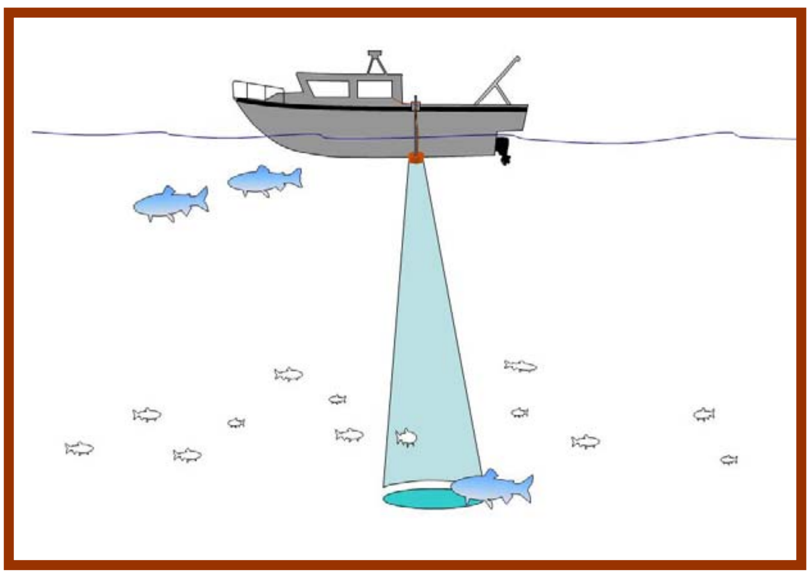
FISHERY RESEARCH

HYDROACOUSTIC ESTIMATES OF LARGE PELAGIC FISH IN LAKE PEND OREILLE

LAKE PEND OREILLE FISHERY RECOVERY PROJECT

ANNUAL PROGRESS REPORT, PART 4
March 1, 2005—February 28, 2006



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IDFG Report Number 07-35
June 2007

Hydroacoustic Estimates of Large Pelagic Fish in Lake Pend Oreille

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U.S. Department of Energy
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Division of Fish and Wildlife
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ABSTRACT

We conducted hydroacoustic surveys in Lake Pend Oreille, Idaho during 2005 in an attempt to estimate abundance of large pelagic fish. Based on previous population estimates and habitat requirements, we thought most of these fish would be rainbow trout *Oncorhynchus mykiss* and lake trout *Salvelinus namaycush*. Our intent was to monitor efforts to reduce these predators in order to recover kokanee *Oncorhynchus nerka,* their main prey. We only included targets corresponding to large fish (>-30 dB, which translates to a fish length of 590 mm) to separate large predators from the smaller sized kokanee. Side-scanning hydroacoustics and down scanning with the boat engine off while being towed by a second boat failed to find any large targets in the top 12 m of water during the August surveys. Temperatures in the epilimneon were 23ºC, which may have caused salmonids to move deeper in the water column. We estimated the pelagic area of the lake contained 9,173 fish over 590 mm during down-scanning surveys with the engine running. Confidence limits on this estimate were large (±98%, 90% CI) since only 12 fish were recorded on the 107 km of transects. Future surveys should increase the number of transects or multiplex two transducers to increase sample size and improve accuracy.

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INTRODUCTION

Lake Pend Oreille, Idaho had been widely known for its kokanee *Oncorhynchus nerka* and trophy trout fishing. Prior to closing the fishery in 2000, kokanee provided both a popular sport fishery and an abundant prey base for native bull trout *Salvelinus confluentus* and trophy Gerrard rainbow trout *Oncorhynchus mykiss*. Since the mid-1960s kokanee numbers have steadily declined, and along with them, the fisheries that relied on them. Much of the decline between 1966 and 1997 was attributed to the fall drawdowns of the lake and their effect on kokanee spawning (Maiolie and Elam 1993). After 1997, predation appeared to have an increasing impact on the low kokanee population. High predation levels were recognized as early as 1999 and led to the closing of the kokanee fishery in 2000 (Maiolie et al. 2002).

Hydroacoustic surveys have been conducted on Lake Pend Oreille as early as 1974 (Bowler 1975, 1976). Most hydroacoustic work was used to determine kokanee abundance (Maiolie et al. 2000; Maiolie et al. 2001; Maiolie et al. 2002). Research began in 2003 to determine whether hydroacoustics could be used to estimate the abundance of pelagic predators. It seemed plausible that down-looking surveys conducted to estimate kokanee abundance could also estimate the number of large pelagic fish, such as rainbow trout, bull trout, and lake trout *Salvelinus namaycush* (Bassista and Maiolie 2004; Bassista et al. 2005). Maiolie et al. (2006) concluded that a portion of the rainbow trout population might be missed in the down-looking surveys since some rainbow trout were located near the surface during the summer in 2004.

In 2005, we tested different survey designs to see if large fish could be detected closer to the surface. One method involved towing the hydroacoustic boat along transects with its engine turned off. We tested this to see if predators could be detected in shallower water by the silently approaching boat. A second method was to turn the transducer so that it pointed just below the surface to the side of the boat to see if surface oriented predators could be detected.

We also conducted a lakewide hydroacoustic survey to estimate the population of large pelagic fish. This down-scanning survey was then analyzed to determine the number of fish in the pelagic region that were too large to be kokanee. Ultimately, the goal was to develop a quick method to determine pelagic predator abundance so that efforts to balance predator and prey could be assessed. This research was part of an ongoing study funded by the Bonneville Power Administration to restore the fisheries of Lake Pend Oreille.

STUDY AREA

Lake Pend Oreille is located in the northern panhandle of Idaho (Figure 1). It is the state’s largest lake and has a surface area of 32,900 ha, a mean depth of 164 m, and a maximum depth of 357 m when at its normal full-pool elevation of 628.6 m (Fields et al. 1996). Pelagic habitat inside the 70 m contour line was measured at 21,332 ha when the lake was at summer pool elevation of 628.6 m. The Clark Fork River is the largest tributary to the lake. Outflow from the lake forms the Pend Oreille River.

Lake Pend Oreille is a temperate, oligotrophic lake. Summer temperatures (May to October) averaged approximately 9°C in the upper 45 m (Rieman 1977). Thermal stratification typically occurs from late June to September (Maiolie et al. 2002). Operation of Albeni Falls Dam (built in 1952) on the Pend Oreille River keeps the lake level high and stable at 628.7 m between June and September, followed by lowered lake levels between 625.1 m to 626.1 m during fall and winter.

A diverse assemblage of fish species is present in Lake Pend Oreille. Native game fish include bull trout**,** westslope cutthroat trout *Oncorhynchus clarkii lewisi*, and mountain whitefish *Prosopium williamsoni.* Native nongame fish include pygmy whitefish *Prosopium coulteri*, five cyprinids, two catastomids, and one sculpin. Kokanee entered the lake in the early 1930s as downstream migrants from Flathead Lake, Montana and were well established by the 1940s. At its peak in 1953, the estimated harvest of kokanee was around 1.3 million fish. Other introduced game fish include Gerrard rainbow trout*,* lake whitefish *Coregonus clupeaformis*, and lake trout*,* as well as several other cold-, cool-, and warmwater species.

PROJECT GOAL

Our project's goal is to recover the sport fisheries of the lake that have been impacted by the federal hydropower system and to enhance the Lake Pend Oreille ecosystem to the benefit of fish and wildlife, thereby enhancing fishing, recreational opportunities, and other resource values. This is to be accomplished while managing the lake levels for the balanced benefit of fish, wildlife, flood control, and power production.

PROJECT OBJECTIVE

Objective 1. To have balanced populations of predators and prey fish in Lake Pend Oreille at a ratio of less than 1:6 (by weight) before 2010.

METHODS

Silent Down-scanning Survey

A down-scanning hydroacoustic survey was conducted on Lake Pend Oreille with the research boat's engine turned off and the boat towed by another vessel. This survey was conducted on August 11, 2005 to determine the depth distribution of large pelagic fish. Moon phase was ½ moon. The approach was to see if larger fish could be found at shallower depths if surveys were conducted more quietly along the transects. The research boat was towed on a 100 m rope tied to the starboard cleat so that it planed off to the side and behind the towing vessel. The bottoms of both boats had been coated with black antifouling paint, which may have made them less visible from below. Surveys were conducted at night similar to previous surveys for large pelagic fish (Bassista and Maiolie 2004, Bassista et al. 2005). We used a Simrad EK60 portable scientific echosounder equipped with a 120 kHz split beam transducer set to ping at 0.2 to 0.3 s intervals. The transducer was located 0.5 m under the lake surface and placed in a down-looking position off the port side of the boat. The echosounder was calibrated for signal attenuation to the sides of the acoustic axis using Simrad software prior to the survey. Four transects were surveyed in the southern and central sections of the lake (Figure 1).

We determined fish target strengths using Echoview software version 3.10.135.03. Hydroacoustic traces (a single returned echo from a fish) were accepted if they were greater than -60 dB and the echo length was between 30% and 180% of the original pulse length at a point 6.0 dB below the peak echo value. Fish traces were considered large pelagic predators if they were greater than -30 dB, the equivalent of a 590 mm fish using Love's (1971) equation. Additionally, the correction value returned from the transducer gain model could not exceed a two-way maximum gain compensation of 6.0 dB (therefore, we only included targets within the 3.0 dB beam width) and the maximum standard deviation of the minor and major axis angles was less than 0.6 degrees. Fish traces that met the above criteria were plotted on a graph of target strength versus depth to examine the distribution of large fish in the top 15 m of water.

Side-scanning Survey

We also tested a second method to look for surface oriented predators by conducting side-scanning hydroacoustic surveys. We surveyed at night on August 8 and 9, 2005. Moon phase was a waxing crescent. Six transects were conducted in areas thought to contain rainbow trout and covered a total distance of 20.8 km (Figure 1). The echosounder was set to ping at 0.5 s intervals, with the transducer pointed 90 degrees to the port side of the boat and 0.5 m below the lake surface with the acoustic beam axis set at 7 degrees downward tilt. The acoustic beam insonified water between 1.1 m and 9.6 m deep at ranges of 10 m to 50 m. As stated above, the same Echoview software and the same criteria were used to record target strengths of fish. Target strengths of fish greater than -33 dB and at a range of 10 m to 50 m were plotted by depth to determine the distribution of large fish near the surface.

Water Temperatures

Water temperatures were recorded on August 11, 2005. We used an oxygen/temperature meter made by Yellow Springs Instrument Company (model 57) to measure temperatures at 1 m intervals to a depth of 33 m. Temperatures were recorded at a midlake location at the southern end of the lake (Figure 1).

Lakewide Down-scanning Survey

We conducted lakewide hydroacoustic surveys on Lake Pend Oreille between August 22 and August 26, 2005 to monitor fish populations. Surveys were conducted at night with a Simrad EK60 portable scientific echo sounder equipped with a 120 kHz split beam transducer. The transducer was located 0.5 m under the lake surface, placed in a down-looking position off the port side of the boat, and set to ping at 0.6 s intervals during the hydroacoustic survey. Before the survey, the echosounder was calibrated for signal attenuation to the sides of the acoustic axis using Simrad's software.

We used a stratified systematic sampling design. We followed a uniformly spaced, zigzag pattern of transects moving from shoreline to shoreline as described by MacLennan and Simmonds (1992). Twenty-one transects were completed in the lake with eight in the southern section, six in the middle section, and seven in the northern section (Figure 2). Transect lengths ranged from 3.6 km to 7.7 km with a total of 107.3 km of transects. Transects were located using the global positioning system (GPS). For all transects we utilized a 7.3 m boat and maintained a speed of approximately 1.3 m/s (boat speed did not affect our calculations of fish density).

Density estimates of large fish were determined using echo-counting techniques. Echoview software version 3.10.135.03 was used to view and analyze the collected data. Hydroacoustic traces (a single returned echo from a fish) were examined if they were >-40 dB and the echo length was between 30% and 180% of the original pulse length at a point of 6.0

dB below the peak echo value. Additionally, the correction value returned from the transducer gain model could not exceed a two-way maximum gain compensation of 6.0 dB (therefore, it included all targets within the 3.0 dB beam width) and the maximum standard deviation of the minor and major axis angles was less than 0.6 degrees. Fish tracks (a series of traces from the same fish) were defined as large pelagic fish if the average target strength of all traces was >-30 dB, if the track was more than 10 m off of the lake bottom, if it was not aggregated with other similar sized fish, if it was between the surface and a depth of 35 m, and if it was in water >75 m deep (bottom depth). The number of traces on these fish within the 3 dB beam width was binned into 1 m depth intervals and divided by area sampled at that depth to calculate fish density. The area sampled in each bin was calculated by multiplying the number of pings in the transect by the 3 dB beam width at the center of the bin.

To determine a population estimate, a weighted (by transect length) average density was calculated for each lake section and multiplied by the area of that section. Abundance in each of the three sections was then summed to estimate the total population.

We calculated a 90% confidence interval for the lakewide abundance estimate by standard formulas for stratified sampling designs (Scheaffer et al. 1979):

$$\bar{x} \pm t_{n-1}^{90} \sqrt{\frac{1}{N_{total}^2} \sum_{i=1}^{3} N_i^2 \left(\frac{N_i - n_i}{N_i} \right) \frac{s_i^2}{n_i}}$$

where:

$\bar{x}$ = the estimated mean number of large fish in the lake,
t = the Student's t value,
N_i = the number of possible samples in a section i,
n_i = the number of samples collected in a section i, and
s_i = the standard deviation of the samples in strata i,

RESULTS

Silent Down-scanning Survey

We did not locate any large fish that could be potential predators in the epilimnetic waters. In fact, these down-scanning surveys with the boat's motor turned off failed to find any fish >-50 dB (50 mm total length) at depths less than 12 m. Larger targets (>410 mm total length) were detected at depths from 13 to 33 m where water temperatures ranged from 15.8ºC–5.9ºC (Figure 3; Table 1). Numerous smaller fish were recorded at depths from 12 m to 50 m, but only one small fish out of the thousands recorded was located above 10 m. This fish was in 23ºC water and was estimated at 50 mm in length. Echoes recorded within the top 2 m of the water column were likely surface noise from wave turbulence and were not strong enough to be large fish (Figure 3).

Side-scanning Survey

We recorded no large fish >-33 dB during the side-scanning survey. Numerous very small targets (<-60 dB or <15 mm) were recorded near the surface and were later identified as larval fish through subsequent sampling with a one meter hoop net.

Water Temperatures

Temperature profile showed a very strong metalimnion between 12 m and 16 m (Table 1). The sharpest change (thermocline) within the water column occurred between 12 m and 13 m where temperatures dropped from 22.1 to 15.8ºC.

Lakewide Down-scanning Survey

We estimated the lake contained 9,173 (213-18,371, 90% CI) fish >590 mm (0.43 fish/ha) in the open pelagic area of Lake Pend Oreille. Our estimates in the southern, middle, and northern sections of the lake were 772, 5,687, and 2,713 fish, respectively. Fish were distributed from 13 m to 30 m in depth (Figure 4). Of the 12 fish recorded on the survey, most were estimated to be between 590 mm and 800 mm total length (Figure 5).

DISCUSSION

From this investigation we found no evidence that large rainbow trout, lake trout, and bull trout utilized the shallow (<10 m) pelagic habitat of Lake Pend Oreille during mid-August 2005 at night. If this remains true, the down-scanning surveys to enumerate kokanee could also be used to estimate these predators in the open water of the lake when epilimnetic temperatures exceed 23ºC as during these surveys.

Our down-scanning survey with the motor turned off appeared to be a good approach to minimize the problem of fish avoidance. The boat was particularly quiet on calm nights when no waves lapped the hull. Lights were kept to a minimum with only the running lights on during most of the survey. The black bottom of the boat may have also helped conceal it. However, fish very near the surface may still avoid the boat, and our acoustic beam, at 6.6º beam angle, would insonify only a small area in shallow water. A better approach to scanning the near-surface water would be to tow the transducer at a depth of approximately 30 m with the transducer pointed upward. The acoustic beam would then be larger near the surface, and target strengths of fish would still be a good indicator of fish length. Therefore, we recommend up-looking surveys in future years to look for surface-oriented predators.

Side-scanning surveys had the advantage of covering much more shallow water, especially as the beam gets larger at ranges to 50 m from the boat. However, no large fish were recorded even with this increased area of sampling. Since aspect of fish cannot be determined during side scanning (fish could be broadside, facing, or at various other angles relative to the transducer), estimating total length would be much less precise. However, in this investigation, no fish returned even a single echo >-33 dB, making it seem doubtful that large predatory fish were within 10 m of the surface.

Lake Pend Oreille had an unusually sharp metalimnion during this study. Previous temperature measurements did not show such a pronounced gradient (Maiolie et al. 2002). Epilimnetic temperatures during mid-August at the 10 m depth were 21.2°C in 2004, 18.6°C in 2003, 18.0°C in 2002, and 17.6°C in 2001 (agency files); indicating that warm temperatures seen in this study may have been unusually high.

Temperature preferences of rainbow trout have been studied in other waters. Rainbow trout in Jocassee Reservoir, South Carolina were tracked with temperature-sensing radio transmitters. They were found to prefer water from 8.3-13.4°C and were not found in water warmer than this range from July to September (Barwick et al 2004). In Spada Lake, Washington on September 1, rainbow trout densities were found to be very low in the top 3 m where water temperatures reached more than 22ºC (Stables and Thomas 1992). Warner and Quinn (1995) found rainbow trout in Lake Washington used the top 3 m of water 90% of the time in water temperatures up to 21ºC. Rainbow trout in Lake Pend Oreille were tracked in 2004 using depth-sensitive sonic tags (Maiolie et al. 2006). During this 2004 study, rainbow trout were found to use the top 12 m of water during summer stratification, which suggested that down-looking surveys might miss a portion of their population. We replotted these rainbow trout depth locations on a graph of water temperatures to examine trout locations at the peak of summer stratification (Figure 6). Depths of the trout were plotted on a graph of temperature isopleths from the southern end of the lake. Temperatures at the location of individual fish may have varied a couple of degrees from the graphed temperature. One rainbow trout did stay on the surface all summer in water temperature up to 22.8ºC. All others were found in cooler water (Appendix A).

Unlike previous studies, we needed to raise the minimum target strength level from -33 dB to -30 dB in order to exclude kokanee. Kokanee were larger in 2005 than any time previously measured (back to 1977) due to their low density (Maiolie et al. 2006b). Only 12 large fish were recorded with this raised minimum threshold. The confidence interval was also wide due to the low number of fish recorded. Future surveys should increase the number of transects or multiplex two transducers to increase sample size and improve accuracy.

A previous estimate of rainbow trout was made in Lake Pend Oreille that could be compared to the results from this study. In 1998, population abundance of rainbow trout was estimated at 6,820 fish of age 6 and older, with the mean length of the age 6 cohort at 593 mm (Vidergar 2000). We removed half of the age 6 cohort as being below 593 mm, resulting in an estimate of 5,571 rainbow trout greater than 593 mm in 1998. Our estimate of 9,000 fish over 590 mm was considerably higher, but it likely included some lake trout and bull trout. We found that rainbow trout in 2004 stayed above 17.7 m in depth during our sonic tracking and that lake trout and bull trout were more common below 20 m (Maiolie et al. 2006). If only targets above 18 m in depth were used in our survey (Figure 4), the resulting population estimate would be 4,172 fish ± 122% (90% CI), similar to Vidergar's (2000) estimate. However, the very wide confidence limits of these results make them of questionable value. Future surveys will need much larger samples in order to make more precise estimates.

During this investigation, fish >-33 dB were not found in epilimnetic water where temperatures exceeded 23ºC. Thus, future down-scanning surveys conducted during similar warm temperatures may not miss trout in the near surface, pelagic waters.

RECOMMENDATIONS

1. Conduct down-looking hydroacoustic surveys for pelagic predators when temperatures are at their summer peak. If temperatures in the top 10 m of water are >23ºC, the survey may not miss many pelagic predators.

2. We recommend developing and testing up-looking hydroacoustic survey techniques to estimate the abundance of large pelagic predators near the surface during years when epilimnetic temperatures are below 23ºC. Up-looking surveys would sample a large volume of near-surface water if the transducer were towed at a depth of about 30 m.

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Many people contributed to making this study possible. Fishery technician Mark Duclos and biological aide Jacob Miller assisted with many of the field activities and the maintenance of equipment. The Bonneville Power Administration provided funding for this study. We wish to thank Carlos Matthew for his help in administering our BPA contract and Eric Stark and Kevin Meyer for editing drafts of this report. The help from these people and agencies was greatly appreciated.

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Table 1. Temperature profile of Lake Pend Oreille on August 11, 2005 at the southern end of the lake. Note abrupt change in temperature at 12 m.

Depth (m)	Temperature (C^o)
Surface	23.8
1	23.6
2	23.4
3	23.3
4	23.3
5	23.5
6	23.5
7	23.3
8	23.1
9	23.0
10	23.0
11	22.9
12	22.1
13	15.8
14	13.2
15	12.0
16	11.2
17	11.0
18	10.1
19	9.8
20	9.1
21	8.8
22	8.5
23	8.1
24	7.8
25	7.6
26	7.2
27	7.2
28	6.9
29	6.6
30	6.2
31	6.0
32	6.0
33	5.9

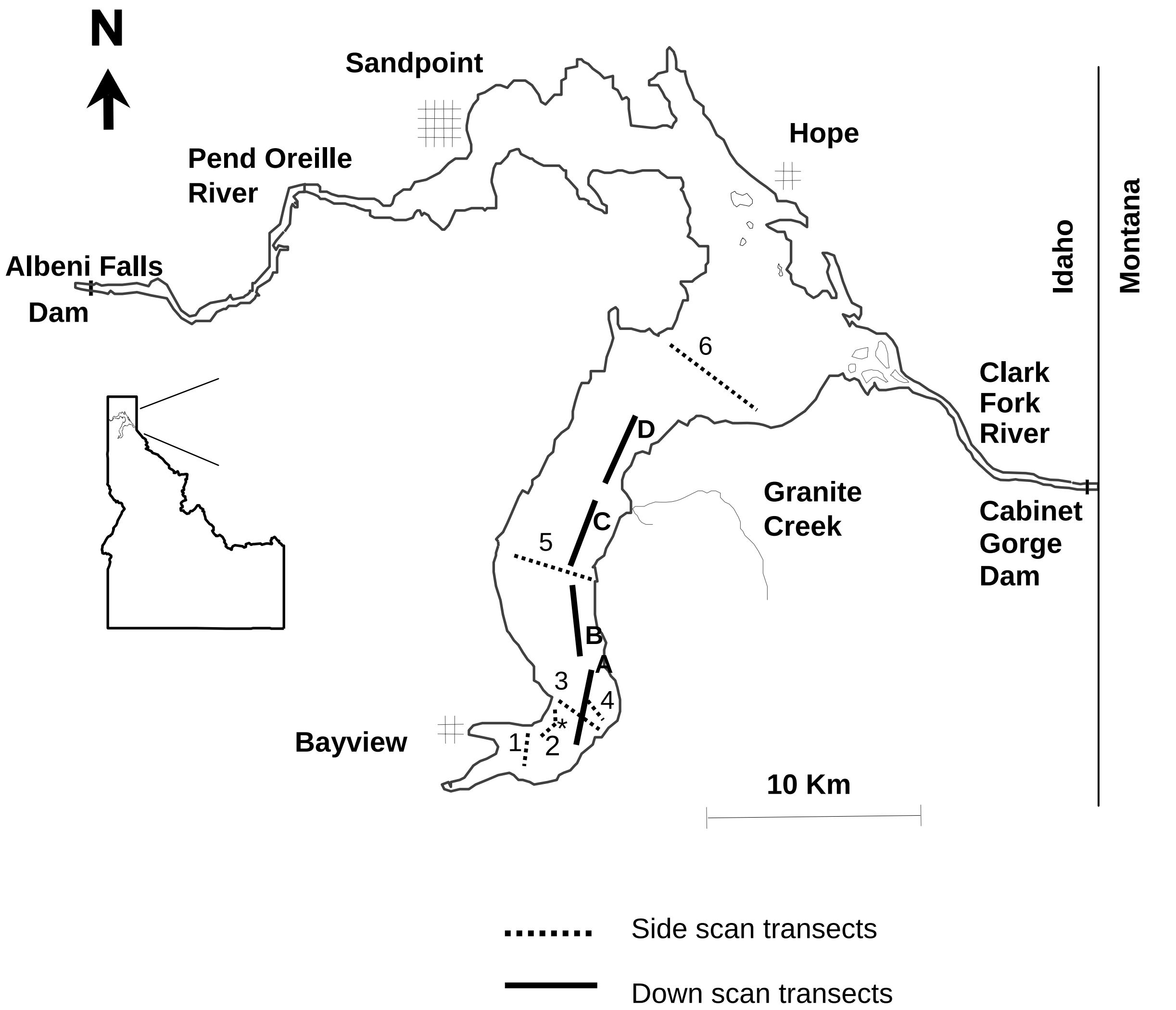

Figure 1. Locations of side-scanning and towed down-scanning hydroacoustic surveys for large fish in Lake Pend Oreille during 2005. Star indicates the location of temperature measurements.

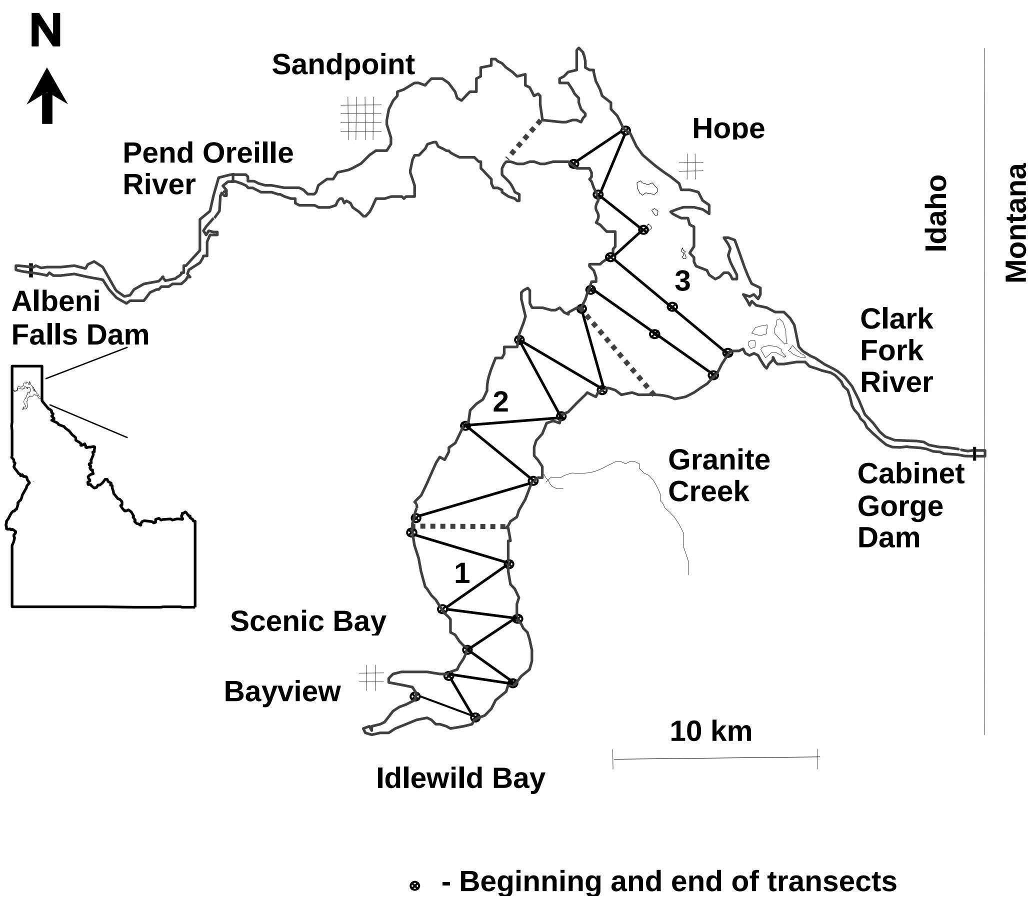

Figure 2. Map of Lake Pend Oreille, Idaho, showing the location of down-scanning hydroacoustic transects used to estimate abundance of large pelagic fish in 2005. Dotted lines indicate section boundaries.

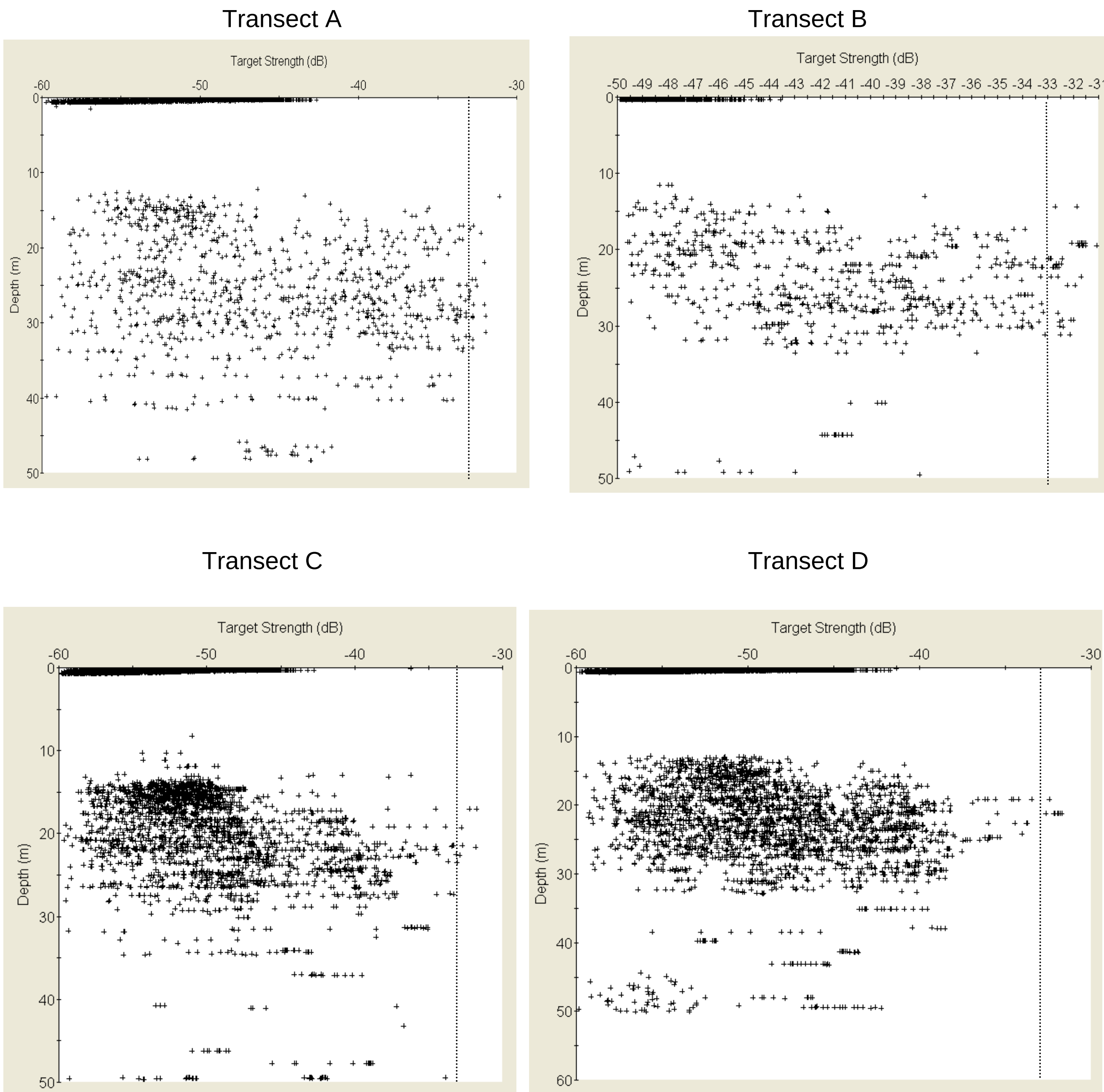

Figure 3. Depth distribution of targets in Lake Pend Oreille, Idaho, during silent down-scanning surveys. Fish > -33 dB (410 mm total length [Love 1971]) were considered large enough to be potential predators. Transect locations are shown in Figure 1. Note that no large fish were found above 12 m.

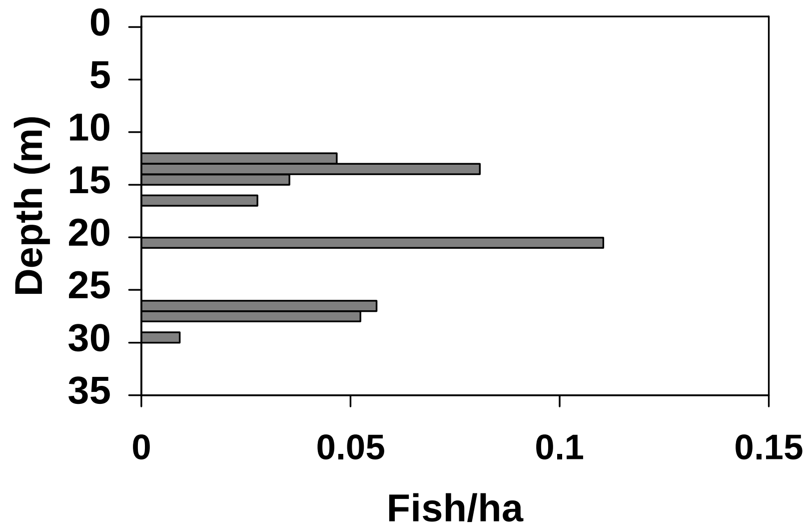

Figure 4. Densities of large pelagic fish over -30 dB (590 mm, Love [1971]) in Lake Pend Oreille, Idaho during a down-looking hydroacoustic survey in August 22-26, 2005.

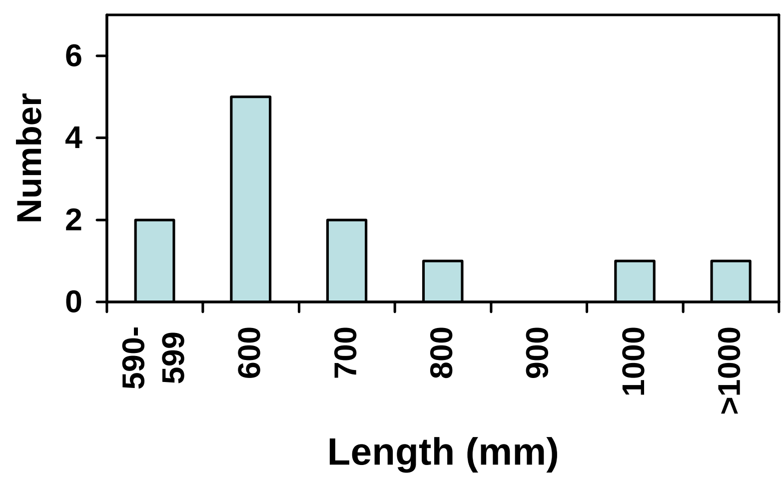

Figure 5. Length-frequency distribution of large pelagic fish recorded on a down-scanning hydroacoustic survey in Lake Pend Oreille, Idaho August 22-26, 2005. Target strengths were converted to fish lengths based on Love's (1971) equation.

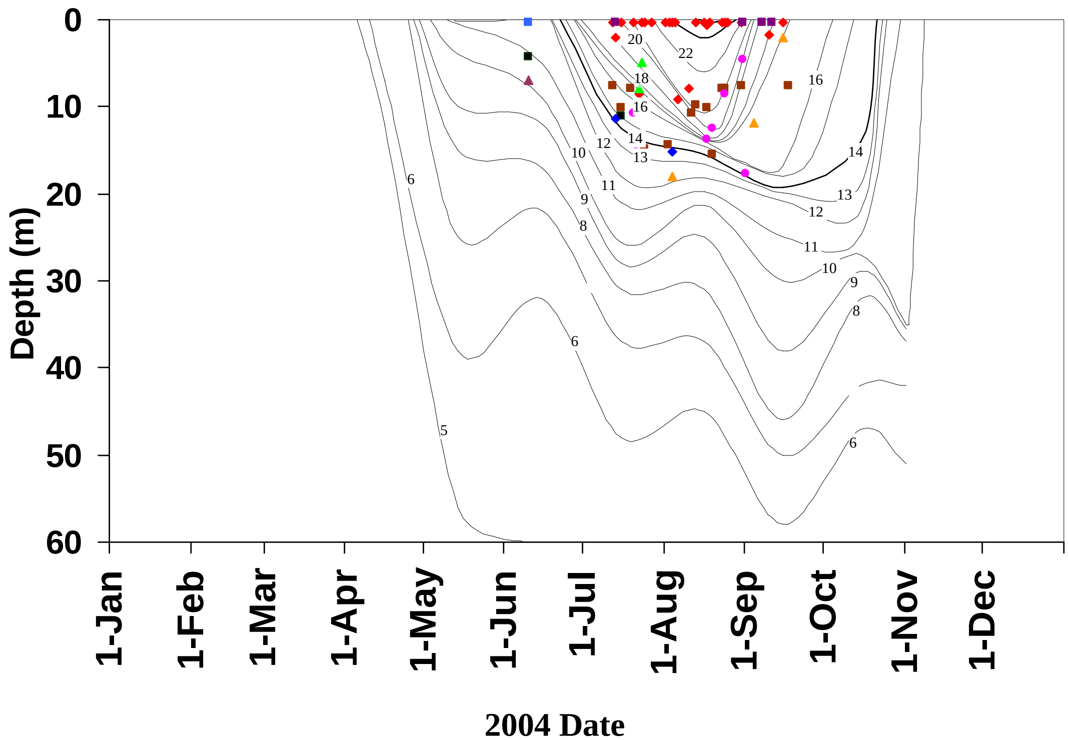

Figure 6. Isotherms in Lake Pend Oreille, Idaho, 2004. Symbols represent the location of individual rainbow trout based on fish tracking using depth-sensitive sonic tags during the night. Different symbol types represent different fish (n = 8). Temperatures were measured at a mid-lake station and were not necessarily the same as those at the location of the fish.

APPENDIX

Appendix A. Nighttime locations of rainbow trout tracked with sonic tags in Lake Pend Oreille, Idaho 2004.

Summer				
Tag number	Date	Fish depth (m)	Lake depth (m)	Temperature (ºC)
4768	8/4/2004	18.0	210.7	13.5
4768	9/4/2004	11.9	303.4	14.0
4768	9/4/2004	11.9	309.8	14.0
4768	9/15/2004	2.1	309.8	16.6
4758	7/13/2004	0.3	221.6	19.8
4758	8/31/2004	0.3	307.6	19.9
4758	9/7/2004	0.3	172.3	18.8
4758	9/11/2004	0.3	232.9	18.2
4758	9/11/2004	0.3	232.9	18.2
4458	7/12/2004	0.3	247.9	18.0
4458	7/13/2004	2.1	213.4	15.6
4458	7/15/2004	0.3	252.7	21.8
4458	7/16/2004	0.3	233.8	21.1
4458	7/20/2004	0.3	253.7	21.6
4458	7/22/2004	8.5	263.4	19.5
4458	7/23/2004	0.3	270.1	20.5
4458	7/24/2004	0.3	257.9	20.7
4458	7/27/2004	0.3	128	21.5
4458	7/27/2004	0.3	188.4	21.2
4458	8/1/2004	0.3	200.6	22.5
4458	8/3/2004	0.3	147	21.5
4458	8/4/2004	0.3	274.4	22.0
4458	8/5/2004	0.3	291.8	21.5
4458	8/6/2004	9.1	158.5	20.5
4458	8/10/2004	7.9	20.4	20.9
4458	8/13/2004	0.3	277.7	22.1
4458	8/16/2004	0.3	280.8	22.0
4458	8/17/2004	0.6	252.1	22.8
4458	8/17/2004	0.3	277.1	22.8
4458	8/17/2004	0.3	96	22.6
4458	8/17/2004	0.3	115.9	22.2
4458	8/18/2004	0.3	143.3	22.8
4458	8/23/2004	0.3	340.9	20.4
4458	8/24/2004	0.3	336	19.3
4458	8/25/2004	0.3	332.6	19.3
4458	8/30/2004	0.3	332.6	19.6
4458	9/10/2004	1.8	236	17.7
4766	7/13/2004	11.3	70.1	14.9
4766	8/4/2004	15.2	100.6	15.0
4449	7/15/2004	11	54.9	16.5
4666	7/22/2004	7.9	63.7	19.5
4666	7/22/2004	4.6	87.8	20.0
4666	7/23/20004	2.4	93	20.0
4666	7/23/2004	4.9	85.4	20.0
4647	7/20/2004	10.7	346.3	17.0
4647	7/21/2004	11	349.4	17.0
4647	7/21/2004	14.3	349.7	16.0
4647	8/17/2004	13.7	24.4	15.3
4647	8/19/2004	11.6	82.9	16.2

Appendix A. Continued.

Summer				
Tag number	Date	Fish depth (m)	Lake depth (m)	Temperature (ºC)
4647	8/19/2004	11.6	29.6	16.2
4647	8/19/2004	12.5	152.4	16.0
4647	8/24/2004	8.5	343.6	14.3
4647	8/24/2004	8.5	328.7	14.3
4647	8/31/2004	4.6	254.9	19.0
4647	9/1/2004	17.7	312.5	17.0
4459	7/12/2004	7.6	22.3	16.9
4459	7/15/2004	7.6	289.6	18.8
4459	7/15/2004	10.1	305.5	16.8
4459	7/19/2004	7.9	281.7	17.1
4459	7/23/2004	10.1	338.1	19.0
4459	7/24/2004	14.9	335.4	18.1
4459	7/24/2004	11.6	332.6	18.5
4459	8/2/2004	14.3	61	15.9
4459	8/11/2004	10.7	338.1	21.0
4459	8/13/2004	9.8	152.4	20.0
4459	8/17/2004	10.1	365.9	20.9
4459	8/17/2004	10.1	365.9	20.9
4459	8/17/2004	9.1	268.6	20.6
4459	8/19/2004	15.5	42.7	15.0
4459	8/19/2004	14.6	39.3	15.1
4459	8/23/2004	7.9	21.3	13.5
4459	8/24/2004	7.9	44.2	13.5
4459	8/24/2004	7.9	18.3	15.0
4459	8/30/2004	7.6	30.5	18.5
4459	9/17/2004	7.6	45.7	16.8

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