

2014 Lake Pend Oreille Creel Survey

Dissolved Gas Supersaturation Control, Mitigation, and Monitoring: TDG
Alternative Mitigation and Monitoring Program

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ABSTRACT

Lake Pend Oreille (LPO) is Idaho's largest waterbody and hosts a variety of popular and economically important fisheries. An angler creel survey was conducted from March 16, 2014 - March 15, 2015 to estimate angler effort, catch, and harvest. Survey results were used to describe fishery trends and evaluate the fishery response to ongoing management actions. A total of 1,439 parties representing 2,937 individuals were interviewed and 198 angler counts (flights) were conducted. Total effort was estimated at 199,302 angler hours, targeting mainly kokanee *Oncorhynchus nerka* (40%), Rainbow Trout *O. mykiss* (39%), warmwater fishes (11%) and Lake Trout *Salvelinus namaycush* (9%). Over 236,000 fish were caught, of which 73% (173,000) were kokanee, 14% (33,000) were Smallmouth Bass *Micropterus dolomieu*, 6% (15,000) were Rainbow Trout, 2% (4,000) were Lake Trout and 1% (3,000) were Bull Trout *S. confluentus*. Other species comprised less than 1% of the catch. While total angler effort was comparable to the previous two surveys (2001, 2007), overall catch rates in 2014-15 were the highest documented since 1953. The creel survey demonstrated substantial changes in the fishery since 2007, including re-emergence of the kokanee fishery, a diminished Lake Trout fishery, and increased effort and catch for warmwater fishes. Overall, the creel survey indicated that the LPO fishery has responded favorably to recent management actions.

INTRODUCTION

Lake Pend Oreille (LPO) is Idaho's largest (36,000 surface ha) and deepest (360 m) natural lake. The native salmonid species assemblage consists of Bull Trout *Salvelinus confluentus*, Westslope Cutthroat Trout *Oncorhynchus clarkii lewisi*, Mountain Whitefish *Prosopium williamsoni*, and Pygmy Whitefish *P. coulteri*. LPO supports one of the strongest remaining adfluvial Bull Trout populations in the United States. Lake Pend Oreille also has a substantial non-native sport fish component including Rainbow Trout *O. mykiss*, Lake Trout *S. namaycush*, kokanee *O. nerka*, Smallmouth Bass *Micropterus dolomieu*, Largemouth Bass *M. salmoides*, Yellow Perch *Perca flavescens*, Black Crappie *Pomoxis nigromaculatus*, Lake Whitefish *P. clupeiformis*, Walleye *Sander vitreus*, and two sunfishes *Lepomis spp.* The lake is known for its premier sport fishery for trophy Rainbow Trout, but also supports notable kokanee, Bull Trout and Westslope Cutthroat Trout fisheries, as well as increasingly popular warmwater fisheries. The LPO fishery provides significant economic input to the state of Idaho's economy, estimated at around \$17.7 million in 2003 and \$13.5 million in 2012 (IDFG 2003, 2012).

Kokanee have been the primary driver of the LPO fishery since they were introduced in the 1930s. They serve a dual role by providing both a high-yield sport fishery and the primary prey source for pelagic predators (e.g., Rainbow Trout, Bull Trout) that support trophy fisheries. From the 1950s (when creel surveys began) through the mid-1970s, LPO anglers targeted mainly kokanee, with commensurately high kokanee harvests, and there was an active commercial fishery (Bowles et al. 1986). A world renowned trophy fishery for Rainbow Trout and Bull Trout also existed during that era. However, kokanee abundance began declining in the mid-1960s and reached a depressed state by the 1970s. The commercial fishery was closed in 1973. Lake Trout, introduced initially in the early part of the 20th century, became increasingly abundant by the early 2000s, and increased predation threatened to collapse the already diminished kokanee population (Wahl et al. 2015). This prompted the implementation of fishing regulation changes intended to balance high predator abundance, specifically Lake Trout and Rainbow Trout, with the declining kokanee prey base. In 2000, the kokanee fishery was closed, Rainbow Trout limits were liberalized, and the limit on Lake Trout was removed. Despite these efforts, the Lake Trout population continued to expand, and the kokanee fishery did not show signs of recovery (Fredericks et al. 2003).

More intensive predator management became a necessary focus for kokanee recovery in LPO. Examination of the impacts of Lake Trout introductions in other waters strongly suggested that Lake Trout posed a significant threat to the fishery (Donald and Alger 1993; Fredenberg 2002). During a 1991 LPO creel survey, only 43 Lake Trout were observed in the angler catch; in fact, they were encountered infrequently enough that estimates of total catch and harvest were not made that year (Paragamian and Ellis 1994). During the 2000 creel census, creel clerks documented the catch of over 400 Lake Trout and the total estimated catch of Lake Trout was 6,025 fish (Fredericks et al. 2003). In 2007, the Lake Trout catch estimate approached 20,000 fish (Ryan and Jakubowski 2009).

Partially funded using Avista Clark Fork Settlement Agreement (CFSA) funds, a predator removal program was initiated in 2006 with the long-term goal of suppressing Lake Trout and the short-term goal of reducing Rainbow Trout abundance. The removal program had two components. First, an Angler Incentive Program (AIP) was implemented and incentivized harvest by paying anglers \$15 for every Lake Trout and Rainbow Trout harvested. The harvest incentive for Rainbow Trout was discontinued in 2013 in response to increased kokanee abundance and limited success by anglers to reduce the Rainbow Trout population (Wahl et al. 2015). However, angler harvest of Lake Trout was significant, and that program continues. The second component of the predator removal program was large-scale trap netting and gill netting to reduce Lake Trout abundance. Through 2015, over 82,000 Lake Trout have been removed by angling and over 107,000 Lake Trout have been removed by netting. Concurrently, kokanee abundance has increased substantially (Wahl et al. 2015). A kokanee harvest fishery was re-opened in 2013, and the daily bag limit was increased from 6 to 15 fish in early 2014.

Given the active management of LPO fish populations in recent years, it is important to understand how the fishery has responded to these actions. Additionally, introduced warmwater fish populations have continued to expand within the lake and their influence on the fishery warrants monitoring. Thus, our objective was to conduct a lake-wide creel survey on LPO to estimate angler effort, catch, and harvest of all species targeted by anglers. These data were used to describe the status of the fishery and evaluate trends relative to past surveys.

METHODS

An angler survey was conducted on LPO from March 16, 2014 - March 15, 2015. The angler survey was used to estimate angler effort, catch rates, and harvest. Survey results were used to describe trends in the fishery over time and the fishery response to management actions. Historical data were derived from various sources (Ellis and Bowler 1981, Bowles et al. 1986, Paragamian and Ellis 1994, Fredericks et al. 2003, Ryan and Jakubowski 2009), and these data were collected and analyzed using various methods and are probably not directly comparable for fine-scale comparisons. Regardless, large-scale comparisons of general trends are possible, realizing that limitations are inherent when comparing data collected over such a long period.

During the current sampling period, some special rules applied to the LPO fisheries. First, there was no limit on the number of rods a boat angler could use. There was no limit on Lake Trout and Northern Pike harvest, and there was no allowable harvest of Bull Trout and Westslope Cutthroat Trout. The bass limit was six fish daily, only two of which could be Largemouth Bass, and no Largemouth Bass could be less than 16 inches in length. The Rainbow Trout limit was 6, only one of which could be over 20 inches in length. The kokanee harvest limit was raised to from 6 to 15 fish on May 15, 2014 due to increased measured abundance.

The angler survey was completed using an aerial-access design (Robson and Jones 1989, Pollock et al. 1994). Angler counts were completed using randomly scheduled flights. A

12-month sampling year was divided into 26 two-week strata and each 2-week strata was then further stratified day type (weekend or weekday). Two weekend/holidays and two weekdays were randomly selected for aerial surveys within each strata. Two randomly selected times were chosen for flights on each selected day; one time was chosen in the morning and one in the afternoon. In the event bad weather prohibited a flight on a particular day or time, a second “makeup” flight was attempted on the next available day type (weekend/holiday or weekday) during the same interval and time as the original flight was scheduled.

All flights started at the same location (Long Bridge at Sandpoint; Figure 1). Although it was assumed that counts were “instantaneous”, we attempted to avoid any potential counting bias by flying in one of two randomly determined directions; along the North and East shoreline of the lake or along the South and West shoreline. The flight route was a complete circle of the lake. Only boats actively angling were counted. We did not attempt to quantify shore- or ice-based angling activity as these represent minor components of the LPO fishery.

To provide estimates of effort, average daily boat count was first computed by averaging available boat count data by day type and strata. Average daily angler count was then computed by multiplying the average boat count by the corresponding average number of anglers per boat as summarized from angler interviews. Total daily effort was then estimated by multiplying average angler count by the average number of daylight hours in the sampling period (Pollock et al. 1994).

Two full-time creel clerks were employed during the survey period to collect catch and harvest information. Clerks were scheduled to work 8-hour days, except from May 11 to August 3, when they worked 10-hour days to better cover the longer summer daylight hours. Clerks were given randomly selected consecutive days off arranged such that at least one weekend day was sampled per week. Daylight hours (0.5 hour before sunrise to 0.5 hour after sunset) were split into two equal time periods (morning and afternoon), and one was randomly selected for sampling each day. Two days off were provided during weeks when clerks worked 8-hour shifts, while three days off were scheduled during weeks with 10-hour shifts.

Creel clerks divided effort geographically across the lake. One clerk surveyed the western and southern half of the lake (Garfield, Farragut, Bayview) and the other surveyed the northern half of the lake (Sandpoint, Hope marinas, Boat Basin, Johnson Creek, and Trestle Creek; Figure 1). Sampling effort was apportioned to sample the locations in proportion to apparent angler use. More effort was spent sampling high-use areas, and if there was little evidence of use (e.g. no boat trailers in the parking lot, etc.) then clerks moved on to the next location.

Creel questions were designed to determine if the trip was complete, how many angler hours were fished during each trip, party size (as the number of residents and non-residents), number of rods fished, whether or not anglers were aware of the AIP, if anglers participated in the AIP, target species for the current trip, the number and species

caught, and the number and species harvested. Creel clerks measured total length (TL; mm) of harvested fish opportunistically as they were encountered.

Catch and harvest rates were reported as the number of fish caught and harvested per angler-hour for anglers targeting particular species or species groups (directed effort). Because all data were from completed trips, catch rates were calculated using a ratio of means estimator (Pollock et al. 1994). Mean daily catch rate was computed by averaging daily CPUE values across the days sampled. The total number of fish released, harvested or caught and associated 80% confidence intervals was derived by multiplying total fishing effort by the appropriate total rate estimator (harvest, release or catch), by strata, according to methods outlined in Pollock et al. (1994).

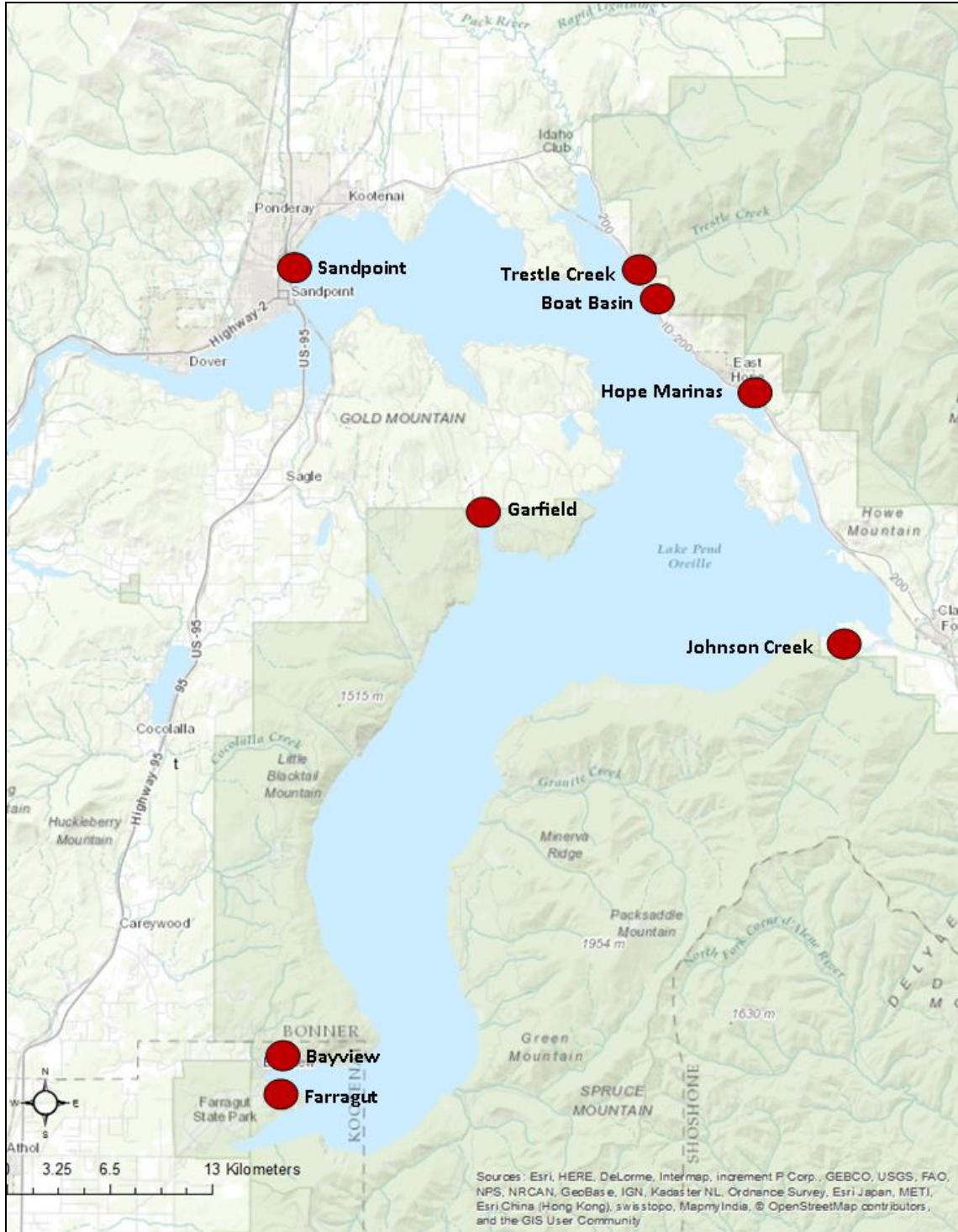


FIGURE 1. Map of Lake Pend Oreille showing creel survey sampling locations.

RESULTS

A total of 1,439 parties were interviewed between March 16, 2014 and March 15, 2015, each representing a completed trip. A total of 198 individual flights were made, with boat counts ranging from 0 to 111 boats actively fishing. Mean party size was 2.0 anglers per boat and mean completed trip length was 4.5 hours. Across all interviews, 90% of the anglers were aware of the AIP, but only 20% indicated that they had participated in the program. Of those that identified themselves as Lake Trout anglers, 97% were aware of the AIP, and 82% indicated that they had participated in the program. The majority (83%) of the 2,937 anglers interviewed were residents of the State of Idaho.

EFFORT

Total estimated angler effort during the surveyed period was 199,302 angler hours (Table 1; Figure 2). Observed angler effort was seasonally variable, with the highest effort occurring between April and October and peaking in July. Almost 80% of the effort was directed at either kokanee or Rainbow Trout. Approximately 11% of the total effort was directed at warmwater species (e.g., bass, Black Crappie, sunfish, Yellow Perch) and slightly over 9% was directed at Lake Trout. Less than 2% of the directed effort targeted Walleye, Brown Trout, whitefish, and Westslope Cutthroat Trout combined (Table 1; Figure 3).

TABLE 1. Estimate of directed fishing effort (angler hrs.) in Lake Pend Oreille by species and month from March 16, 2014-March 15, 2015.

Month	Kokanee	Rainbow Trout	Warmwater Fish ²	Lake Trout	Walleye	Brown Trout	Whitefish sp.	Westslope Cutthroat	Total	80% CI
March ¹	607	4,755	293	836	207	439	30	0	7,167	147
April	301	9,354	502	959	45	28	68	0	11,258	1,974
May	5,680	17,024	1,118	1,571	211	0	47	0	25,651	821
June	14,174	6,080	4,729	4,781	312	0	0	0	30,076	7,738
July	19,375	9,667	3,108	3,440	161	0	0	0	35,751	3,478
August	17,186	3,201	5,910	2,205	0	0	53	0	28,555	2,594
September	16,410	5,512	3,526	2,133	0	47	0	0	27,628	3,183
October	5,003	8,289	1,796	589	33	0	0	58	15,768	1,413
November	166	7,262	886	555	0	0	0	0	8,869	1,306
December	0	4,975	83	285	0	55	64	0	5,462	1,552
January	120	924	18	296	90	138	30	0	1,616	254
February	106	669	11	591	16	53	56	0	1,502	203
Total	79,128	77,712	21,980	18,241	1,075	760	348	58	199,302	9,949
80% CI	5,975	4,476	2,813	2,568	538	292	245	8	9,949	
%	39.7	39.0	11.0	9.2	0.5	0.4	0.2	0.0	100.0	

¹ March summaries are derived from data collected March 16-30, 2014 and March 1-15, 2015.

² Includes both bass species, Black Crappie, sunfish, and Yellow Perch.

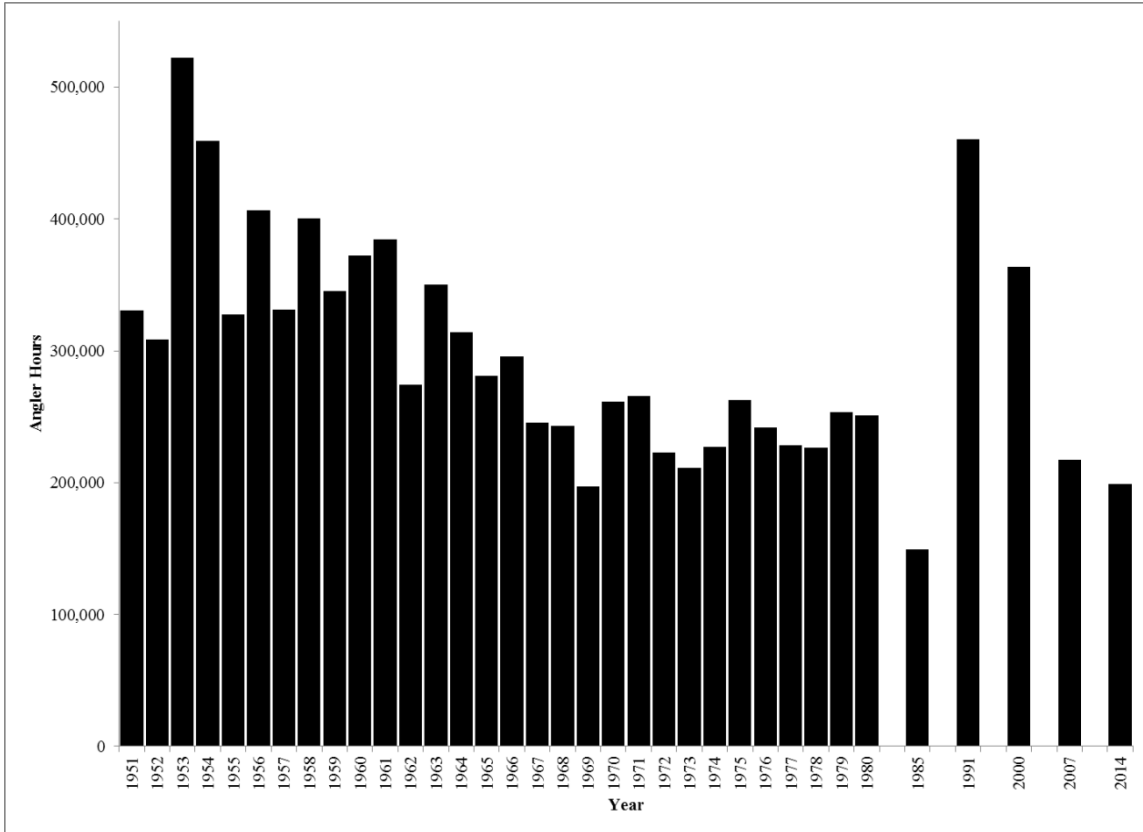


FIGURE 2. Total annual estimates of fishing effort (angler hrs.) in Lake Pend Oreille for years when surveys were conducted from 1951-2014. Historical data were taken from Ellis and Bowler (1981), Bowles et al. (1986), Paragamian and Ellis (1994), Fredericks et al. (2003) and Ryan and Jakubowski (2009). Note that years are not to scale on the x-axis after 1980.

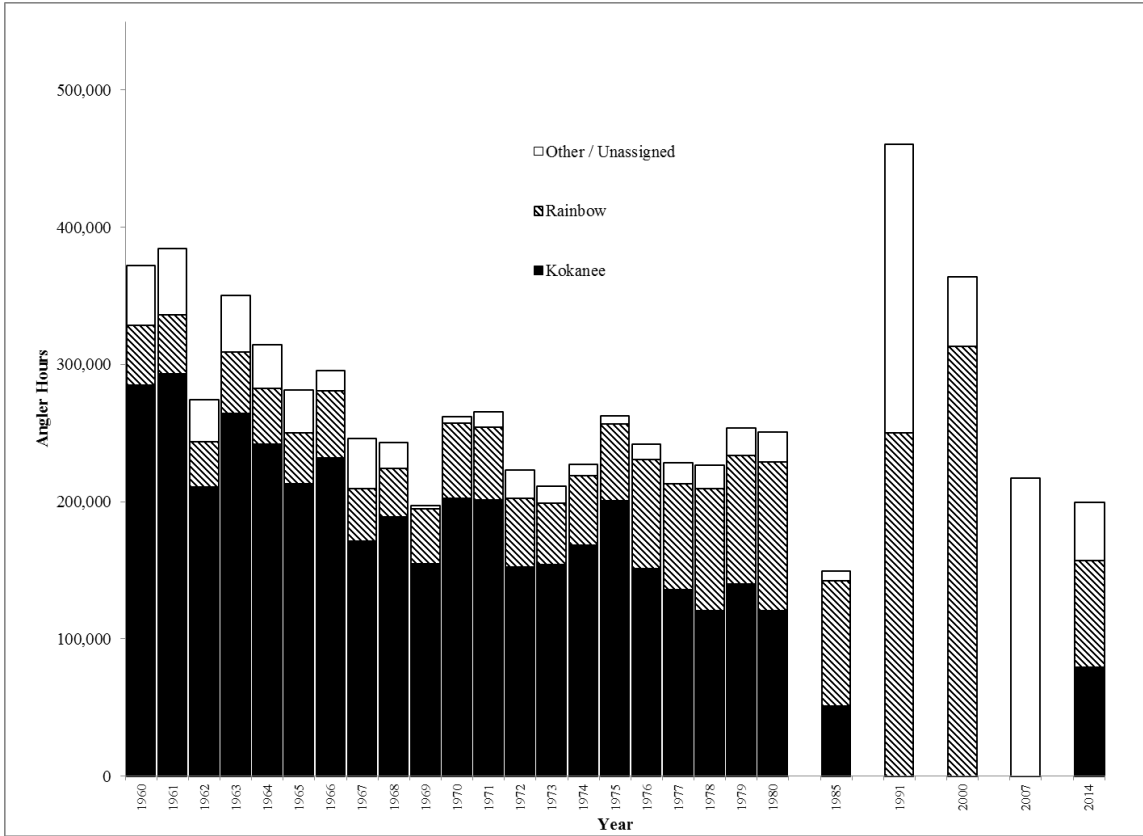


FIGURE 3. Total estimated fishing effort (angler hrs.) for Lake Pend Oreille, by target species and year when surveys were conducted from 1960 through 2014. Historical data were taken from Ellis and Bowler (1981), Bowles et al. (1986), Paragamian and Ellis (1994), Fredericks et al. (2003) and Ryan and Jakubowski (2009). Note that effort was not broken out by species during the 2007 survey and that years are not to scale on the x-axis after 1980.

Overall, angling parties used an average of 3.8 rods per boat, or 1.9 rods per angler in 2014. However, broken down by target species, Rainbow Trout anglers were the only angler group that, on average, utilized more than two rods per angler (Table 2).

TABLE 2. Average number of anglers per boat, rods per boat, and rods per angler, by target species, 2014.

Target Species	Anglers/boat	Rods/boat	Rods/Angler
Kokanee	2.1	2.6	1.3
Rainbow Trout	2.1	5.8	3.2
Warmwater Fish ²	1.7	1.8	1.1
Lake Trout	1.8	2.7	1.6

² Includes both bass species, Black Crappie, sunfish, and Yellow Perch.

CATCH

Kokanee were the most commonly caught species. Over 236,000 fish of all species were estimated to be caught during the survey period, with over 170,000 (73.2 %) being kokanee (Table 3). The 2014 kokanee catch, which was the first harvest estimate since the closure prior to the 2000 season, most closely resembled the kokanee catch during the late-1970s and was substantially lower than catches documented in the 1950s (Figure 4). Almost 90% of the kokanee caught were harvested (Table 3). Smallmouth Bass were the second most commonly caught species in 2014 (33,000). The number of Smallmouth Bass caught was negligible as recently as 2000 (Figure 5). In contrast to kokanee, the majority (89%) of Smallmouth Bass caught was released (Table 1). Almost 15,000 Rainbow Trout were caught, which was the third highest estimated catch on record (Figure 6); over half of these fish were released (Table 3). Over 4,000 Lake Trout were caught in 2014, which was 80% lower than was estimated in 2007. Approximately 2,000 Westslope Cutthroat Trout were caught, which was similar to catches documented since about 1960. Bull Trout total catch was estimated at about 3,000 fish, which was also similar to historical catches (Figure 5). All other species were estimated to comprise less than one percent of the catch, and due to low sample sizes, there was low confidence in the accuracy of our point estimates as evidenced by the fact that the 80% confidence intervals included zero (Table 3).

TABLE 3. Estimate of total catch in LPO by species from March 16, 2014 - March 15, 2015.

Species	No. Harvested	No. Released	Total Catch	80% CI	% Harvested	% of Catch
Kokanee	154,978	18,099	173,077	20,202	89.5	73.2
Smallmouth Bass	3,788	29,366	33,154	5,681	11.4	14.0
Rainbow Trout	5,666	9,184	14,850	3,276	38.2	6.3
Lake Trout	3,854	323	4,177	3,939	92.3	1.8
Bull Trout	28	3,154	3,182	2,061	0.9	1.3
Northern Pikeminnow	106	2,108	2,214	2,573	4.8	<1
Yellow Perch	142	1,771	1,913	3,103	7.4	<1
Westslope Cutthroat	0	1,912	1,912	1,171	0.0	<1
Largemouth Bass	0	703	703	2,095	0.0	<1
Whitefish sp.	54	330	384	1,728	14.1	<1
Brown Trout	232	76	308	1,354	75.3	<1
Walleye	67	89	156	1,574	42.9	<1
Cutthroat/Rainbow Hybrids	9	138	147	1,171	6.1	<1
Peamouth	25	78	103	1,108	24.3	<1
Crappie	28	26	54	1,283	51.9	<1
Sucker sp.	0	46	46	840	0.0	<1
Northern Pike	39	0	39	115	100.0	<1
Total	169,016	67,403	236,419		71.5	100

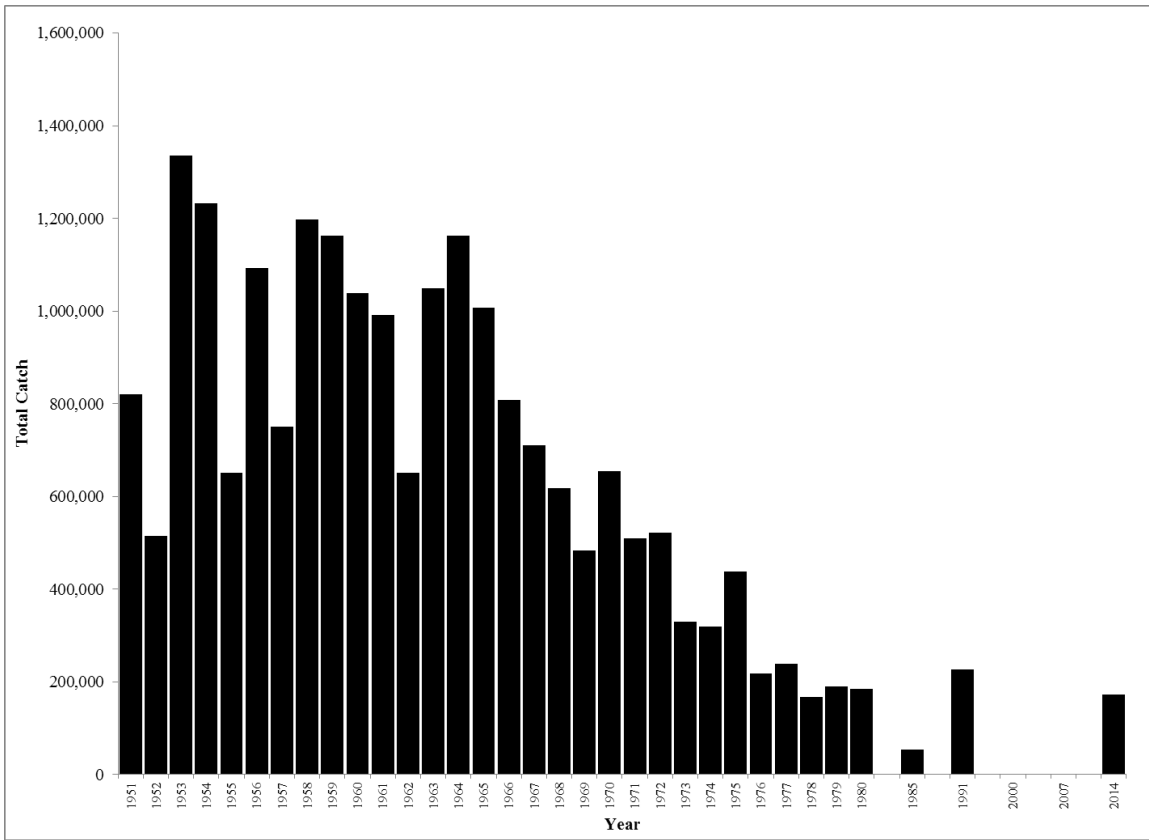


FIGURE 4. Total estimates of kokanee catch in Lake Pend Oreille for years when surveys were conducted from 1951 through 2014. Historical data were taken from Ellis and Bowler (1981), Bowles et al. (1986), Paragamian and Ellis (1994), Fredericks et al. (2003) and Ryan and Jakubowski (2009). Note that years are not to scale on the x-axis after 1980.

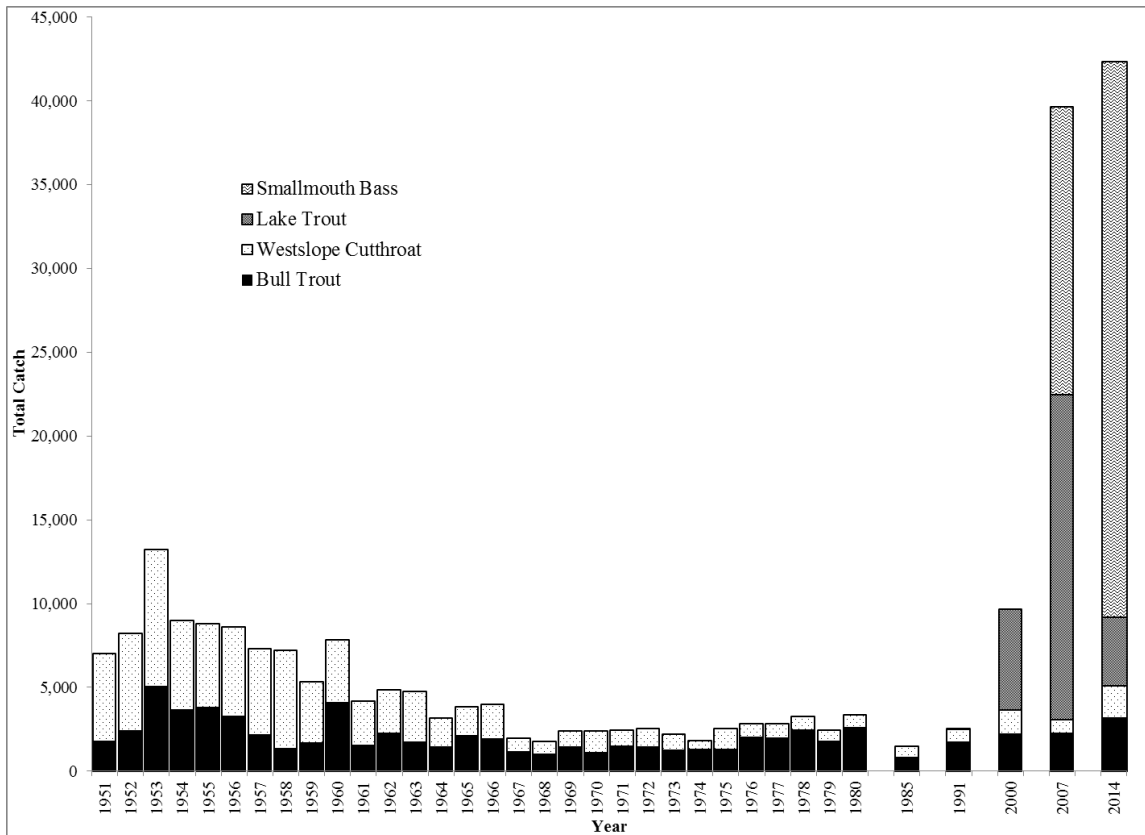


FIGURE 5. Total estimated Smallmouth Bass, Lake Trout, Westslope Cutthroat Trout, and Bull Trout catch in Lake Pend Oreille for years when surveys were conducted from 1951 through 2014. Historical data were taken from Ellis and Bowler (1981), Bowles et al. (1986), Paragamian and Ellis (1994), Fredericks et al. (2003) and Ryan and Jakubowski (2009). Note that years are not to scale on the x-axis after 1980.

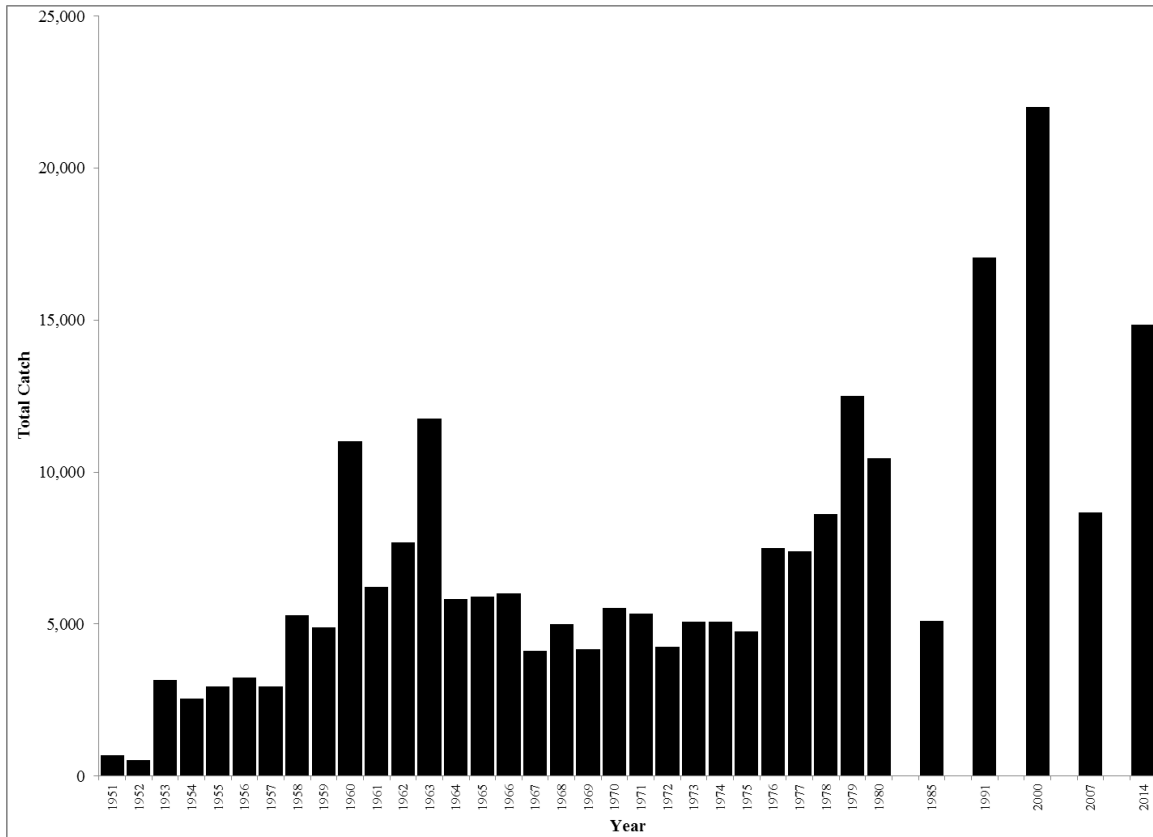


FIGURE 6. Total estimated Rainbow Trout catch in Lake Pend Oreille for years when surveys were conducted from 1951 through 2014. Historical data were taken from Ellis and Bowler (1981), Bowles et al. (1986), Paragamian and Ellis (1994), Fredericks et al. (2003) and Ryan and Jakubowski (2009). Note that years are not to scale on the x-axis after 1980.

The majority of all fish were caught between May and October (Table 4). Most kokanee were caught in July and September, while most Smallmouth Bass were caught in June, July, and August. The highest monthly catches of Rainbow Trout occurred in May, July, and October. Both Lake Trout and Bull Trout had peak monthly catches that occurred in July.

Overall, directed catch rates (fish caught/hour) were highest for kokanee (4.1/hr) and warmwater fish (1.9/hr; Table 5). Catch rates for all species were seasonally variable, with catch rates for coldwater species generally being higher in spring and fall and catch rates for warmwater fish being greater during July, August, and September.

Length measurements of harvested fish were taken from 443 kokanee, 89 Rainbow Trout, 35 Lake Trout, and 29 Smallmouth Bass (Figure 7). Kokanee averaged 247 mm (10 inches) in length. The majority of the Rainbow Trout measured were 350-450 mm (14 to 18 inches); although seven fish over 650 mm (25 inches) were measured. Measured Lake Trout ranged from 365 to 940 mm (14 to 37 inches) and Smallmouth Bass ranged from 293 to 457 mm (12 to 18 inches).

TABLE 4. Estimate of total catch in Lake Pend Oreille by species and month from March 16, 2014-March 15, 2015.

Month	March ¹	April	May	June	July	August	September	October	November	December	January	February	Total	80% CI
Kokanee	0	188	15,854	28,544	47,657	21,903	39,654	19,013	249	9	0	6	173,077	20,202
Smallmouth Bass	24	204	611	6,199	7,407	9,754	5,511	2,765	679	0	0	0	33,154	5,681
Rainbow Trout	488	1,115	3,141	1,134	2,815	406	1,506	2,298	1,368	460	39	80	14,850	3,276
Lake Trout	26	127	751	875	1,389	138	412	121	155	88	59	36	4,177	3,939
Bull Trout	48	58	479	650	1,338	128	203	89	110	45	17	17	3,182	2,061
Northern Pikeminnow	8	44	565	855	492	179	43	0	11	0	17	0	2,214	2,573
Yellow Perch	0	0	120	233	0	460	1,091	9	0	0	0	0	1,913	3,103
Westslope Cutthroat Trout	88	49	320	466	236	102	181	268	132	27	9	34	1,912	1,171
Largemouth Bass	0	0	0	194	236	51	0	89	88	45	0	0	703	2,095
Whitefish	0	10	25	117	226	0	0	0	0	0	0	6	384	1,728
Brown Trout	78	5	121	28	0	0	0	0	16	18	30	12	308	1,354
Walleye	0	14	65	28	0	26	23	0	0	0	0	0	156	1,574
Cutthroat/Rainbow Hybrids	33	15	60	0	39	0	0	0	0	0	0	0	147	1,171
Peamouth	0	0	25	78	0	0	0	0	0	0	0	0	103	1,108
Crappie	0	0	0	28	0	26	0	0	0	0	0	0	54	1,283
Sucker Sp.	0	0	20	0	0	26	0	0	0	0	0	0	46	840
Northern Pike	9	0	0	0	0	0	0	0	5	15	10	0	39	115
Total	802	1,829	22,157	39,429	61,835	33,199	48,624	24,652	2,813	707	181	191	236,419	

¹ March summaries are derived from data collected March 16-30, 2014 and March 1-15, 2015.

TABLE 5. Estimate of targeted catch rates (fish/angler hr) in Lake Pend Oreille by species and month from March 16, 2014-March 15, 2015.

Month	Kokanee	Warmwater Fish ²	Westslope Cutthroat	Lake Trout	Rainbow Trout	Walleye	Brown Trout	Whitefish sp.
March ¹	0.00	0.27		0.11	0.19	0.06	0.37	0.00
April	0.43	0.36		0.07	0.28	0.27	0.00	0.00
May	4.01	0.54		0.50	0.37	0.79		0.00
June	4.11	1.76		0.37	0.59	0.50		
July	4.71	2.03		1.00	1.11	0.25		
August	2.89	2.35		0.44	0.20			0.00
September	4.06	2.44		0.23	0.42		0.00	
October	6.58	0.22	0.83	0.22	0.44	0.00		
November	0.72	0.87		0.38	0.32			
December		1.00		0.63	0.17		0.00	0.00
January	0.00	0.00		0.14	0.07	0.08	0.17	0.00
February	0.00	0.00		0.27	0.10	0.00	0.45	0.00
Overall	4.07	1.92	0.83	0.46	0.44	0.37	0.28	0.00
80% CI	0.15	0.30	0.26	0.60	0.46	1.41	0.72	-

¹ March summaries are derived from data collected March 16-30, 2014 and March 1-15, 2015.

² Includes both bass species, Black Crappie, sunfishes, and Yellow Perch.

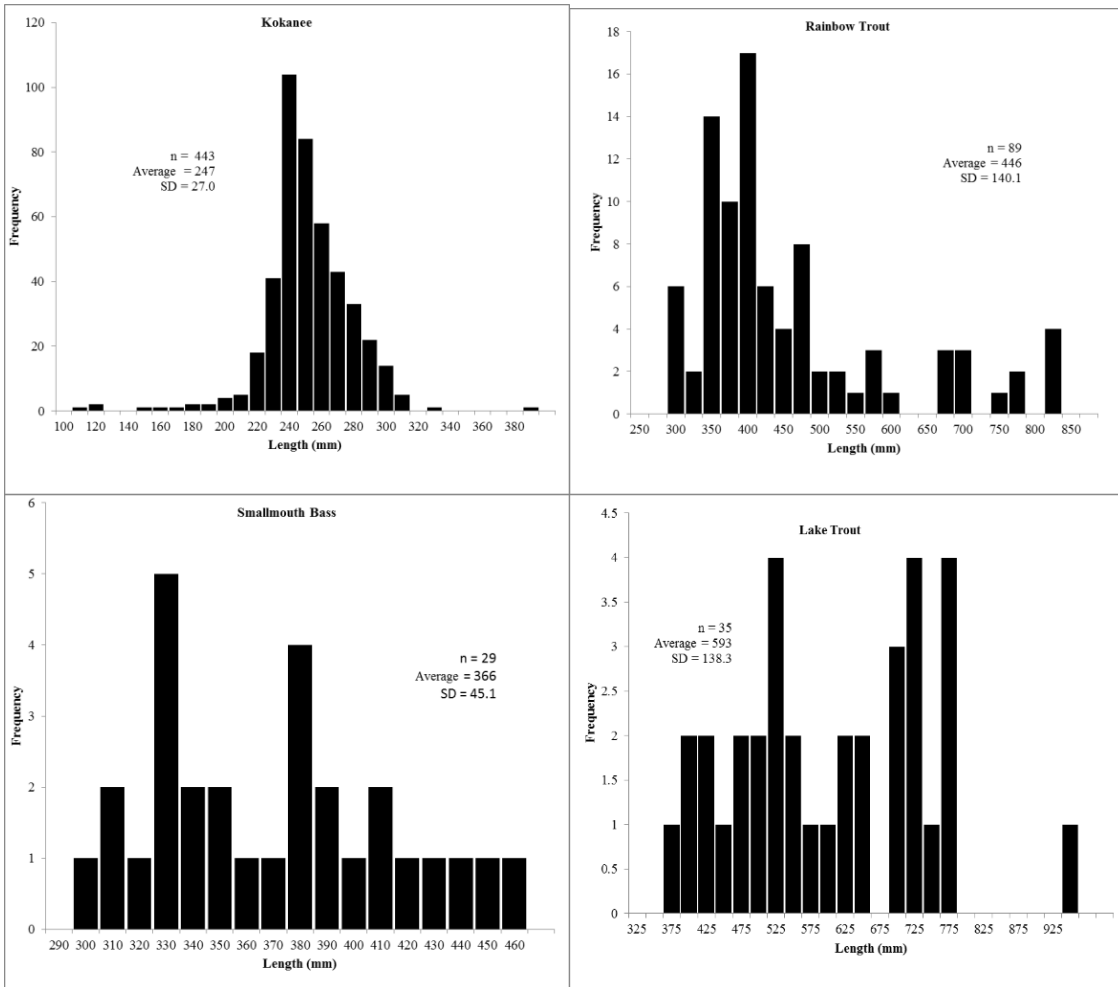


FIGURE 7. Length-frequency histograms for all kokanee, Rainbow Trout, Lake Trout, and Smallmouth Bass measured by creel clerks from LPO during March 16, 2014-March 15, 2015.

DISCUSSION

The 2014 creel survey demonstrated the dynamic nature of the LPO fishery. Survey results have varied in response to factors such as changes in absolute and relative abundances of target species, introduction of non-native species, establishment of incentivized angling, and changes in available fishing equipment and methods. Historical data were derived from numerous sources (Ellis and Bowler 1981, Bowles et al. 1986, Paragamian and Ellis 1994, Fredericks et al. 2003, Ryan and Jakubowski 2009), and these data were collected and analyzed using various methods that are not directly comparable for fine-scale comparisons. For example, in some years the commercial kokanee catch was included in the estimates of total harvest, while it is unclear if commercially caught kokanee were included in other surveys. Regardless, large-scale comparisons of general trends are possible, realizing that limitations in the data are inherent when comparing data collected over such a long time period.

Prior to the 1990s, the LPO fishery could be characterized as primarily a kokanee and Rainbow Trout fishery, with a small, but relatively steady Bull Trout and Westslope Cutthroat component. In the early years of record (the 1950s), kokanee were the primary target species. Kokanee effort declined rather steadily over the next 50 years, with an inverse increase in Rainbow Trout effort. Total effort peaked in 1991, with a large portion of anglers targeting Rainbow Trout, and secondarily kokanee. By 2000, Rainbow Trout angling dominated the fishery, with 86% of the effort directed at that species. The total catch of Rainbow Trout also peaked in 2000 at over 20,000 fish caught. This is not entirely surprising, because the kokanee fishery was closed to harvest at the time, and Lake Trout were just beginning to support a fishery, so Rainbow Trout was one of the only remaining target species. During this time, the majority of the anglers were catch-and-release oriented, and there was not a substantial harvest fishery on LPO. Low levels of effort were directed at other species, such as Westslope Cutthroat Trout and warmwater fishes, but these species were not targeted by a substantial number of anglers.

By 2007, the LPO fishery had reverted from the primarily non-consumptive trophy fishery of the early 2000s to a fishery with substantial harvest. However, harvest was focused on Lake Trout and Rainbow Trout instead of the traditional kokanee harvest, which was still closed at the time. In the 2007 creel survey, effort was not partitioned by targeted species, but about 85% of the anglers interviewed stated that they were targeting either Lake Trout or Rainbow Trout (Ryan and Jakubowski 2009). This was partially in response to implementation of the AIP in 2006. Lake Trout were documented in the harvest in 2000, but by 2007 they were much more prevalent in the catch. In addition, Smallmouth Bass began representing a large part of the catch for the first time in 2007, which was a result of this introduced species becoming more abundant in the lake.

Predator control efforts begun in 2006 eventually led to a resurgence of the kokanee population (Wahl et al. 2015). The fishery was reopened in 2013 with a daily bag limit of 6 kokanee, after being closed for 13 years. In the spring of 2014, the daily bag limit was raised to 15 kokanee. As a result, the fishery in 2014 differed markedly from that observed in 2007. The most notable change was the return to high levels of directed

fishing effort (40%) and high catch rates (4.1 fish/hour) for kokanee. The kokanee fishery brought a group of anglers back to LPO that had not participated in the fishery for about 15 years. In contrast to the more specialized fisheries for Rainbow Trout and Lake Trout, the kokanee fishery offered high catch rates for anglers with relatively simple gear and smaller boats.

High kokanee catch rates reflected an increase in their abundance in LPO. The 2013 abundance estimate for age-2 kokanee (4.4 million) was the highest since 1995, when age-specific estimates began (Wahl et al. 2015). These fish survived well and produced a strong cohort that was susceptible to anglers in 2014. The estimated abundance of adult kokanee (ages-3 and -4) in 2014 was 1.4 million fish (N. Wahl, IDFG, personal communication). Thus, our harvest estimate of 155,000 kokanee suggests that total harvest was sustainable (11% exploitation rate) and provides support for the increased daily bag limit in 2014 (15 fish from six fish).

Rainbow Trout were the second-most commonly targeted species in the 2014 fishery, attracting slightly less than 40% of the estimated 199,000 angler hours of effort. Estimated targeted catch rates (0.4 fish/hour or 2.3 hours/fish) were high by historical comparison. Ryan and Jakubowski (2009) reported Rainbow Trout catch rates from 1978 to 2007 ranging from 12 hours to 20 hours of angling effort per fish caught, but we estimated a much higher targeted catch rate. Rainbow Trout anglers informally reported good fishing, but not to the extent that we would expect catch rates to be an order of magnitude higher than in the past. The large disparity with past surveys and anecdotal angler reports together suggest that our 2014 estimate of Rainbow Trout catch rates may have been biased high.

Differentiating kokanee from juvenile Rainbow Trout was difficult for some anglers and may explain the potential estimation bias for Rainbow Trout catch rate. The distinct spotting and red band typically associated with Rainbow Trout is sometime less apparent in the pelagic rainbow trout of LPO. Incidental catch and misidentification of kokanee by Rainbow Trout anglers could have inflated our estimate. In cases where creel clerks were able to examine harvested fish, they were properly re-identified. However, this was not possible for released fish that made up a large portion (62%) of the Rainbow Trout catch. Unfortunately, we did not record how often kokanee were misidentified as Rainbow Trout and subsequently corrected in the harvest data. Identification errors may have had the most influence on estimates of overall catch rate and targeted catch rates during June and July. Our data indicated that Rainbow Trout catch rates were highest during these months. However, Rainbow Trout fishing is generally not very good during mid-summer, to the extent that experienced LPO anglers generally do not target Rainbow Trout during this time. The anglers reportedly targeting Rainbow Trout during the mid-summer months may have been less familiar with the LPO Rainbow Trout fishery, and therefore might have also had less experience with identifying fish in LPO. Kokanee fishing was good (over 4 fish/hour) during this period, which suggests that potential existed for some anglers to readily catch kokanee and misreport them as Rainbow Trout.

Another possible explanation for the higher than expected Rainbow Trout catch rates is that an angler hour in 2014 may not compare directly to historical angler hours. Anglers were allowed to fish with an unlimited number of rods beginning in 2011 to encourage harvest. During our survey, it was not uncommon for some Rainbow Trout anglers report fishing over 10 rods/boat. However, this does not necessarily mean that the number of rods fished is directly proportional to catch rate per angler hour, so a simple conversion to rod hours was not appropriate. Still, overall there were more hooks in the water per angler (more effort) than in the past, which was not captured in a comparison of angler hours. In addition, some Rainbow Trout anglers today utilize fairly specialized equipment, including advanced electronics (e.g., GPS, autopilots). It could be argued that modern anglers are better at catching fish than in the past and produce higher resultant catch rates.

Although our estimate of Rainbow Trout catch rate (and subsequently total catch) may be biased, it is apparent that the total number of Rainbow Trout caught in 2014 was one of the highest on record. Only 1991 and 2000 surveys produced higher estimates. Additionally, although our total catch estimate is high, the 2014 Rainbow Trout harvest of about 5,600 fish was of similar magnitude to historic harvests (3,000 - 8,000 annually; Ryan and Jakubowski 2009). Together, this information suggests that existing fishing regulations are effectively preventing recruitment overfishing.

One of the major changes in the fishery in 2014 compared to prior years was the increased popularity of warmwater fish, especially Smallmouth Bass. Warmwater fish generated more fishing effort (11%) and supported a higher overall catch rate (1.9 fish/hr.) than during past surveys. These increases were driven primarily by the apparent growth of the Smallmouth Bass population. The Smallmouth Bass total catch estimate was about twice as high as in 2007, and they were not a significant component of the catch in creel surveys prior to 2007. Despite the growing popularity of the Smallmouth Bass fishery and high angler catch rates, harvest was uncommon. Almost 90% of Smallmouth Bass were released, even though current fishing regulations allow harvest of up to 6 fish daily.

The Lake Trout harvest in 2014-15 (about 3,800 fish) was substantially lower than in 2007 (19,000 fish) and lower than the harvest estimate from 2000 when the Lake Trout population was just beginning to expand rapidly. Over 165,000 Lake Trout were removed from LPO between 2006 and 2014, reducing the adult Lake Trout population in LPO by approximately 80% (Wahl 2015). Thus, reduced Lake Trout harvest appears to be a result of successful suppression efforts.

The AIP allowed us to double-check our estimates of Lake Trout harvest against the number of fish turned in for payment. During the survey period, 2,444 Lake Trout, or 63% of the estimated harvest, were turned in to the AIP for payment. Given that about 83% of the Lake Trout anglers indicated that they participate in the AIP, we would have expected about 3,100 (83% of 3,800) Lake Trout to be turned in by anglers targeting them. Additionally, some Lake Trout were harvested incidentally by anglers targeting other species. However, their participation rate in the AIP was likely lower since the

overall angler population had about a 20% AIP participation rate. Collectively, this information suggests that our Lake Trout harvest estimate is reasonable.

Our data also suggests that the AIP is still effective. In 2014, approximately 11,600 Lake Trout were removed from suppression efforts, with over 20% of those removed by angling. This is a substantial component of the total number removed. The high level of participation in the program by Lake Trout anglers suggests that the program is maintaining directed effort on this species, despite decreasing Lake Trout abundance and catch rates. The high level of participation also indicates that Lake Trout suppression continues to be supported amongst the majority of Lake Trout anglers.

The Bull Trout population appears to have remained fairly stable in LPO. During this study, all the Bull Trout caught were incidental to the Rainbow Trout and Lake Trout fisheries. No anglers specifically stated they were targeting Bull Trout in 2014-15, which was likely influenced by the ongoing harvest closure for the species. Estimated LPO Bull Trout catch peaked at about 5,000 fish in 1953 when anglers did actively target them. We estimated about 3,000 Bull Trout were incidentally caught in 2014, despite the lack of directed angling effort. In comparison, this estimate was higher than all of the total Bull Trout catch estimates since about 1960. One Bull Trout was documented as misidentified and harvested during our survey. In general, misidentification of Bull Trout was rare, likely demonstrating the effectiveness of the ongoing Bull Trout education campaign sponsored by Avista through the Clark Fork Settlement Agreement and implemented by the Idaho Department of Fish and Game (IDFG) and the Panhandle Chapter of Trout Unlimited.

There was some evidence that the Westslope Cutthroat Trout fishery has remained stable. More Westslope Cutthroat Trout were caught in 2014 than in any year surveyed since the early 1960s. However, we are unsure if this increase in catch provides an index to relative abundance of Westslope Cutthroat Trout over time, or if it is a function of small sample size. Only four anglers (all in October) reported targeting Westslope Cutthroat Trout to creel clerks in 2014. Data from these anglers provided an estimated catch rate of 0.83 fish/hour. Despite sampling limitations for targeted angling, the total catch estimate for all anglers combined was almost 2,000 Westslope Cutthroat Trout. Although our confidence in this point estimate is not strong and most of these fish were caught by anglers targeting other species, this estimate still provides evidence that Westslope Cutthroat Trout were fairly prevalent in LPO. Additionally, it suggests that Westslope Cutthroat Trout abundance in LPO may be sufficient to support a catch-and-release fishery with good catch rates if angler interest increased.

Recommendations:

1. Repeat this study approximately every five years to evaluate how the fishery responds to management actions and naturally occurring changes in the lakewide fish assemblage.
2. Continue the AIP for Lake Trout to encourage angler harvest that contributes towards long-term suppression of this species.

3. Conduct a creel survey on the major tributaries to LPO (Clark Fork River, Lightning Creek drainage, and the Pack River drainage) and on the Pend Oreille River to better understand these associated fisheries and their interaction with the LPO fishery.

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