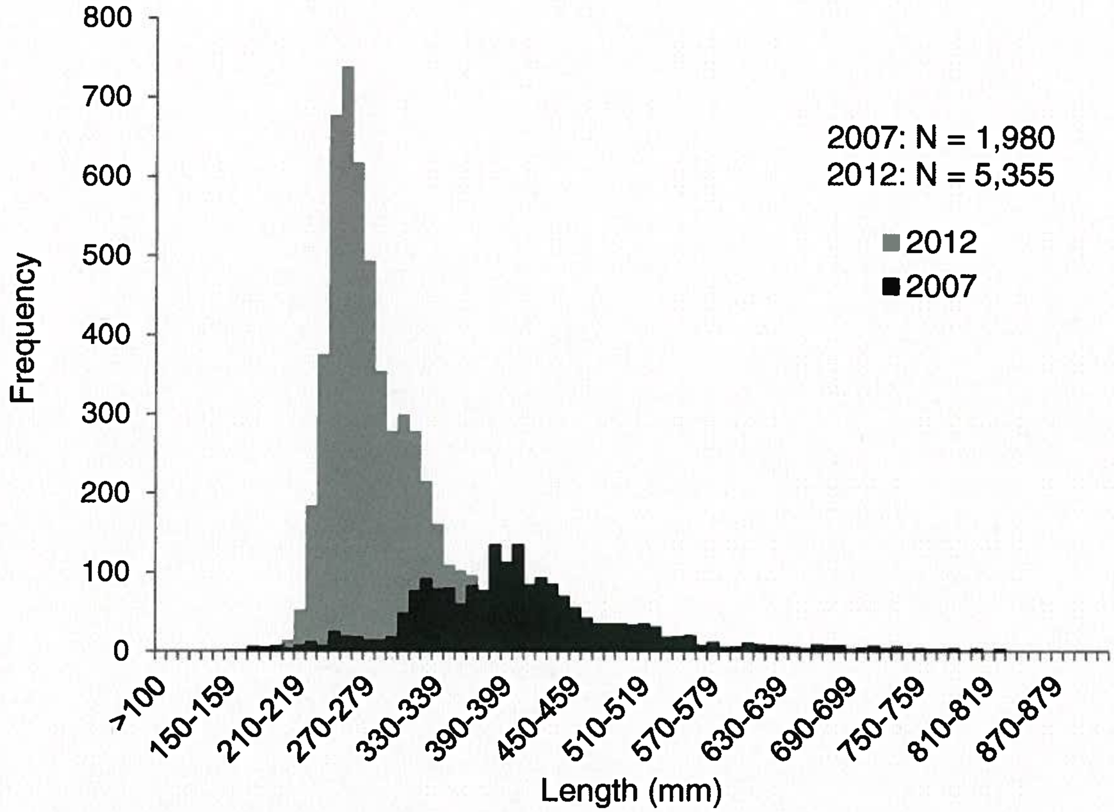

Figure 8. Length frequency of lake trout caught in gill nets in Upper Priest Lake, Idaho, May, 2012 and 2007. Gill netting included the use of smaller mesh nets in 2012.

CHAPTER 4: SPIRIT LAKE KOKANEE

ABSTRACT

Spirit Lake is managed for a high yield kokanee *Oncorhynchus nerka* fishery. Unlike other larger kokanee lakes in Idaho, Spirit Lake does not contain a large population of kokanee predators. It therefore illustrates kokanee population dynamics without top-down effects. During 2012, we monitored the kokanee population solely by hydroacoustic surveys, without the benefit of midwater trawling. We estimated the lake contained 1,307,700 fry (2,235 fry/ha), very similar to the 1,236,000 fry estimated the previous year. We also found the lake contained an estimated 1,207,900 kokanee in the age classes from 1 to 3 (2,065 kokanee/ha). This was a 69% increase from the previous year. Based on these results, Spirit Lake should continue to provide a high yield fishery of relatively small kokanee.

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OBJECTIVE

Maintain a high yield kokanee fishery in Spirit Lake.

INTRODUCTION

Spirit Lake is one of Idaho's top producers of kokanee on an area basis. In fact, Spirit Lake had the highest yield of kokanee (12.7 kg/ha) of any of the 28 kokanee fisheries in northern Idaho, Washington, Oregon, Montana, Utah, Colorado, and British Columbia listed by Rieman and Meyers (1990). It remains a regionally important fishery both during summer and winter, and because of its small size and generally good ice cover, can be a particularly good ice fishery.

Spirit Lake is northern Idaho's only significant kokanee fishery which does not also support a significant population of pelagic predators. As such, Spirit Lake can be viewed as a baseline population to monitor such parameters as survival between year classes, egg-to-fry survival, production, and growth without the effects of predation.

Past management actions have included stocking kokanee fry in the hopes of providing more consistent recruitment and angling. The last stocking was in 2008 when 169,000 early spawning kokanee were stocked. Monitoring in recent years has shown high numbers of adult kokanee and no additional stocking was thought to be necessary. A second management action was the change in harvest limits. Limits were reduced in 2000 from 25 fish to 15 fish to be consistent with the region-wide kokanee limits. We continued our monitoring of kokanee in 2012 to see how kokanee are responding to management changes and determine if kokanee abundance is sufficient to provide good fisheries in future years.

STUDY AREA

Spirit Lake is located near the town of Spirit Lake in the Idaho Panhandle. It has a surface area of 598 ha, with 585 ha of kokanee habitat. Maximum depth of the lake is about 27 m.

For northern Idaho, Spirit Lake is a fairly rich body of water. Chlorophyll 'a' was measured at 5.3 µg/l (Soltero and Hall 1984), total phosphorus was 18 µg/l, Secchi transparency was 3.9 m, conductance was 240 μmhos/cm^2, and the morphoedaphic index was 22.0 (Rieman and Myers 1990). Based on this concentration of total phosphorus, the general level of lake productivity would be classed as meso-eutrophic (Wetzel 1975). This lake also was known to carry the highest standing stock of kokanee in northern Idaho at 54.5 kg/ha (Rieman and Myers 1991). More recent estimates in 2010 using hydroacoustics have raised this estimate to 67 kg/ha (Maiolie et al. in press).

Idaho Department of Fish and Game (IDFG) transplanted kokanee from Lake Pend Oreille to Spirit Lake in the 1930's and 1940's. These fish are genetically most similar to those from Lake Whatcom, Washington (Winans et al 1996). Spirit Lake kokanee are "late spawners" that typically spawn during November through early January on shoreline gravel rather than in tributary streams. During the last decade, early spawning kokanee were stocked in 2000 (200,000 fry), 2001 (198,000 fry), 2004 (200,000 fry), 2007 (163,000 fry) and 2008 (169,000 fry), to ensure adequate recruitment of kokanee fry. No additional kokanee had been stocked in Spirit Lake since 2008.

METHODS

A hydroacoustic survey was conducted on the night of July 11, 2012 to determine kokanee densities. This was the seventh year that a hydroacoustic survey was conducted on Spirit Lake. Methods, equipment, and transect locations were similar to those used since 2009 (Maiolie et al. 2011). We used a Simrad EK60 scientific echosounder with a 6.5° transducer. The transducer was mounted on a pole on the port side of the boat and pointed straight downward. The boat traveled at 7.4 km/h while surveying the lake. Ten evenly spaced transects were established perpendicular to the long axis of the lake, with the original starting point chosen at random (Figure 1).

Similar to all previous years, kokanee densities were estimated by echo integration. We used EchoView software, version 5.2, to calculate nautical area scattering coefficients (NASC) and mean target strengths in situ. NASC values were calculated by drawing a box around the kokanee layer on the volume backscattering (S_v) fileset and having the software integrate backscattering in this region on echoes with a minimum uncorrected target strength (TS) threshold of -66 dB and a maximum threshold of -20 dB. We then created a virtual echogram showing all single target echos with a corrected target strength between -60 dB and -20 dB. The mean TS was calculated from the virtual echogram for each transect. NASC and TS values for each transect were then used to calculate fish densities by the following formula:

$$\text{Kokanee density (fish/ha)} = \frac{NASC}{4\pi 10^{ts/10}} * 0.00292$$

Age-0 kokanee densities were calculated directly from the echograms by including all targets with a corrected TS between -60.0 dB and -49.0 dB. The arithmetic mean density of fry was calculated for the 10 transects and multiplied by the area of the lake (585 ha) to obtain an abundance estimate for fry.

Age-1 and older kokanee overlap in their target strengths and could not be separated on the echograms. We therefore calculated a single density estimate for kokanee from ages 1 to 3 for each transect. The arithmetic mean density for kokanee ages 1 to 3 was calculated for the 10 transects and multiplied by the area of the lake to obtain an abundance estimate. No trawling was conducted in 2012. So unlike past years we could not separate this group of kokanee into individual age classes based on their percentage in the trawl catch.

The 90% confidence limits were calculated by the methods used the previous years (Maiolie et al. 2011). Since the data set was small (n=10) and skewed (contagious distribution), we log transformed the density estimates (Log_{10}+1), calculated the error bounds, then retransformed the data as in Elliott (1983). The log transformed confidence interval was then placed around the arithmetic mean density.

RESULTS

Two size groups of kokanee were noted based on target strengths, which corresponded to fry and all other age classes (Figure 3). Based on this distribution, we divided fry from older age classes of kokanee at -49.0 dB. The modal length of fry was -52.5 dB or about 39 mm [based on Love's (1971) equation].

Kokanee were unevenly distributed around the lake. The highest density estimate of fry was seen on the western end of the lake (transect 1), where densities of fry reached 8,700 fry/ha (Table 1). The highest density estimate of the older age classes of kokanee was seen in the central part of the lake (transect 5), where densities reached 4,500 kokanee/ha.

We estimated that Spirit Lake contained 1,307,700 age-0 kokanee (2,235 fry/ha) (90% CI, -37% to +59%), and 1,207,900 age-1 through 3 kokanee (2,065 fish/ha) (90% CI, -27% to +37%) (Table 2). Total population estimate of all kokanee was estimated at 2,515,600 (4,300 kokanee/ha) with a 90% C.I. of -25% to +34%.

DISCUSSION

The kokanee population in Spirit Lake has increased greatly in recent years. Concerns were raised by anglers during the winter of 2007-2008 and the spring of 2008 that the kokanee fishery had declined. Monitoring during July 2007 indicated a relatively low number (90/ha) of age-2 kokanee entered the fishery that fall. Since then, both winter and summer fisheries appear to have improved. Population estimates based on hydroacoustics (Table 2) showed consistently higher densities of age-2 kokanee since 2007.

Kokanee creel limits were reduced from 25 fish to 15 fish in 2000. This seemed to have the desired effect as kokanee numbers rebounded by the next population estimate in 2005 (Maiolie et al. 2011). Since this time overall kokanee numbers have increased. Total density estimates of over 4,000 kokanee/ha were very high compared to other Idaho water bodies.

The early spawning kokanee that were last stocked in Spirit Lake in 2008 were likely gone from the system by 2012. Only three adults of the early spawning strain were collected by trawling the lake in 2011 (Maiolie and Fredericks, in press). All were age-3 indicating that a few fish of this strain may mature a year later than most. All kokanee in the lake during 2012 would therefore have been from natural reproduction. We recommend looking for early spawning fish in the trawl catch or in Brickle Creek in future years to see if the early spawning strain of kokanee has become established.

NASC values are a sum of the areal backscattering of fish in the analyzed kokanee layer (Simmonds and MacLennan 2005). Figure 4 compares NASC values for kokanee surveys for several lakes in Idaho. These data indicated Spirit Lake had a relatively high mass of kokanee for waters in northern Idaho. Only Anderson Ranch Reservoir in southern Idaho had a higher NASC value during our recent surveys. NASC values are a measurement of area of the targets, and so may not directly correlate with fish biomass when comparing bodies of water. It does however show that Spirit Lake had considerably more kokanee than some of these other systems.

MANAGEMENT RECOMMENDATIONS

1. Monitor the contribution of early spawning kokanee in the trawl catch during future years to see if a self-sustaining population has developed.

2. No supplemental stocking of kokanee is recommended at this time.

3. Consider increasing the kokanee creel limit to 25 fish during the next rule making cycle.

Table 1. Density estimates of kokanee and unknown larger fish in Spirit Lake on July 11, 2012 based on a hydroacoustic survey.

Transect number	Depths analyzed (m)	Number of single targets	Number of pings	NASC	Mean TS (dB)	Total density (fish/ha)	% Fry	Fry density (fish/ha)	% Age 1-3	Age 1-3 density (fish/ha)	Percent fish >-33dB	Density of fish >-33dB	Mean length (mm)
1	6-18	3,127	3,002	516	-48.9	9578	91%	8,711	9%	860	0.00%	0	60
2	7-18	2,364	2,965	623	-45.5	5076	69%	3,489	31%	1,587	0.00%	0	91
3	7-20	1,326	1,982	788	-42.7	3424	30%	1,025	70%	2,399	0.00%	0	127
4	7-21	1,904	3,086	824	-42.1	3139	22%	689	78%	2,450	0.00%	0	136
5	7-20	3,178	2,788	1,515	-42.6	6459	30%	1,949	70%	4,508	0.03%	2.0	128
6	7-20	1,822	4,247	519	-42.9	2370	38%	890	62%	1,480	0.00%	0	124
7	7-22	1,102	2,156	628	-42.4	2534	30%	759	70%	1,775	0.00%	0	132
8	7-21	585	1,717	280	-44.4	1812	54%	969	46%	842	0.00%	0	103
9	7-20	1,111	2,425	561	-44.5	3640	63%	2,277	37%	1,363	0.00%	0	103
10	7-21	2,999	3,961	1,350	-42.0	4980	32%	1,596	68%	3,384	0.00%	0	138
Mean				760	-43.6	4301	46%	2,235	54%	2,065	0.003%	0.2	114

Table 2. Kokanee population estimates based on hydroacoustic surveys in Spirit Lake, Idaho 2004-2012. NASC is the nautical area scattering coefficient and TS is the target strength.

	Age Class									
Year	Eggs	Age-0	Age-1	Age-2	Age-3	Total of ages 1-3	Total kokanee	Age 3/ha	Mean NASC	Mean TS
2012[a]	-	1,307,700	-	-	-	1,207,900	2,515,600	-	760	-43.60
2011	13,700,000	1,236,400	209,200	430,700	73,800	713,700	1,950,200	126	600	-43.99
2010	17,000,000	366,800	587,000	113,400	78,600	779,000	1,145,800	134[b]	646	-41.34
2009	12,400,000	567,500	345,100	142,400	60,200	547,700	1,115,200	103[b]	448	
2008	11,300,000	553,500	292,500	198,700	60,700	551,900	1,105,400	103	505	
2007	5,490,000	495,900	266,900	52,500	25,900	345,300	841,200	44	494	
2005-06	-	-	-	-	-	-	-	-	-	
2004[a]	-	279,000	-[a]	-[a]	-[a]	637,800	916,800	-	458	

[a] No trawling was conducted in 2004 and 2012 to delineate kokanee in age classes 1 to 3.
[b] Does not include mature age-2 kokanee that were of similar size to age-3 late spawners.

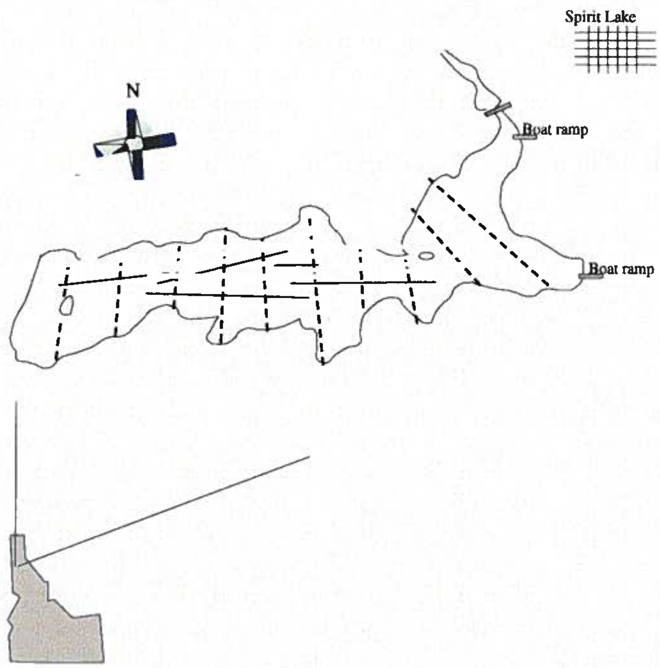

Figure 1. Location of ten hydroacoustic transects (dashed lines) used to estimate kokanee population abundance in Spirit Lake, Idaho during 2012.

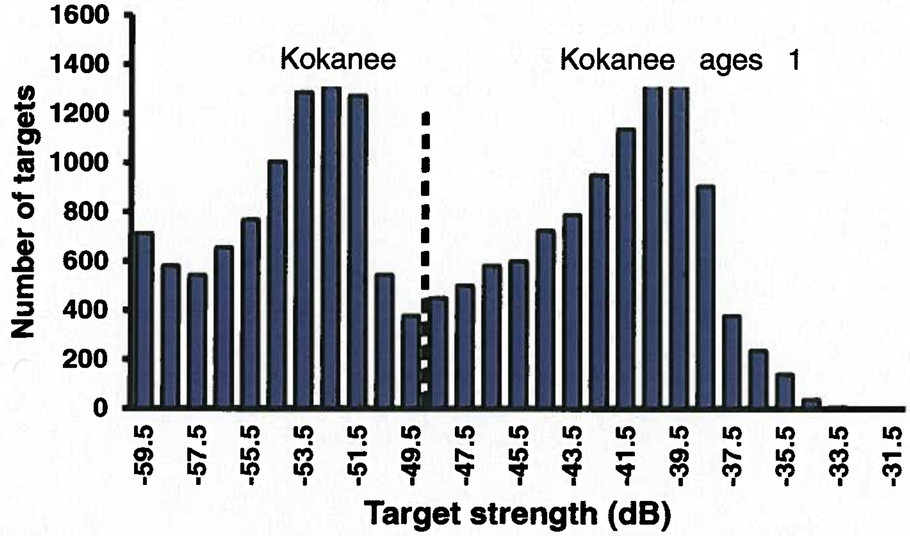

Figure 2. Target strength-frequency distribution of kokanee in Spirit Lake, Idaho, on July 11, 2012. Kokanee fry were separated from older age classes at a target strength of -49.0 dB.

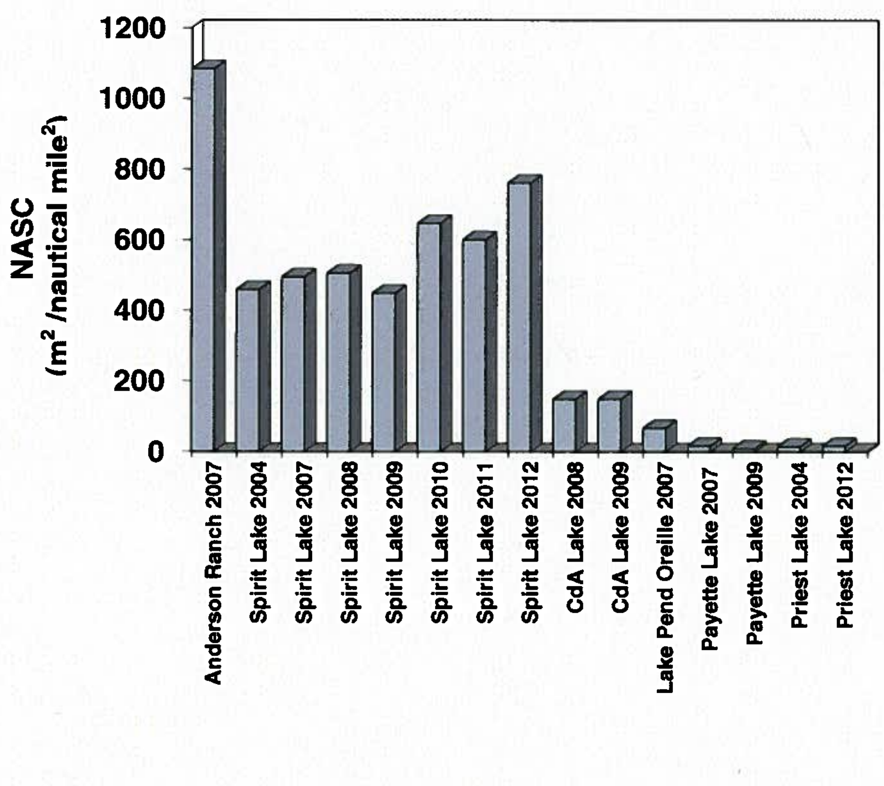

Figure 3. Nautical area scattering coefficients (NASC) for several lakes and reservoirs in Idaho.

CHAPTER 5 - HIGH MOUNTAIN LAKE SURVEYS

ABSTRACT

During 2012, we attempted to survey the amount of fishing pressure and harvest on five high mountain lakes in the Little North Fork Clearwater River drainage. We tested the novel approach of using trail cameras to take a picture of the lake's shoreline at 5 min intervals throughout the day during the entire summer. We also set one trail camera to photograph hikers on their way to, and from, one of the lakes. Each camera stationed at a high lake malfunctioned and stopped taking pictures at the specified 5 min interval, but would restart once triggered by motion, and then periodically quit again. If photographs could be considered instantaneous counts, we estimated 11 h of fishing pressure on Fish Lake, 55 h on Lost Lake, 14 h on Noseeum Lake, 1 h on Steamboat Lake and 0 h on Little Lost Lake at one section of shoreline on each lake. The camera on the trail to Fish Lake showed that 43 people visited the lake, with most staying less than 1 h. We attempted to estimate harvest by placing a box containing postcards for anglers to fill out at the trailhead to each of these lakes as well as Big Talk Lake. Only six postcards were filled out and returned to us indicating a total of 22 cutthroat trout *Oncorhynchus clarkii* had been caught, for a catch rate of 1.0 fish/h.

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INTRODUCTION

During 2012 we attempted to estimate angler use on several high mountain lakes in the Little North Fork (LNF) Clearwater River drainage. Each of these lakes has a hiking trail to the lake, but it was unknown how often they were fished. Because of the remoteness of the lakes and the expected light fishing pressure, doing a traditional creel survey was not attempted. Instead, we tried a novel approach of using trail cameras to photograph the lakes. We could then look through the photographs at the end of summer and estimate fishing pressure. This was our first attempt at using this approach on high mountain lakes.

STUDY SITE

The lakes we examined included Fish Lake (2.4 ha, 3.7 m maximum depth), Lost Lake (1.8 ha), Little Lost Lake (1.3 ha, maximum depth 4.1 m), Noseeum Lake (2.2 ha), Steamboat Lake (3.2 ha), and Big Talk Lake (1.9 ha). These lakes are in the Little North Fork Clearwater River drainage. Fish, Lost and Little Lost lakes are in the upper end of the drainage. Noseeum and Steamboat lakes are located on tributaries to Butte Creek which flows into the LNF Clearwater River towards the middle of the drainage. Big Talk Lake is located on a tributary to Foehl Creek which flows into the LNF Clearwater River at the lower end of the drainage. Elevation of these lakes are between 1,650 m and 1,800 m. Due to the elevation, these lakes had a short recreation season and the trails to the lakes were still partially snow covered in early July 2012.

Five of the six lakes contained salmonids during 2012. Idaho Department of Fish and Game (IDFG) routinely stocked westslope cutthroat trout *Oncorhynchus clarkii lewisi* fingerlings in Noseeum Lake and Big Talk Lake. Steamboat Lake had been stocked with Arctic grayling *Thymallus arcticus.* Fish Lake and Lost Lake contained naturally reproducing populations of cutthroat trout. Little Lost Lake was thought to be fishless during surveys in 1992 (Raleigh Consultants 1992) and no evidence of fish were seen during this study.

OBJECTIVES

A statewide objective for the management of high mountain lakes includes “maintain a diversity of fishing...opportunities” (IDFG 2005). In addition high mountain lakes in the Clearwater River drainage have the stated objective of “maintain catch rates of 0.5 to 1.0 fish/hour” (IDFG 2007). This report outlines our efforts to assess the fisheries on these six high mountain lakes to see if the objectives were being met.

METHODS

We used Bushnell Trophy Cam™ HD cameras to photograph anglers on five high mountain lakes; Fish, Lost, Little Lost, Noseeum, and Steamboat lakes. The cameras were locked to a tree and pointed across the lake to a section of shoreline that appeared to have the most use by fishermen. Cameras were set to take a picture every 5 minutes between 0500 and 2100 h each day. The date and time was recorded on each picture and pictures were set to a resolution of 5 megapixels. On this model of camera there was no way to shut off the motion sensor so pictures during the day or at night were taken when movement was detected.

The cameras were placed at Fish Lake on July 3, at Lost and Little Lost lakes on July 10, and at Steamboat and Noseeum lakes on July 12. All of the cameras were recovered on September 5th and 6th, 2012. We checked each camera once during summer to see if settings were correct and determine if pictures were being taken.

We expanded the counts of people seen in the photographs to make an estimate of angling pressure on the lake. All people standing on the shoreline were considered anglers for this calculation even if angling gear could not be resolved in the photographs. Counts were stratified by weekend and weekday, and by month (Malvestuto 1985). The mean angler count on each day was multiplied by the mean hours of daylight for that month to get angler hours for that day. Fishing pressure on each day type was averaged for each month and multiplied by the number of each day type during the month. On two occasions, no photographs were taken on weekend days during a month. On those occasions we expanded the mean estimate for fishing pressure for weekdays multiplied by the days in the month to get a monthly estimate of pressure. Estimates of fishing pressure were summed for all of the months to get a total estimate for a lake during the period the cameras were deployed.

We also set one camera on the trail about 100 m from Fish Lake. This camera was set to only take pictures when motion activated. The hope was to use this camera to determine the length of time anglers were at the lake by keeping track of their hikes up and down the trail. The time stamp on their photographs was used to determine the length of time they spent at the lake.

As a second part of the study, we attempted to gather information on angler catch and harvest by placing a "post card box" at the trailhead to each of the six lakes. Boxes were placed at the trailheads to Fish, Lost, Little Lost, Noseeum and Steamboat lakes on June 29, 2012. Because of downed trees preventing road access, a post card box was not placed at Big Talk Lake until August 15, 2012. A steel post was driven into the ground about 100 m up the trail to the lakes. On each post was hung a wooden box with a hinged lid. On the box was the text "Anglers please help by filling out one card from inside this box" and then the logo for IDFG. Inside the wooden box was a plastic bag containing postage paid postcards addressed to IDFG. On the back of the postcard were the following questions: 1) What lake did you fish, 2) on this trip how many days did you fish, 3) dates, 4) how many hours did you fish each day, 5) how many fish did you catch and release and what kind, 6) how many fish did you keep and what kind, 7) your name (optional), and 8) your contact phone number (optional)? Above the questions was a short explanation of why this creel survey was important and a note that filling out the card was important even if they did not catch any fish. Boxes at all lakes were picked up on September 5th and 6th, 2012.

RESULTS

All of the cameras placed at the lakes failed to take pictures as set. They all started taking pictures at 5 min intervals, but quit after a few days of taking pictures. At some point days or weeks later, they started taking pictures again, which appeared to be triggered by the motion sensor. The cameras quit and restarted several times over the course of the summer. A total of 10,739 photographs were taken by the five cameras located at the five lakes (Table 1). The number of days that cameras operated over the course of the summer were: 34 days on Fish Lake, 29 days on Lost Lake, 17 days on Noseeum Lake, 9 days on Steamboat Lake, and 4 days on Little Lost Lake (Table 1).

With such intermittent sampling, creel survey results were very questionable. An additional problem was that fishing rods could not always be seen in the photographs so that pressure estimates included people who were standing on the lakeshore but not fishing. However, we calculated fishing pressure as if each photograph was an instantaneous count and all people were anglers. On Noseeum Lake during July and Steamboat Lake during August, there were no photographs taken on weekend days. Estimated effort therefore was based on weekdays but expanded to a monthly estimate. The highest estimate of "fishing" effort was on Lost Lake with a total of 55 h. Second highest was Noseeum Lake with 14 h, then Fish Lake with 11 h, Steamboat Lake with 1 h, and 0 h at Little Lost Lake (Table 1). Fishing pressure was generally inversely proportional to the distance to the lake from the end of the trail open for motorized travel.

The camera on the trail to Fish Lake recorded 43 people traveling to, or from, the lake. Thirty of the people could be seen in photographs traveling in both directions so it was possible to calculate their length of stay at the lake. Twenty eight of the people stayed at the lake less than 1 h (mean time 33 min), and two people stayed for 47 h. Four of the people (10%) could be seen carrying fishing rods or rod cases. Others could have had fishing gear hidden from view, so we did not separate anglers from non-fishermen. The mean time at the lake for all 30 individuals (excluding night-time for overnight campers) was 2.57 h. This value times the 48 individuals (includes those seen only coming or going) that visited the lake yielded an estimate of 123 visitor hours at Fish Lake. Angling time would have been some unknown fraction of the estimate of visitor hours.

Only six postcard surveys were completed by anglers (Table 2). Three of the surveys were completed for trips to Fish Lake, one on Noseeum Lake, one on Lost Lake, and one on Noseeum and Steamboat Lake combined. No cards were returned from Big Talk Lake or Little Lost Lake. The mean catch rate for all six of the returned cards was 1.0 fish/h. One card from Fish Lake may have been more than a single angler since they reported harvesting 18 cutthroat trout and releasing 20 cutthroat trout during 2 h.

DISCUSSION

Remote cameras may be an effective, low-labor method of obtaining angler information for high mountain lakes. However, several problems need to be overcome. First, a different brand of camera would need to be chosen that could keep taking pictures at the specified intervals. We do not recommend using the Bushnell Trophy Cam™ HD for this application since all five cameras placed at high-mountain lakes quit operating as setup in 3 days or less. Secondly, three or four cameras may be needed per lake to cover all of the access points for fishing. Lastly, we recommend placing cameras close to the fishing areas so that fishing rods can be seen in the photographs. Many of the visitors to these high lakes were not carrying fishing gear based on the trail camera. With multiple cameras, a total estimate of fishing pressure may be possible.

Trail cameras placed on the trails appeared to be an effective method to obtain a count of "visitor days" at each lake. Some anglers could be seen carrying a fishing rod, but others may have fishing gear hidden from view in backpacks. So it was impossible to know if visitors were anglers. The method also would not distinguish "visitor time" at the lake from "angling hours" while actively fishing. Therefore it would not be a good method to determine actual amounts of angling time. In general though, if visitor hours to a high mountain lake are very low, angler hours could only be lower and this index may suffice for managers to know if a lake is being fished enough to affect the fish populations.

Angling effort on this series of high lakes appeared low, although the non-random, intermittent sampling, and low return of postcards, makes any conclusions difficult.

MANAGEMENT RECOMMENDATIONS

1. Cameras at high lakes should be placed close to prominent fishing spots so that anglers in the process of fishing can be identified. Three to four cameras may be needed to cover all the prominent fishing spots around the lake.

2. Cameras placed on access trails may provide valuable information on the number of visitors to a lake and give a general index of the amount of public use.

3. Until better information is available, stocking these lakes should be based on achieving the density of fish that will allow them to grow to catchable size. It appeared doubtful that stocking would need to consider angler exploitation as a factor determining sportfish population abundance.

ACKNOWLEDGEMENTS

The authors wish to thank the following people for their assistance in setting the cameras and looking through the thousands of photographs to count the people: Kelly Carter-Lynn, Chaz Lawson, and Christopher Wilson. We also wish to thank the people involved with the Bureau of Land Management's Challenge Cost Share Program for the funding assistance for this work.

Table 1. Estimated fishing effort at five high mountain lakes based on photographs of trail cameras. Each trail camera malfunctioned and did not take pictures at 5 minute intervals as programed. Estimated hours of effort are for one section of shoreline on each lake, using the available photographs as an instantaneous count.

Lake	Month	Number of days sampled	Number of photos taken	Number of anglers in photos	Weekend days sampled (yes/no)	Estimated Hours of Effort (+/- 95% CI)	Percent of total estimated effort
Fish Lake	July	10	1254	0	yes	0	0
	August	19	3431	2	yes	0.26 (0.08)	2
	September	5	875	32	yes	10.39 (0.72)	98
	Total	34	5560	34		10.65 (0.73)	100
Little Lost Lake	July	1	90	0	-	-	-
	August	2	3	0	-	-	-
	September	1	1	0	-	-	-
	Total	4	94	0	-	-	-
Lost Lake	July	7	747	1	yes	0.53 (.19)	1
	August	15	874	20	yes	54.70 (14.67)	99
	September	7	8	0	yes	0	0
	Total	29	1629	21		55.23 (14.68)	100
Noseeum Lake	July	8	850	19	no	13.69 (2.04)	100
	August	9	1145	0	yes	0	0
	September	1	16	0	yes	0	0
	Total	17	2011	19		13.69 (2.04)	100
Steamboat Lake	July	3	410	2	yes	1.16 (0.29)	100
	August	6	1005	0	no	0	0
	September	1	30	0	yes	0	0
	Total	9	1445	2		1.16 (0.29)	100

Table 2. Results of angler survey postcards placed on trailheads to six high mountain lakes. All fish reported were cutthroat trout.

Lake	Number of postcards returned	Hours fished	Number of fish caught and released	Number of fish harvested	Catch rate (fish/h)
Fish Lake	3	7	21	18	3
Lost Lake	1	1.5	1	1	0.7
Little Lost Lake	0	-	-	-	-
Noseeum Lake	1	1	4	0	4
Steamboat and Noseeum Lake	1	6	0	0	0
Big Talk Lake	0	-	-	-	-
Total	6	25.5	26	19	
Mean catch rate for all lakes					1.0

CHAPTER 6 - EXPLOITATION OF HATCHERY TROUT IN LOWLAND LAKES

ABSTRACT

In 2012 we evaluated the harvest rate of stocked, catchable-sized rainbow trout *Oncorhynchus mykiss* in Calder Pond, Clee Creek Pond, Day Rock Pond, Gold Creek Pond, Lucky Friday Pond and Steamboat Pond. Five hundred fifty-nine rainbow trout were tagged with Floy T-bar anchor tags and released with each lake receiving 85-100 tagged fish during May 2012. As of February 13, 2013, angler exploitation rates for hatchery rainbow trout were estimated to range from a low of 0% in Gold Creek Pond to a high of 58% in Day Rock Pond. Day Rock Pond was the only pond that exceeded the objective of a 40% angler exploitation rate.

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INTRODUCTION

In Idaho, approximately 15 million trout are produced annually in 13 hatcheries by Idaho Department of Fish and Game (IDFG) for angling. Rainbow trout *Oncorhynchus mykiss* and cutthroat trout *O. clarkii* are most often stocked in Idaho's reservoirs and streams where habitats are not capable of supporting wild production sufficient to meet angler demand (IDFG 2007). Catchable rainbow trout raised for put-and-take use in the Panhandle Region are usually Trout Lodge or Hayspur strain raised at Mackey, Grace or Nampa Hatcheries. The fish are transported to either Sandpoint or Mullan Hatcheries, and then distributed throughout the spring and summer. The Trout Lodge strain is used throughout the Panhandle Region for a variety of reasons including availability, growth, feed conversion and disease resistance. Only triploid (i.e. sterile) rainbow trout were stocked in the Panhandle Region in 2012. The cost of production and distribution to lakes in the Panhandle Region from the Mullan and Sandpoint hatcheries averaged $1.41 and $0.83 per catchable, respectively.

OBJECTIVE

IDFG's objectives for its hatchery trout program included providing angling "opportunities specific to the needs of beginners, youth, people with disabilities and families." Additionally, "put-and-take waters are expected to return 40% of stocked trout to the angler catch" (IDFG 2007). During 2012 we evaluated the return-to-creel for stocking at six lakes in the Panhandle Region.

STUDY SITES

Calder Pond

Calder Pond is a 0.63 ha pond located on the opposite side of the St. Joe River from the town of Calder, Idaho. Calder Pond can be accessed from Calder Road which is 29 km east of St. Maries, Idaho following the St. Joe River Road (NF-50). IDFG manages Calder Pond under general fishing rules and has stocked 1,500-2,300 catchable-sized rainbow trout at the site annually since 2003.

Clee Creek Pond

Clee Creek Pond is a 0.22 ha pond located 44 km north of Kingston, Idaho along the Coeur d'Alene River on Road 208. The site is a developed day use area maintained by the U.S. Forest Service with a small parking area and an outhouse. Access is provided to the pond which is located on the opposite side of Road 208 from the North Fork Coeur d'Alene River. IDFG manages Clee Creek Pond under general fishing rules and has stocked 1,800-2,100 catchable-sized rainbow trout at this site annually since 2003.

Day Rock Pond

Day Rock Pond is a 0.25 ha pond located in the Silver Valley 5.1 km northeast of Wallace, Idaho on Nine Mile Creek. Day Rock Pond is at the junction of Nine Mile Creek and the East Fork of Nine Mile Creek. Maximum depth was roughly 3-5 meters. Day Rock Pond was managed under family fishing water rules and IDFG has stocked 1,300-3,350 catchable-sized rainbow trout into Day Rock Pond annually since 2002. Prior to 2002, varying strains of domestic and unspecified rainbow trout were stocked into the pond dating back to 1996.

Gold Creek Pond

Gold Creek Pond is a 0.3 ha pond located at exit 66 off of I-90 traveling east only. The site is less than 5 km west of the town of Mullan, Idaho. Gold Creek Pond is managed under general fishing rules. IDFG stocking records dating back to 1968 indicate extensive fish stocking in Gold Creek Pond. Various stocks and sizes (catchables and adults) of rainbow trout including domestic Kamloops, Hayspur, Mt. Lassen, Trout Lodge triploid and several unspecified stocks of rainbow have been stocked since 1968. Rainbow trout stocking rates have varied from 200 to 2,600 fish per year.

Lucky Friday Pond

Lucky Friday Pond is a 0.65 ha pond located on Larson Road 0.48 km from Friday Avenue. The site is accessed from the Lucky Friday Mine site, east from Mullan, Idaho at exit 69 off of I-90. Lucky Friday Pond is managed under general fishing rules. IDFG stocking records date back to 2001 with domestic Kamloops being stocked in 2001 only. Triploid Trout Lodge Kamloops have been stocked annually since 2003 with stocking rates varying between 1,300 and 4,000 fish per year.

Steamboat Pond

Steamboat Pond is a 1.03 ha pond located next to the North Fork of the Coeur d'Alene River. The pond is approximately 18 km north of the Kingston exit off of I-90 on Forest Highway 9. Steamboat Pond is managed under family fishing water rules with a parking area and restrooms available at the site. Steamboat Pond has high banks with some eroded areas. In 2012 the North Idaho Fly Casters and IDFG partnered to improve angler access at the site. Three fishing access points were added, trail building was done on the south side of the pond, and a grant was secured to build three 4 m wide platforms to make the site more easily accessible. IDFG has stocked 3,500-7,000 rainbow trout into Steamboat Pond annually since 2003.

METHODS

We tagged a total of 559 Trout Lodge strain rainbow trout with Floy T-bar anchor tags and released them in Calder, Clee Creek, Day Rock, Gold Creek, Lucky Friday and Steamboat ponds. Each lake was stocked with 85-100 tagged fish during May 2012.

All fish used in this study were raised at the IDFG Nampa Hatchery then transferred to the Mullan Hatchery. On the day of stocking, trout were crowded, a random selection was tagged with Floy T-bar anchor tags, and they were loaded into the fish transport truck for stocking. The Floy tags were inserted just below the dorsal fin. Tags were labeled on two sides with one side stating “IDFG 1-866-258-0338” and the other side with a tag number. IDFG operates a toll free automated hotline and website through which anglers could report tags, although some tags were mailed in or dropped off at the Panhandle Regional Office. Additionally IDFG distributes posters and stickers to license vendors, regional offices and sporting goods outlets that explain the tagging effort, how to report tags, and how the information is used.

To determine angler exploitation, the number of fish harvested by anglers (determined by tag returns) was divided by the number of fish we tagged. We assumed a 53% reporting rate, which is typical of non-reward tags (Meyer et al. 2010), and adjusted the return rate accordingly to provide an exploitation estimate. Tag loss was assumed to be 8.2% while tagging mortality was assumed to be 3% based on work conducted on rainbow trout by Meyer et al. (2010).

RESULTS

Through February 13, 2013 the number of tag returns per lake ranged from 0 at Gold Creek Pond to 31 from Day Rock Pond (Table 1). Through the same time period, anglers reported catching 16, 8, 4, and 2 of the 370 tagged rainbow trout stocked in Lucky Friday, Clee Creek, Steamboat and Calder Ponds, respectively. After correcting for the angler report rate, tag loss, and tagging mortality, angler exploitation was estimated to range from a low of 0% for Gold Creek Pond to a high of 58% for Day Rock Pond during 2012 (Table 1). Statewide estimates made in 2009 determined that methods used by anglers to report tag returns were broken down as follows: the tag return 1-800 hotline (48%), website (45%), by mail (2%) and returned to the regional office in person (5%) (Meyer et al. 2010).

DISCUSSION

Day Rock and Lucky Friday Ponds were in the upper end of exploitation rates reported for other Idaho lakes and reservoirs. On average, exploitation for hatchery rainbow trout across Idaho lakes and reservoirs from 2006-10 was 15.9%, and ranged from 0-79% (Meyer et al. 2010).

We found that Calder, Clee Creek, Gold Creek, Lucky Friday, and Steamboat Ponds were not meeting the objective of 40% returns of stocked trout. Nevertheless, returns in Lucky Friday Pond were above the state average based on the estimates from Meyer et al. (2010). Day Rock Pond was the only pond of the six ponds evaluated in 2012 that met or exceeding the 40% objective. Additionally, we felt that our objective to provide opportunities for beginners, youth, people with disabilities and families was being met. Continued access site improvements such as those at Steamboat Pond and stocking at sites that have exploitation rates within the IDFG objectives are providing opportunities to the desired demographic.

In 2013 we will continue our assessment of catchable rainbow trout return-rates in Panhandle Region lakes and reservoirs. Stocking rates may be adjusted based on established stocking criteria which included impacts to native fish, accessibility, return to creel rates, catch rates and the ability of a water body to provide a fishery without stocking.

MANAGEMENT RECOMMENDATIONS

1. Periodically recheck exploitation rates to see if return-to-creel has improved.

2. Re-allocate trout stocking from ponds with the lowest exploitation to ones with better return rates.

3. Continue to seeking funding for access site improvements. Improving the angler access at some ponds may help boost exploitation rates.

Table 1. Estimates of angler exploitation for hatchery rainbow trout at various Panhandle Region ponds that were examined in 2012.

Pond	Number of Tags	Tags Returned by February 13, 2013	Corrected Exploitation Rate (%)
Calder	85	2	4.5
Clee Creek	100	8	9.6
Day Rock	90	31	57.5
Gold Creek	99	0	0
Lucky Friday	98	16	29.3
Steamboat	87	4	8.8

CHAPTER 7: EVALUATION OF CHANNEL CATFISH POPULATIONS IN FIVE NORTHERN IDAHO LAKES

ABSTRACT

We sampled channel catfish *Ictalurus punctatus* in five northern Idaho ponds and lakes to evaluate our stocking program. We used pectoral spine sections to back-calculate mean length-at-age for 658 channel catfish. Channel catfish in northern Idaho are long lived but exhibited slow growth when compared with 102 channel catfish populations across North America. Based on catch curve analysis, total annual mortality ranged from 28-83% among the lakes sampled. The majority of channel catfish were above the minimum stock length (280 mm) with some individuals above quality length (>410 mm). On average, channel catfish weighed above or near 100% of the standard weight and condition (W_r) and varied little by length category (i.e., sub-stock, stock, quality). A total of 539 channel catfish from all six lakes were tagged to assess angler exploitation. After correcting for the angler reporting rate, tag loss, and tagging mortality, angler exploitation for channel catfish was estimated to be less than 10% in all six of the lakes sampled. We also evaluated the use of two different commercially prepared baits (soybean cake and cheese logs) to capture channel catfish during the two year study. Overall, nets baited with soybean cake caught 62% of all channel catfish sampled and soybean cake was easier to store since it did not require refrigeration. We recommend that a series of three hoop nets, baited with soybean cake, should be adopted as the standard method to evaluate channel catfish populations in northern Idaho. The channel catfish stocking program in northern Idaho appeared to meet the objective of diversifying the angling opportunities in lowland lakes, but was currently underutilized by anglers.

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INTRODUCTION

Channel catfish *Ictalurus punctatus* belong to the family Ictaluridae, in the order Siluriformes. The order includes over 2,000 species; most of them inhabit the fresh waters of the tropics. Channel catfish are native to parts of Quebec, Ontario and Manitoba, south from the St. Lawrence River and tributaries including all of the Gulf States and Mexico, but not the Atlantic slope drainages (Scott and Crossman 1998) (Figure 1). Channel catfish have been widely introduced outside this native range and can be found almost everywhere in the United States (Scott and Crossman 1998).

State-wide, Idaho Department of Fish and Game (IDFG) has stocked channel catfish into 67 waterbodies since 1967. In the past 28 years IDFG has introduced channel catfish into a number of northern Idaho rivers and lakes, in an effort to increase predation on overabundant forage fish populations and/or add angling opportunity and diversity to mixed-species fisheries. Of the 11 water bodies stocked with channel catfish in the Panhandle Region since 1985, six lakes continue to be stocked (Table 1). Channel catfish stocked into northern Idaho lakes in 2011 ranged from 119-330 mm with a mean total length of 249 mm; no catfish were stocked in 2012.

Channel catfish spawn in late spring or summer when water temperatures reach 24°-29.5°C (Scott and Crossman 1998). Because cooler water temperatures in northern Idaho are not conducive to successful channel catfish reproduction (Becker 1983; Fredericks et al 1997), channel catfish numbers were influenced primarily by stocking, natural mortality and angler harvest.

Idaho rules in 2012 set no bag limit, size or possession limits on channel catfish and exploitation rates have not been estimated for most Idaho catfish fisheries. Therefore, it is important to evaluate key characteristics of channel catfish populations in northern Idaho lakes to ensure efficient use of limited hatchery resources.

STUDY AREA

Rose Lake

Rose Lake is located 0.7 km north of the town of Rose Lake, Idaho (Figure 1). The lake has a surface area of approximately 122 ha and has an extensive wetland at the southern end of the lake. Rose Lake is connected to the Coeur d'Alene River by a channel also located at the southern end of the lake, and there is a boat ramp maintained by IDFG on the eastern shore. Rose Lake is managed under general fishing rules and is primarily a warmwater fishery. Channel catfish were first stocked in Rose Lake in 1999 and approximately 2,500-4,900 catfish were stocked annually since 2003. Additionally, 14,000 bluegill *Lepomis macrochicrus* were stocked in 1990.

Smith Lake

Smith Lake is located 8 km north of Bonner's Ferry, ID (Figure 1). The lake has a surface area of 15.4 ha, a maximum depth of 11 m and a mean depth of 6.7 m. The lake's shoreline consists mainly of mud and sand though the southern end of the lake has a small area of marl bottom with extensive vegetation growth. The U. S. Forest Service maintains a camping and picnic area which includes a boat launch and fishing dock. Smith Lake is designated as a family fishing water and special rules limit fishing boats to electric motors only. The lake offers a mixed-fishery with 5,000-6,000 catchable-sized rainbow trout *Oncorhynchus mykiss* and approximately 300 channel catfish stocked annually. Channel catfish were first stocked in Smith Lake in 1997. Kokanee salmon *Oncorhynchus nerka* and westslope cutthroat trout *Oncorhynchus clarkii lewisi* are occasionally stocked in Smith Lake. Bluegillwere stocked in 1989 and have established a reproducing population.

Jewel Lake

Jewel Lake is a 12 ha lake located in Bonner County, Idaho 12 km west of Cocolalla Lake and 5.6 km southeast of Laclede, Idaho (Figure 2). The land around the lake is owned by a single landowner who has allowed public access since 1951 in exchange for IDFG maintaining the boat launch. Jewel Lake is eutrophic and has a maximum depth of 10 m. In the late 1970s yellow perch *Perca flavescens* were illegally introduced, and became overpopulated and stunted. IDFG personnel renovated the lake with rotenone in 1989 to remove yellow perch; however, by 1992 yellow perch were reestablished. In 2007 all species present in Jewel Lake were game fish and included bluegill, black crappie *Pomoxis nigromaculatus*, channel catfish, rainbow trout and pumpkinseed *L. gibbosus*. Channel catfish were first stocked in Jewel Lake in 2001 with 300-1500 catfish stocked annually. Few bluegill were in the quality designation and did not appear to be contributing to the fishery. Jewel Lake was once managed as a quality trout fishery. However, the fishery has deteriorated and, due to poor trout growth, the lake was managed under the Family Fishing Water rules and was stocked with catchable-sized rainbow trout. In 2011, 5,924 catchable-sized rainbow trout were stocked in Jewel Lake.

Fernan Lake

Fernan Lake is located in Kootenai County just east of Coeur d'Alene, Idaho (Figure 1). The Fernan Lake watershed is approximately 4,872 ha; has a surface area of 154 ha and a mean depth of 8.5 m. In 2003 the Idaho Department of Environmental Quality categorized Fernan Lake as mesotrophic. Most of the shoreline is forested; however, the northwest end of the lake is residential. There are several wetlands located on the east, west and northern areas of the lake. Fernan Lake supports both a warmwater and a coldwater fishery and is considered one of the most successful urban fisheries in the state. Natural reproduction maintains the warmwater species: bluegill, largemouth bass *Micropterus salmoides*, smallmouth bass *M. dolomieu*, black crappie, brown bullhead *Ameiurus nebulosus*, pumpkinseed, tench *Tinca tinca*, northern pike *Esox lucius* and yellow perch, while rainbow trout are stocked on a regular basis. In 2011, 19,102 catchable triploid rainbow trout and 6,214 fingerling westslope cutthroat trout were stocked into Fernan Lake.

A few brook trout and cutthroat trout enter the lake via Fernan Creek and Coeur d'Alene Lake respectively. Channel catfish were first stocked into the lake in 1987 with two to six thousand catfish stocked annually.

Cocolalla Lake

Cocolalla Lake is located in Bonner County 12 km south of Sagle, Idaho (Figure 2). The lake has a surface area of 326 ha and a mean depth of 8 m. Cocolalla Lake is in an advanced state of eutrophication and has potential low oxygen/high temperature limiting conditions for salmonids during late summer. Boat access is available via an IDFG maintained boat ramp at the northern end. The western and northern shorelines are developed with year-round and seasonal residences. The entire eastern shoreline is owned by Burlington Northern Santa Fe Railway Company. The primary summer fisheries on Cocolalla Lake are for hatchery supported rainbow trout and channel catfish. Channel catfish were introduced in 1985 to utilize the abundant yellow perch and pumpkinseed forage base. Approximately five to nine thousand catfish have been stocked in Cocolalla Lake annually. In 2011, 22,548 fingerling westslope cutthroat trout, 1,740 catchable westslope cutthroat trout and 25,200 fingerling triploid rainbow trout were stocked. The lake contains a total of 11 game fish species. Yellow perch are the most abundant game fish by number followed by largemouth bass. Bluegill, brown trout *Salmo trutta*, brook trout, black crappie and brown bullhead are also present.

OBJECTIVES

One of IDFG's objectives is to "provide diverse angling opportunities in lowland lakes" by enhancing the diversity of warmwater fisheries with maintenance stocking of channel catfish (IDFG 2007). This study represents the second year of a two year evaluation in six Panhandle Region lakes to determine whether channel catfish stocking is accomplishing this objective.

METHODS

Channel catfish were sampled with baited tandem hoop nets as described by Michaletz and Sullivan (2002) in Rose, Smith, Jewel, Cocolalla and Fernan lakes in 2012. Each hoop net series (HNS) consisted of three hoop nets (Figure 2), attached bridle to cod end. A 5.4 kg Danforth anchor was attached to the rear end of the rear net and the front end of the front net to increase tension and improve stability during fishing. Additional 2.7 kg weights were attached between the middle and front net and to the bridle on the rear net so that the nets would not collapse when fish were being removed. Each net in a series was baited with two bags containing 1.8 kg of commercially prepared cheese logs (Boatcycle, Inc., Henderson TX.) or soybean cake (MaxYield Cooperative, West Bend, IA) as a fish attractant.

We fished two HNS with each individual net consisting of 91 cm diameter hoops and measuring approximately 3.4 m in length. The nets were constructed of #15 twine with 25.4 mm bar mesh, and were equipped with 6 m bridles that separated consecutive nets. Two-fingered crow foot throats were attached to the second and fourth hoop.

For each sampling trip two HNS were set parallel to shore in the littoral zone of each lake at depths ranging from 3-4 m. Anoxic water below the thermocline was avoided to reduce fish mortality and increase catches. Steep slopes were identified and avoided to prevent nets from rolling into deeper water. Each HNS was left undisturbed for 72-96 hours before nets were retrieved. Three to four day soak durations were used because we anticipated lower densities of channel catfish than in reservoirs sampled by Michaletz and Sullivan (2002) and Sullivan and Gale (1999). This procedure was repeated 1-3 times at each lake. We deployed baited hoop nets at Rose Lake on June 11 when water temperatures reached 15°C and again on June 14. Additional sets were deployed in Smith Lake on June 21 and 25, in Jewel Lake on July 2, 5, and 9, in Lake Cocolalla on July 12 and in Fernan Lake on July 16. We finished sampling on July 19 with a water temperature of 25.8°C at Fernan Lake.

All live fish were released immediately after processing. Catches were recorded separately for each net within a series but were pooled by HNS for analysis. Catch per unit effort (CPUE) was expressed as the number of channel catfish caught per HNS per 72 hours. Natural log transformation was used to normalize CPUE data prior to analysis.

On retrieval, fish were removed from the nets and placed in live wells. Channel catfish were measured for total length (TL) and weight was recorded in grams. Pectoral spines were removed for age and growth determinations. The right spine was removed by grasping the spine at the articulation, pressing flat against the body, and rotating it in a counterclockwise direction allowing the entire spine to be removed (Ashley and Garling 1980). Spines were stored dry in scale envelopes on which length, weight and location where recorded. Pectoral spines were sectioned at the distal end of the basal groove using a Buehler Isomet Low Speed Saw (Koch and Quist 2007). Spine sections were examined through a dissection microscope (7-45X). Measurements used to determine age at annulus formation were taken using an image analysis system. Two readers estimated the age of structures and disagreements were resolved by mutual examination of questionable structures.

Channel catfish were tagged with either Carlin dangler or T-bar tags to assess angler exploitation. Carlin dangler tags were attached to channel catfish in Rose and Smith lakes by U-shaped stainless steel wire. The open ends of the U-shaped wire were inserted into hypodermic needles, passed through the body of the fish between the dorsal pterygiophores. When the needles were withdrawn the wires were pulled snugly against the body and the ends crimped together. T-bar (Floy) tags were attached to catfish in Jewel Lake using a tagging gun loaded with clips of T-bar anchor tags that were inserted just below the dorsal fin between the dorsal pterygiophores. Tags were labeled on two sides with one side stating "IDFG 1-866-258-0338" and the other side with a tag number. IDFG operates a toll free automated hotline and website through which anglers can report tags. Additionally IDFG distributes posters and stickers to license vendors, regional offices and sporting goods outlets that publicize tagging efforts and explain how to report tags and what the information is used for. To determine angler exploitation, the number of fish harvested by anglers (determined by tag returns) was divided by the number of fish we tagged. We assumed a 53% reporting rate, which is typical of non-reward tags (Meyer et al. 2010), and adjusted the return rate accordingly to provide an exploitation estimate. Tag loss was estimated at 0% as Carlin dangler tags typically eliminate the uncertainty associated with tag loss (Travnichek 2004 and Holley 2006); while tagging mortality was assumed to be 3% based on work conducted on rainbow trout by Meyer et al. (2010).

Population size was estimated in Lake Cocolalla using the Petersen mark-recapture method (Ricker 1975). Catfish were either tagged or marked on July 25 and 28, 2011. Fish were tagged as described above or marked by punching a small hole through the upper caudal fin. Fish were released at the south end of the lake where the netting took place. Netting to recapture catfish also took place at the south end of the lake on August 11, 2011. Our hope was that the marked catfish would mix into the unmarked population during the two weeks between marking and recapture.

Unlike 2011 data for Hauser Lake, we estimated total annual mortality by adjusting catch-at-age data for unequal recruitment as described by Miranda and Bettoli (2007). We then constructed weighted catch curves using Fisheries Analysis and Simulation Tools (FAST) Version 2.1 software. Weighted catch curve analysis deflates the influence of older and rarer fish. Back calculated length at age data was used to construct Von Bertalanffy growth curves using FAST software. We compared mean back calculated length at age to mean length at age of capture estimates to evaluate potential bias as a result of using retrospective size at age data to construct our Von Bertalanffy growth curves (Jones 2000). These curves were then compared to the growth standard for North American channel catfish (Jackson et al. 2008)

We calculated channel catfish relative weights (*Wr*), which compares weights of channel catfish found in northern Idaho lakes to that of a standard developed from multiple populations. Relative weight was calculated using the formula:

$$Wr = (W/Ws) \times 100$$

where W is the actual fish weight, and Ws is a standard weight for fish of the same length. Minimum total lengths to calculate Ws as specified by (Brown et al. 1995) is 70 mm, however, our minimum length used was 126 mm.

We calculated Proportional Stock Density (PSD), which is a numerical descriptor of length-frequency data (Anderson 1976) for channel catfish. PSD is calculated as number of fish ≥ minimum quality length/ number of fish ≥ minimum stock length. For channel catfish, quality length (% related to world record size) was set at 410 mm and stock length (approximate size recruited to the sampling gear); was set at 280 mm (Gabelhouse 1984).

RESULTS

A total of 1,017 channel catfish were captured during 2012 in five northern Idaho lakes using hoop nets baited with commercially prepared cheese logs and soybean cake. Eighteen HNS consisting of 1,471 individual net hours ranging from 68-97 hours/set were fished from June 11 to July 19, 2012.

CPUE ranged from 9 to 54 catfish/HNS/72 h for tandem hoop nets baited with soybean cakes and from 4 to 67 catfish/HNS/72 h for nets baited with cheese logs (Table 2). Overall, nets baited with soybean cake caught 62% of all channel catfish sampled and averaged 22 fish/net while nets baited with cheese logs averaged 14 fish/net. For the five lakes sampled, cheese had a higher CPUE on two lakes (Cocolalla and Fernan lakes) while soybean cake was the more productive bait on three lakes (Jewel, Rose, and Smith lakes).

Channel catfish mortality was observed on only one occasion; 6 (0.6% of total catch) mortalities occurred on June 21 when we believe catfish were held at depths deeper than our typical sets resulting in exposure to low oxygen concentrations. Tandem hoop nets caught a variety of non-target species (Table 3) resulting in mortality of 3-4%. Non-target species consisted mostly of bluegill, black crappie, and tench with these species making up 92% of the bycatch.

The majority of channel catfish sampled were above the minimum stock length (280 mm) with some individuals above quality length (>410 mm) in each lake (Table 4). Length frequencies of channel catfish captured in tandem hoop nets were similar between Rose, Smith, Fernan and Cocolalla lakes and ranged from 210 to 570 mm TL (Figure 4). Length frequencies of channel catfish captured in Jewel Lake indicated fish were smaller than in the other lakes, with the majority being below 300 mm TL (Figure 3). Rose Lake had catfish with the highest relative weight, while Fernan had the highest PSD followed by Rose Lake (Tables 2 and 5).

On average, channel catfish weighed above or near 100% of the standard weight and their condition (W_r) varied little by length category (i.e., sub-stock, stock, quality). Rose and

Jewel lakes, however, showed higher W_r in the sub-stock category than the other lakes (Table 5, Figure 4). Sub-stock fish (<280 mm) W_r ranged from 101 in Lake Cocolalla to 122 in Rose Lake. Relative weight of stock length fish (281-410 mm) ranged from 98 in Jewel to 105 in Cocolalla and Rose Lakes. W_r for Quality length (>410 mm) channel catfish ranged from 95 in Fernan lakes to 110 in Rose Lake. The overall mean W_r of all fish was 105 in Lake Cocolalla, 101 in Fernan, 105 in Jewel, 107 in Rose and 104 in Smith Lakes (Table 5).

We examined pectoral spine sections to back-calculate length-at-age for 101 channel catfish from Rose Lake, 79 for Smith Lake, 54 for Jewel Lake, 132 for Lake Cocolalla and 116 for Fernan Lake. Overall, mean length-at-age at capture was fairly similar among Fernan, Cocolalla and Smith lakes up to age-6 with Rose Lake having higher overall mean length-at-age values and Hauser and Jewel having lower values (Figure 6). Estimated ages of collected fish ranged from 2 to 12 years. Catfish reached 410 mm (quality length) at ages ranging from roughly 5-9 years though mean length at age of capture for fish of all ages in Jewel and Cocolalla lakes were below quality length (Figure 6). Von Bertalanffy curves created using mean back-calculated length-at-age data from all five lakes were compared to 102 populations of channel catfish from across the North America (Hubert 1999; Jackson et al. 2008). Channel catfish growth was typically above that described by Hubert (1999) up to age-6 in Cocolalla, Fernan, Smith and Rose lakes and up to age-3 in Jewel Lake and age-4 in Hauser Lake, then diverged each year thereafter (Figure 8). Based on catch curve analysis of channel catfish age-4 to age-8 in Rose Lake, total annual mortality was 48% (Figure 9); age-4 to age-7 in Smith Lake, total annual mortality was 83% (Figure 10); age-4 to age-8 in Jewel Lake, total annual mortality was 64% (Figure 11); age-5 to age-8 in Lake Cocolalla, total annual mortality was 55% (Figure 12) and age-5 to age-9 in Fernan Lake, total annual mortality was 28% (Figure 13). Mortality estimates for Jewel Lake should be considered with caution as adjusted catch values fell below five individuals per age group potentially introducing extreme variation due to the small sample size (Van Den Avyle and Hayward 1999).

Angler exploitation of channel catfish appeared low. Through December 31, 2012, 4 of 86 tagged channel catfish in Rose Lake were returned. Through the same time period, no angler tag returns were reported from Smith or Jewel lakes. After correcting for the angler reporting rate, tag loss, and tagging mortality, angler exploitation for channel catfish was estimated at 7% in Rose Lake. Angler exploitation was estimated to be zero for channel catfish in Smith and Jewel lakes in 2012 (Table 6). No additional catfish tagged in Hauser, Fernan, Cocolalla or Jewel lakes in 2011 were reported in 2012.

We calculated a population estimate of channel catfish for Cocolalla Lake. A total of 1,228 catfish were tagged and marked on July 25 and 28, 2011. We recaptured 47 marked fish while capturing a total of 1,200 catfish on August 11, 2011. Our population estimate was therefore 30,751 catfish for a density estimate of 94 channel catfish/ha.

DISCUSSION

One of the hindrances to management of channel catfish in northern Idaho was the lack of basic population data which stemmed from our inability to efficiently sample them. Using baited hoop nets in 2011 and 2012, we found we could effectively sample large numbers of channel catfish. Our combined 2011-2012 catches exceeded suggested sample sizes of 300-400 channel catfish to develop precise length-frequency distributions (Vokoun et al. 2001; Michaletz and Sullivan 2002). This method also surpassed all previous catches from IDFG standard lake surveys. We therefore recommend baited tandem hoop nets as the standard method for sampling channel catfish in northern Idaho. Additionally, our 2012 catches were consistent with our 2011 data showing a generally higher catch rate for soybean cake when compared to cheese logs. The approach we used was not sufficient to statistically show the best bait. However, we recommend soybean cake as the bait of choice as it is less expensive, easier to store, requires no refrigeration, does not have the unpleasant odor associated with cheese logs, and worked at least as well as cheese logs if not better.

We did not capture any channel catfish larger than 570 mm TL during either year of our survey. Channel catfish larger than 600 mm TL have been reported in previous IDFG studies and anglers occasionally report catching channel catfish larger than 570 mm from Panhandle Region lakes. Michaletz and Sullivan (2002) suggested that length frequencies of channel catfish captured in tandem hoop nets accurately reflect the size structure of the sampled population except for fish shorter than 250 mm TL. Our results indicated that channel catfish in northern Idaho have W_r values above 80, below which has been used to designate crowded populations (Bonar et al 1997), slower than average growth (Hubert 1999; Jackson et al. 2008) and varying total annual mortality between lakes. Bonar et al (1997) suggested that growth of channel catfish in the Pacific Northwest may be improved by selecting lakes with appropriate prey types or by stocking catfish with suitable forage organisms citing previous studies whose findings indicated that channel catfish growth was slowest when their forage base consisted mainly of sunfish *Lepomis* spp. and yellow perch *Perca flavescens.* We therefore recommend sampling in July prior to annual stocking to avoid complications of recently stocked fish. We also recommend conducting forage fish studies to determine whether channel catfish are reducing the numbers of forage fish in lakes where they were stocked to reduce overabundant forage fish populations.

There was a high degree of overlap in lengths between age groups. The range of lengths in fish of the same age is not believed to be indicative of an error in age determination, but is probably a real difference in growth of various year classes due to different sources of fingerlings and length at stocking. IDFG purchases fingerling channel catfish from Fish Breeders of Idaho Inc. who have obtained channel catfish fry from several different private hatcheries in Missouri, Arkansas and Oklahoma in recent years (Leo Ray, owner, personal communication). In the future we recommend sampling channel catfish as they are stocked to conduct age analysis comparing spines to otoliths to try and sort out some of the discrepancies in the lengths of age 1-2 fish.

Channel catfish stocked into north Idaho lakes in 2011 ranged from 119-330 mm and had a mean total length of 249 mm. Ideally channel catfish should be stocked large enough to escape predation by largemouth bass and provide a suitable fishery in a relatively short time. Krummrich and Heidinger (1973) found channel catfish less than 200 mm TL were highly vulnerable to predation by largemouth bass while Storck and Newman (1988) showed that stocking 200 mm channel catfish gave the greatest return for the investment. Our 2012 data indicated that in lakes where mean length was greater at age 1-2, length at age remained higher throughout the lives of the fish as compared to lakes where smaller fish were stocked. Therefore stocking fewer fish of greater size may potentially produce a more desirable fishery.

The cost of production and distribution of channel catfish fingerlings in the Panhandle Region during 2011 averaged $0.90 per fish (Tom Frew, IDFG Resident Hatchery Manager, Personal Communication). Considering about 20,000 channel catfish were being stocked annually, the total cost for the stocking program was about $18,000/yr. Our results collected during 5-month creel surveys on Hauser and Fernan lakes in 2011 estimated approximately 13% of angler effort was directed toward channel catfish on each of the two lakes (Fredericks et al. 2013). Data from our tag returns estimated angler exploitation for channel catfish was 7% in Rose Lake in 2012, but was zero for Smith and Jewel lakes in 2012. These results were similar to those reported in Fernan, Hauser and Cocolalla lakes in 2011. Taking into consideration the cost of stocking, low estimates of angler exploitation and slow growth rates, we recommend reducing stocking rates in Hauser, Fernan, Cocolalla, Smith and Rose lakes. We also recommend that stocking in Jewel Lake be discontinued based on poor catch per unit effort estimates, slow growth, high mortality and the small size of the catfish.

Growth of channel catfish in north Idaho is slow compared to southerly populations but they appear to be long lived. Catfish, 535 mm and age-15 were captured in Hauser Lake and age-12 (≥525 mm) in Fernan and Cocolalla lakes; a literature review by Hubert (1999) indicated that only 23 of 102 North American channel catfish populations contained fish older than age-11. Mosher (1999) reported that in the wild, channel catfish over ten years of age and 530 mm TL are unusual. While channel catfish growth is influenced by a combination of various biotic and abiotic factors, colder water temperatures in northern Idaho may be the limiting factor relative to channel catfish growth rates. Slow growth rates in northern Idaho lakes may also be a function of density dependent stocking rates. In 2012 we began to examine this as no channel catfish were stocked in the region's lakes. Our mark and recapture data from Cocolalla Lake combined with our catch per unit effort estimates suggested that there was likely a surplus of channel catfish in the region's lakes and harvest was most likely regulated by factors other than catfish abundance. A reduction in stocking rates or alternate year stocking will likely provide adequate harvest opportunity and may allow for improved growth rates for channel catfish in northern Idaho lakes. A reduction will probably go unnoticed by most anglers as channel catfish exploitation appears to be less than 10% in each of the lakes studied (Fredericks et al. 2013). In the future, we anticipate continued monitoring of this fishery to help guide management decisions.

In conclusion we find that the objective to "Provide diverse angling opportunities in lowland lakes" by enhancing the diversity of warmwater fisheries with maintenance stocking of channel catfish (IDFG 2007) was being met. Catfish angling was a new sport for most Idaho anglers and it may take time for this fishery to develop and become popular.

MANAGEMENT RECOMMENDATIONS

1. Conduct sampling surveys in late spring / early summer prior to annual stocking.

2. Use tandem hoop nets baited with soybean cake as the standard sampling gear for channel catfish evaluations.

3. Discontinue stocking channel catfish in Jewel Lake.

4. Reduce stocking rates in remaining five lakes and conduct follow up survey to evaluate growth, survival and angler exploitation.

5. Obtain population estimates for channel catfish in northern Idaho lakes.

6. In lakes where channel catfish were introduced to reduce perch and bluegill, conduct surveys to determine if this objective was met.

Table 1. Five years of channel catfish stocking history for six Panhandle Region lowland lakes surveyed in 2011-2012.

Lake	Lake size (hectares)	2007		2008		2009		2010		2011	
		Stocked	fish/ha	Stocked	fish/ha	Stocked	fish/ha	Stocked	fish/ha	Stocked	fish/ha
Cocolalla	326	9020	28	8048	25	8015	25	7498	23	8008	25
Fernan	154	4921	32	3741	24	3021	20	3000	19	3011	20
Hauser	223	4980	22	4730	21	5508	25	5000	22	5544	25
Jewel	12	1368	114	352	29	350	29	350	29	347	29
Rose	122	4880	40	2495	20	2988	24	2997	25	2997	25
Smith	15	1728	115	304	20	298	20	304	20	308	21

Table 2. Number of channel catfish captured in baited tandem hoop nets (HNS), range (TL mm), PSD, and CPUE for cheese logs and soybean cake in Panhandle Region lowland lakes in 2012.

Lake	Total (N)	Range (mm)	PSD	Bait type	Catfish per bait	% Total	CPUE (fish/HNS/72 hrs)
Cocolalla	110	278-555	5	Cheese	88	78.60	67.36
				Soybean	22	21.40	16.94
Fernan	44	300-450	18	Cheese	27	61.40	28.46
				Soybean	17	38.60	17.83
Jewel	57	126-485	7	Cheese	26	44.00	4.00
				Soybean	31	56.00	8.98
Rose	565	210-570	15	Cheese	178	31.50	10.51
				Soybean	387	68.50	54.27
Smith	241	264-482	11	Cheese	68	28.20	29.78
				Soybean	173	71.80	42.30

Table 3. Number of fish captured, species, mean length and range (mm) of by-catch in each of the five Panhandle Region lowland lakes sampled in 2012 channel catfish evaluations.

Species	Rose Lake		Smith Lake		Jewel Lake		Lake Cocolalla		Fernan Lake	
	N	Mean length (mm) (Range)	N	Mean length (mm) (Range)	N	Mean length (mm) (Range)	N	Mean length (mm) (Range)	N	Mean length (mm) (Range)
Black Crappie	3	264 (252-280)	0	0	272	173 (133-373)	0	0	6	186 (162-203)
Bluegill	79	197 (163-257)	0	0	384	132 (113-192)	0	0	175	156 (123-210)
Brown Bullhead	10	257 (210-306)	0	0	0	0	5	252 (190-285)	16	276 (225-316)
Crayfish	0	0	0	0	0	0	3	0	0	0
Large Scale Sucker	0	0	0	0	0	0	4	243 (216-266)	0	0
Long Nose Sucker	0	0	0	0	0	0	1	425 (425-425)	0	0
Northern Pike	7	397 (365-424)	0	0	0	0	0	0	1	925 (925-925)
Painted Turtle	0	0	2	0	16	0	0	0	0	0
Pumpkinseed	3	140 (132-147)	0	0	0	0	5	147 (133-157)	1	119 (119-119)
Rainbow Trout	0	0	1	292 (292-292)	1	257 (257-257)	0	0	0	0
Tench	67	402 (220-481)	0	0	0	0	0	0	145	407 (252-492)
Yellow Perch	0	0	0	0	2	204 (200-207)	11	219 (150-290)	2	194 (182-205)

Table 4. Surface area (ha), total number sampled and number of channel catfish sampled per 50 mm length group in four Panhandle Region lowland lakes in 2012.

Lake	Surface area (ha)	N	CPUE	Number per length group (mm)							
				≤250	251-300	301-350	351-400	401-450	451-500	501-550	551-600
Cocolalla	326	110	34.02	-	9	53	37	10	-	-	1
Fernan	154	44	22.55	-	-	14	18	12	-	-	-
Jewel	12	57	6.06	12	29	12	2	1	1	-	-
Rose	122	565	24.23	1	13	130	304	107	8	1	1
Smith	15	241	35.79	-	24	76	103	35	3	-	-

Table 5. Mean length and mean relative weight (W_r) by length category and overall W_r for channel catfish captured in five Panhandle Region lowland lakes in 2012.

Lake	Mean length (TL)	W_r Sub-stock (<280mm)	W_r Stock (280-409mm)	W_r Quality (410-609mm)	W_r Overall
Cocolalla	341 mm	101	105	103	105
Fernan	375 mm	--	102	95	101
Jewel	282 mm	114	98	99	105
Rose	378 mm	122	105	110	107
Smith	352 mm	103	104	99	104

Table 6. Estimates of angler exploitation for channel catfish at various Panhandle Region lakes sampled in 2011 and 2012.

Lake	Year tagged	Number of tags	Tag type	Tags returned as of 12/21/2012	Number of different anglers	Corrected exploitation rate during first year after tagging
Cocolalla	2011	104	Carlin	0	N/A	0
Fernan	2011	105	Carlin	3	3	4%
Hauser	2011	120	Carlin	1	1	1%
Jewel	2011	10	Carlin	0	N/A	0
Jewel	2012	49	T-bar	0	N/A	0
Rose	2012	86	Carlin	4	2	7%
Smith	2012	65	Carlin	0	N/A	0

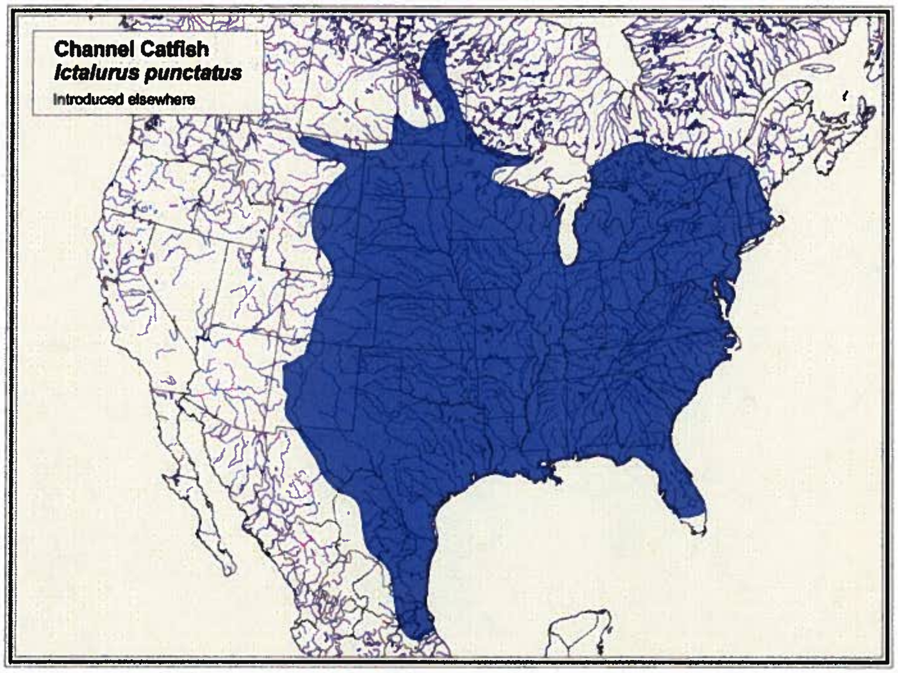

Figure 1. North American distribution of channel catfish native range (map courtesy of the Florida Museum of Natural History, Gainesville Florida).

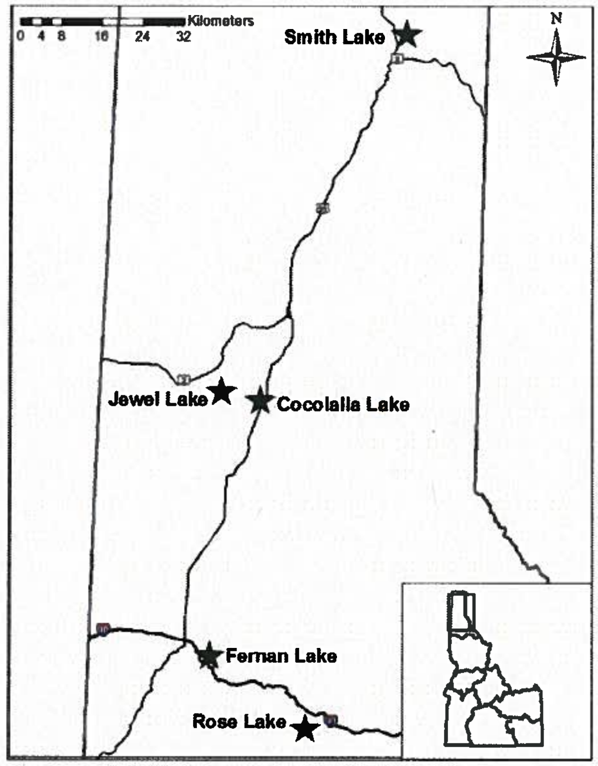

Figure 2. Map of five Panhandle Region lakes included in the 2012 channel catfish evaluation.

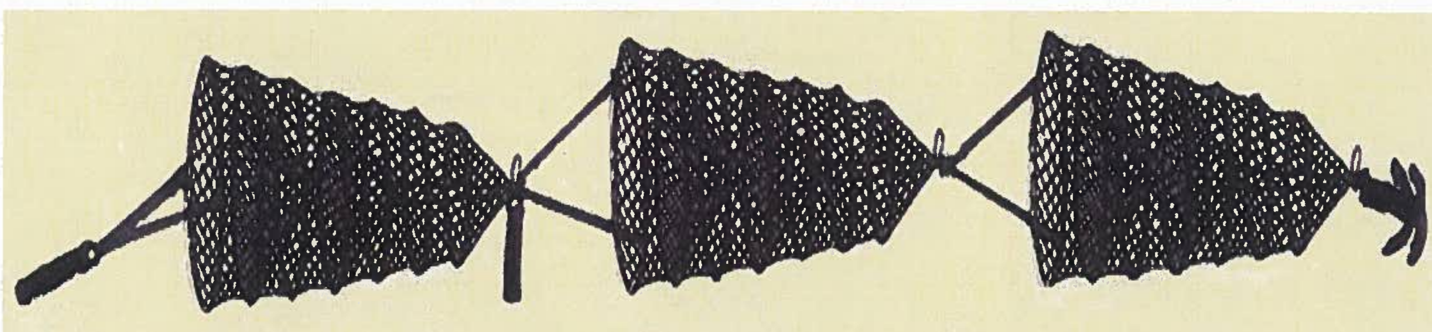

Figure 3. Illustration of typical hoop net series (HNS) used during 2012 channel catfish evaluation. Figure was not drawn to scale. Bridles between nets were 6 m in length.

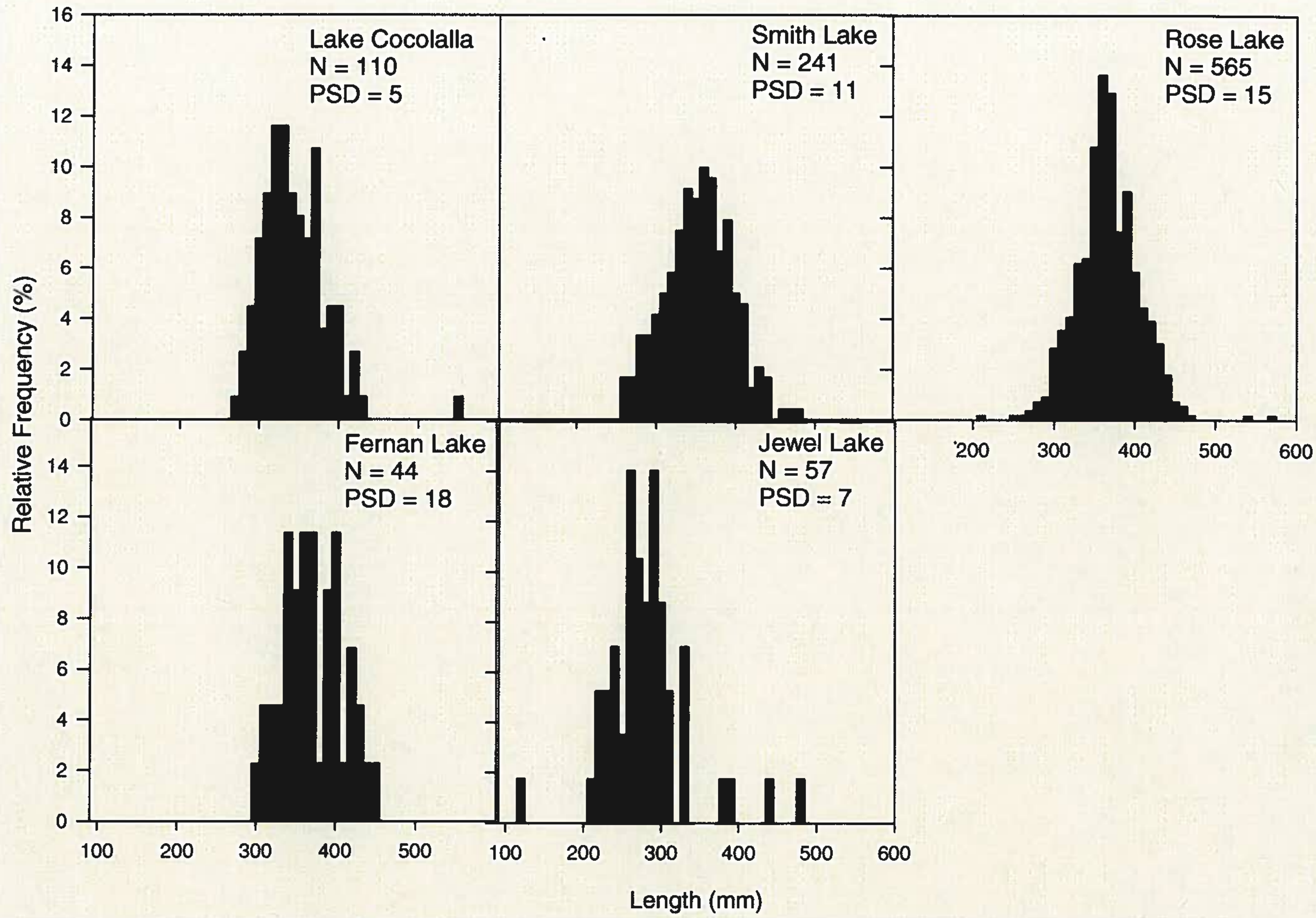

Figure 4. Relative length frequency of channel catfish collected in baited hoop nets in Cocolalla, Smith, Rose, Fernan and Jewel Lakes, Idaho in 2012.

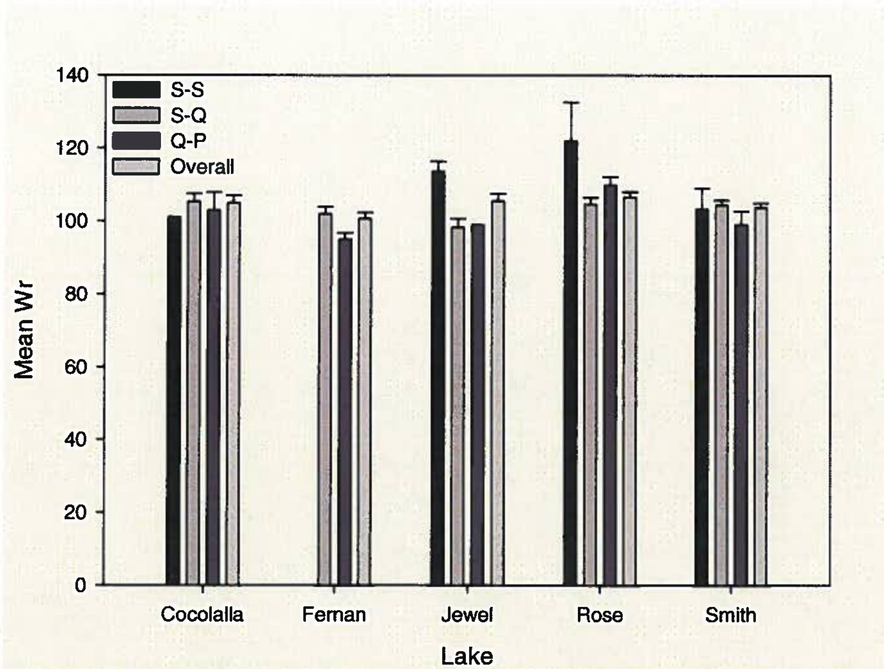

Figure 5. Mean relative weight of sub-stock (S-S), stock to quality (S-Q) and quality to preferred (Q-P) length channel catfish in Cocolalla, Fernan, Jewel, Rose and Smith Lakes, Idaho in 2012.

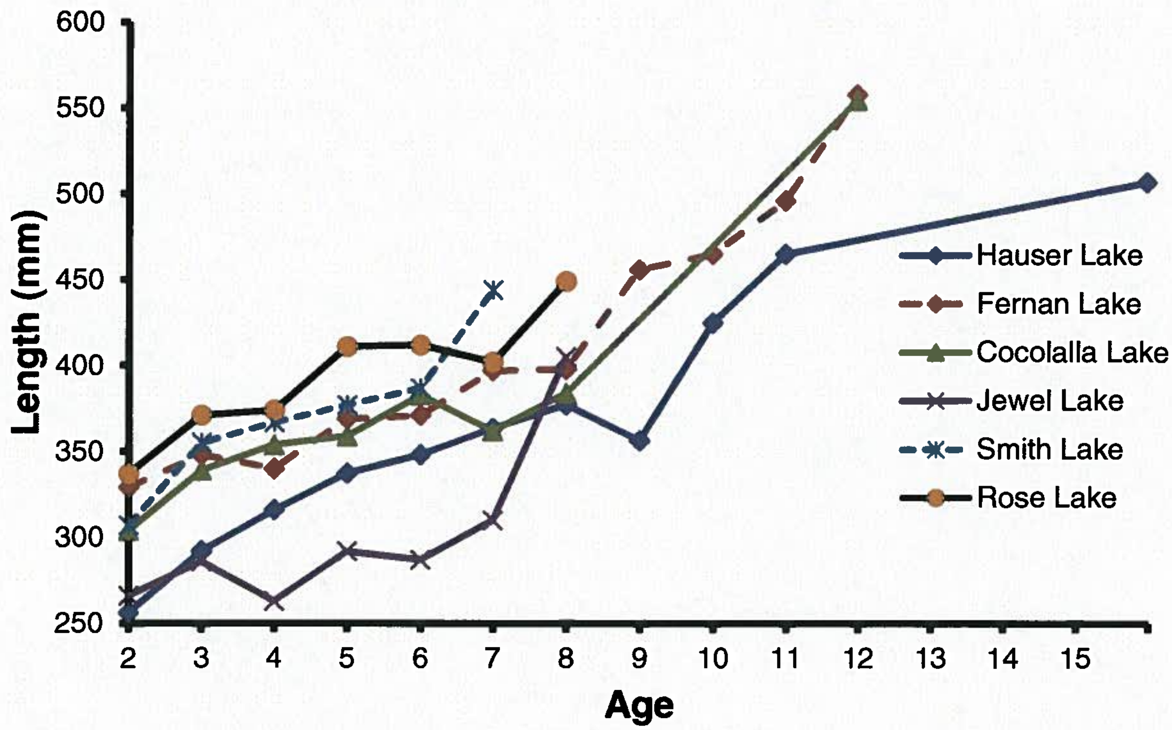

Figure 6. Mean length-at-age (at capture) of channel catfish in Hauser, Fernan, Cocolalla, Jewel, Smith and Rose Lakes, Idaho in 2011 and 2012.

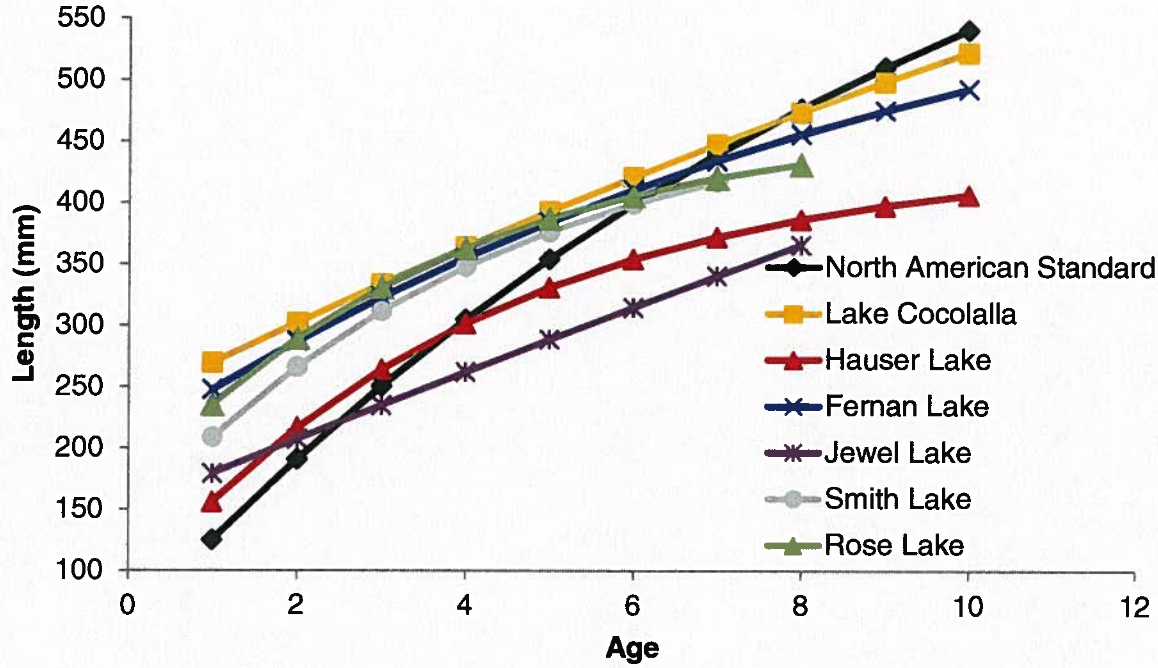

Figure 7. Predicted length-at-age derived from back calculated length-at-age of channel catfish in Cocolalla, Hauser, Fernan, Jewel, Smith and Rose lakes, Idaho in 2011 - 2012 compared to predicted length-at-age (based on the Von Bertalanffy growth equation) for North American channel catfish.

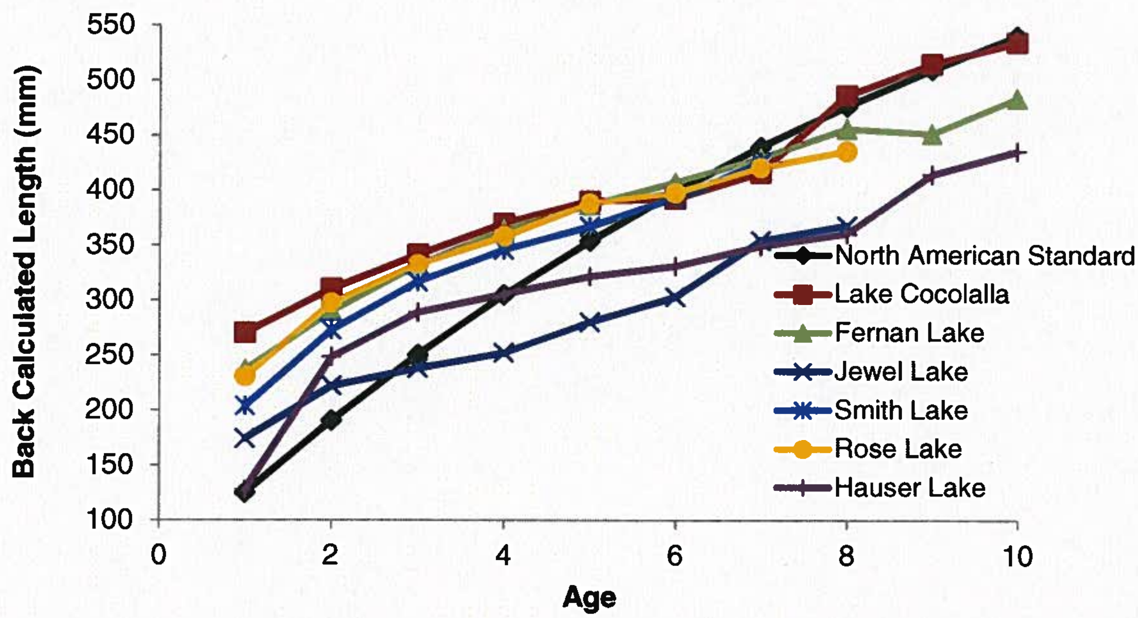

Figure 8. Back calculated length-at-age of channel catfish in Cocolalla, Hauser, Fernan, Jewel, Smith and Rose lakes, Idaho in 2011 - 2012 compared to predicted length-at-age (based on the Von Bertalanffy growth equation) for North American channel catfish.

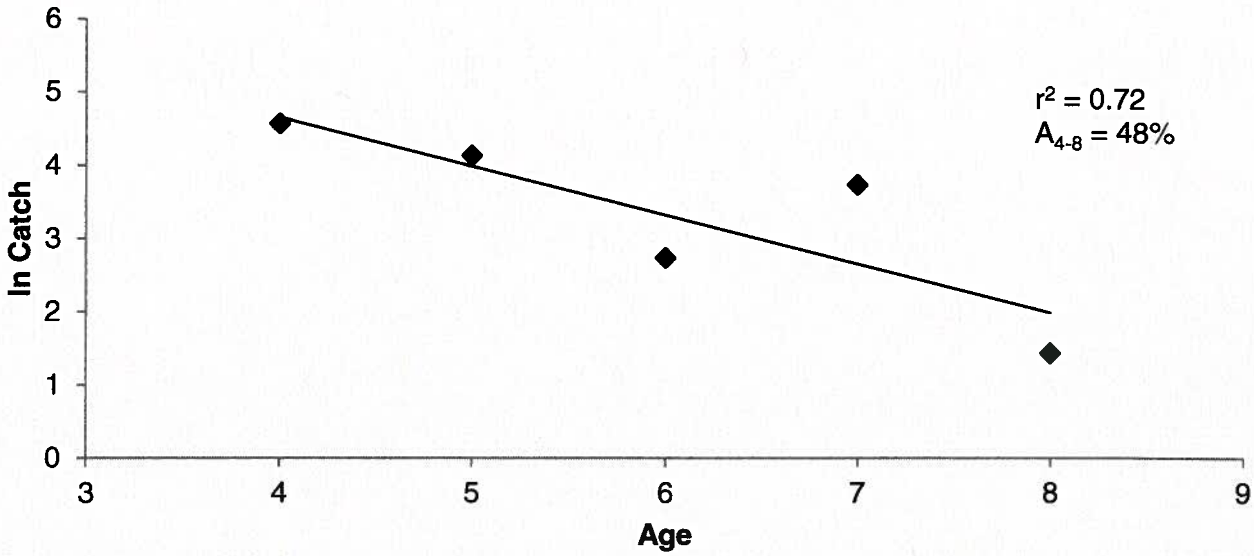

Figure 9. Weighted catch curve representing the age distribution of channel catfish in Rose Lake, Idaho in 2012. A_{age} represents total annual mortality.

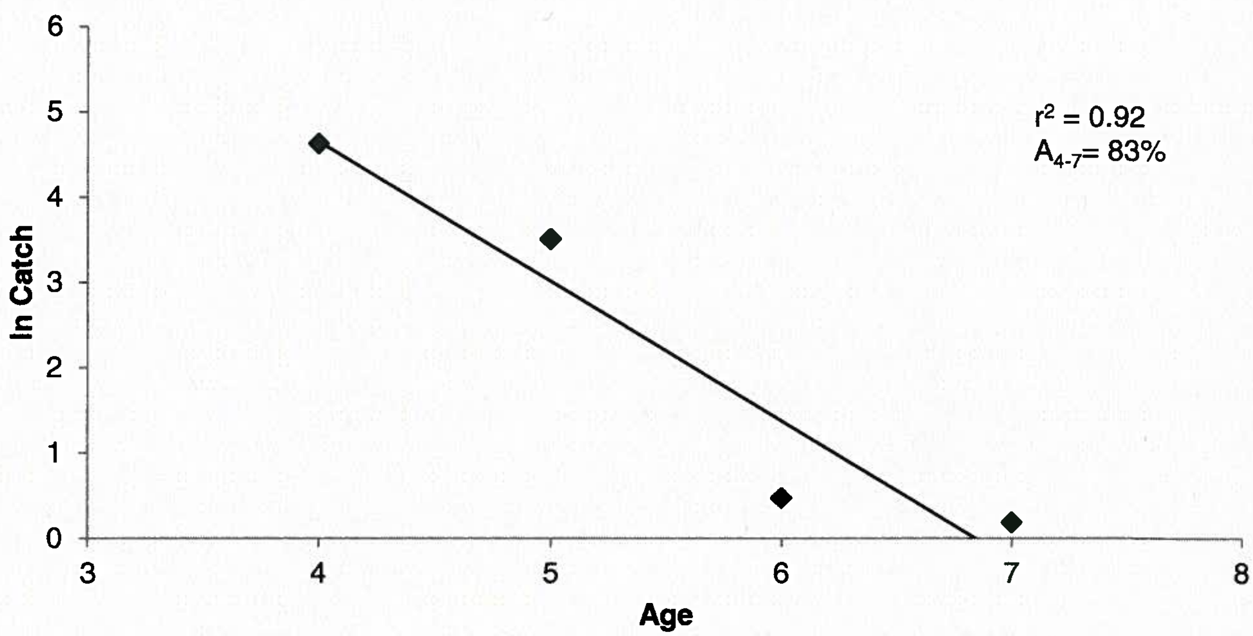

Figure 10. Weighted catch curve representing the age distribution of channel catfish in Smith Lake, Idaho in 2012. A_{age} represents total annual mortality.

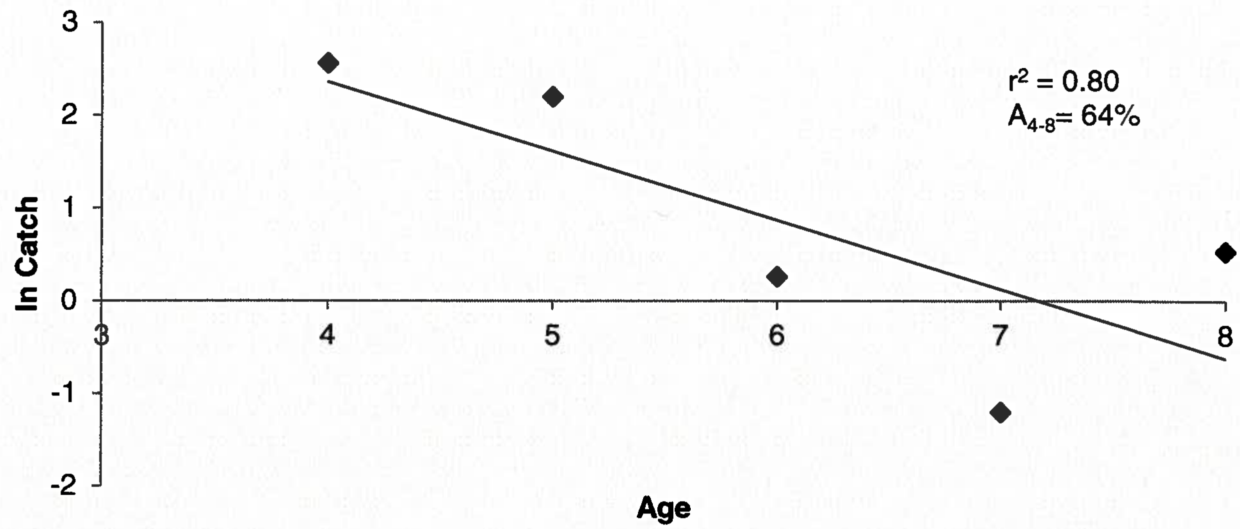

Figure 11. Weighted catch curve representing the age distribution of channel catfish in Jewel Lake, Idaho in 2012. A_{age} represents total annual mortality.

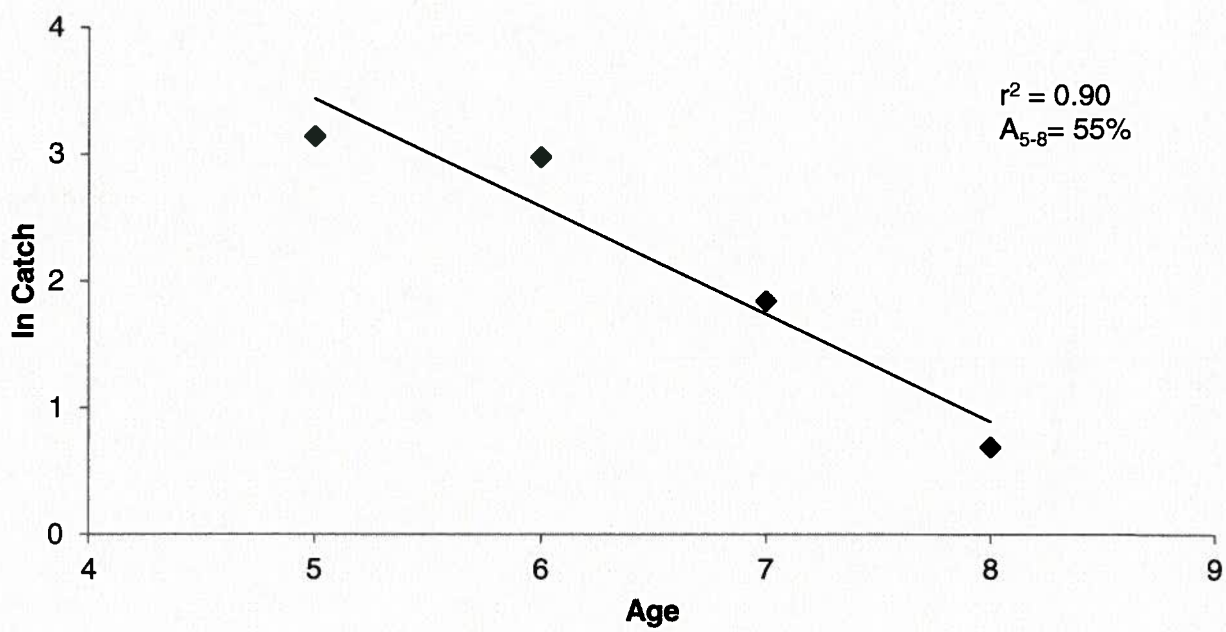

Figure 12. Weighted catch curve representing the age distribution of channel catfish in Lake Cocolalla, Idaho in 2012. A_{age} represents total annual mortality.

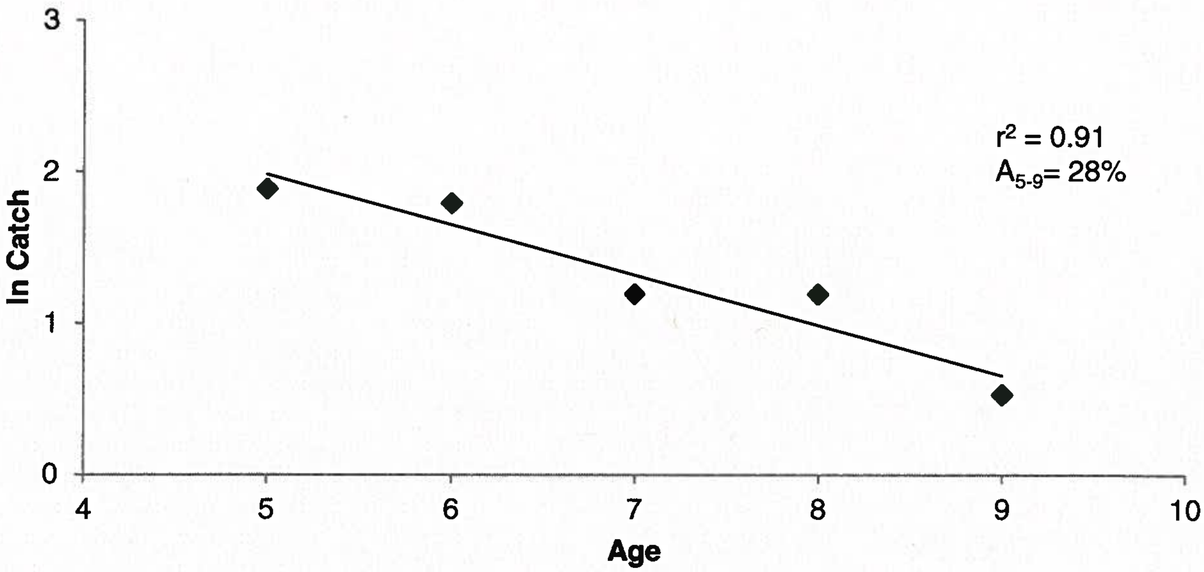

Figure 13. Weighted catch curve representing the age distribution of channel catfish in Fernan Lake, Idaho in 2012. A_{age} represents total annual mortality.

CHAPTER 8: TROUT SURVEYS IN THE COEUR D'ALENE, ST. JOE AND LITTLE NORTH FORK CLEARWATER RIVERS

ABSTRACT

We monitored fish densities at established transects in three river systems as part of a long term data set to evaluate a variety of fishery management and habitat improvement efforts. We snorkeled 42 transects in the Coeur d'Alene River, 35 in the St. Joe River, and 48 in the Little North Fork Clearwater River. Densities of westslope cutthroat trout *Oncorhynchus clarkii lewisi* greater than 300 mm total length were 0.23 fish/100 m^2, 0.45 fish/100 m^2, and 0.67 fish/100 m^2 in the three rivers, respectively. Each of these systems has shown significant improvements in densities of cutthroat trout over 300 mm during the last 15 years.

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INTRODUCTION

During 2012 we monitored fish densities in the Coeur d'Alene, St. Joe, and Little North Fork Clearwater rivers. Monitoring was part of a long-term data series to examine the overall effects of changing fishing rules, habitat improvements, weather, and other conditions that might affect fish populations. We snorkeled at established sites in each river and counted the fish as was done in previous years. Data collected in 2012 were compared to previous counts to determine trends in the fish populations.

OBJECTIVE

Idaho Department of Fish and Game (IDFG) has listed statewide objectives to direct fish management activities that apply to these three river drainages. These include: 1) maintain or improve fish populations to meet the demand for fishing, 2) ensure the survival of native fish, and 3) increase the capacity of habitat to support fish (IDFG 2005). Our surveys in this report were to monitor the progress on these objectives.

STUDY SITES

We estimated fish abundance in three separate river systems during 2012: the North Fork Coeur d'Alene River, the St. Joe River, and the Little North Fork Clearwater River. The North Fork Coeur d'Alene River has its headwaters in the Coeur d'Alene and Bitterroot mountains and flows into Coeur d'Alene Lake. Our 42 sampling sites surveyed in 2012 were spread throughout the North Fork Coeur d'Alene River and Little North Fork Coeur d'Alene River (Figure 1). Snorkel transects for monitoring fish abundance were established in the North Fork (NF) Coeur d'Alene River in 1973 (Bowler 1974).

The St. Joe River lies to the south of the Coeur d'Alene drainage. Its headwaters lie in the Bitterroot Mountains and it also flows into Coeur d'Alene Lake. We surveyed 35 sites in the mainstem of the St. Joe River from Ruby Creek to Calder (Figure 2). Twenty eight of the snorkel sites were established in 1969 between Avery and Ruby Creek (Rankel 1971). Seven additional transects were added in 1993 between Avery and the town of Calder (Davis et al. 1996).

The Little North Fork Clearwater River lies to the south of the St. Joe River and passes from IDFG's Panhandle Region into the Clearwater Region. The river begins at Fish Lake in the St. Joe National Forest and flows into Dworshak Reservoir. We surveyed 48 sites between Lund Creek and a spot 0.8 km downstream of Foehl Creek (Figure 3). Thirty five of the sites were selected in 1997 (Davis et al. 2000). An additional 13 transects were established in 2002 at the upper part of the drainage, above Adair Creek, to better sample the roaded part of the drainage.

METHODS

Snorkeling sites were located by Global Positioning System (GPS) coordinates and photographs in all three drainages. Sites were the same as those used in 2011, but some had changed since the earliest surveys. For example in cases where a pool had filled in, a nearby pool was selected and a new GPS coordinate was recorded. This practice has been done over the years of this trend survey as the river has shifted positions (DuPont et al. 2009).

Snorkeling was used at each site to estimate fish abundance following standardized methods described by DuPont et al. (2009). We snorkeled 42 transects on the North Fork Coeur d'Alene River from July 24-27, 2012, 35 transects on the St. Joe River from July 31-August 2, 2012, and 48 transects on the Little North Fork Clearwater River from August 7-9 and 14-15, 2012. In the upper most headwaters only one snorkeler was used, however we used two snorkelers, one on each side of the river, at most sites.

In addition to the snorkel survey, we estimated angler exploitation of cutthroat and rainbow trout *Oncorhynchus mykiss* on the Little North Fork Clearwater River by tagging fish over 250 mm total length. Seventy two trout were caught and tagged in early July 2012. Sixty three were cutthroat trout and nine were rainbow trout. Non-reward Floy tags were inserted into the dorsal musculature of the fish after they were caught by hook and line. Tags contained the phone number for IDFG so anglers could report the catch of tagged fish. Exploitation was estimated after correcting for a one year tag loss of 8%, a non-reporting rate of 48%, and assuming no mortality due to fish tagging.

RESULTS

North Fork Coeur d'Alene River

We counted a total of 1,204 cutthroat trout, 213 rainbow trout, 4 brook trout *Salvelinus fontinalis*, 3,526 mountain whitefish *Prosopium williamsoni*, 1,533 northern pikeminnow *Ptychocheilus oregonensis*, and 866 largescale suckers *Catostomus macrocheilus* in the North Fork Coeur d'Alene River transects (Appendix A). Densities of cutthroat trout in all size classes on all transects averaged 0.73 fish/100 m^2. Density of cutthroat over 300 mm averaged 0.23 fish/100 m^2. Although a decline from last year, densities of larger cutthroat trout remained well above the densities estimated prior to 2002 (Figure 4). Densities of all sizes of cutthroat trout declined to the lowest levels seen in the last six years, but remained higher than most years before 2004 (Figure 5).

We estimated mountain whitefish densities at 2.15 fish/100 m^2 for the entire survey in the North Fork Coeur d'Alene drainage during 2012 (Appendix A). Whitefish densities in this drainage have been on a general increasing trend over the last 20 years (r^2=0.54; Figure 6). As in previous years, densities of mountain whitefish were much higher in the North Fork Coeur d'Alene River than in the Little North Fork Coeur d'Alene River (Figure 6 and Appendix A).

We estimated the density of rainbow trout at 0.13 fish/100 m^2 (Appendix A). Their densities dropped in the early 1990's with the reduction of stocking, but they have remained in the system at lower densities since this time (Figure 7). The locations of rainbow trout were localized in both rivers with more rainbow trout found in the lower reaches (Appendix A and Figure 8).

St. Joe River

We counted a total of 1,313 cutthroat trout, 6 rainbow trout, 1,156 whitefish, 417 largescale suckers, and 291 northern pikeminnows during the survey in the St. Joe River (Appendix B). Density of cutthroat trout over 300 mm averaged 0.46 fish/100 m^2. These larger cutthroat trout have been on an increasing trend since 1997 (Figure 4). Total density of cutthroat trout of all sizes averaged 1.16 fish/100 m^2.

Only six rainbow trout were seen during the 2012 survey. They were found in the middle to lower sections of the river at transects SJ03, SJ04, SJ05, SJ33, and SJ34 (see Figure 2 for transect locations). Overall density of rainbow trout averaged 0.005 fish/100 m^2. Rainbow trout density dropped in 2000 and has remained low since this time (Figure 9).

Mountain whitefish had the second highest density of fish in the St. Joe River with 1.02 fish/100 m^2 (Appendix B). They were seen in nearly every section of the river that we surveyed. No overall trend in whitefish densities was noted in the years of our whitefish surveys (r^2=0.01, Figure 10).

Little North Fork Clearwater River

We counted 419 cutthroat trout, 219 mountain whitefish, 280 rainbow trout, and 12 bull trout in the Little North Fork Clearwater River (Appendix C). Density of cutthroat trout over 300 mm was estimated at 0.66 fish/100 m^2, and has increased about six fold since the earliest survey in 1997 (Figure 4). We estimated the density for all sizes of cutthroat trout at 1.34 fish/100 m^2; the highest of the three rivers surveyed in 2012.

We calculated the density of each species of fish seen in our survey by the various sections of river (Appendix C and D). In the lower, less accessible sections of the river, density of cutthroat trout over 300 mm was estimated at 0.75 fish/100 m^2. This density was about twice as high as the trout density in the more easily accessible, upper river where road access to the river is better (Appendix D). We estimated similar densities of smaller cutthroat trout in the upper and lower sections of the river, 1.48 and 1.30 fish/100 m^2, respectively.

Exploitation estimates were very low for fish tagged in the Little North Fork Clearwater River. Only three fish were reported to the IDFG phone number on the tags. All three were cutthroat trout, two were caught and released, and one trout was harvested. We calculated exploitation (harvested rate) of cutthroat trout at 4% after correcting for tag loss and non-reporting based on the one returned tag (Table 1). In addition, we estimated a total catch rate (released and harvested trout) at 11%. These estimates were similar to the low rates estimated in 2009, and may indicate a declining trend since 1997 when exploitation was estimated at 16% (Table 1).

DISCUSSION

All three rivers examined in 2012 appeared to be meeting the rather general objectives for these waters (see objectives section). In each case fish populations have improved to meet the demand for fishing. Each drainage currently supports viable populations of native fish to help ensure their survival. Lastly, improvements in trout and whitefish densities tend to support that fishing rule changes and the work of other agencies to improve the habitat has had a beneficial effect.

North Fork Coeur d'Alene River

Past researchers found declines in the Coeur d'Alene River fishery were directly related to over harvest, habitat degradation, and toxic mine wastes (Rankel 1971; Bowler 1974; Lewynsky 1986; Rabe and Sappington 1970; Mink et al. 1971). Efforts such as habitat improvements and fishing rule changes have been on-going to try to mitigate these impacts. It appears as though these efforts are having the desired effect.

Cutthroat trout densities in the North Fork Coeur d'Alene River have greatly increased since we began our surveys in the early 1970's. Overall densities of cutthroat trout >300 mm declined a bit this year from the record high levels seen last year (Figure 4). The small decline may be within the typical variability seen within the snorkel count data set. Many changes in fishing rules (DuPont et al. 2009), habitat improvements, and weather conditions have occurred within this drainage over the last decade. It is therefore difficult to state which has contributed the most to the increase in cutthroat trout densities. We can say that the increases in larger trout densities seen after 2002 occurred two years after a change toward more restrictive fishing rules. Specifically the rule change made the areas upstream of Yellow Dog and Laverne creeks catch-and-release, and the lower section of the river changed to a slot limit with no harvest between 200 mm and 406 mm. It was thought these rule changes contributed to the recent improvement in trout densities.

Rainbow trout have established a viable population that prefers lower sections of the North Fork and Little North Fork Coeur d'Alene rivers during summer (Figure 8). Their population provides a continuing source for hybridizing with the native cutthroat population. Though somewhat localized there is currently no practical method to remove rainbow trout from the river.

The data set also shows an increasing trend in the abundance of mountain whitefish (r^2=0.54) (Figure 6). Mountain whitefish were not part of the change toward more restrictive fishing rules and their creel limit remains a rather liberal 25 fish/angler/day in 2012. An increasing trend in whitefish densities may be showing a general improvement in fish habitat.

St. Joe River

The St. Joe River has shown a pronounced increase in the abundance of cutthroat trout over 300 mm, particularly since 1997 (Figure 4). Density estimates of these larger trout dropped in 1997 and 1998, likely due to high spring run-offs, but increased with the next generation of trout. In recent years densities gradually increased to where the St. Joe River remains about a third higher than the Coeur d'Alene River in the density of larger trout (Figure 4).

Densities of rainbow trout in the St. Joe River during the 1970's were as high as 0.5 to 0.6 trout/100 m^2 due to stocking roughly 10,000 catchable-size trout (>150 mm) and 100,000 fingerling rainbow trout in some years (Figure 9). At that time the cutthroat trout densities were very low; generally well below 0.05 trout/100 m^2. The situation has reversed. Native cutthroat trout (>300 mm) provide densities on the order of 0.45 trout/100 m^2, while rainbow trout provide very little to the overall trout densities (Figures 4 and 9). The latter situation was much preferred because it protected native fish, provided larger trout, was more dependable, and was much less expensive. Anglers were willing to support the restrictive rules in order to have the better fishing.

Little North Fork Clearwater River

The Little North Fork Clearwater River had the highest density of trout over 300 mm of the three drainages surveyed (Figure 4). Similar to the other drainages, it also showed lower trout densities in 1997, but has greatly increased since this time. Currently it is one of the few rivers in northern Idaho where the harvest of cutthroat trout is allowed. Exploitation appears to be low enough (Table 1) that we recommend continuing to allow the harvest of two cutthroat trout/angler/day.

The density of cutthroat trout over 300 mm was about twice as high in the lower, less accessible sections of the Little North Fork Clearwater River during the 2009 and 2012 snorkel surveys (Appendix D). This may be due to the restricted access, but it also may have been due to the lower river having larger and deeper pools. In 1997 and 2002 the reverse was true with the upper river having the higher densities of larger cutthroat trout. Considering the variety of habitat and the movements of fish, it was difficult to say if the remoteness of the lower river is the reason for the higher densities.

MANAGEMENT RECOMMENDATIONS

1. Continue habitat improvement work in the Coeur d'Alene River to determine if cutthroat trout densities will continue to improve.

2. Maintain catch and release regulations on cutthroat trout in the Coeur d'Alene and St. Joe rivers, and continue to allow the harvest of two cutthroat trout in the Little North Fork Clearwater River.

ACKNOWLEDGEMENTS

The authors would like to thank Ed Lider, Christopher Blaschka-Wilson, Kelly Carter-Lynn, Charles Tapia, Charles Lawson, Matt Davis, Kijsa Stromberg and Coulter Smart for their help in snorkeling the river systems. We also wish to thank Josh Stanley for his help in packing the crew's equipment into, and out of, the Little North Fork Clearwater River.

Table 1. Number of westslope cutthroat trout tagged, recaptured and harvested on the Little North Fork Clearwater River, Idaho during studies between 1997 and 2012. Percent recaptured and angler exploitation were corrected for tag loss and non-reporting. Data in 2005 was corrected for an additional week of fishing prior to tagging trout.

Date	Number Tagged	Number Recaptured	Percent Recaptured	Number Harvested	Annual Exploitation
2012	63	3	11%	1	4%
2009	119	12	16%	2	4%
2005	142	16	18%	9	12%
2005 corrected	142	20	23%	11	15%
2002	31	6	32%	2	12%
1997	75	--	--	6	16%

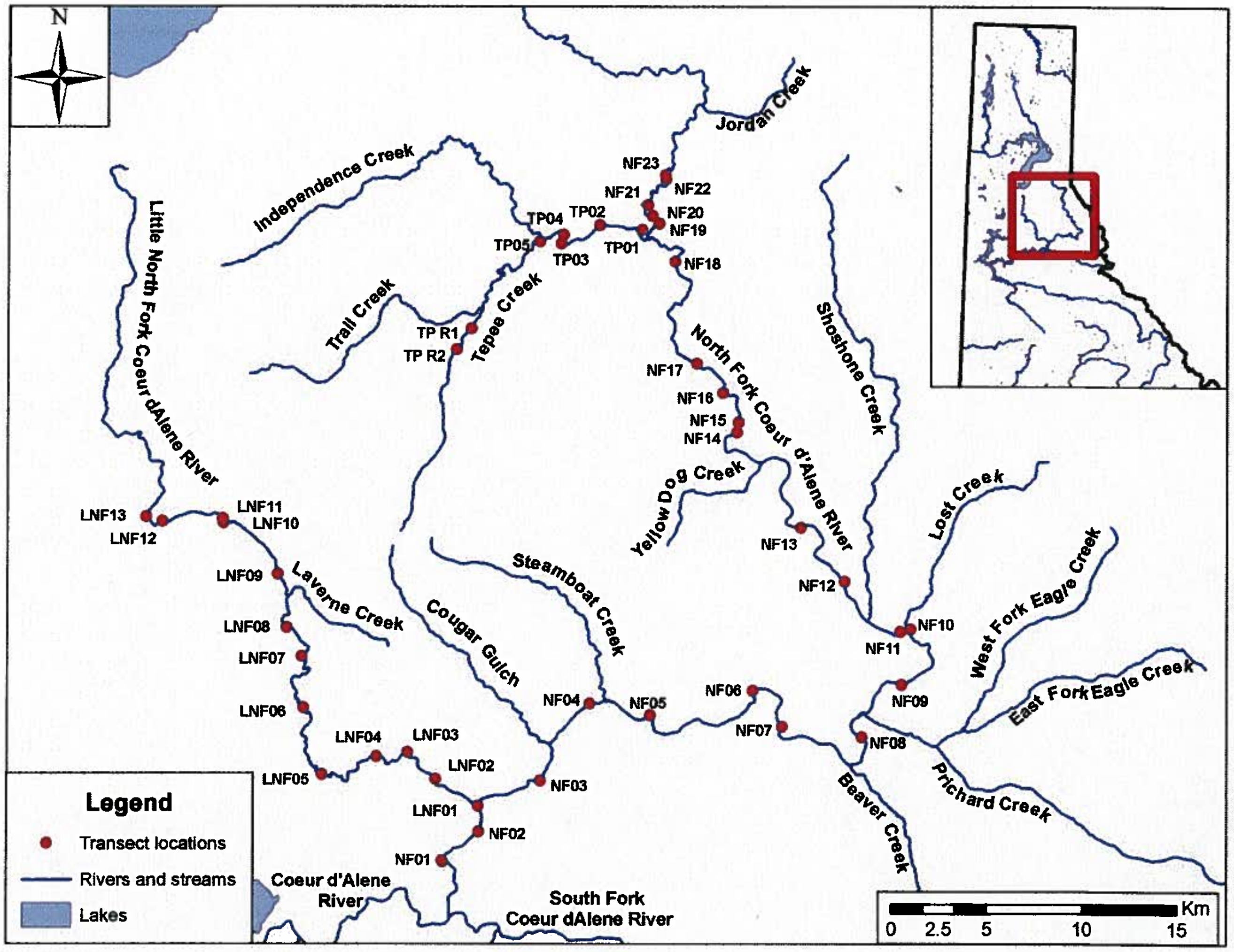

Figure 1. Location of 42 transects snorkeled on the Coeur d'Alene River, Idaho during July 24-27, 2012.

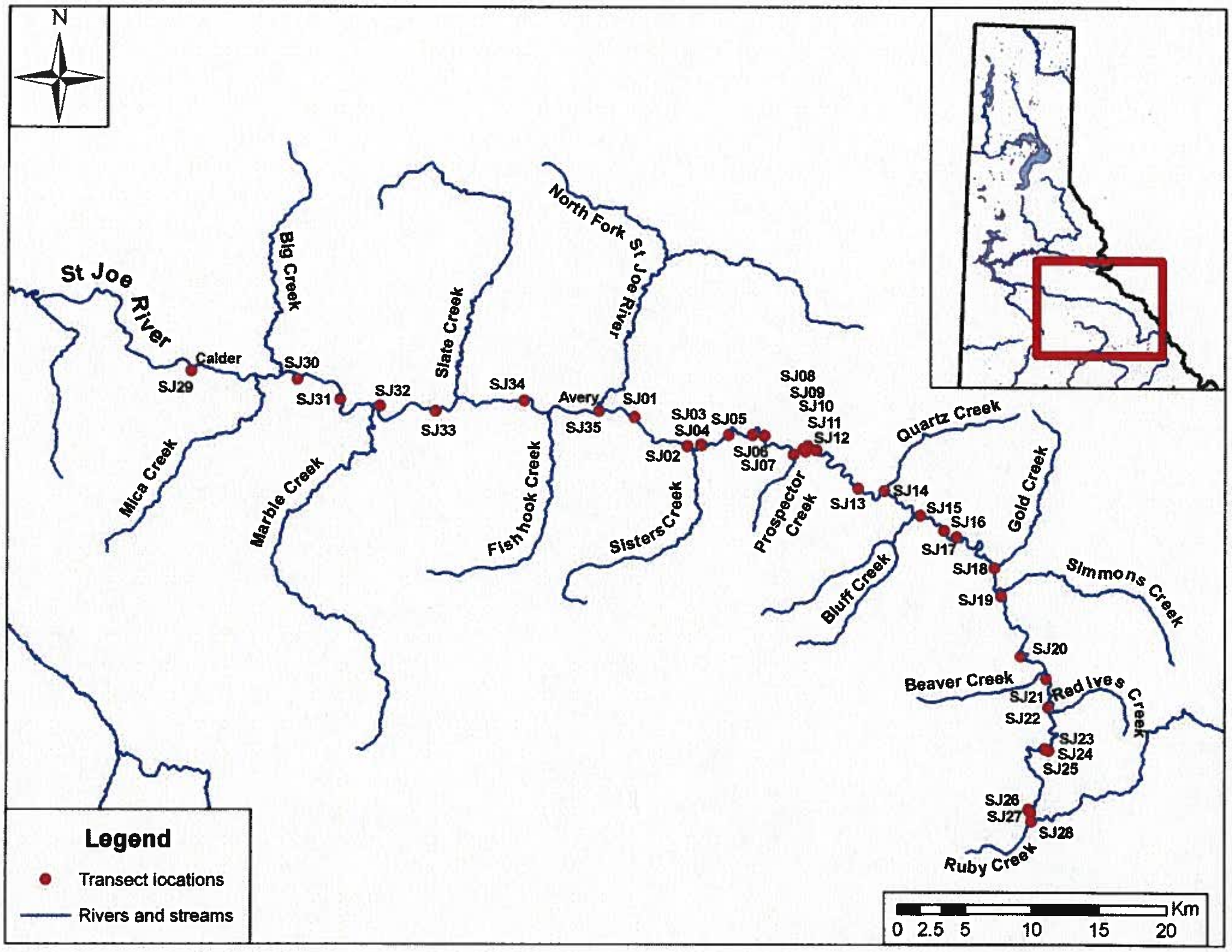

Figure 2. Location of 35 transects that were snorkeled on the St. Joe River, Idaho, during July 31- August 2, 2012

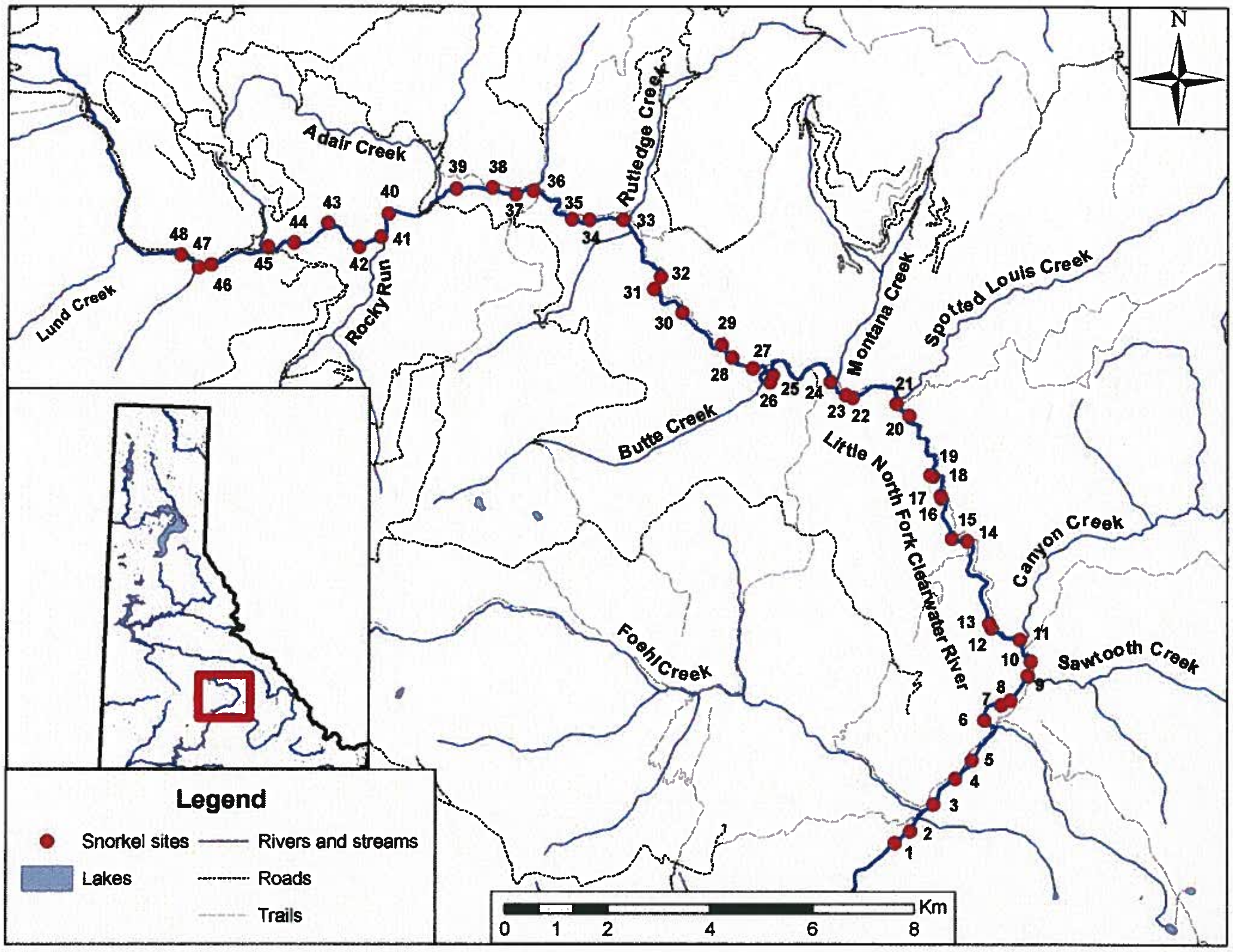

Figure 3. Locations of 48 transects snorkeled in the Little North Fork Clearwater River, Idaho, during August 7-9 and 14-15, 2012.

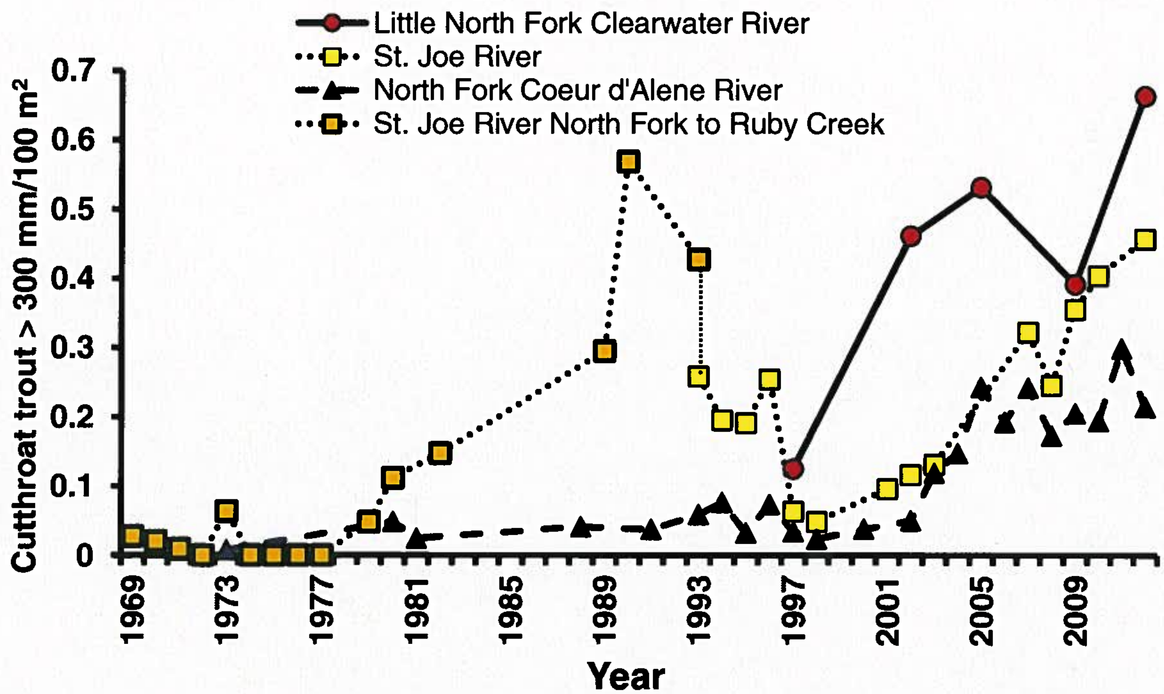

Figure 4. Densities of cutthroat trout over 300 mm in the North Fork of the Coeur d'Alene River, the St. Joe River, and the Little North Fork Clearwater River 1969-2012.

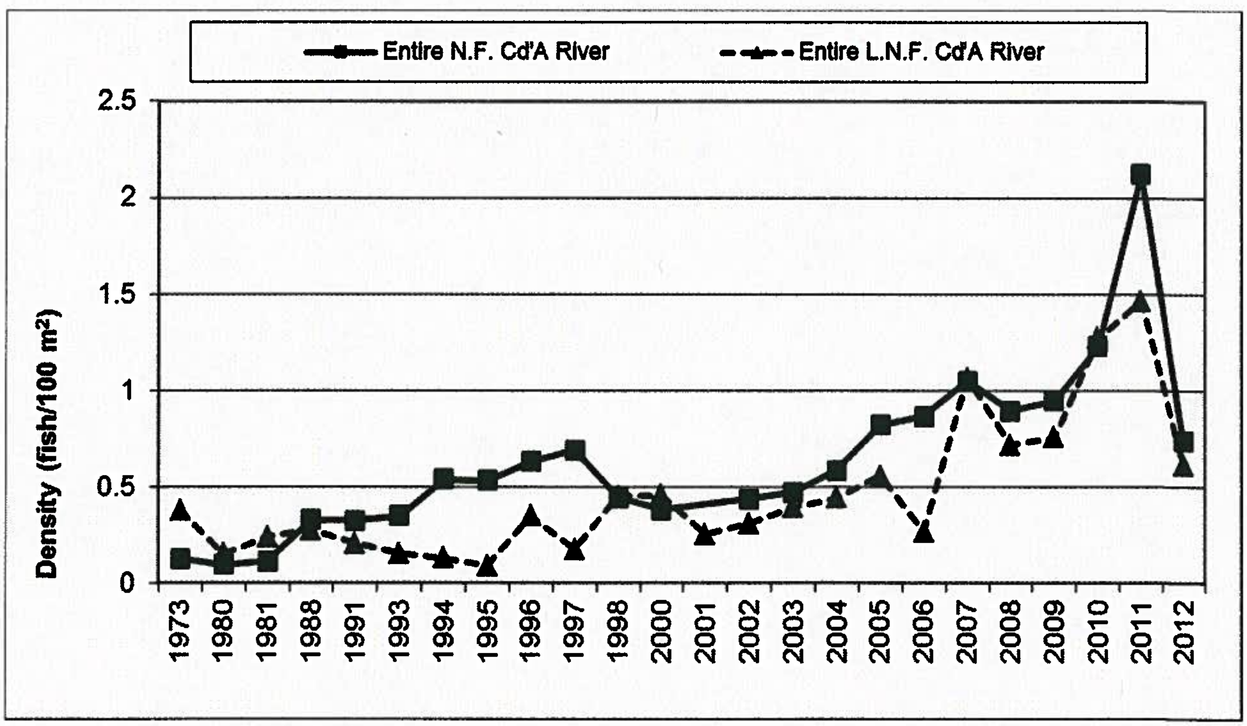

Figure 5. Densities of cutthroat trout of all sizes in the North Fork and Little North Fork of the Coeur d'Alene River, Idaho 1973-2012.

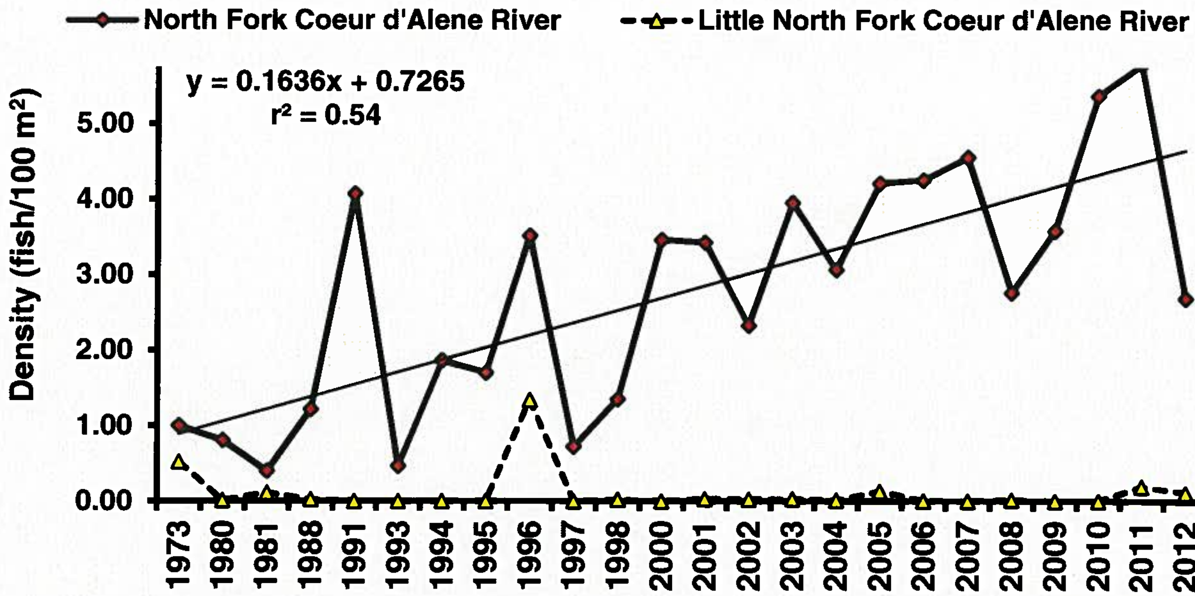

Figure 6. Densities of mountain whitefish in the North Fork and Little North Fork of the Coeur d'Alene River, Idaho 1973-2012. Trend line and correlation coefficient are for the North Fork Coeur d'Alene River data set.

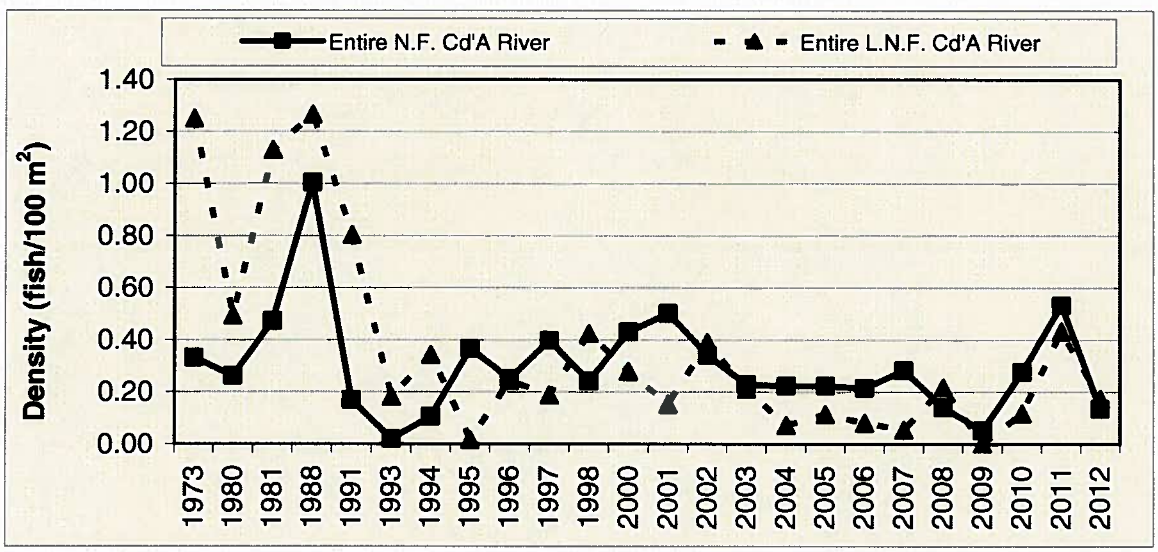

Figure 7. Densities of rainbow trout in the North Fork (N.F.) and Little North Fork (L.N.F.) of the Coeur d'Alene River, Idaho 1973-2012.

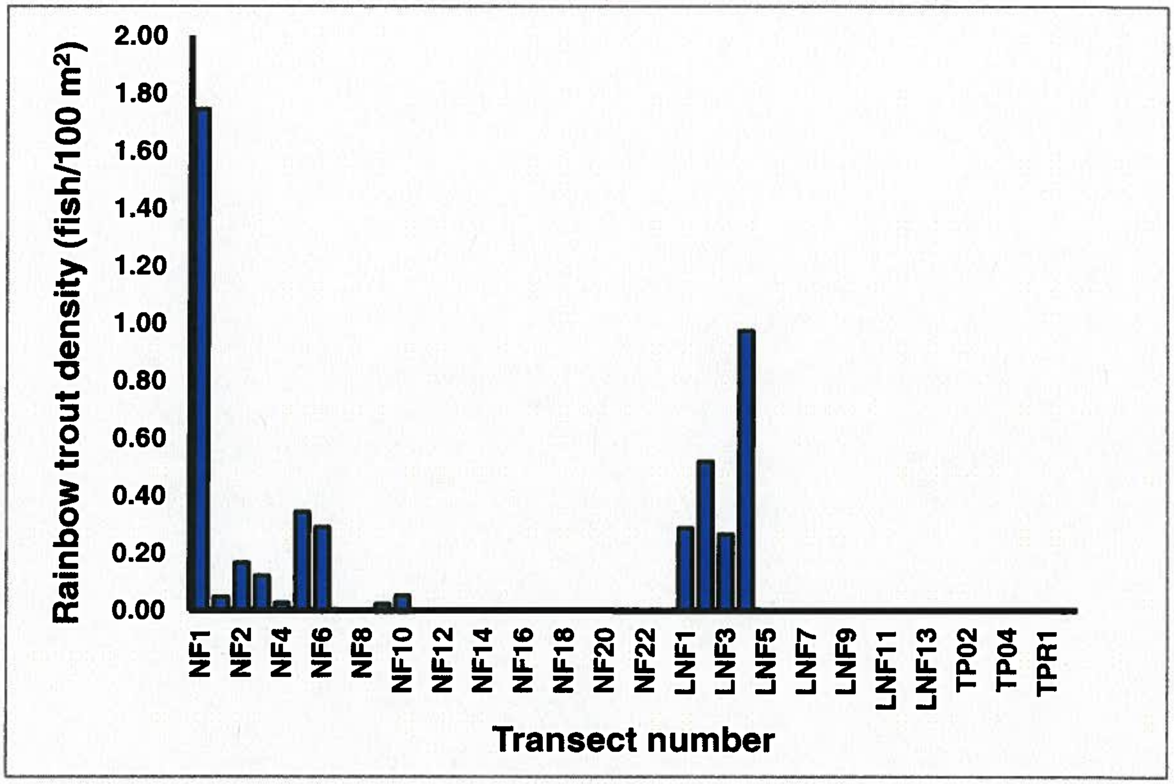

Figure 8. Densities of rainbow trout recorded during the surveys of the North Fork (NF) and Little North Fork (LNF) Coeur d'Alene rivers during 2012. Transect locations are given in Figure 1.

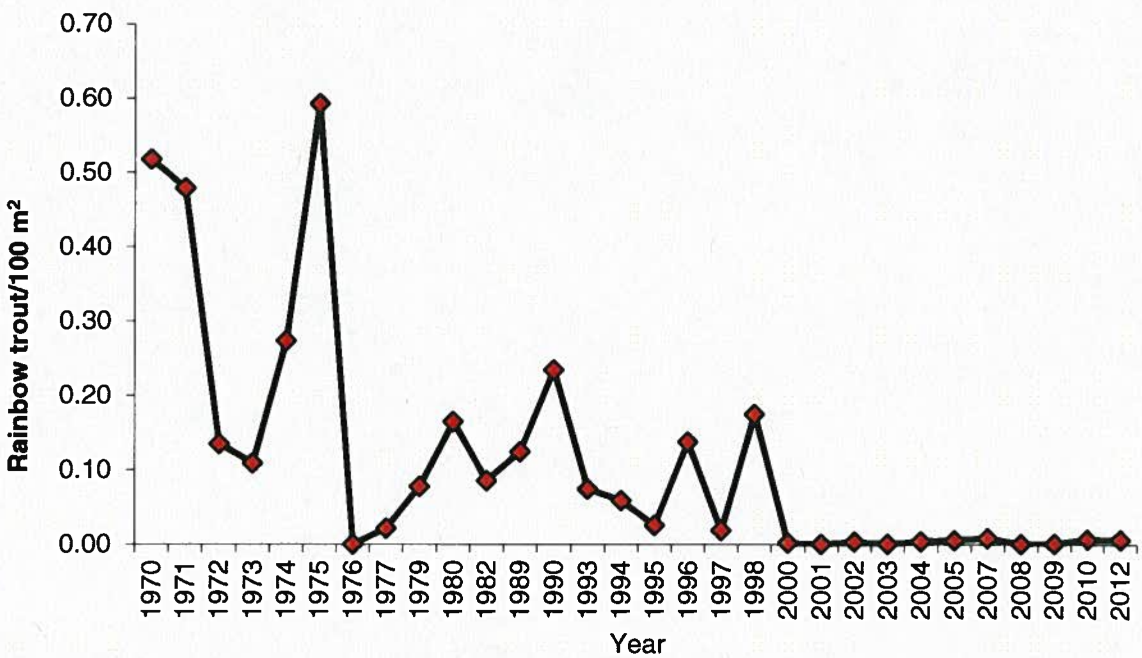

Figure 9. Densities of rainbow trout in the St. Joe River, Idaho 1970-2012.

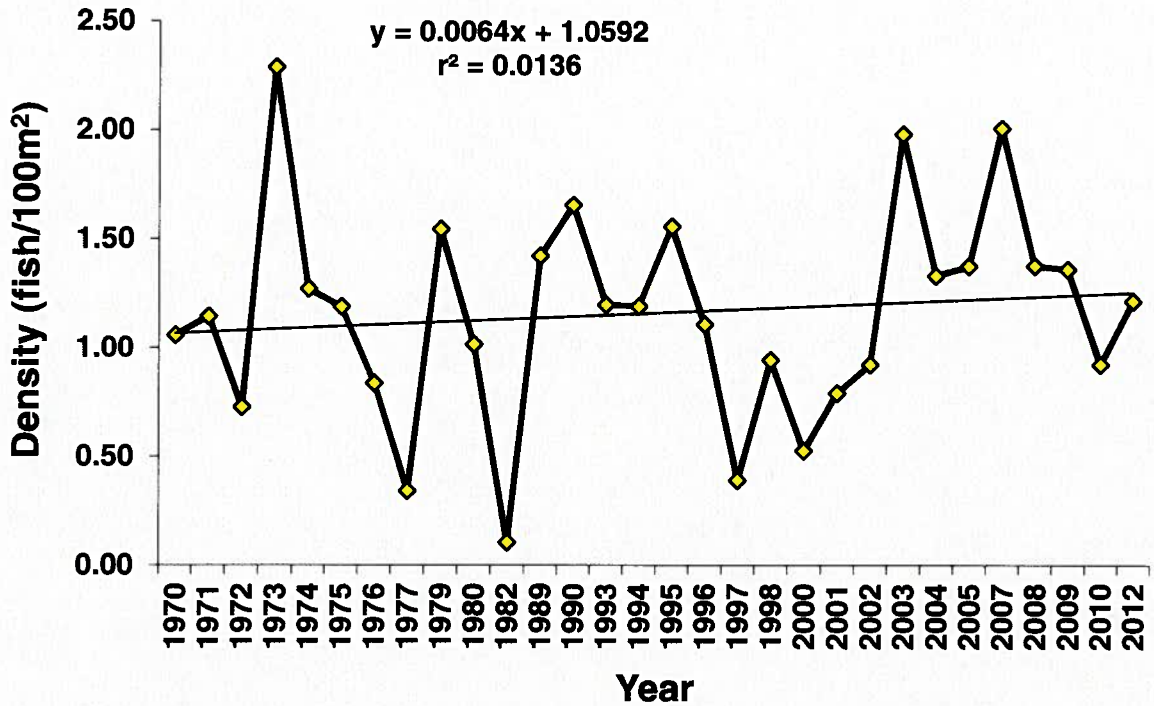

Figure 10. Densities of mountain whitefish in the St. Joe River, Idaho 1970-2012.

CHAPTER 9: BULL TROUT REDD COUNTS

ABSTRACT

During the fall of 2012 we counted bull trout redds as an index of adult abundance in each of the major drainages in northern Idaho. With the help of personnel from federal and state agencies, a total of 867 redds were counted: 52 redds were in the Upper Priest Lake drainage, 6 in the Kootenai River drainage, 652 in the Pend Oreille drainage, 69 in the St. Joe drainage, and 90 in the Little North Fork Clearwater drainage. Several streams in each drainage were considered "index streams" and counted every year to note trends. Only the Little North Fork Clearwater River showed an increase in the redd counts in the index streams over the previous three year average.

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INTRODUCTION

Bull trout *Salvelinus confluentus* were listed by the U.S. Fish and Wildlife Service (USFWS) as a threatened species under the Endangered Species Act in 1999. Idaho Department of Fish and Game (IDFG) personnel, along with employees of other agencies, annually count bull trout redds in to monitor long term trends of these populations.

STUDY SITES

Bull trout redds were counted in headwater streams within the Priest River, Pend Oreille Lake, Kootenai River, St. Joe River, and Little North Fork (LNF) Clearwater River drainages where bull trout were known to spawn. 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 (NF) Clearwater River. The boundaries of the Kootenai River and NF Clearwater River core areas extend outside of the Panhandle Region so our counts represent only a fraction of the population in these core areas.

METHODS

We counted bull trout redds in selected tributaries of the Priest Lake, Priest River, Pend Oreille Lake, Kootenai River, St. Joe River, and LNF Clearwater basins where bull trout were known or believed to occur. We summarized counts in each of these basins for each core area. Redd counts in the Middle Fork (MF) 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. 2009). We counted all redds at similar times (late September and October) as had occurred in the past. Survey techniques and identification of bull trout redds followed the methodology described by Pratt (1984). During the surveys, we counted the number of redds in each stream or stream section, and recorded the location of redds on maps and/or recorded the global positioning system (GPS) location.

Number of bull trout redds can be converted to an estimate of the spawning escapement for an individual stream or drainage. We used Downs and Jakubowski (2006) findings that an average of 3.2 adult bull trout entered tributaries of Lake Pend Oreille for every redd that was counted during annual surveys. We decided to use this adult-to-redd ratio because this estimate came from one of the core areas in the Panhandle Region, and because it was consistent with that found in the Flathead Lake system (Fraley and Shepherd 1998). Further justification for this conversion was explained by Dupont et al. (2009).

To reduce observer variability in counting bull trout redds, we typically hold an annual training class at Trestle Creek, a tributary to Lake Pend Oreille. No class was held in 2012 since all observers had previous training or experience counting redds. The objective of the training was to provide consistency in bull trout redd counts by standardizing survey techniques and familiarizing new surveyors in bull trout redd identification. 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).

RESULTS AND DISCUSSION

Priest Lake Core Area

We counted a total of 52 bull trout redds in the Upper Priest River basin on October 1, 2012 (Table 1). The highest number of redds were counted in the upper two sections of Upper Priest River (36 redds). Second and third highest counts were in Hughes Fork (7 redds), and Gold Creek (4 redds). The total redd count was the highest recorded since 1999 when 58 redds were found. Redd count in the seven index streams that were counted each year since 1985 was 15 redds; up from 13 redds last year, but down from 20 and 23 redds the previous two years. By expanding the number of redds observed by 3.2 fish/redd, we estimated a spawning escapement of 166 bull trout for the Upper Priest Lake basin.

Kootenai River Core Area

We surveyed three tributaries (North Callahan, South Callahan, and Boulder creeks) on October 19 and 23, 2012 for bull trout redds in the Idaho portion of the Kootenai River Core Area. A total of 6 redds were counted, all of which were in North Callahan Creek (Table 2). The Montana portion of this core area was not counted in 2012. We did not define a trend for this core area with this limited information.

Pend Oreille Core Area

We completed Pend Oreille core area redd counts between October 15 and 23, 2012. A total of 652 bull trout redds were counted among all surveyed streams (Table 3). Six index streams counted consistently since 1983 accounted for 434 of the total redds (Table 3). Overall counts were below the previous ten year averages for total and index counts of 548 and 828 respectively. Total counts included 3 bull trout redds from Hellroaring Creek, a Pack River tributary. This represents the first survey of bull trout spawning in this stream.

Three historical redd survey locations were not surveyed in 2012. Two of these locations, Twin Creek and the Clark Fork River spawning channel were not surveyed because they have not represented consistent spawning locations or local populations. Both Twin Creek and the Clark Fork River spawning channel have been historic locations of bull trout spawning. However, following initiation of upstream bull trout pass efforts at Cabinet Gorge Dam, spawning and rearing use at these locations dropped dramatically. We did not survey Savage Creek, a tributary of East Fork Lightning Creek, in 2012. High water conditions in Savage Creek during the survey period prevented meaningful survey efforts. High, turbid water impacted observer ability in most surveys conducted in Lightning Creek tributaries. Caution should be taken in interpretation of results from this drainage.

Using the figure of 3.2 bull trout per redd counted, we calculated a minimum spawning escapement of 2,086 bull trout in the Pend Oreille Core Area.

Coeur d'Alene Lake Core Area

A total of 69 redds were counted in the St. Joe River drainage during the fall of 2012 (Table 4). This count included several new streams that had not been counted before including: Cascade, Mill, North Fork Bean, My, Pole, and Tinear creeks. With the additional streams, the total count in the St. Joe drainage increased from 52 redds last year to 69 redds this year.

Three of the survey areas are considered index areas including Medicine Creek, St. Joe River from Heller Creek to St. Joe Lake, and Wisdom Creek. Twenty nine redds were counted in the index area; down from 43 redds the previous year (Table 4). This count was the lowest count in the index streams since 1999. Large declines in Wisdom and Medicine creeks drove the decline in the index count. Medicine Creek was found to have 20 redds during 2012. This count was down from a high of 71 redds in 2008 and has been generally declining since that year (Table 4).

To our knowledge no spawning or rearing of bull trout occurred in the Coeur d' Alene River drainage. No bull trout were seen in the extensive snorkeling within the drainage in 2012 (see chapter on snorkel surveys in this report), and no redd surveys were conducted.

Using the figure of 3.2 bull trout per redd counted, we calculated a spawning escapement of 221 bull trout in the Coeur d'Alene Lake Core Area.

North Fork Clearwater River Core Area

We counted 90 bull trout redds in the surveyed section of the North Fork Clearwater River drainage on September 25 and 26, 2012 (Table 5). This count was up from 46 redds last year. The five index areas that included Lund Creek, Little Lost Lake Creek, Lost Lake Creek, Little North Fork Clearwater River between Lund and Lost Lake creeks, and the Little North Fork Clearwater River between its headwaters and Lost Lake Creek contained a total of 62 redds, up from 26 the previous year.

This redd survey represents only a small part of the North Fork Clearwater Core Area. Based on 3.2 bull trout per redd, we estimated this section of the core area had a spawning escapement of 288 fish.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor bull trout spawning escapement at two to five year intervals in the Kootenai, St. Joe and Little North Fork Clearwater river drainages. We recommend annual monitoring of the Upper Priest Lake and Pend Oreille Lake watersheds because of ongoing restoration activities.

2. Define a new set of index streams for the Upper Priest Lake drainage. We suggest using the streams counted in 2012 as the index data set.

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Table 1. Description of bull trout survey locations, distance surveyed and number of redds observed in the Upper Priest River drainage, Idaho, 1992-2012; Cr = Creek.

Stream	Transect Description	Length (km)	Year 1985	1986	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Upper Priest River	Falls to Rock Cr.	12.5	--	--	--	--	--	--	15	4	15	33	7	7	17	8	5	13	21	5	14	5	17	10	24
	Rock Cr. to Lime Cr.	1.6	--	--	--	2	1	1	2	0	3	7	0	2	0	0	0	0	1	0	0	2	4	1	12
	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	1	5	10	3	1	4
	Snow Cr. to Hughes Cr.	11.0	--	--	--	0	0	--	0	3	7	4	2	8	3	13	2	10	0	1	2	4	0	7	1
	Hughes Cr. to Priest Lk	2.3	--	--	--	0	0	--	0	--	--	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	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	0	0	0	0	0	0
Cedar Cr.	Mouth upstream 3.4 km	3.4	--	1	--	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ruby Cr.	Mouth to waterfall	3.4	--	--	0	0	--	--	--	0	0	--	--	--	0	--	--	0	--	0	0	0	0	--	--
Hughes Cr.	Trail 311 to trail 312	2.5	1	17	7	3	2	0	1	4	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
	F.S. road 622 to Trail 311	4.0	35[c]	2[c]	2	0	7	1	2	0	0	0	0	0	0	1	2	1	1	0	0	5	0	7	5
	F.S. road 622 to mouth	7.1	4[d]	0[d]	--	1	--	--	2	3	1	0	2	6	1	0	1	1	1	0	0	3	11	3	2
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	0	0	0	0	0	0
Jackson Cr.	Mouth to F.S. trail 311	1.8	--	--	4	0	0	0	0	0	0	--	--	--	0	0	0	0	1	0	0	0	0	0	0
Gold Cr.	Mouth to Culvert	3.7	24	23	5	2	6	5	3	0	1	1	9	5	2	2	0	1	0	0	1	5	6	2	4
Boulder Cr.	Mouth to waterfall	2.3	--	--	0	0	0	--	0	0	0	--	0	--	--	--	--	0	--	0	0	0	0	--	0
Trapper Cr.	Mouth upstream 5.0 km upstream from East Fork	5.0	--	--	--	4	4	2	5	3	8	2	0	1	0	0	0	0	--	0	0	0	0	--	0

Table 1. continued

Stream	Transect Description	Length (km)	Year																					
			1985	1986	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Caribou Cr.	Mouth to old road crossing	2.6	--	--	--	1	0	0	0	0	0	--	--	--	--	--	--	--	--	--	--	--	0	--	--
All stream reaches combined		70.5	80[e]	50[e]	18	18	28	12[f]	41	22	45	58	29	34	24	41	23	29	29	7	22	34	42	31	52
Only those stream reaches counted during 1985-6		23.8[g]	80	50	14[h]	11	21[h]	8[f]	17	10	12	12	20	16	4	20	15	6	6	1	6	23	20	13	15

[a] Redds were counted from Lime Creek to Cedar Creek, which is about half the distance that is currently counted.

[b] Redds were counted from the mouth to FS road 1013, which is about 1/4 of the distance that is currently counted.

[c] About 2/3 of the distance was counted 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 20% 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 reach was counted..

[h] Two of the sites were not counted.

Table 2. Number of bull trout redds counted in tributaries to the Kootenai River from 1990 to 2012. North and South Callahan creeks are a combined total of the counts in Montana and Idaho.

Stream	Length (km)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Idaho																								
Boulder Creek	1.8	--	--	--	--	--	--	--	--	--	--	--	2	2	0	0	1	0	0	0	0	0	0	0
Idaho and Montana																								
North Callahan Creek	3.3	--	--	--	--	--	--	--	--	--	--	--	--	13	32	17	12	29	3	17	10	9	3	6[a]
South Callahan Creek	4.3	--	--	--	--	--	--	--	--	--	--	--	--	4	10	8	8	4	0	0	0	1	2	0[a]
Montana																								
Quartz Creek	16.1	76	77	17	89	64	67	47	69	105	102	91	154	62[d]	55	49	71	51	35	46	31	39	37	--
O'Brien Creek	6.9	--	25	24	6	7	22	12	36	47	37	34	47	45	46	51	81	65	77	79	40	27	32	--
Pipe Creek	12.9	6	5	11	6	7	5	17	26	34	36	30	6[a]	11	10	8	2	6	0	4	9	16	2	--
Bear Creek	6.9	--	--	--	--	--	6	10	13	22	36[b]	23	4[c]	17	14	6	3	14	9	14	6	8	3	--
West Fisher Creek	16.1	--	--	--	2	0	3	4	0	8	18	23	1	1	1	21	27	4	18	6	8	12	3	--
Idaho Total	9.4	0	0	0	0	0	0	0	0	0	0	0	2	19	40	25	21	33	3	17	10	10	2	6
Montana Total	58.9	82	107	52	103	78	103	90	144	216	229	201	212	136	126	135	184	140	139	149	94	102	80	--
Quartz/O'Brien/Pipe	35.9	82	107	52	101	78	94	76	131	186	175	155	207	118	111	108	154	122	112	129	80	82	71	--
Total all streams	68.3	82	107	52	103	78	103	90	144	216	229	201	214	155	166	160	205	173	142	166	104	112	82	6

[a] Only the Idaho portion of the creek was counted.

Table 3. Number of bull trout redds counted per stream in the Pend Oreille Lake, Idaho, Core Area, from 1983 to 2012; Cr=Creek.

STREAM (*Index)	Avg 1983-2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Clark Fork R.	8	8	1	0	3	2	0	1	0	0	--
Lightning Cr.	10	8	9	22	9	3	10	11[b]	0	20	1
East Fork Cr.*	50	38	77	50	51	34	38	85	26	64	11[b]
Savage Cr.	8	7	15	7	25	0[b]	8	5	6	1	--[b]
Char Cr.	11	7	14	15	20	1	5[e]	1[e]	4[e]	9[e]	0[b,e]
Porcupine Cr.	10	5	10	14	8	8	8	15	11	13	2[b]
Wellington Cr.	9	8	7	6	29	9	10	4[b]	7	6	5
Rattle Cr.	20	37	34	34	21	2	24	62[b]	43	65	59
Johnson Cr.*	19	0	32	45	28	32	40	47	57	54	54
Twin Cr.	9	3	6	7	11	0	4	0	0	1	--
Morris Cr.	2	1	1	3	16	0	6	6	9	0	0[b]
Strong Cr.	1	--	0	--	--	--	7	6	2	11	3
Trestle Cr.[a]*	253	361	102[b]	174	395	145	183	279	188	178	187
Pack R.	22	24	31	53	44	16	11	4	0	1	7
Grouse Cr.*	37	45	28	77	55	38	31	51	27	116	69
Granite Cr.	33	101	149	132	166	104	52	106[c]	75[c]	129[c]	68
Sullivan Springs Cr.	15	12	14	15	28	17	7[c]	2[c]	9[c]	11[c]	4
North Gold Cr.*	29	21	56	34	30	28	17	28[c]	28[c]	6[c]	3[b]
Gold Cr.*	117	126	167	200	235	179	73	107[c]	130[c]	56[c]	110
W. Gold Cr.	NA	--	--	--	4	0	7	5	4	0	8
M.F. East R.	6	21	20	48	71	34	36	25	22	28	28
Uleda Cr.	4	3	7	4	7	2	7[b]	16	6	9	24
N.F. East R.	NA	--	1	0	0	--	0	--	0	--	--
Caribou Creek	NA	--	--	--	--	--	--	--	--	37	6
Hellroaring	NA	--	--	--	--	--	--	--	--	--	3
Total 6 index streams	503	591	462	580	794	456	382	597	456	474	434
Total of all streams	625	836	781	940	1256	654	584	866	654	815	652

[a] Additional apprx. 0.5 km reach immediately upstream of index reach on Trestle Creek added in 2001
[b] Impaired observation conditions (ice, high water, etc)
[c] Abundant early spawning kokanee made identification of bull trout redds in lower reaches difficult
[d] Partial Count
[e] Barrier excluded bull trout from accessing typical spawning habitat

Table 4. The number of bull trout redds counted in the St. Joe River drainage, Idaho, between 1992 and 2012; Cr = Creek.

Stream Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Aspen Cr.	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--
Bacon Cr.	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	--	0
Bad Bear Cr.	--	0	0	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--
Bean Cr.	14	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1
Beaver Cr.	2	2	0	0	0	0	1	0	--	0	0	0	0	0	0	0	0	0	3	--	0
Bluff Cr.- East Fork	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
California Cr.	2	4	0	2	3	0	--	--	0	0	0	0	0	0	0	0	0	2	--	--	0
Cascade Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2
Copper Cr.	--	--	0	--	0	--	--	--	--	--	0	0	0	--	--	0	0	--	--	--	--
Entente Cr.	--	--	--	--	--	--	--	0	--	--	1	0	--	--	--	--	--	--	--	--	--
Fly Cr.	1	--	--	0	0	0	2	0	--	--	1	0	0	0	--	0	2	1	0	--	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	--	0	--	--	--	--	--	--	--	--
Heller Cr.	0	0	0	0	--	1	0	0	0	--	0	0	7	1	5	0	0	3	9	5	5
Indian Cr.	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Medicine Cr.	11	33	48	17[a]	23[a]	13[a]	11[a]	48[a]	43	16	42	28	52	62	71	55	71	41	48	35	20
Mill Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9
Mosquito Cr.	0	--	0	0	4	0	2	--	--	--	--	--	0	0	--	--	--	--	--	--	--
My Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
North Fork Bean Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19
Pole Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
Quartz Cr.	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--
Red Ives Cr.	--	0	1	1	0	1	0	0	0	0	0	0	0	1	0	1	1	--	2	4	0
Ruby Cr.	0	1	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
Sherlock Cr.	0	3	0	2	1	1	0	1	0	--	--	0	0	0	0	0	3	--	1	--	2
Simmons Cr. - Lower	--	0	0	0	--	--	--	--	--	0	--	--	--	--	--	--	1	0	--	--	--
Simmons Cr. - NF to Three Lakes	--	5	0	--	--	--	--	--	--	--	--	--	--	--	0	--	--	0	--	--	--
Simmons Cr. - Three Lakes to Rd 1278	--	3	5	5	0	0	0	0	--	--	--	--	--	--	0	--	--	0	--	--	--
Simmons Cr. - Rd 1278 to Washout	--	0	0	0	1	0	1	0	--	--	--	--	--	--	--	--	--	0	--	--	--
Simmons Cr. - Upstream of Washout	--	0	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--
Simmons Cr. - East Fork	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--
St. Joe River - below Tento Cr.	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 4. continued

Stream Name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
St. Joe River - Spruce Tree CG to St. Joe Lodge	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
St. Joe River - St. Joe Lodge 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	9	10	0	6	8	1	5	7	4
Three Lakes Creek	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Timber Cr.	--	0	1	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tinear Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2
Wampus Cr	--	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Washout Cr.	--	3	0	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Wisdom Cr	1	1	4	5	1	0	4	11	3	13	9	9	11	19	12	32	27	8	1	1	5
Yankee Bar	1	0	--	--	--	0	--	--	1	0	0	0	0	0	3	0	0	--	--	--	--
Total - Index Streams [c]	22	48	55	42	38	19	15	69	48	40	54	46	72	91	83	93	106	50	54	43	29
Total - All Streams	42	71	62	64	48	23	21	70	49	41	56	46	79	93	91	94	113	57	69	52	69

[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.

[c] Index streams include Medicine Creek, St. Joe River from Heller Creek to St. Joe Lake, and Wisdom Creek.

Table 5. Number of bull trout redds counted in the Little North Fork Clearwater drainage between 1994 and 2012. Trend sites include Lund Creek, Little Lost Lake Creek, Lost Lake Creek, Little North Fork Clearwater River between Lund and Lost Lake creeks, and the Little North Fork Clearwater River between its headwaters and Lost Lake Creek; Cr=Creek.

Stream	Length (km)	1994	1996	1997	1998	1999	2000	2001	2001[a]	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Buck Creek	4.8	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	-
Canyon Creek	5.5	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	-
Butte Creek	1.2	--	--	--	--	--	--	--	5	0	--	--	--	--	--	--	--	--	--	-
Rutledge Creek		--	--	--	--	--	--	--	--	--	1	1	6	0	--	--	--	--	--	-
Rocky Run Creek	1.5	--	--	--	--	--	--	--	--	5	1	3	21	13	6	--	8	10	1	14
Lund Creek	3.9	0	7	2	2	1	1	13	5	7	7	5	19	7	30	22	11	6	1	8
Little Lost Lake Creek	3.9	0	1	1	1	7	3	1	--	2	4	15	1	34	31	14	5	19	2	2
Lost Lake Creek	3.0	0	0	0	0	--	1	--	--	0	--	1	--	10	13	8	9	7	6	5
Little North Fork Clearwater River																				
1268 Bridge to Lund Cr.	7.0	--	--	--	--	--	--	--	17	6	13	8	16	18	20	13	3	6	19	14
Lund Cr. to Lost Lake Cr.	3.8	--	--	3	1	9	8	3	12	5	7	5	8	16	21	9	11	9	11	16
Lost Lake Cr. to headwaters	5.4	0	2	0	0	--	5	1	--	5	5	5	11	13	8	20	14	7	6	31
All stream reaches surveyed	40.0	0	10	6	4	17	18	18	39	30	43	43	82	111	129	86	61	64	46	90
Trend sites (five streams)	20.0	0	10	6	4	17	18	18	17	25	28	32	39	84	108	73	50	48	26	62

[a] Streams were surveyed between 9/16/1994 and 9/19/1994, one week earlier than surveys in following years.

APPENDICIES

Appendix A. Number and density (fish/100 m^2) of fishes observed while snorkeling transects in the Coeur d'Alene River, Idaho, during July 24-27, 2012. Transect locations are shown in Figure 1.

Transect	Area (m^2)	Cutthroat Trout Number counted <300mm	Cutthroat Trout Number counted >300mm	Cutthroat Trout Total	Cutthroat Trout Density (No./100m^2)	Rainbow Trout Total	Rainbow Trout Density (No./100m^2)	Mountain Whitefish Total	Mountain Whitefish Density (No./100m^2)	Largescale Sucker Total	Northern Pikeminnow Total	Brook Trout Total	Salmonid Density (No./100m^2)
Lower North Fork													
NF1	5,451	59	31	90	1.65	95	1.74	350	6.42	175	600	0	9.81
NF1slough	2,190	0	4	4	0.18	1	0.05	16	0.73	0	0	0	0.96
NF2	9,792	12	1	13	0.13	16	0.16	126	1.29	44	33	0	1.58
NF3	10,063	7	2	9	0.09	12	0.12	175	1.74	70	55	0	1.95
NF4	12,520	17	7	24	0.19	3	0.02	375	3.00	250	175	0	3.21
NF5	4,982	26	56	82	1.65	17	0.34	500	10.04	300	600	0	12.02
NF6	7,258	30	11	41	0.56	21	0.29	500	6.89	20	66	0	7.74
NF7	6,944	85	2	87	1.25	0	0.00	145	2.09	6	0	0	3.34
NF8	5,499	24	4	28	0.51	0	0.00	191	3.47	0	0	0	3.98
NF9	9,840	10	8	18	0.18	2	0.02	0	0.00	0	0	0	0.20
NF10	8,116	108	38	146	1.80	4	0.05	425	5.24	0	4	0	7.08
NF11	8,506	12	9	21	0.25	0	0.00	4	0.05	0	0	0	0.29
NF12	6,070	8	9	17	0.28	0	0.00	0	0.00	0	0	0	0.28
NF13	2,953	0	3	3	0.10	0	0.00	0	0.00	0	0	0	0.10
North Fork													
NF14	3,179	74	11	85	2.67	0	0.00	180	5.66	0	0	0	8.34
NF15	2,749	40	12	52	1.89	0	0.00	190	6.91	0	0	0	8.80
NF16	3,083	2	0	2	0.06	0	0.00	0	0.00	0	0	0	0.06
NF17	9,602	35	22	57	0.59	0	0.00	105	1.09	0	0	0	1.69
NF18	2,449	9	12	21	0.86	0	0.00	75	3.06	0	0	0	3.92
NF19	941	40	10	50	5.31	0	0.00	20	2.12	0	0	0	7.44
NF20	1,315	15	8	23	1.75	0	0.00	5	0.38	0	0	0	2.13
NF21	817	18	6	24	2.94	0	0.00	30	3.67	0	0	0	6.61
NF22	1,814	30	6	36	1.98	0	0.00	1	0.06	0	0	0	2.04
NF23	626	3	0	3	0.48	0	0.00	0	0.00	0	0	0	0.48
Little North Fork													
LNF1	1,400	0	0	0	0.00	4	0.29	1	0.07	0	0	0	0.36
LNF2	3,472	7	8	15	0.43	18	0.52	0	0.00	0	0	1	0.98
LNF3	4,528	7	0	7	0.15	12	0.27	25	0.55	0	0	0	0.97
LNF4	822	45	2	47	5.72	8	0.97	0	0.00	1	0	3	7.06
LNF5	2,870	5	10	15	0.52	0	0.00	0	0.00	0	0	0	0.52
LNF6	1,790	6	1	7	0.39	0	0.00	0	0.00	0	0	0	0.39
LNF7	1,055	3	5	8	0.76	0	0.00	0	0.00	0	0	0	0.76
LNF8	2,622	12	5	17	0.65	0	0.00	2	0.08	0	0	0	0.72

Appendix A. Continued.

Transect	Area (m^2)	Cutthroat Trout Number counted <300mm	Cutthroat Trout Number counted >300mm	Cutthroat Trout Total	Cutthroat Trout Density (No./100m^2)	Rainbow Trout Total	Rainbow Trout Density (No./100m^2)	Mountain Whitefish Total	Mountain Whitefish Density (No./100m^2)	Largescale Sucker Total	Northern Pikeminnow Total	Brook Trout Total	Salmonid Density (No./100m^2)
LNF9	938	0	0	0	0.00	0	0.00	0	0.00	0	0	0	0.00
LNF10	1,714	4	1	5	0.29	0	0.00	0	0.00	0	0	0	0.29
LNF11	1,360	3	3	6	0.44	0	0.00	0	0.00	0	0	0	0.44
LNF12	796	0	4	4	0.50	0	0.00	0	0.00	0	0	0	0.50
LNF13	893	11	6	17	1.90	0	0.00	0	0.00	0	0	0	1.90
Teepee Creek													
TP01	2,751	11	15	26	0.95	0	0.00	0	0.00	0	0	0	0.95
TP02	4,431	5	5	10	0.23	0	0.00	0	0.00	0	0	0	0.23
TP03	1,342	7	10	17	1.27	0	0.00	10	0.75	0	0	0	2.01
TP04	1,628	1	0	1	0.06	0	0.00	0	0.00	0	0	0	0.06
TP05	1,262	19	7	26	2.06	0	0.00	75	5.94	0	0	0	8.00
TPR1	1,055	17	12	29	2.75	0	0.00	0	0.00	0	0	0	2.75
TPR2	833	7	4	11	1.32	0	0.00	0	0.00	0	0	0	1.32
Totals	**164,322**	**834**	**370**	**1,204**	**0.73**	**213**	**0.13**	**3,526**	**2.15**	**866**	**1,533**	**4**	**3.01**

Appendix B. Number and density of fishes observed while snorkeling transects in the St. Joe River, Idaho, during July 31- August 2, 2012.

Transect	Area (m^2) snorkeled	Cutthroat trout: Number counted ≥300mm	Cutthroat trout: Number counted all sizes	Cutthroat trout: Density (No./100m^2)	Rainbow trout: Number counted	Mountain whitefish: Number counted	Mountain whitefish: Density (No./100m^2)	Largescale sucker: Number counted	Northern pikeminnow: Number counted	Salmonid: Density (No./100m^2)
N.F. St. Joe River to Prospector Creek										
SJ01	3,879	1	1	0.03	0	12	0.31	0	0	0.00
SJ02	2,306	13	24	1.04	0	85	3.69	70	65	0.05
SJ03	1,422	5	21	1.48	2	45	3.16	1	0	0.05
SJ04	1,170	15	16	1.37	1	35	2.99	0	1	0.04
SJ05	4,811	30	67	1.39	1	37	0.77	27	50	0.03
SJ06	7,277	28	50	0.69	0	32	0.44	2	10	0.01
SJ07	5,496	24	39	0.71	0	28	0.51	0	1	0.01
Prospector Creek to Red Ives Creek										
SJ08	1,571	5	12	0.76	0	15	0.95	0	27	0.02
SJ09	2,369	7	52	2.20	0	25	1.06	0	0	0.03
SJ10	4,259	46	136	3.19	0	72	1.69	0	3	0.05
SJ11	2,004	26	58	2.89	0	7	0.35	0	0	0.03
SJ12	2,673	31	79	2.96	0	39	1.46	0	1	0.04
SJ13	2,967	21	76	2.56	0	23	0.78	0	1	0.03
SJ14	2,590	19	47	1.81	0	49	1.89	8	0	0.04
SJ15	2,006	3	49	2.44	0	12	0.60	0	0	0.03
SJ16	3,131	17	109	3.48	0	11	0.35	0	0	0.04
SJ17	2,258	16	54	2.39	0	62	2.75	2	0	0.05
SJ18	871	20	42	4.82	0	14	1.61	0	0	0.06
SJ19	1,004	10	16	1.59	0	5	0.50	0	0	0.02
SJ20	1,650	6	18	1.09	0	0	0.00	0	0	0.01
SJ21	756	21	51	6.75	0	55	7.28	1	15	0.14
SJ22	2,457	21	34	1.38	0	17	0.69	0	2	0.02
Red Ives to Ruby Creek										
SJ23	705	6	13	1.84	0	2	0.28	0	0	0.02
SJ24	1,651	11	23	1.39	0	5	0.30	0	0	0.02
SJ25	1,551	11	44	2.84	0	2	0.13	0	0	0.03
SJ26	2,096	12	27	1.29	0	25	1.19	0	0	0.02
SJ27	1,814	10	20	1.10	0	100	5.51	0	0	0.07
SJ28	543	3	22	4.05	0	2	0.37	0	0	0.04
Calder to N.F. St. Joe										
SJ29	6,995	23	38	0.54	0	30	0.43	28	0	0.01
SJ30	9,860	2	8	0.08	0	70	0.71	105	50	0.01
SJ31	7,288	16	16	0.22	0	50	0.69	39	25	0.01
SJ32	6,208	18	21	0.34	0	50	0.81	35	13	0.01
SJ33	6,994	3	7	0.10	1	10	0.14	4	0	0.00
SJ34	2,979	9	10	0.34	1	60	2.01	35	9	0.02
SJ35	5,784	9	13	0.22	0	70	1.21	60	18	0.01
Total	**113,395**	**518**	**1,313**	**1.16**	**6**	**1,156**	**1.02**	**417**	**291**	**2.21**

Appendix C. Number and density of fishes observed while snorkeling transects in the Little North Fork Clearwater River, Idaho, during August 7-9, 2012 and August 14-15, 2012.

	Transect		Cutthroat trout			Mountain whitefish		Rainbow trout		Bull trout	
			Number counted		Density	Number	Density	Number	Density (No./100 m^2)	Number	Density (No./100 m^2)
Reach	Number	Area (m^2)	>300mm	All sizes	(No./100 m^2)	counted	(No./100 m^2)	counted		counted	
Downstream of Canyon Creek	1	1763.0	0	9	0.51	12	0.7	0	0.0	0	0.0
	2	1466.1	10	16	1.09	25	1.7	0	0.0	0	0.0
	3	1007.6	7	17	1.69	18	1.8	3	0.3	0	0.0
	4	1259.5	6	12	0.95	8	0.6	0	0.0	0	0.0
	5	636.9	4	9	1.41	0	0.0	4	0.6	0	0.0
	6	1026.0	0	1	0.10	0	0.0	0	0.0	0	0.0
	7	1192.8	14	17	1.43	25	2.1	5	0.4	0	0.0
	8	738.3	0	0	0.00	12	1.6	3	0.4	0	0.0
	9	1109.9	3	5	0.45	7	0.6	1	0.1	0	0.0
	10	1278.9	21	31	2.42	12	0.9	2	0.2	0	0.0
Canyon Creek to Spotted Louis Creek	11	677.8	8	9	1.33	8	1.2	0	0.0	0	0.0
	12	580.4	16	18	3.10	2	0.3	1	0.2	0	0.0
	13	761.2	12	20	2.63	20	2.6	2	0.3	0	0.0
	14	493.6	22	25	5.06	15	3.0	20	4.1	0	0.0
	15	1577.0	9	11	0.70	8	0.5	11	0.7	0	0.0
	16	503.4	11	19	3.77	8	1.6	31	6.2	0	0.0
	17	739.7	2	10	1.35	0	0.0	15	2.0	0	0.0
	18	514.1	15	18	3.50	5	1.0	10	1.9	0	0.0
	19	640.2	0	1	0.16	2	0.3	10	1.6	0	0.0
	20	869.0	4	8	0.92	2	0.2	7	0.8	0	0.0
	21	620.5	1	7	1.13	2	0.3	7	1.1	0	0.0
Spotted Louis Creek to Rutledge Creek	22	998.4	1	11	1.10	0	0.0	9	0.9	0	0.0
	23	1244.4	6	25	2.01	0	0.0	15	1.2	1	0.1
	24	258.5	2	7	2.71	1	0.4	4	1.5	0	0.0
	25	384.1	4	6	1.56	1	0.3	8	2.1	0	0.0
	26	440.0	1	1	0.23	1	0.2	4	0.9	1	0.2
	27	392.0	2	4	1.02	1	0.3	0	0.0	0	0.0
	28	459.7	1	4	0.87	3	0.7	12	2.6	0	0.0
	29	387.0	3	3	0.78	0	0.0	7	1.8	0	0.0
	30	274.3	1	1	0.36	0	0.0	7	2.6	0	0.0
	31	550.6	1	1	0.18	6	1.1	6	1.1	0	0.0
	32	282.1	1	1	0.35	0	0.0	3	1.1	0	0.0

Appendix C. Continued.

Reach	Transect Number	Area (m^2)	Cutthroat trout Number counted >300mm	Cutthroat trout Number counted All sizes	Cutthroat trout Density (No./100 m^2)	Mountain whitefish Number counted	Mountain whitefish Density (No./100 m^2)	Rainbow trout Number counted	Rainbow trout Density (No./100 m^2)	Bull trout Number counted	Bull trout Density (No./100 m^2)
Rutledge Creek to F.S. Road 1268	33	544.5	6	13	2.39	3	0.6	22	4.0	0	0.0
	34	361.8	0	0	0.00	0	0.0	1	0.3	0	0.0
	35	339.4	1	2	0.59	0	0.0	1	0.3	0	0.0
	36	472.5	1	4	0.85	6	1.3	9	1.9	0	0.0
	37	380.8	0	2	0.53	0	0.0	2	0.5	0	0.0
	38	386.9	6	14	3.62	0	0.0	4	1.0	0	0.0
	39	252.0	1	16	6.35	0	0.0	10	4.0	0	0.0
Upstream of F.S. Road 1268	40	185.9	0	4	2.15	0	0.0	0	0.0	0	0.0
	41	431.1	4	8	1.86	6	1.4	0	0.0	3	0.7
	42	262.6	0	3	1.14	0	0.0	0	0.0	0	0.0
	43	449.9	0	0	0.00	0	0.0	7	1.6	0	0.0
	44	1115.5	0	4	0.36	0	0.0	10	0.9	0	0.0
	45	262.2	0	3	1.14	0	0.0	2	0.8	0	0.0
	46	203.5	1	13	6.39	0	0.0	0	0.0	3	1.5
	47	390.0	0	6	1.54	0	0.0	5	1.3	1	0.3
	48	193.8	0	0	0.00	0	0.0	0	0.0	3	1.5
Total	**48 sites**	**31,359**	**208**	**419**	**1.34**	**219**	**0.7**	**280**	**0.9**	**12**	**0.0**

Appendix D. Average density (fish/100 m^2) of westslope cutthroat trout counted by snorkeling during 1997, 2002, 2005, 2009 and 2012 in specific reaches of the Little North Fork Clearwater River, Idaho.

Stream Reach	Transect Number	(all sizes) 1997	2002	2005	2009	2012	> 300 mm 1997	2002	2005	2009	2012
Downstream of Canyon Creek	1-10	0.27	1.21	1.10	1.14	1.02	0.11	0.26	0.49	0.43	0.57
Canyon Creek to Spotted Louis Creek	11-21	0.59	2.79	1.27	1.99	1.83	0.12	0.94	0.82	0.58	1.25
Spotted Louis Creek to Rutledge Creek	22-32	0.36	0.95	0.94	0.85	1.13	0.12	0.32	0.55	0.17	0.41
Rutledge Creek to F.S. Road 1268	33-39	0.52	2.93	1.71	3.90	1.86	0.35	0.55	0.27	0.17	0.55
Upstream of F.S. Road 1268	40-48	--	3.16	0.92	3.36	1.17	--	0.64	0.16	0.29	0.14
Unroaded	1-32	0.38	1.51	1.12	1.33	1.30	0.11	0.44	0.61	0.42	0.75
Roaded	33-48	0.52	3.06	1.31	3.64	1.48	0.35	0.60	0.22	0.22	0.32
All Sites	1-48	0.39	1.75	1.16	1.66	1.34	0.13	0.46	0.53	0.39	0.66

Appendix E. Average density (fish/100 m^2) of rainbow trout, mountain whitefish and bull trout counted by snorkeling during 1997, 2002, 2005, 2009 and 2012 in specific reaches of the Little North Fork Clearwater River, Idaho.

		Rainbow Trout					Mountain Whitefish					Bull Trout				
Stream Reach	Transect Number	1997	2002	2005	2009	2012	1997	2002	2005	2009	2012	1997	2002	2005	2009	2012
Downstream of Canyon Creek	1-10	0.13	0.38	0.04	0.02	0.16	1.05	1.11	1.65	1.96	1.04	0.00	0.03	0.04	0.02	0.00
Canyon Creek to Spotted Louis Creek	11-21	0.98	0.63	0.12	0.49	1.43	0.80	1.20	1.27	1.36	0.90	0.03	0.12	0.08	0.01	0.00
Spotted Louis Creek to Rutledge Creek	22-32	0.58	1.65	0.62	1.36	1.32	0.30	0.82	1.01	0.31	0.23	0.00	0.03	0.24	0.02	0.04
Rutledge Creek to F.S. Road 1268	33-39	1.04	1.10	1.61	0.72	1.79	0.43	0.43	0.50	0.93	0.33	0.00	0.43	0.20	0.08	0.00
Upstream of F.S. Road 1268	40-48	--	0.94	0.16	1.06	0.69	--	0.21	0.13	0.05	0.17	--	0.64	1.34	0.34	0.29
Unroaded	1-32	0.50	0.78	0.21	0.43	0.82	0.78	1.05	1.37	1.45	0.81	0.01	0.05	0.10	0.02	0.01
Roaded	33-48	1.04	1.00	0.88	0.88	1.17	0.43	0.30	0.32	0.52	0.24	0.00	0.55	0.78	0.20	0.16
All Sites	1-48	0.52	0.81	0.34	0.50	0.89	0.76	0.94	1.16	1.31	0.70	0.01	0.13	0.24	0.05	0.04

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