AN ESTIMATE OF JUVENILE SOCKEYE SALMON (*Oncorhynchus nerka*) DENSITIES IN SKILAK AND KENAI LAKES, ALASKA THROUGH THE USE OF DUAL BEAM HYDROACOUSTIC TECHNIQUES

by

Kenneth E. Tarbox
and
Bruce E. King

Regional Information Report[1] No. 2S88-2

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 3150
Soldotna, Alaska 99669

April 1988

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[1]Contribution 88-2 from the Upper Cook Inlet area. The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished Divisional reports. These reports frequently serve diverse ad hoc informational purposes or achive basic uninterpreted data. To accommodate needs for up-to-date information, reports in this series may contain preliminary data.

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AREA DATA REPORTS: This series of reports is designed to facilitate archiving of small data sets and internal agency information. It generally consists of data sets of less significant nature that frequently are combined on an annual basis and published through the ADF&G Technical Data Report Series. This series also includes noteworthy field observation, feasibility studies, Board of Fisheries Reports and staff meeting notes. To promote documentation of as many observations as possible which would otherwise remain unreported, this informal report series receives very little editing, thus caution is recommended in use of data and any analysis persented within.

TABLE OF CONTENTS

Section	Page
ABSTRACT	1
INTRODUCTION	2
METHODS	3
RESULTS	5
DISCUSSION	7
ACKNOWLEDGMENTS	12
LITERATURE CITED	13
APPENDICES	49

LIST OF TABLES

Table		Page
1.	Species composition and mean length at age of fish captured by tow net in Kenai and Skilak Lakes, Alaska, 1986	16
2.	The estimated number of fish in Kenai and Skilak Lakes, Alaska as determined from acoustic surveys in the fall of 1986	17
3.	Estimated number of fish not available to the hydroacoustic equipment because of surface orientation in Skilak and Kenai Lakes, Alaska during the fall of 1986	19
4.	Estimated number of fish not available to the hydroacoustic equipment because of bottom orientation in Skilak Lake, Alaska during the fall of 1986	21
5.	The estimated number of fish in Skilak and Kenai Lakes, Alaska based on actual hydroacoustic measurements and corrections for bias associated with surface and bottom areas	25
6.	Area (millions of square meters) and volume (millions of cubic meters) in Kenai and Skilak Lake, Alaska 1986	27

LIST OF FIGURES

Figure		Page
1.	The Upper Cook Inlet area showing the location of the Northern and Central Districts and the major sockeye salmon spawning drainages	28
2.	The Kenai River drainage, Alaska and the location of the major lake systems which are utilized by rearing sockeye salmon	29
3.	Skilak Lake, Alaska area designations, hydroacoustic transect locations, and tow netting stations, 1986	30
4.	Kenai Lake, Alaska area designations, hydroacoustic transect locations, and tow netting stations, 1986	31
5.	Length frequency of sockeye salmon collected in Kenai Lake, Alaska during October 1986	32
6.	In situ target strength measurements and proportion by depth strata collected from Kenai Lake, Alaska, September 1986. (Note: the proportion of targets was scaled by 1/range^2)	33
7.	In situ target strength measurements and proportion by depth strata collected from Skilak Lake, Alaska, October 1986. (Note: the proportion of targets was scaled by 1/range^2)	34
8.	Horizontal fish distribution (mean density/1000m^2) measured in Skilak Lake, Alaska during October 1986: (a) Area 1, Transects 1 and 2; (b) Area 2, Transects 3 and 4; and (c) Area 3, Transects 5 and 6. Sequence group 1 is north shore	35
9.	Horizontal fish distribution (mean density/1000m^2) measured in Kenai Lake, Alaska during September 1986: (a) Area 1, Transects 9A, 8, 7, 6; (b) Area 2, Transects 11A, 10, 10A, 9; and (c) Area 3, Transects 13A, 12, 12A, 11. Sequence group 1 is north shore	36
10.	Horizontal fish distribution (mean density/1000m^2) measured in Kenai Lake, Alaska during September 1986: (a) Area 4, Transects 13, 14A, 14, 15A; and (b) Area 5, Transects 15, 16A, 16, 17, 18, 19. Sequence group 1 is north shore	37

LIST OF FIGURES (Continued)

Figure		Page
11.	Vertical distribution of fish density measured during the hours of darkness in Skilak Lake, Alaska (Area 1: Transects 1 and 2) in October 1986	38
12.	Vertical distribution of fish density measured during the hours of darkness in Skilak Lake, Alaska (Area 2: Transects 3 and 4) in October 1986	39
13.	Vertical distribution of fish density measured during the hours of darkness in Skilak Lake, Alaska (Area 3: Transects 5 and 6) in October 1986	40
14.	Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 1: Transects 6, 7, 8, 9A) in September 1986	41
15.	Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 2: Transects 9, 10A, 10, 11A) in September 1986	42
16.	Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 3: Transects 11, 12A, 12, 13A) in September 1986	43
17.	Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 4: Transects 13, 14A, 14, 15A) in September 1986	44
18.	Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 5: Transects 15, 16A, 16, 17, 18, 19) in September 1986	45
19.	Vertical distribution of fish density measured during the hours of daylight in Kenai Lake, Alaska (Areas 1 and 2: Transects 6, 8, 9, 10) in September 1986	46
20.	Vertical distribution of fish density measured during the hours of daylight in Kenai Lake, Alaska (Areas 3 and 4: Transects 11, 12, 13, 14) in September 1986	47

LIST OF FIGURES (Continued)

Figure | Page

21. Vertical distribution of fish density measured during the hours of daylight in Kenai Lake, Alaska (Area 5: Transects 15, 16, 18, 19) in September 1986 48

LIST OF APPENDIX TABLES

Table		Page
1.	Calibration and processing parameters used in collection and analysis of Kenai and Skilak Lakes, Alaska 1986 hydroacoustic data	49
2.	Average backscattering cross section (sigma) and target strength data by depth strata for all transects combined, Kenai Lake, Alaska, 1986	50
3.	Average backscattering cross section (sigma) and target strength data by depth strata for all transects combined, Skilak Lake, Alaska, 1986	51
4.	Summary of analysis of variance of target strength data by depth strata for Kenai and Skilak Lakes, Alaska, 1986	52
5.	Hydroacoustic estimate of fish inhabiting Area 1, Skilak Lake, Alaska based on Transect 1 integrator output	53
6.	Hydroacoustic estimate of fish inhabiting Area 1, Skilak Lake, Alaska based on Transect 2 integrator output	54
7.	Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska based on Transect 3 integrator output	55
8.	Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska based on Transect 4 integrator output	56
9.	Hydroacoustic estimate of fish inhabiting Area 3, Skilak Lake, Alaska based on Transect 5 integrator output	57
10.	Hydroacoustic estimate of fish inhabiting Area 3, Skilak Lake, Alaska based on Transect 6 integrator output	58
11.	Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 6 (night survey) integrator output	59
12.	Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 7 (night survey) integrator output	60

LIST OF APPENDIX TABLES (Continued)

Table		Page
13.	Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 8 (night survey) integrator output	61
14.	Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 9A (night survey) integrator output	62
15.	Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 9 (night survey) integrator output	63
16.	Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 10A (night survey) integrator output	64
17.	Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 10 (night survey) integrator output	65
18.	Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 11A (night survey) integrator output	66
19.	Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 11 (night survey) integrator output	67
20.	Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 12A (night survey) integrator output	68
21.	Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 12 (night survey) integrator output	69
22.	Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 13A (night survey) integrator output	70
23.	Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 13 (night survey) integrator output	71
24.	Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 14A (night survey) integrator output	72

LIST OF APPENDIX TABLES (Continued)

Table		Page
25.	Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 14 (night survey) integrator output	73
26.	Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 15A (night survey) integrator output	74
27.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 15 (night survey) integrator output	75
28.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 16A (night survey) integrator output	76
29.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 16 (night survey) integrator output	77
30.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 17 (night survey) integrator output	78
31.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 18 (night survey) integrator output	79
32.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 19 (night survey) integrator output	80
33.	Hydroacoustic estimate of the number of fish per 1000 square meters in Skilak Lake, Alaska, October 1986	81
34.	Hydroacoustic estimate of the number of fish per 1000 square meters in Kenai Lake, Alaska, September 1986	83
35.	Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 6 (day survey) integrator output	86
36.	Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 8 (day survey) integrator output	87

LIST OF APPENDIX TABLES (Continued)

Table		Page
37.	Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 9 (day survey) integrator output	88
38.	Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 10 (day survey) integrator output	89
39.	Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 11 (day survey) integrator output	90
40.	Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 12 (day survey) integrator output	91
41.	Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 13 (day survey) integrator output	92
42.	Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 14 (day survey) integrator output	93
43.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 15 (day survey) integrator output	94
44.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 16 (day survey) integrator output	95
45.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 18 (day survey) integrator output	96
46.	Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 19 (day survey) integrator output	97

LIST OF APPENDIX FIGURES

Figure		Page
1.	Echogram of transect 10A (one minute segments 9-12, depth interval 5m) in Kenai Lake (night survey), Alaska, September 1986	98
2.	Echogram of transect 14A (one minute segments 20-23, depth interval 5m) in Kenai Lake (night survey), Alaska, September 1986	99
3.	Echogram of transect 1 (one minute segments 15-18 and 42-45, depth interval 5m) in Skilak Lake (night survey), Alaska, October 1986	100
4.	Echogram of transect 4 (one minute segments 33-35, depth interval 5m) in Skilak Lake (night survey), Alaska, October 1986	101

ABSTRACT

The number and distribution of sockeye salmon (Oncorhynchus nerka) rearing in two glacial lakes (Skilak and Kenai Lakes, Alaska) was estimated from hydroacoustic surveys conducted in the fall of 1986. Application of a dual beam acoustic system during the survey allowed the collection of in situ target strength (and backscattering cross section) information for scaling of the echo integrator outputs to absolute fish density.

The average target strength of fish sampled in Skilak and Kenai Lakes was -53.78 dB and -55.35 dB, respectively. Statistically significant differences in target strength were measured between 5 m depth strata for both lakes.

Approximately 21.5 million fry were estimated to inhabit Skilak Lake, with the majority (68%) located in the western third of the lake. In contrast, Kenai Lake was estimated to contain approximately 4.5 million fish and fish distribution was consistent with that observed in Skilak Lake (62% of the fish were located in the western third of the lake). The depth distribution of rearing fry was similar in both lakes with the highest densities of fish found 15 m below the surface. Tow netting of the lakes indicated that 97% and 88% of the targets were age-0 sockeye salmon in Kenai and Skilak Lakes, respectively.

Comparison of the results of a survey of Kenai Lake during the day with the results of an evening survey indicated strong surface orientation of rearing sockeye salmon during the day.

The estimate of rearing sockeye salmon fry from these glacial lakes will be used to develop a forecast methodology for adult return to the drainage.

KEY WORDS: hydroacoustic survey, sockeye salmon, target strength, glacial lake, Alaska.

INTRODUCTION

The commercial salmon fishing industry within the State of Alaska is a multi-million dollar industry which requires factual and accurate information on the status of the fishery resource. Of particular significance to the industry is the forecast of returning adult salmon to the fishery. This information is used for a variety of planning purposes including securing loans, planning market strategy, setting starting prices for the raw product, and establishing operational dates and logistical requirements. In this context, the State of Alaska annually provides a statewide forecast of salmon returns to the fishing industry (Eggers 1986).

For Upper Cook Inlet, Alaska (Figure 1) the forecast of adult sockeye salmon (Oncorhynchus nerka) returns is based on spawner/return relationships (Tarbox and Waltemyer 1986). Unfortunately, the data base is limited to just a few years of returns because the glacial character of the major sockeye salmon systems prohibited the enumeration of spawning adults until the early 1970's when refinement of hydroacoustic techniques allowed counts to be made (Tarbox et al. 1983). In addition, a forecast of returns based strictly on adult spawners is subject to extreme variability and assumptions regarding density dependent factors (Ricker 1954). Ideally, the enumeration of migrating sockeye salmon smolt as they exit these river systems would document freshwater production and provide data to establish a second relationship to adult spawners. However, the glacial nature and size of the major sockeye salmon producing systems in Upper Cook Inlet makes a smolt enumeration project cost prohibitive. Therefore, a secondary forecast technique independent of adult spawner/return relationships and/or smolt enumeration was desired.

Recent advances in the field of hydroacoustic enumeration of rearing sockeye salmon fry in lake systems provided an alternative to smolt enumeration. The use of hydroacoustic techniques for this purpose was initially tried in the 1960's (Rogers 1967), but the limitations of the acoustic equipment made this approach appear unsuccessful. However, technological advances since those early days have resulted in numerous successful applications of hydroacoustic equipment for estimating juvenile sockeye salmon densities in lakes (Thorne et al. 1975; Thorne and Woodey 1970; Dawson 1972; Nunnallee and Mathisen 1972; Lemberg 1975; Thomas 1980; Thorne and Thomas 1982, 1983, 1984; Thomas et al. 1986 [a, b], 1987). The development of in situ target strength measurements by application of a dual beam hydroacoustic system (Ehrenberg 1974; Burczynski and Dawson 1984; Traynor and Ehrenberg 1979) has significantly expanded the opportunity to refine echo integration for estimates of absolute abundance (average backscattering cross section is now available in situ). Burczynski and Johnson (1986) recently reported the successful application of this approach for Cultus Lake, British Columbia.

Obtaining an estimate of the number of rearing sockeye salmon fry also provides the opportunity to augment biological information on rearing sockeye salmon in glacial lake systems of Alaska. Historically, biological data have been based primarily on methods which provide catch per unit effort data (notably tow nets and fish traps). These methods suffer primarily from limitations on effort, but also are affected by fish density, distribution,

and behavior. To date, the costs associated with obtaining adequate sample volume in low fish density situations typical of glacial systems has limited the usefulness of these data. However, the sampling power of hydroacoustic techniques has resulted in new effort to document the biological requirements of rearing sockeye salmon fry in glacial systems. Within Upper Cook Inlet, an extensive study of Tustumena Lake has been underway since 1981 (Tarbox et al. 1984; Flagg et al. 1985, 1986) as part of a hatchery evaluation project. In addition, lake enrichment studies have been evaluated and reported on by Koenings et al. (1986) for seven lakes. The results of these studies are helping to define the role of density dependent and density independent factors which impact sockeye salmon rearing success.

The project reported herein is part of the continuum of rearing sockeye salmon fry studies of Upper Cook Inlet, Alaska. The system investigated in this paper was the Kenai River drainage (Figure 2), which is the major sockeye salmon system of the Inlet with annual adult returns reaching over 3.0 million fish (Cross et al. 1984). The drainage encompasses approximately 5,200 km^2 of the western Kenai Peninsula. Mean annual discharge of the river, measured at River Mile 19, is 5,340 cfs and the river is classified as underfit (the present flow regime is less than the river bed is capable of passing, Scott 1982). Peak flows occur in the summer as a result of glacial melt and precipitation runoff. The system has a number of sockeye salmon rearing lakes which include Kenai, Skilak, Hidden, Upper Russian, Lower Jean, and Tern. However, the major production is assumed to be from Kenai and Skilak Lakes, which are glacially occluded, and Upper Russian Lake. Both Kenai and Skilak Lakes are characterized by steep shorelines and water depths in excess of 400 m and 160 m, respectively.

METHODS

Hydroacoustic surveys of Kenai Lake were conducted on 26 September 1986 (day survey) and the night of 30 September 1986. A single survey of Skilak Lake was completed the evening of 6 October 1986. The selection of sampling dates was predicated on the assumption that sockeye salmon fry had left the littoral areas of the lakes and moved to the adjacent limnetic areas. This behavioral pattern has been documented for a number of sockeye salmon systems and within the Tustumena Lake system on the Kenai Peninsula, Alaska (Thorne and Thomas 1982). In addition, recruitment of sockeye salmon fry into the lake systems was assumed to have been completed and the higher rates of mortality associated with summer rearing had decreased to the more consistent rates of winter rearing. Initially, the day survey of Kenai Lake was to gain an impression of fish distribution and bottom characteristics of the lake as well as logistical requirements associated with the survey techniques and equipment. The night surveys of Kenai and Skilak Lakes were conducted to estimate population densities. Night surveys were selected to increase the probability of fish detection because of midwater orientation as opposed to surface or bottom orientation.

The survey design was based on transect sampling in a zig-zag pattern for both lakes and consisted of six transects in Skilak Lake (Figure 3) and 22 transects in Kenai Lake (Figure 4). The selection of a zig zag pattern was

based on: 1) ease of transecting during the night; and 2) the results of Kimura and Lemberg (1981) who reported that stratified methods of sampling (i.e., zig zag) were uniformly more efficient than random parallel sampling, especially at low sampling intensities.

The hydroacoustic equipment for survey data acquisition consisted of a Biosonics, Inc. Model 105 echo sounder with dual beam receivers, a 420 kHz, 6/15 degree dual beam transducer mounted in a towed body, a Model 171 tape recorder interface, a Sony model SL-HF400 video cassette recorder and PCM-501ES digital audio processor, a Model 115 chart recorder, and a Model 315P oscilloscope. The selected pulse width was 0.4 milliseconds (ms) and the ping rate varied from 5-6 pings/second (additional acoustic parameters used during data collection and processing are presented in Appendix Table 1). The system was calibrated at Biosonics, Inc. prior to and following the survey. The entire system was powered by batteries and the equipment was housed in a 22 foot vessel powered by a 150 hp outboard motor. Transect speed was estimated at 2.7 meters/second (m/s) and beginning and end points of the transects were marked with flashing lights prior to darkness. The towed body was approximately 1 m below the surface during transecting.

Data reduction and analysis was facilitated by the use of microcomputers and associated software. Dual beam data were processed through a Biosonics, Inc. Model 181 dual beam processor. A returning pulse was accepted as a valid target if the amplitude of the pulse was below the bottom threshold of 5000 millivolt (mV; -36dB) and above the threshold level of 98 mV (-70dB). Single targets were separated from multiple targets if the pulse width was within 20% of the transmitted pulse width at -6 decibels (dB). The beam pattern threshold was selected at -4 dB. Data stored by the dual beam processor were transferred to microcomputer data files for analysis using Biosonics, Inc. software program TS112 (revised). Computation of target strengths and backscattering cross sections were made and printed out by preselected 5 m depth intervals. Individual echos were used to calculate the mean target strength.

Estimates of fish density were made for each transect by echo integration using a Biosonics, Inc. Model 120 echo integrator (representative echograms for each lake are presented in Appendix Figures 1-4). Correction from the 40 log(R) setting used during data collection to 20 log(R) for data processing was accomplished by adjusting the B constant value for each depth strata (Appendix Table 1). The TVG crossover for the system was 2.7 m. The depth strata selected for analysis were 5 m increments starting 2 m below the transducer (3 m below the water surface). Data were processed to 52 m and 97 m below the transducer in Kenai and Skilak Lakes, respectively (visual examination of oscilloscope and chart recordings indicated no fish present below these depths). Voltages from returning echoes were averaged in 1-minute sequences along each transect and the integrator outputs were transferred to diskettes for further reduction and analysis through use of Biosonics, Inc. software entitled Crunch (version 2.43). Fish density was obtained by averaging the integrator output values across the transect by depth strata and multiplying by the integrator scaling factor (derived from mean backscattering cross section obtained with the dual beam processor). The mean backscattering cross section value was selected by depth strata from the transect of interest. In the case where the sample size for establishing

the scaling factor was less than 150 echoes, the mean backscattering cross section for all transects combined for that depth strata was used.

Total fish abundance in each lake was calculated by dividing Kenai and Skilak Lakes into three and five areas, respectively (Figures 3 and 4) and summing the calculated abundance for each area. Transects located within these areas were treated as replicates and the estimated number of fish within each area was calculated from an estimate of water volume by depth strata multiplied by the absolute fish density for that depth strata. Water volume was estimated from analysis of the proportion of the transect sampled for each depth strata and an estimate of surface area from planimeter measurements of each area from USGS maps. The final number of fish for each area was estimated by calculation of a mean by adding each transect estimate for the area of interest and dividing by the total number of transects. Corrections for bias associated with surface orientation of fish (i.e., within 3 m of the surface) were made from extrapolation of measured vertical distributions of fish density plotted from mean densities per stratum to the surface. Fish associated with the bottom and not available to the hydroacoustic system were estimated by multiplying the average fish densities measured just above the bottom times the volume of water not sampled (a bottom window of 2 m was selected during data processing).

In an effort to quantify species composition of measured fish targets, tow netting (utilizing a 2.7 m x 2.7 m Burgner tow net) was conducted on 13 October 1986 in Kenai Lake and on 15 and 17 October 1986 in Skilak Lake. A total of 210 and 810 minutes of surface tow netting were completed for Kenai and Skilak Lakes, respectively. Sample locations were in areas previously identified to have relatively high fish abundance (Figures 3 and 4). All fish captured were enumerated and identified, and preserved in 10% formalin. In the laboratory, specimens were measured to the nearest mm (fork length) and aged from analysis of scale patterns.

RESULTS

Approximately 96.6% of the 235 fish captured by tow net in Kenai Lake were age-0.0 sockeye salmon and the remainder were age-1.0 sockeye salmon. Tow net results from Skilak Lake were less than satisfactory. Although 810 minutes of tow netting took place in the lake, only 18 fish were captured and of these 15, or 88.2%, were age-0.0 sockeye salmon, two were age-1.0 sockeye salmon, and the remaining fish was a threespine stickleback, *Gasterosteus aculeatus* (Table 1).

Mean fork lengths of sockeye salmon for each age class by lake system are presented in Table 1 and a length frequency histogram for Kenai Lake specimens in Figure 5. Age-0.0 sockeye salmon captured in Kenai Lake at a mean of 52 mm were approximately 5 mm smaller than those captured from Skilak Lake. A differential of 3 mm was noted for age-1.0 sockeye salmon with Kenai Lake specimens averaging 74 mm as opposed to 77 mm for Skilak Lake.

Compilation of all single echo measurements for target strength determination in Kenai Lake indicated a mean target strength of -55.35 dB with a standard

deviation of 4.74 dB (n = 21,519; Appendix Table 2). Skilak Lake measurements were similar with a mean target strength of -53.78 dB with a standard deviation of 4.69 dB (n = 25,157; Appendix Table 3). Of the echos measured, approximately 5,215 and 5,302 had beam pattern factors greater than 0 dB for Kenai and Skilak Lakes, respectively (80% were within the range of 0 to 1 dB). Graphic representation of the data by depth for both lakes is presented in Figures 6 and 7. An apparent pattern of decreasing target strength with depth was evident in the data set. Within Kenai Lake, surface measurements (2-7 m) averaged -52.34 dB, decreasing consistently to -58.24 dB for the 42 m - 72 m depth strata (Appendix Table 2). Similarly, surface measurements decreased from -50.63 dB near the surface to -55.42 dB at 37 - 42 m depth in Skilak Lake (Appendix Table 3). Test of the hypothesis of no difference in target strength with depth for each transect resulted in the rejection of the hypothesis for all Skilak Lake transects and 18 of the 22 Kenai Lake transects (alpha 0.05; Appendix Table 4).

As previously noted, the estimation of the total number of fish in the lake systems was derived from the summation of three components: a) the actual measurement of fish targets during the hours of darkness by hydroacoustic techniques (Table 2); b) the estimate of those fish in the surface waters above the transducer (Table 3); and c) the estimate of fish below the bottom window of the data processing equipment (Table 4). The total estimate of fish in Skilak and Kenai Lakes was 21,452,000 and 4,493,800 fish, respectively (Table 5).

Relative to the spatial distribution of fish within the lake systems, a pattern was observed with most of the fish located near the western end of the lakes. Approximately 68% or 14,675,000 fish were located in Area 1 of Skilak Lake, which comprised 43.5% of the surface area of the lake and 26.1% of the volume sampled (Table 6). Within Kenai Lake, 62% of the fish were located within Areas 1 and 2 which were estimated to be 35.4% of the surface area of the lake and 31.9% of the volume sampled. Lowest densities of fish were observed at the eastern end of each lake. Only 3% of the fish were located in Area 5 of Kenai Lake, which was 19.7% and 19.4% of the surface area and volume sampled, respectively. The same distribution was observed in Skilak Lake with only 9% of the fish found in Area 3 which was 22.7% and 30.1% of the surface area and volume (Table 6). Individual transect estimates of volume and fish numbers by depth strata for each lake are presented in Appendix Tables 5 through 32.

Further analysis of the horizontal distribution of fish was accomplished by the vertical summation of fish densities for five individual one minute sequences and computation of a mean fish density per 1000 square meters (Appendix Tables 33 and 34; Figures 8 through 10). Within Skilak Lake, the maximum fish density (1,360 fish/1000 square meters) was recorded on Transect 1 near the north shore of the lake. However, consistently higher relative fish densities were observed on the south shore of the lake for Transects 1-4 (Figure 8). Relatively equal densities across the lake were observed for Transects 5 and 6 and, consistent with the volume estimates, the surface estimates were indicative of lower fish numbers at the upper end of the lake (Figure 8). Considerably lower fish densities were measured in Kenai Lake with a range of measurements from 0/1000 square meters (Transect 18) to a high of 476/1000 square meters along Transect 10 (Appendix Table 34; Figure 9). No obvious distributional patterns across the lake were evident in the

data set. However, as with Skilak Lake, the headwaters of the lake had the lowest overall densities (less than 46 fish/1000 m^2).

The vertical distribution of recorded fish targets, during the hours of darkness, followed a similar pattern within all Skilak Lake transects. Most fish were located between 7 and 22 m below the transducer (Figures 11 through 13; Appendix Tables 5 through 10). Along Transect 2 fish densities reached 26.22 fish/1000m^3 for the 7 - 12 m depth strata, which were the maximum observed in the lake. Similar densities were recorded for the same depth strata along Transect 1 at 25.98 fish/1000m^3. Peak densities for the other transects ranged from 3.31 to 8.97 fish/1000m^3 (Appendix Tables 5 through 10; Figures 11 through 13). Below 32 m, fish densities were less than 1 fish/1000m^3. In contrast, Kenai Lake did not exhibit the same degree of similarity between transects (Figures 14 through 18; Appendix Tables 11 through 32). For example, maximum fish density was observed in the near surface strata in 22% of the transects surveyed, between 12 and 22 m in 64% of the transects, and at variable depths in the remaining 14%. The maximum density measured in Kenai Lake was along Transect 10 where densities reached 20.25 fish/1000m^3 between 17 and 22 m (Appendix Table 17). In contrast, peak densities were less than 5 fish/1000m^3 on 16 of the 22 transects sampled. The remaining transects (except 10) had less than 9 fish/1000m^3.

The vertical distribution of fish targets recorded in Kenai Lake during the hours of daylight were in sharp contrast to the measurements taken during the hours of darkness. Of the 12 transects, nine or 75% had peak densities at 2 - 7 m below the transducer (Figures 19-21; Appendix Tables 35-46). A sharp increase in density from essentially 0 fish to peak densities occurred in seven of the transects beginning at 7 m. Few fish were observed below 22 m and essentially no fish were found below 47 m (data was processed to 97 m for the daylight survey). Further evidence of a strong surface orientation during the day was indirectly inferred from a population estimate for the lake. Using similar techniques as the night survey, the population estimate for the lake would have been 1,827,668 fish in contrast to the 4,203,000 fish estimated from the actual measured densities during the hours of darkness. The steep shoreline of Kenai Lake makes a near bottom orientation of fish unlikely.

DISCUSSION

The use of rearing fry estimates as a forecast tool is predicated on the following assumptions: (1) that an absolute estimate of rearing juvenile sockeye salmon is obtainable in the system of interest; and (2) that the estimate has some predictable relationship to adult returns. Relative to the first requirement, the present investigation has provided an estimate of the number of rearing fish in Kenai and Skilak Lakes. The estimate, however, is dependent on a number of assumptions which may introduce error.

Errors in the population estimate can result from bias associated with sampling design and inaccurate estimate of the integrator scaling factor. The sampling design in the present investigation was established without prior knowledge of fish distribution and therefore an error associated with

non-representative sampling is certainly possible. For example, the zig-zag pattern of sampling essentially represents large areas of the nearshore region on the basis of transects which converge together. In addition, the bias associated with surface and bottom orientation of fish is not well defined. Within the present investigation, the surface and bottom corrections comprised approximately 20% of the total estimate (both lakes) and 22% of the Skilak Lake estimate. Refinement in data processing by closer bottom tracking and the use of an upward looking transducer to further evaluate surface orientation may be warranted. However, the midwater orientation of most of the fish during surveying makes the error associated with these phenomena less significant than a strong surface orientation (which was observed during the Kenai Lake day survey).

The use of a zig zag sampling design, while allowing greater tracking distance, limits the use of the calculated variance to an illustrative value only. The calculated variance estimated from between transect variation assumes that the transects were randomly selected or that the population is randomly distributed (Jolly and Hampton, in press). These assumptions are not met and, therefore, the variance calculation should be viewed accordingly. Jolly and Hampton (in press) suggest that systematic samples may have a slight gain in precision compared to random samples but the variance will be correspondingly overestimated if it is estimated by formula appropriate to a random sample.

The parameters used to calculate the integrator scaling factor are an additional source of potential error. In an attempt to minimize this, the hydroacoustic equipment was calibrated before and after the survey and no major system errors were documented. Potentially, the most significant source of error is associated with the estimate of the fish mean backscattering cross section. The results of this investigation appear to be reasonable relative to the size frequency distribution of the fish sampled when compared with published target strength data for juvenile sockeye salmon. For example, Burczynski and Johnson (1986) reported a target strength of -52.3 dB for 45-mm sockeye salmon. McClain (1985), using a dual beam system in Tustumena Lake, Alaska, reported a target strength of -53.0 dB for 45-mm age-0.0 sockeye salmon. Using the empirical formula of Love (1977), the target strength of the fish captured in Skilak and Kenai Lakes, at 45 degrees orientation, would be -51.89 and -52.62 dB, respectively.

The apparent decrease in target strength with depth in both lake systems is not explainable at this time. The hydroacoustic equipment, specifically the TVG correction, appeared to be accurate and stable during data collection. Therefore, the decrease in target strength with depth may represent a biological phenomena, or the potential loss of signal associated with the glacial nature of the environment (i.e., absorption loss). While no data presently exist to verify the potential for absorption loss, varying target strength values resulting from biological factors such as species differences, orientation or tilt angle, and age composition changes with depth, have been documented on numerous occasions in other systems. In either event, the analysis of data in discrete 5 m depth intervals minimized the impact of change in target strength with range.

Inherent in the preceding presentation of results is the assumption that most of the fish targets measured were sockeye salmon. This assumption was based

on the results of the tow netting effort which indicated that other species were absent in Kenai Lake and relatively insignificant in Skilak Lake. The tow netting results are consistent with previous investigations conducted in the lake by ADF&G and the general knowledge that sockeye salmon juveniles tend to inhabit the offshore zone of the lake environment in the fall.

However, this assumption is based on one sampling technique only and should be viewed accordingly. The depth distribution of the fish targets, especially in Skilak Lake, makes surface tow netting suspect relative to making an accurate measurement of species composition. In addition, the concept of a single species environment does not appear to be biologically sound since adult rainbow trout, Dolly Varden, whitefish, and other salmon species juveniles have been documented to inhabit the lake system. Therefore, the final estimate of relative species abundance will need further investigation. In the absence of this data, we have assumed that the majority of fish targets are sockeye salmon since both the physical location of the targets and the production of this species from the drainage has predominated the historical record.

A relationship of sockeye salmon fry or smolt numbers to adult returns has not been established for the Kenai River drainage and therefore it will be a number of years before a definite conclusion will be reached on the usefulness of these techniques as a forecast method. However, similar data collected from Tustumena Lake, Alaska (Flagg et al. 1986) has provided incentive to continue this program. During these studies hydroacoustic estimates of the number of juvenile sockeye salmon rearing in Tustumena Lake (Thorne and Thomas, 1982, 1983; Thomas et al. 1986a, 1986b, 1987) were made concurrent to estimates of the number of migrating smolt at the outlet of the lake. During four years of investigation, the smolt counts have ranged from approximately 74% to 87% of the number of juvenile sockeye salmon estimated in the lake the previous fall (examined on a brood year basis). This relatively consistent overwinter survival rate appears to offer a reasonable opportunity of success in monitoring the freshwater production of juvenile sockeye salmon.

Data on the spatial and temporal distribution of juvenile sockeye salmon in the Kenai River drainage was a secondary product of the study. The pattern of higher fish densities near the outlet of both lake systems requires further investigation as to the consistency of this distribution, both spatially and temporally. The authors offer no explanation at this time relative to these observations. However, of equal importance is the relative comparison of population estimates between Skilak and Kenai Lakes. From the data gathered, Skilak Lake had approximately four times the number of rearing fish as Kenai Lake, yet Kenai Lake is approximately one-half the surface area of Skilak Lake. A more meaningful comparison between the two lakes than surface area, is their euphotic volume; defined as the volume of the lake associated with autochthonous primary production. Koenings (ADF&G, Soldotna, personal communication) has estimated the euphotic volume of Skilak and Kenai Lakes to be 842 and 392 million cubic meters, respectively (a ratio of 2.1:1). An empirical model for glacial lake systems, based on euphotic volume and developed by Koenings (personal communication) suggested that Skilak and Kenai Lakes should be capable of rearing, on average (assuming 78% survival from fall juveniles to smolt), approximately 25 and 11 million fall juvenile sockeye salmon, respectively. The population estimates for Skilak

Lake compare favorably with these values. However, the Kenai Lake estimate is only 45% of the predicted value. If consistently lower numbers are documented in future investigations, the results may imply that Kenai Lake is spawning limited, although the authors are not suggesting this here.

The sizes of juvenile sockeye salmon measured in both Kenai and Skilak Lakes are consistent with previous tow net results (Tarbox et al. 1984). While the relatively small size of juvenile sockeye salmon can be indicative of a density dependent rearing limitation, this relationship for glacial systems is questionable. Koenings et al. (1986) suggested that density independent factors may be as important in limiting fish production. Within glacial lakes, the temperature regime of the lake appears to be critical to fry growth and survival (Koenings et al. 1986). Therefore, the population estimates for both Kenai and Skilak Lakes, combined with the size frequency data, should not be construed to mean a system at rearing capacity.

The observation of near surface distribution of juvenile sockeye salmon in a glacial lake system was initially reported by Thorne and Thomas (1982). Within Tustumena Lake, they observed that diel variability in juvenile sockeye salmon density was most obvious in September (i.e., higher fish densities were measured in the upper 10 m during the day). They hypothesized that this unusual diel pattern was an effect of reduced hours of daylight in the fall on the feeding behavior of sockeye salmon. The present investigation tends to verify the surface orientation of juvenile sockeye salmon during the hours of daylight. No data exist to verify the hypothesis of a feeding response to light levels. However, the euphotic zone within Kenai Lake has been estimated at approximately 7 m, which would suggest that the availability of light is severely limited.

In summary, the utilization of the dual beam hydroacoustic system, within the glacial lake systems of the Kenai River drainage, has increased the data base significantly on the abundance and spatial distribution of rearing sockeye salmon. The ultimate use of these data as a forecast tool is yet to be decided. However, of equal importance is the increased knowledge future fishery biologists will gain on the salmon rearing abilities of these lake systems.

In an effort to improve the sampling program, the following recommendations are suggested for future investigations:

(1) the sampling design should be modified to use a random design. Because of the apparent differences in density between geographic locations within the lake, a stratified random sample of parallel transects is recommended. This design meets the statistical requirements necessary for variance calculations (Jolly and Hampton, <u>in press</u>);

(2) further investigation into the reason for the target strength distribution is needed. If absorption loss occurred because of glacial silt or some other unknown factor, it could impact future investigations in a number of lake systems in Alaska;

(3) tow netting results were not satisfactory and, therefore, alternate sampling techniques should be explored;

(4) the use of new analysis techniques and estimation procedures should be further explored as they become available; and

(5) limnological data should be collected concurrent to the hydroacoustic survey to evaluate observed fish distribution relative to environmental factors.

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Table 1. Species composition and mean length at age of fish captured by tow net in Kenai and Skilak Lakes, Alaska, 1986.

Location	Dates of Sampling	EFFORT: Number of Stations Sampled	EFFORT: Minutes of Towing	Species		Sample Size: Age 0	Sample Size: Age 1	Mean Length (FL)[1]: Age 0	Mean Length (FL)[1]: Age 1
Kenai Lake	10/13/86	4	210	Sockeye	#	227	8	52	74
					%	96.6	3.4		
Skilak Lake	10/7,15/86	13	810	Sockeye	#	15	2	57	77
					%	88.2	11.8		
				Coho		1		42	

[1] FL - fork length
Length measured in millimeters.
One threespine stickleback also taken in Skilak Lake.

Table 2. The estimated number of fish in Kenai and Skilak Lakes, Alaska as determined from acoustic surveys in the fall of 1986.

Lake	Area	Transect	Estimated Number of Fish	Variance
Skilak	1	1	1.1156E+07	
		2	8.6424E+06	
		mean	9.8992E+06	3.1591E+12
	2	3	5.3476E+06	
		4	4.4850E+06	
		mean	4.9163E+06	3.7204E+11
	3	5	2.0846E+06	
		6	1.5841E+06	
		mean	1.8344E+06	1.2525E+11
TOTAL ALL AREAS			1.6650E+07	3.6564E+12
Kenai	1	6	1.8044E+05	
		7	5.8466E+05	
		8	1.4132E+06	
		9a	5.4323E+05	
		mean	6.8038E+05	2.7165E+11
	2	9	1.1534E+06	
		10a	1.9731E+06	
		10	3.6799E+06	
		11	9.1455E+05	
		mean	1.9302E+06	1.5661E+12
	3	11	4.2020E+05	
		12a	4.6129E+05	
		12	5.3408E+05	
		13a	4.9907E+05	
		mean	4.7866E+05	2.4024E+09
	4	13	1.4448E+06	
		14a	1.5066E+06	
		14	8.3796E+05	
		15a	1.8419E+05	
		mean	9.9339E+05	3.8204E+11

continued

Table 2, continued. The estimated number of fish in Kenai and Skilak Lakes, Alaska as determined from acoustic surveys in the fall of 1986.

Lake	Area	Transect	Estimated Number of Fish	Variance
Kenai	5	15	1.9046E+05	
		16a	2.1138E+05	
		16	7.9762E+04	
		17	3.1140E+04	
		18	8.1657E+04	
		19	1.3087E+05	
		mean	1.2088E+05	4.8828E+09
	TOTAL ALL AREAS		4.2035E+06	2.2271E+12

Table 3. Estimated number of fish not available to the hydroacoustic equipment because of surface orientation in Skilak and Kenai Lakes, Alaska during the fall of 1986.[1]

Lake	Area	Transect	Estimated Fish Density (number/m^3)	Estimated Volume (m^3)	Estimated Number of Fish	Variance
Skilak	1	1	1.8000E-03	8.6060E+06	1.5491E+04	
		2	6.0000E-03	8.6060E+08	5.1636E+06	
		mean			2.5895E+06	1.3252E+13
	2	3	4.0000E-04	6.6920E+06	2.6768E+03	
		4	0.0000E+00	0.0000E+00	0.0000E+00	
		mean			1.3384E+03	3.5826E+06
	3	5	2.0000E-04	2.2500E+07	4.5000E+03	
		6	0.0000E+00	0.0000E+00	0.0000E+00	
		mean			2.2500E+03	1.0125E+07
TOTAL ALL AREAS					2.5931E+06	1.3252E+13
Kenai	1	6	1.3000E-03	2.3160E+07	3.0108E+04	
		7	3.1000E-03	2.3160E+07	7.1796E+04	
		8	1.5000E-03	2.3160E+07	3.4740E+04	
		9a	1.6500E-02	2.3160E+07	3.8214E+05	
		mean			1.2970E+05	2.8672E+10
	2	9	2.8000E-03	3.5730E+07	1.0004E+05	
		10a	1.0000E-03	2.3820E+07	2.3820E+04	
		10	1.8000E-03	2.3820E+07	4.2876E+04	
		11a	0.0000E+00	0.0000E+00	0.0000E+00	
		mean			4.1685E+04	1.8213E+09
	3	11	1.7500E-03	3.1620E+07	5.5335E+04	
		12a	1.0000E-04	5.2700E+06	5.2700E+02	
		12	3.2000E-03	3.1620E+07	1.0118E+05	
		13a	3.6000E-04	2.1080E+07	7.5888E+03	
		mean			4.1159E+04	2.1940E+09
	4	13	4.6000E-03	4.3110E+07	1.9831E+05	
		14a	2.0000E-04	8.6220E+06	1.7244E+03	
		14	2.0000E-04	2.8740E+07	5.7480E+03	
		15a	0.0000E+00	0.0000E+00	0.0000E+00	
		mean			5.1445E+04	9.5917E+09

Continued

Table 3, continued. Estimated number of fish not available to the hydroacoustic equipment because of surface orientation in Skilak and Kenai Lakes, Alaska during the fall of 1986.[1]

Lake	Area	Transect	Estimated Fish Density (number/m^3)	Estimated Volume (m^3)	Estimated Number of Fish	Variance
Kenai	5	15	0.0000E+00	3.2790E+07	0.0000E+00	
		16a	2.1000E-03	3.2790E+07	6.8859E+04	
		16	1.7000E-03	3.2790E+07	5.5743E+04	
		17	3.0000E-05	2.7325E+07	8.1975E+02	
		18	5.2000E-04	3.2790E+07	1.7051E+04	
		19	4.6000E-04	3.2790E+07	1.5083E+04	
		mean			2.6259E+04	8.4609E+08
TOTAL ALL AREAS					2.9024E+05	4.3125E+10

[1] Fish density was estimated from visual extrapolation of measured fish densities 2 m below the transducer to the surface. In the event densities were estimated at 0.0 prior to the surface, the depth of the strata was adjusted to reflect only that portion which contained fish.

Table 4. Estimated number of fish not available to the hydroacoustic equipment because of bottom orientation in Skilak Lake, Alaska during the fall of 1986.[1]

Area	Transect	Bottom Depth(m)	Estimated Fish Density (number/m^3)	Estimated Volume (m^3)	Estimated Number of Fish	Variance
1	1	2-7	5.6635E-03	2.2733E+07	1.2875E+05	
		7-12	2.5980E-02	3.2475E+06	8.4371E+04	
		12-17	4.2530E-02	8.1189E+06	3.4530E+05	
		17-22	4.6750E-02	1.2990E+07	6.0729E+05	
		22-27	6.1330E-03	1.6238E+06	9.9586E+03	
		27-32	2.2380E-03	1.6238E+06	3.6340E+03	
		32-37	7.0520E-04	1.6238E+06	1.1451E+03	
		37-42	1.3160E-04	1.6238E+06	2.1369E+02	
		42-47	4.7200E-05	1.6238E+06	7.6642E+01	
		47-52	1.2400E-04	0.0000E+00	0.0000E+00	
		52-57	1.0720E-04	1.6238E+06	1.7407E+02	
		57-62	5.9850E-05	1.6238E+06	9.7183E+01	
		62-67	5.7050E-05	1.6238E+06	9.2636E+01	
		67-72	1.3970E-04	1.6238E+06	2.2684E+02	
		72-77	3.8810E-05	1.6238E+06	6.3019E+01	
		77-82	1.8040E-05	8.1189E+06	1.4646E+02	
		82-87	3.4670E-05	8.1189E+06	2.8148E+02	
		87-92	1.0620E-05	6.4951E+06	6.8978E+01	
		92-97	0.0000E+00	0.0000E+00	0.0000E+00	
		TOTAL			1.1819E+06	
1	2	2-7	3.6410E-03	1.4083E+07	5.1275E+04	
		7-12	8.9400E-02	2.6600E+07	2.3781E+06	
		12-17	9.3330E-02	7.8236E+06	7.3018E+05	
		17-22	4.7780E-03	3.1295E+06	1.4953E+04	
		22-27	2.4630E-03	4.6942E+06	1.1562E+04	
		27-32	1.3090E-03	1.5647E+06	2.0482E+03	
		32-37	5.0690E-04	0.0000E+00	0.0000E+00	
		37-42	1.1230E-04	0.0000E+00	0.0000E+00	
		42-47	2.3520E-05	0.0000E+00	0.0000E+00	
		47-52	4.4470E-05	0.0000E+00	0.0000E+00	
		52-57	1.5610E-04	1.5647E+06	2.4425E+02	
		57-62	1.1460E-04	0.0000E+00	0.0000E+00	
		62-67	9.6430E-05	1.5647E+06	1.5089E+02	
		67-72	1.6000E-04	0.0000E+00	0.0000E+00	
		72-77	8.3780E-04	1.5647E+06	1.3109E+03	
		77-82	7.4160E-04	0.0000E+00	0.0000E+00	
		82-87	8.2950E-06	0.0000E+00	0.0000E+00	
		87-92	2.6290E-06	1.5647E+06	4.1137E+00	
		92-97	4.0710E-07	0.0000E+00	0.0000E+00	
		TOTAL			3.1898E+06	
		MEAN OF TRANSECTS 1 AND 2			2.1858E+06	2.0159E+12

continued

Table 4, continued. Estimated number of fish not available to the hydroacoustic equipment because of bottom orientation in Skilak Lake, Alaska during the fall of 1986.[1]

Area	Transect	Bottom Depth(m)	Estimated Fish Density (number/m^3)	Estimated Volume (m^3)	Estimated Number of Fish	Variance
2	3	2-7	7.1560E-04	0.0000E+00	0.0000E+00	
		7-12	5.3200E-03	1.1950E+06	6.3574E+03	
		12-17	8.5310E-03	0.0000E+00	0.0000E+00	
		17-22	8.9660E-03	0.0000E+00	0.0000E+00	
		22-27	5.1970E-03	1.1950E+06	6.2104E+03	
		27-32	2.5990E-03	0.0000E+00	0.0000E+00	
		32-37	7.9380E-04	2.3900E+06	1.8972E+03	
		37-42	4.3360E-05	1.1950E+06	5.1815E+01	
		42-47	2.8910E-05	0.0000E+00	0.0000E+00	
		47-52	4.6970E-05	1.1950E+06	5.6129E+01	
		52-57	2.9970E-05	0.0000E+00	0.0000E+00	
		57-62	6.4680E-05	2.3900E+06	1.5459E+02	
		62-67	2.0510E-05	0.0000E+00	0.0000E+00	
		67-72	2.6680E-05	0.0000E+00	0.0000E+00	
		72-77	1.8570E-05	0.0000E+00	0.0000E+00	
		77-82	7.2890E-06	0.0000E+00	0.0000E+00	
		82-87	1.8970E-06	0.0000E+00	0.0000E+00	
		87-92	2.0160E-06	1.1950E+06	2.4091E+00	
		92-97	1.7440E-05	1.1950E+06	2.0841E+01	
		TOTAL			1.4751E+04	
2	4	2-7	8.2290E-05	0.0000E+00	0.0000E+00	
		7-12	4.0610E-03	1.5933E+06	6.4705E+03	
		12-17	8.0270E-03	1.5933E+06	1.2790E+04	
		17-22	6.9480E-03	0.0000E+00	0.0000E+00	
		22-27	5.1520E-03	0.0000E+00	0.0000E+00	
		27-32	1.7150E-03	0.0000E+00	0.0000E+00	
		32-37	6.0870E-04	0.0000E+00	0.0000E+00	
		37-42	1.3320E-04	0.0000E+00	0.0000E+00	
		42-47	1.9740E-05	0.0000E+00	0.0000E+00	
		47-52	1.0370E-04	0.0000E+00	0.0000E+00	
		52-57	2.5280E-04	0.0000E+00	0.0000E+00	
		57-62	1.6010E-04	3.1867E+06	5.1019E+02	
		62-67	1.1690E-04	0.0000E+00	0.0000E+00	
		67-72	1.0230E-04	1.5933E+06	1.6300E+02	
		72-77	8.2000E-05	0.0000E+00	0.0000E+00	
		77-82	1.9410E-05	0.0000E+00	0.0000E+00	
		82-87	7.7360E-06	0.0000E+00	0.0000E+00	
		87-92	0.0000E+00	1.5933E+06	0.0000E+00	
		92-97	0.0000E+00	1.5933E+06	0.0000E+00	
		TOTAL			1.9933E+04	
		MEAN OF TRANSECTS 3 AND 4			1.7342E+04	1.3430E+07

Continued

Table 4, continued. Estimated number of fish not available to the hydroacoustic equipment because of bottom orientation in Skilak Lake, Alaska during the fall of 1986.

Area	Transect	Bottom Depth(m)	Estimated Fish Density (number/m^3)	Estimated Volume (m^3)	Estimated Number of Fish	Variance
3	5	2-7	4.1180E-04	0.0000E+00	0.0000E+00	
		7-12	1.4290E-03	0.0000E+00	0.0000E+00	
		12-17	5.8140E-03	0.0000E+00	0.0000E+00	
		17-22	3.8850E-03	0.0000E+00	0.0000E+00	
		22-27	3.4100E-03	0.0000E+00	0.0000E+00	
		27-32	2.0390E-03	0.0000E+00	0.0000E+00	
		32-37	6.8220E-04	1.6071E+06	1.0964E+03	
		37-42	1.6020E-04	0.0000E+00	0.0000E+00	
		42-47	3.1170E-05	0.0000E+00	0.0000E+00	
		47-52	1.4900E-04	0.0000E+00	0.0000E+00	
		52-57	3.0310E-04	0.0000E+00	0.0000E+00	
		57-62	1.0990E-04	0.0000E+00	0.0000E+00	
		62-67	1.2990E-04	0.0000E+00	0.0000E+00	
		67-72	6.6480E-05	6.4286E+06	4.2737E+02	
		72-77	3.5370E-05	0.0000E+00	0.0000E+00	
		77-82	2.6440E-05	1.6071E+06	4.2493E+01	
		82-87	8.9510E-07	0.0000E+00	0.0000E+00	
		87-92	0.0000E+00	1.6071E+06	0.0000E+00	
		92-97	0.0000E+00	1.6071E+06	0.0000E+00	
		TOTAL			1.5663E+03	
3	6	2-7	0.0000E+00	0.0000E+00	0.0000E+00	
		7-12	1.4530E-03	0.0000E+00	0.0000E+00	
		12-17	3.3110E-03	0.0000E+00	0.0000E+00	
		17-22	2.9640E-03	1.6071E+06	4.7636E+03	
		22-27	2.3870E-03	0.0000E+00	0.0000E+00	
		27-32	1.4580E-03	0.0000E+00	0.0000E+00	
		32-37	4.1510E-04	1.6071E+06	6.6713E+02	
		37-42	1.5730E-04	0.0000E+00	0.0000E+00	
		42-47	1.1290E-04	0.0000E+00	0.0000E+00	
		47-52	6.2000E-05	0.0000E+00	0.0000E+00	
		52-57	2.1650E-04	0.0000E+00	0.0000E+00	
		57-62	3.5500E-04	1.6071E+06	5.7054E+02	
		62-67	5.7720E-04	1.6071E+06	9.2764E+02	
		67-72	2.6680E-04	0.0000E+00	0.0000E+00	
		72-77	3.2920E-04	3.2143E+06	1.0581E+03	
		77-82	1.2520E-04	0.0000E+00	0.0000E+00	
		82-87	1.2330E-04	1.6071E+06	1.9816E+02	
		87-92	1.9450E-04	1.6071E+06	3.1259E+02	
		92-97	1.7560E-04	4.8214E+06	8.4664E+02	
		TOTAL			9.3444E+03	
		MEAN OF TRANSECTS 5 AND 6			5.4553E+03	3.0250E+07
		TOTAL ALL AREAS			2.2086E+06	2.0159E+12

Continued

Table 4, continued. Estimated number of fish not available to the hydroacoustic equipment because of bottom orientation in Skilak Lake, Alaska during the fall of 1986.

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[1] No estimate was made for Kenai Lake as the shoreline was extremely steep and not a significant component of the sample volume.

Table 5. The estimated number of fish in Skilak and Kenai Lakes, Alaska based on actual hydroacoustic measurements and corrections for bias associated with surface and bottom areas.

Lake	Area	Estimation Parameter	Estimated Number of Fish	Variance
Skilak	1	Surface	2.5895E+06	1.3252E+13
		Midwater	9.8992E+06	3.1591E+12
		Bottom	2.1858E+06	2.0159E+12
		Total	1.4675E+07	1.8427E+13
	2	Surface	1.3384E+03	3.5826E+06
		Midwater	4.9163E+06	3.7204E+11
		Bottom	1.7342E+04	1.3430E+07
		Total	4.9350E+06	3.7206E+11
	3	Surface	2.2500E+03	1.0125E+07
		Midwater	1.8344E+06	1.2525E+11
		Bottom	5.4553E+03	3.0250E+07
		Total	1.8421E+06	1.2529E+11
	All	Surface	2.5931E+06	1.3252E+13
		Midwater	1.6650E+07	3.6564E+12
		Bottom	2.2086E+06	2.0159E+12
		Total	2.1452E+07	1.8924E+13
Kenai	1	Surface	1.2970E+05	2.8672E+10
		Midwater	6.8038E+05	2.7165E+11
		Bottom	0.0000E+00	0.0000E+00
		Total	8.1008E+05	3.0032E+11
	2	Surface	4.1685E+04	1.8213E+09
		Midwater	1.9302E+06	1.5661E+12
		Bottom	0.0000E+00	0.0000E+00
		Total	1.9719E+06	1.5679E+12
	3	Surface	4.1159E+04	2.1940E+09
		Midwater	4.7866E+05	2.4024E+09
		Bottom	0.0000E+00	0.0000E+00
		Total	5.1982E+05	4.5964E+09
	4	Surface	5.1445E+04	9.5917E+09
		Midwater	9.9339E+05	3.8204E+11
		Bottom	0.0000E+00	0.0000E+00
		Total	1.0448E+06	3.9163E+11

Continued

Table 5, continued. The estimated number of fish in Skilak and Kenai Lakes, Alaska based on actual hydroacoustic measurements and corrections for bias associated with surface and bottom areas in the fall of 1986.

Lake	Area	Estimation Parameter	Estimated Number of Fish	Variance
Kenai	5	Surface	2.6259E+04	8.4609E+08
		Midwater	1.2088E+05	4.8828E+09
		Bottom	0.0000E+00	0.0000E+00
		Total	1.4714E+05	5.7289E+09
	All	Surface	2.9025E+05	4.3125E+10
		Midwater	4.2035E+06	2.2271E+12
		Bottom	0.0000E+00	0.0000E+00
		Total	4.4938E+06	2.2702E+12
TOTAL COMBINED ESTIMATE			2.5945E+07	2.1194E+13

Table 6. Areas (millions of square meters) and volumes (millions of cubic meters) in Kenai Lake and Skilak Lake, Alaska, 1986.

	Skilak Lake			Kenai Lake		
Area	Surface Area	Volume	Percent of Fish in Area	Surface Area	Volume	Percent of Fish in Area
1	43.03 (43.5%)	1,543.00 (26.1%)	68%	7.72 (13.9%)	237.11 (9.7%)	18%
2	33.46 (33.8%)	2,585.30 (43.8%)	23%	11.91 (21.5%)	542.47 (22.2%)	44%
3	22.50 (22.7%)	1,780.65 (30.1%)	9%	10.54 (19.0%)	502.21 (20.6%)	12%
4				14.37 (25.9%)	686.22 (28.1%)	23%
5				10.93 (19.7%)	475.34 (19.4%)	3%
Total	98.99	5,908.95		55.47	2,443.35	

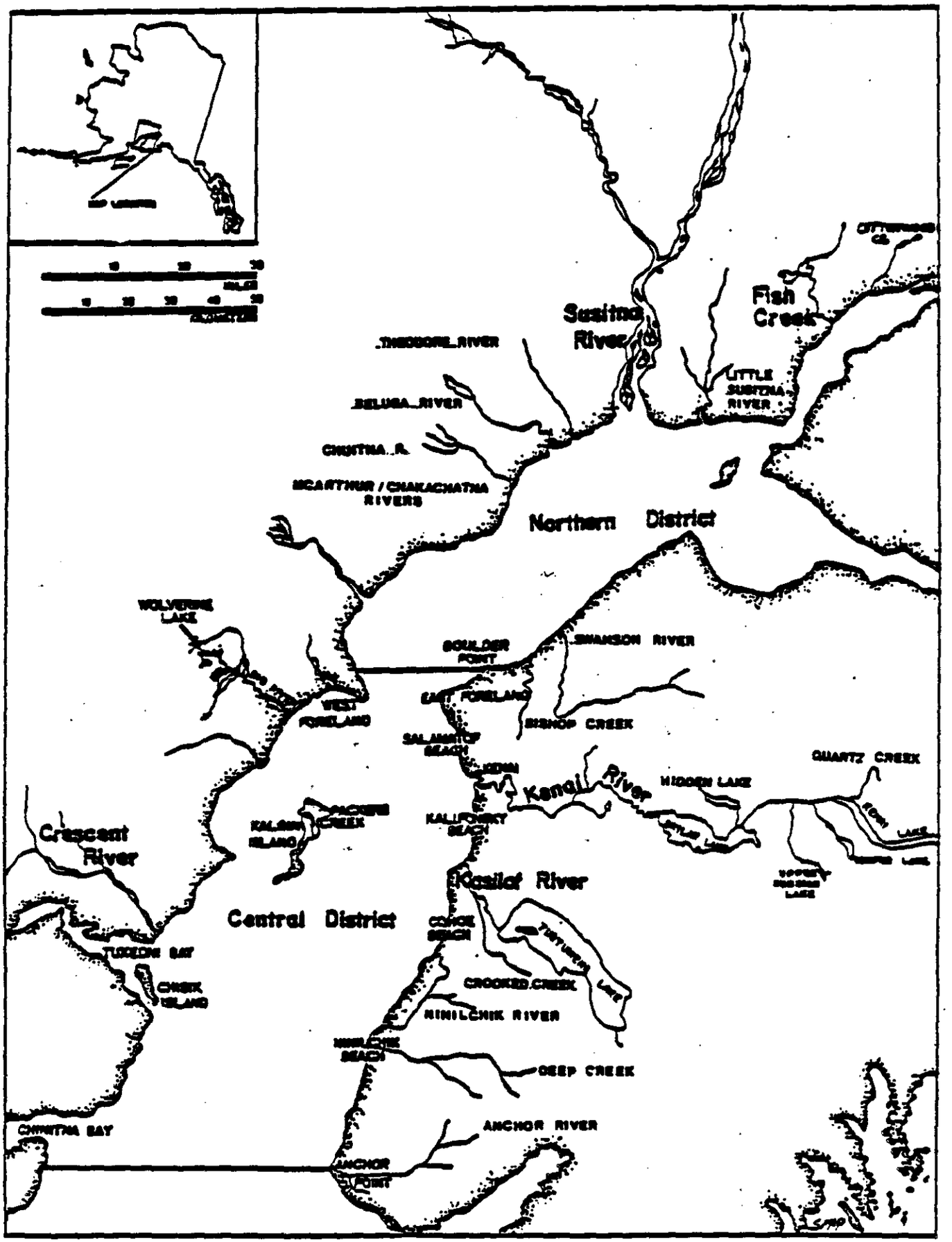


Figure 1. The Upper Cook Inlet area showing the location of the Northern and Central Districts and the major sockeye salmon spawning drainages .

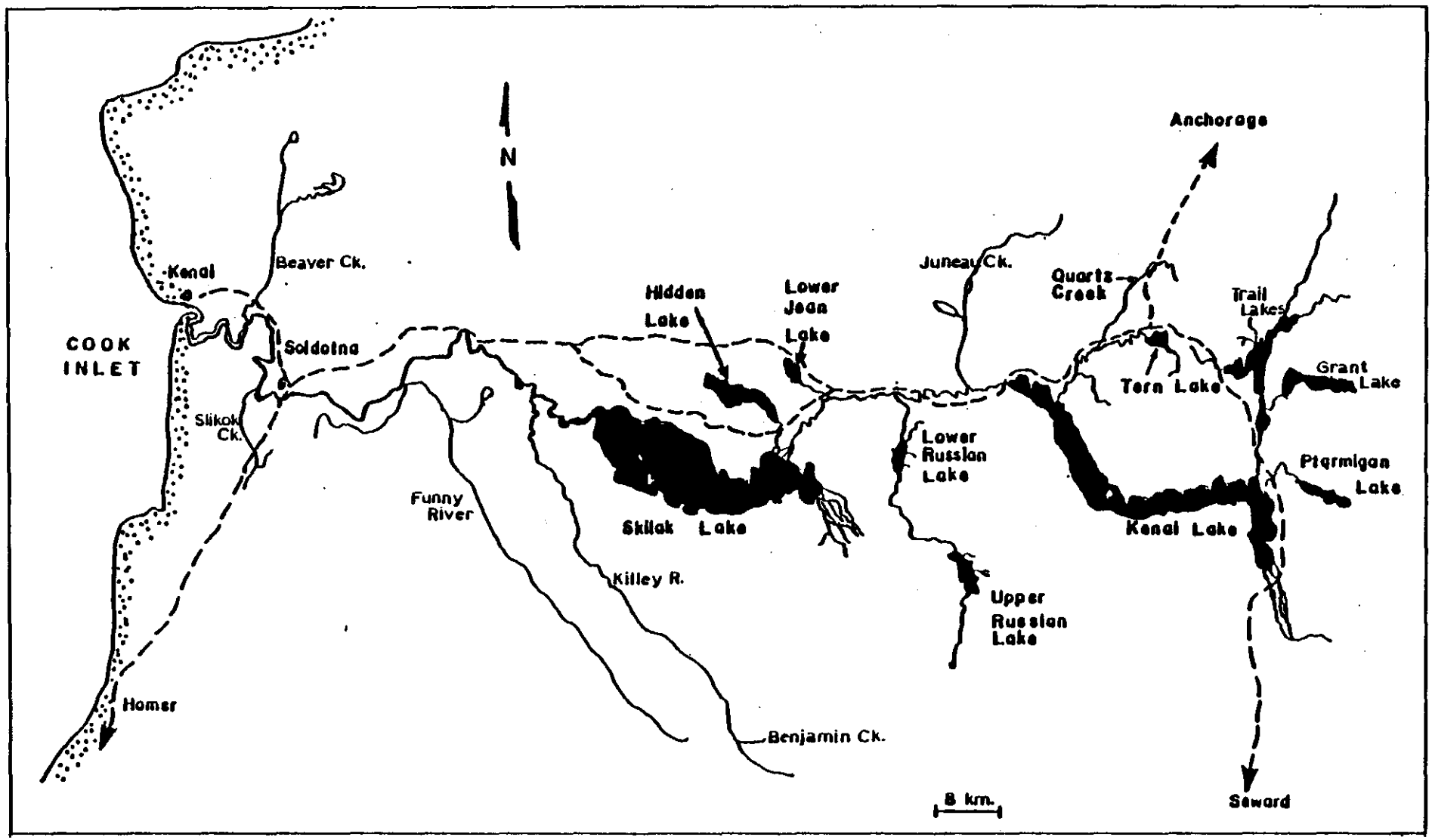


Figure 2. The Kenai River drainage, Alaska and the location of the major lake systems which are utilized by rearing sockeye salmon.

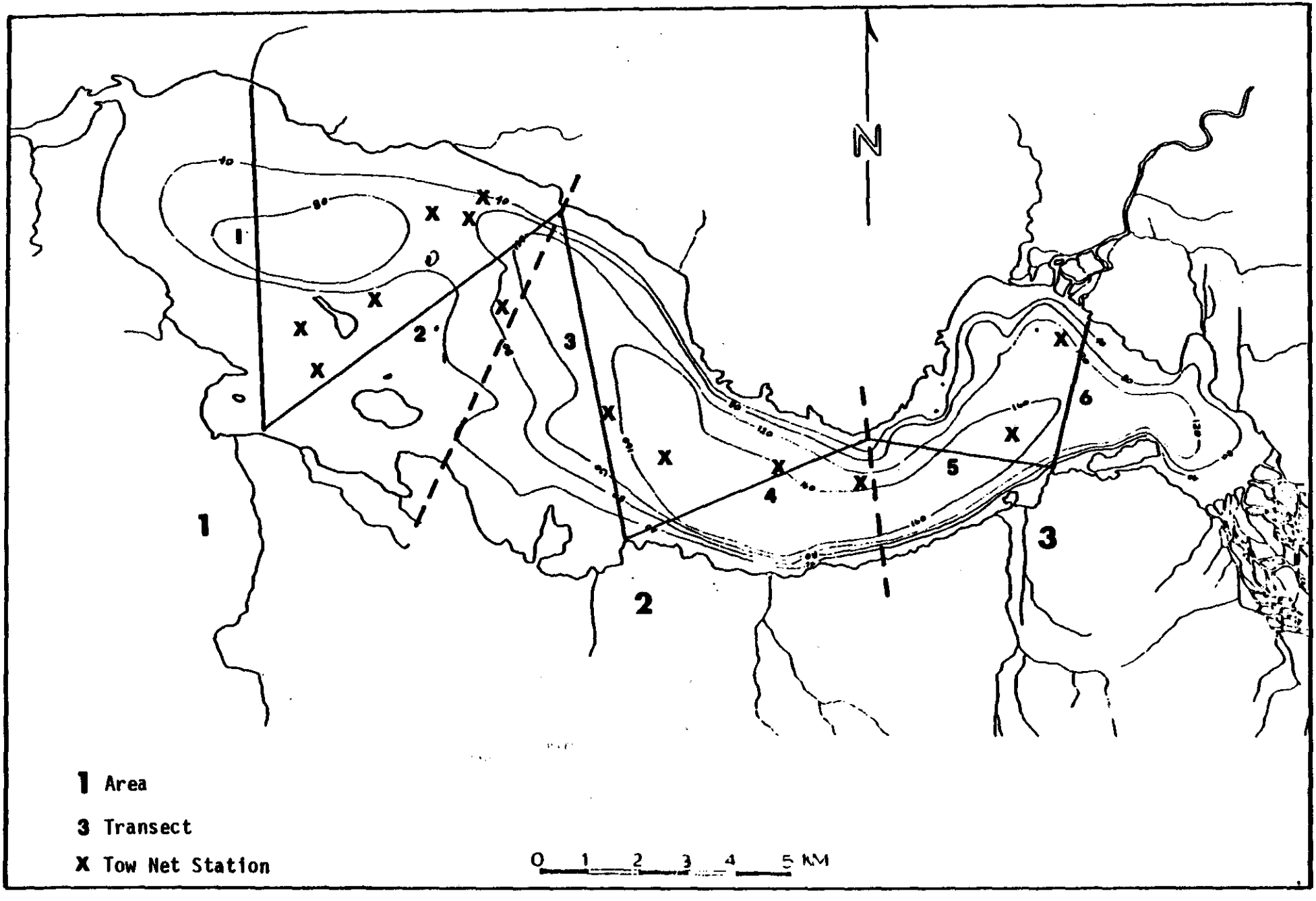


Figure 3. Skilak Lake, Alaska area designations, hydroacoustic transect locations, and tow netting stations, 1986.

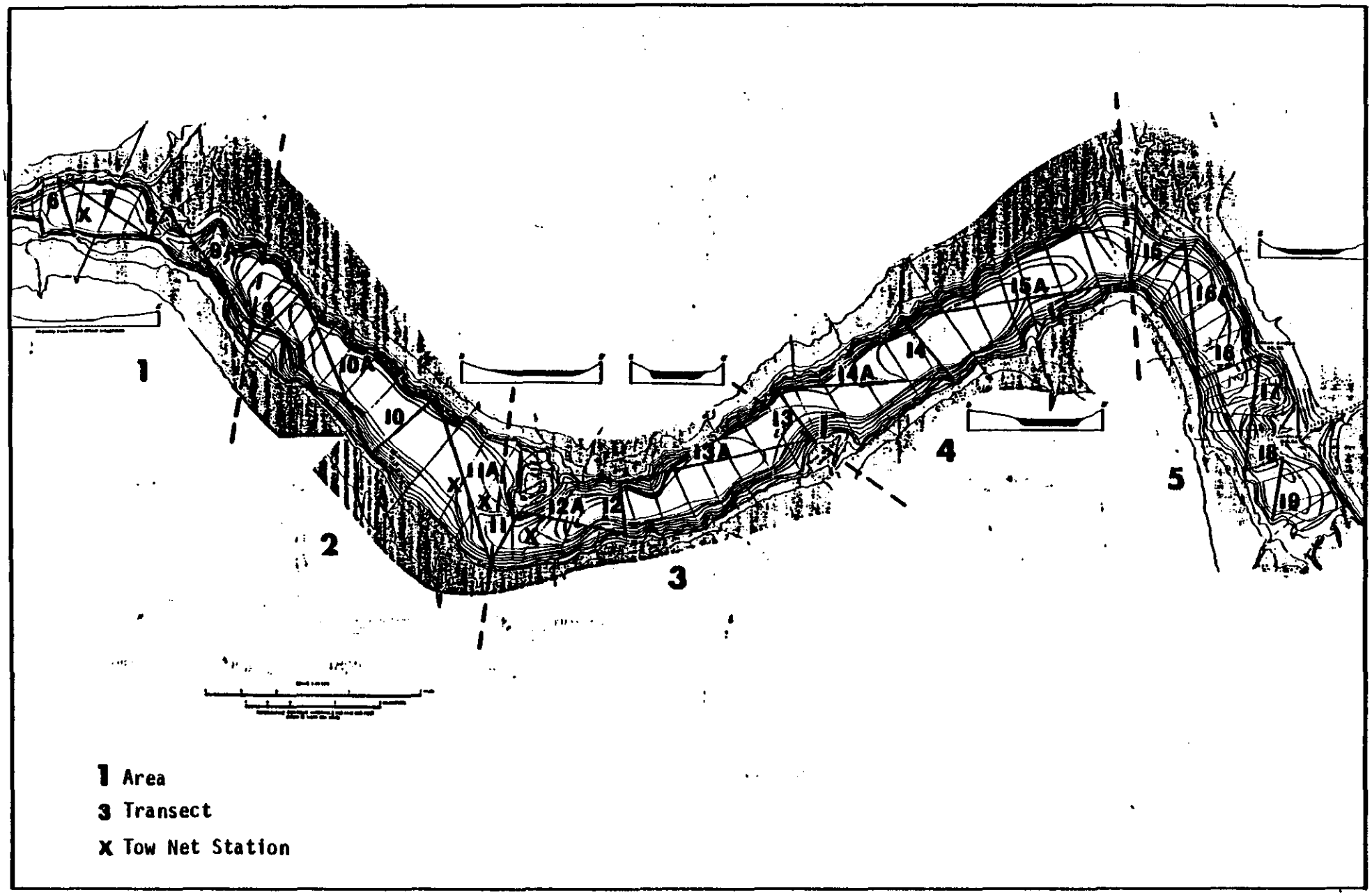


Figure 4. Kenai Lake, Alaska area designations, hydroacoustic transect locations, and tow netting stations, 1986.

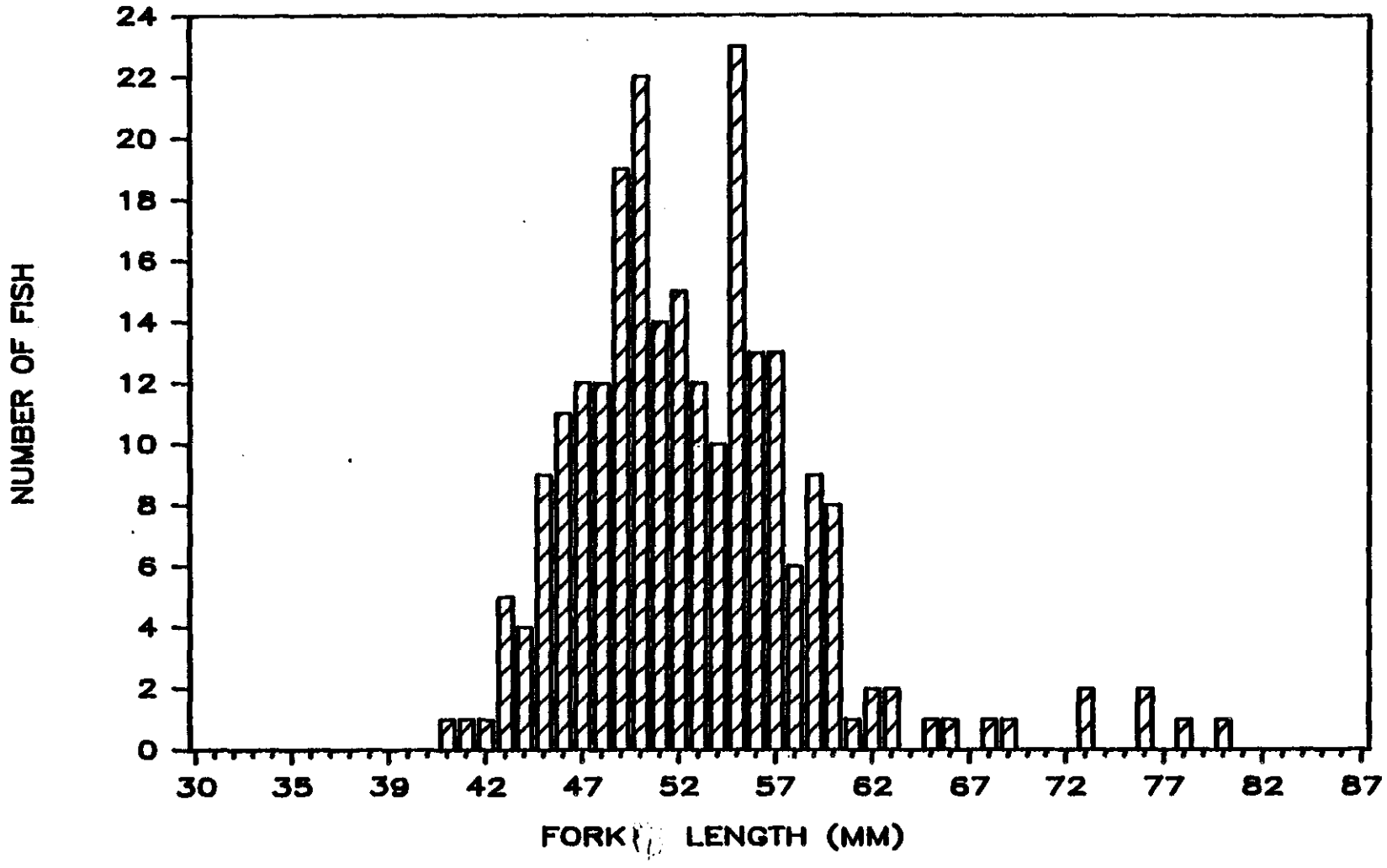


Figure 5. Length frequency of sockeye salmon collected in Kenai Lake, Alaska during October 1986.

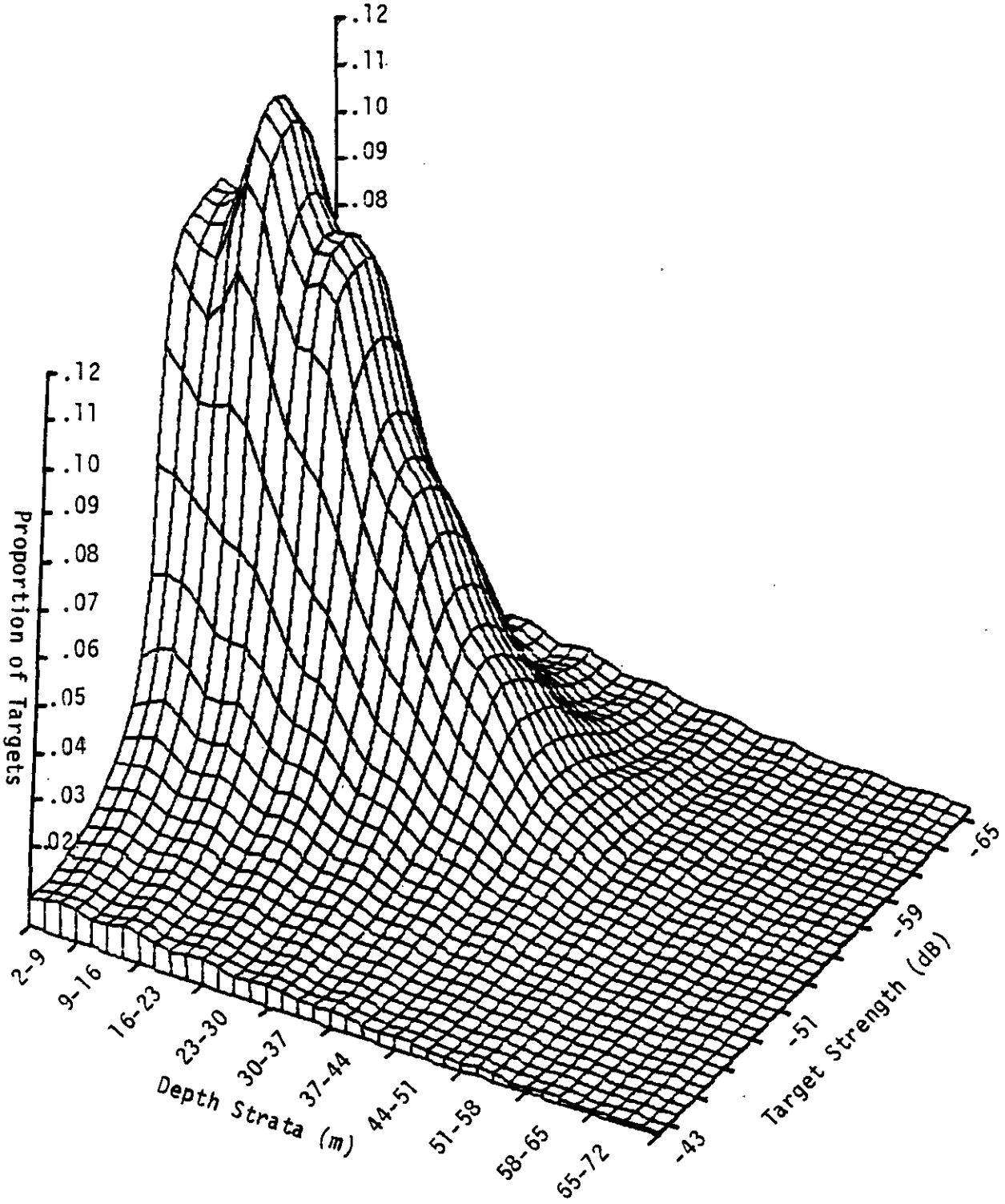


Figure 6. In situ target strength measurements and proportion by depth strata collected from Kenai Lake, Alaska, September 1986. (Note: the proportion of targets was scaled by $1/\text{range}^2$).

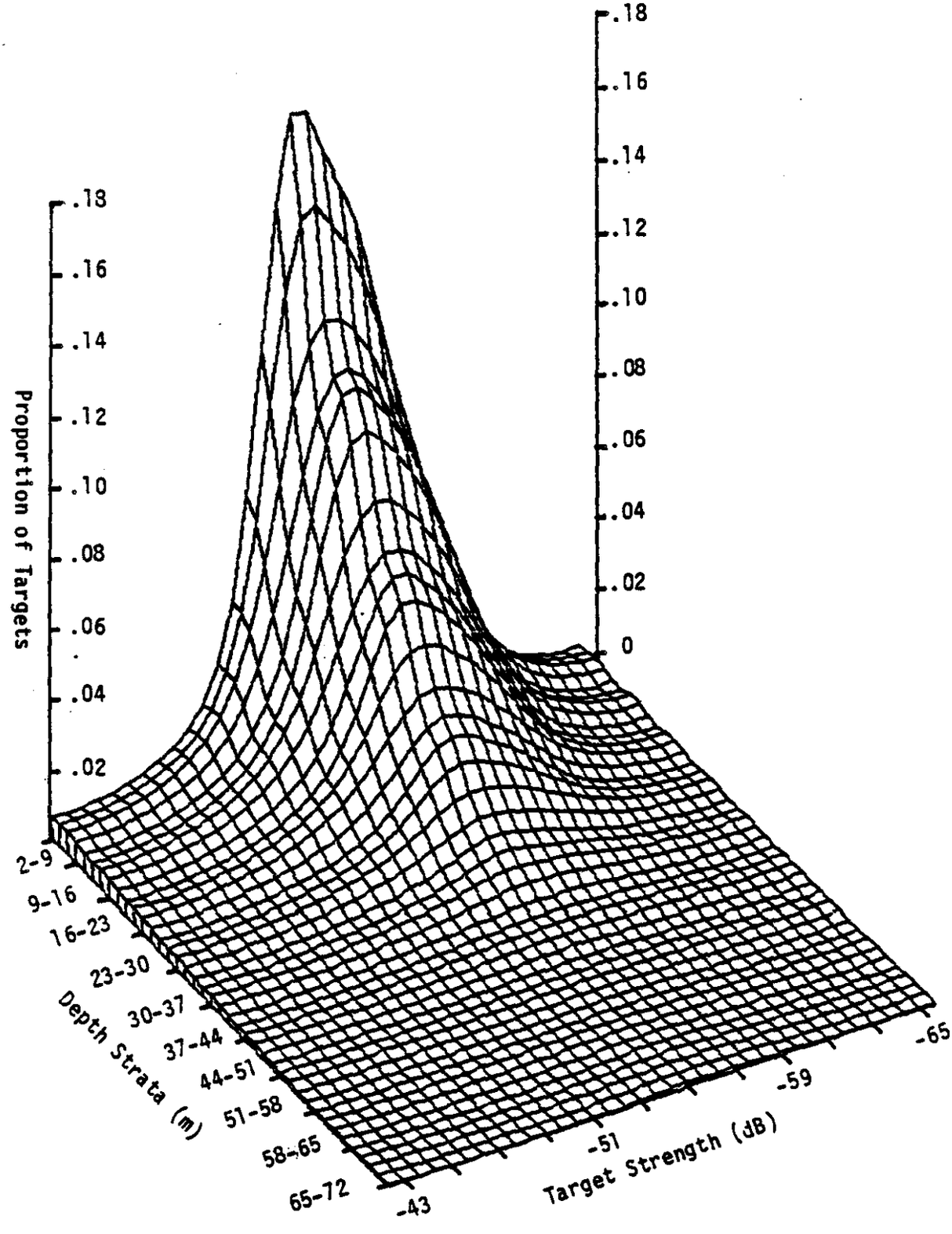


Figure 7. In situ target strength measurements and proportion by depth strata collected from Skilak Lake, Alaska, October 1986. (Note: the proportion of targets was scaled by 1/range^2).

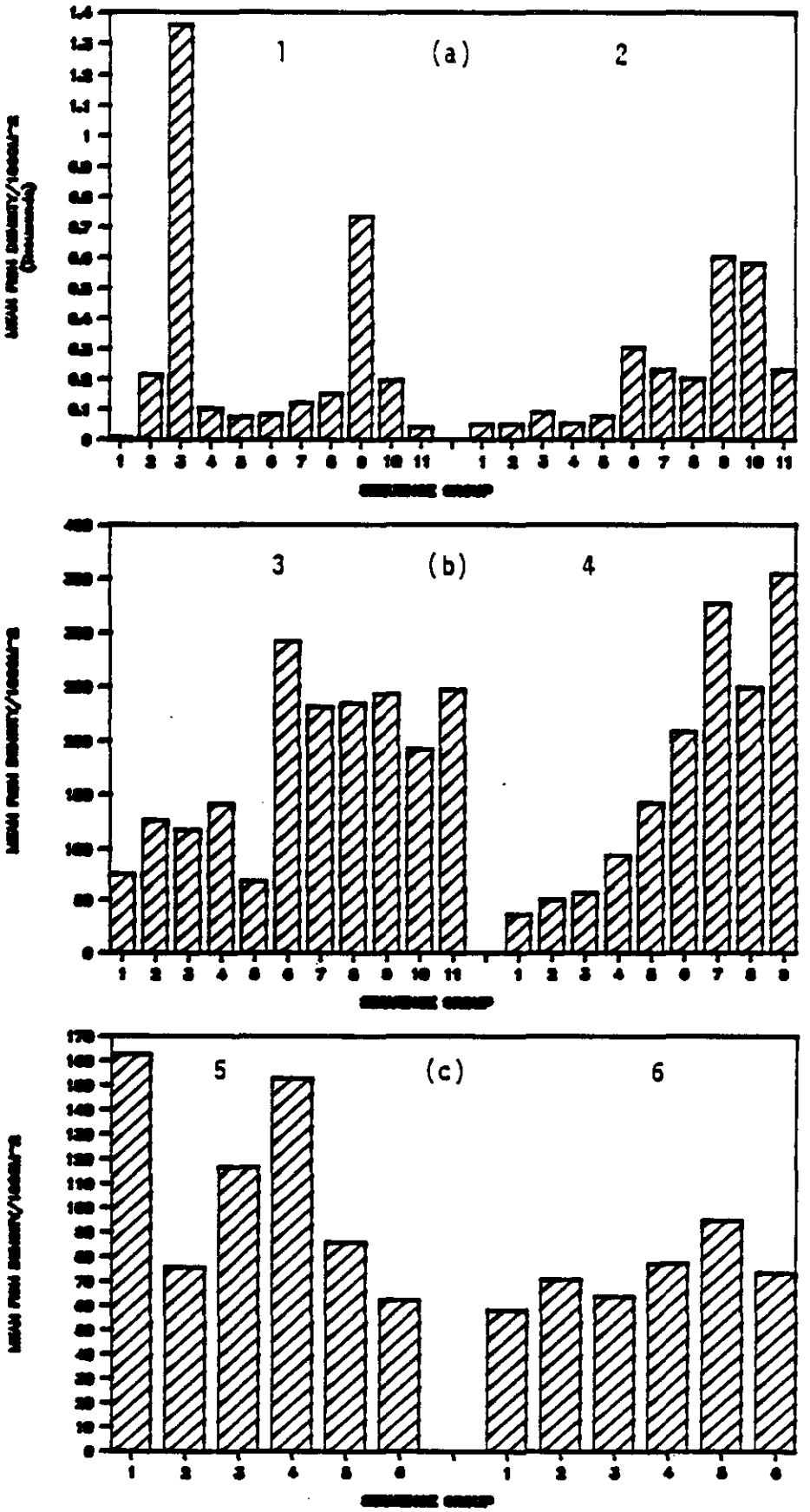


Figure 8. Horizontal fish distribution (mean density/1000m^2) measured in Skilak Lake, Alaska during October 1986: (a) Area 1, Transects 1 and 2; (b) Area 2, Transects 3 and 4; and (c) Area 3, Transects 5 and 6. Sequence group 1 is north shore.

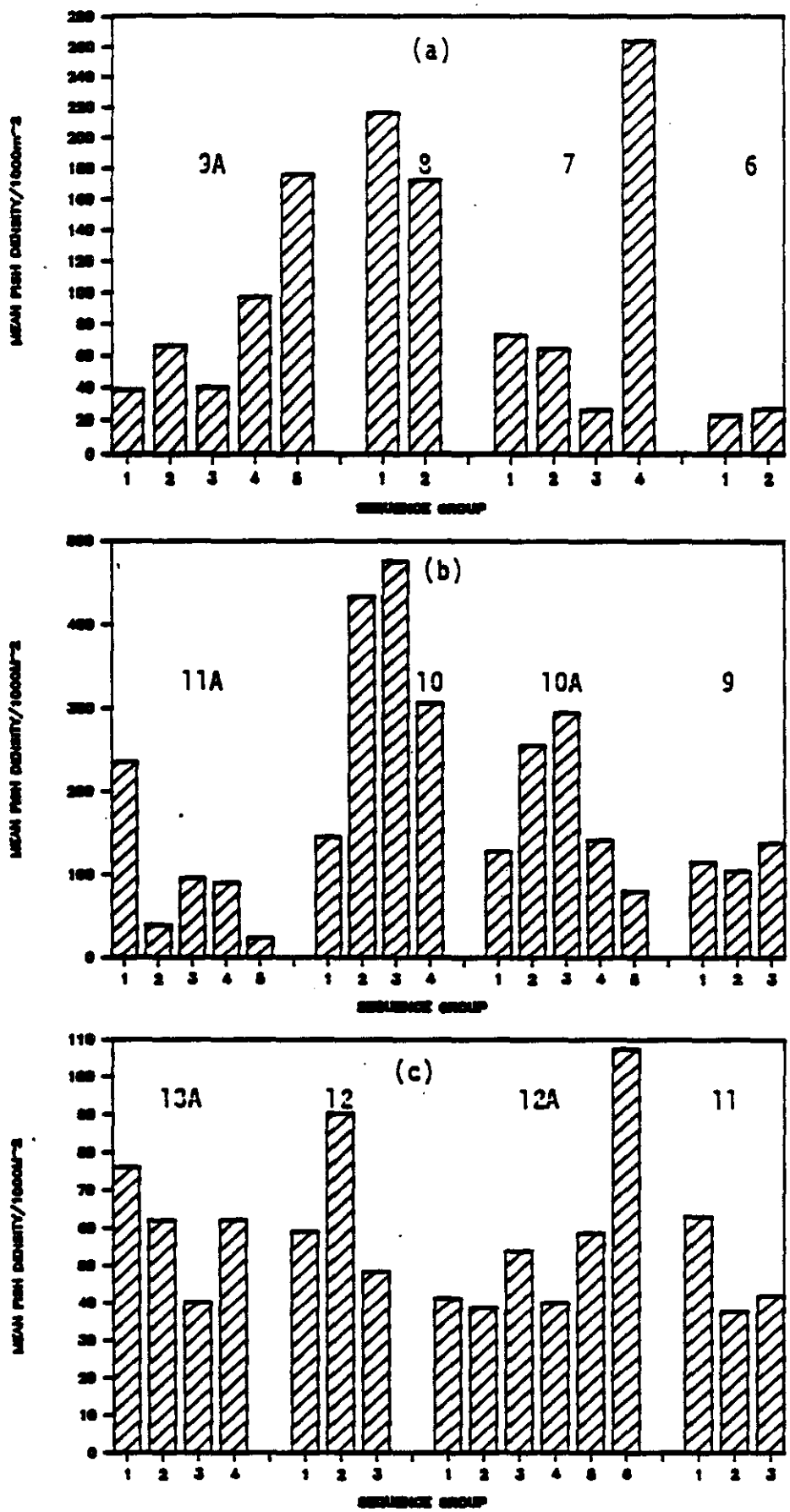


Figure 9. Horizontal fish distribution (mean density/1000m^2) measured in Kenai Lake, Alaska during September 1985: (a) Area 1, Transects 9A, 8, 7, 6; (b) Area 2, Transects 11A, 10, 10A, 9; and (c) Area 3, Transects 13A, 12, 12A, 11. Sequence group 1 is north shore.

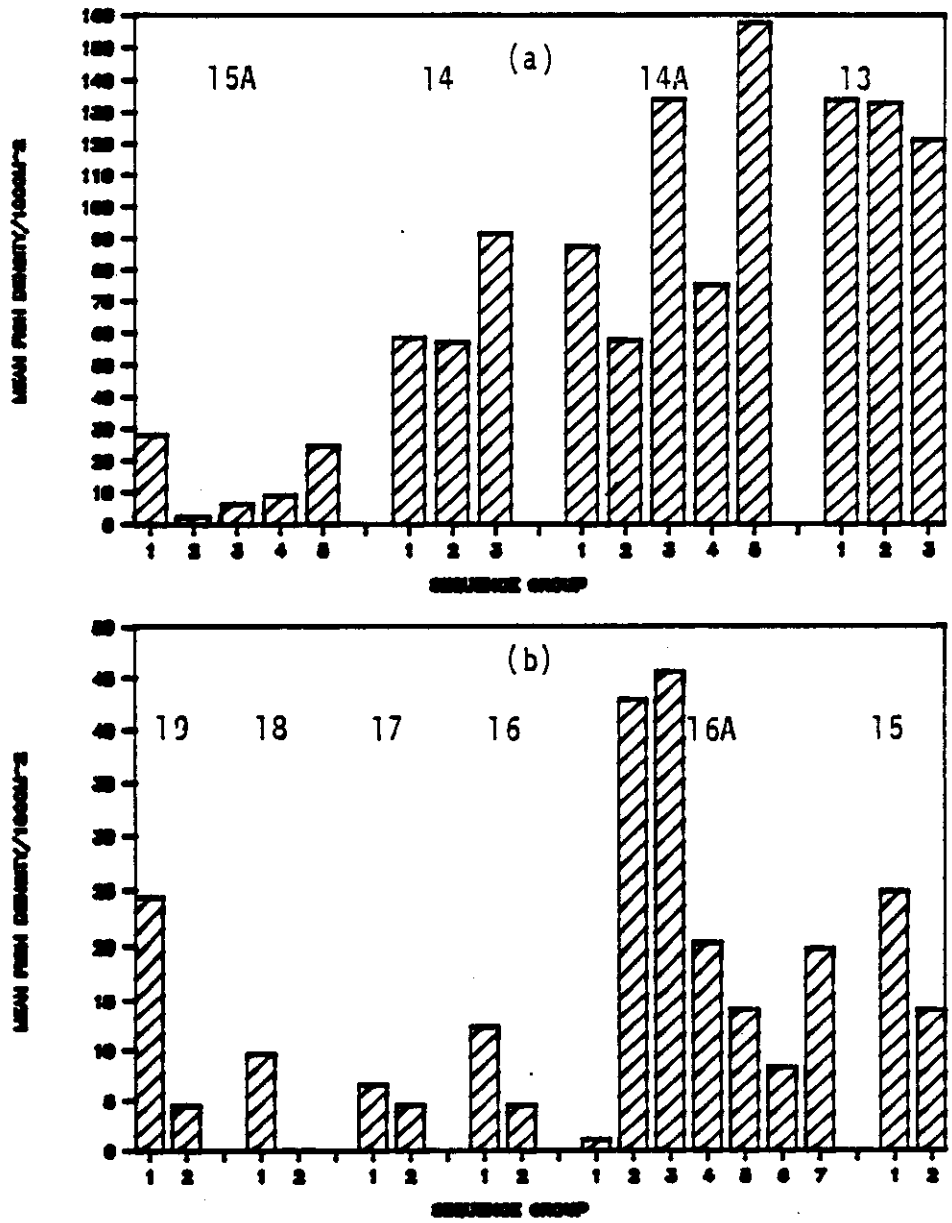


Figure 10. Horizontal fish distribution (mean density/1000m^2) measured in Kenai Lake, Alaska during September 1986: (a) Area 4, Transects 13, 14A, 14, 15A; and (b) Area 5, Transects 15, 16A, 16, 17, 18, 19. Sequence group 1 is north shore.

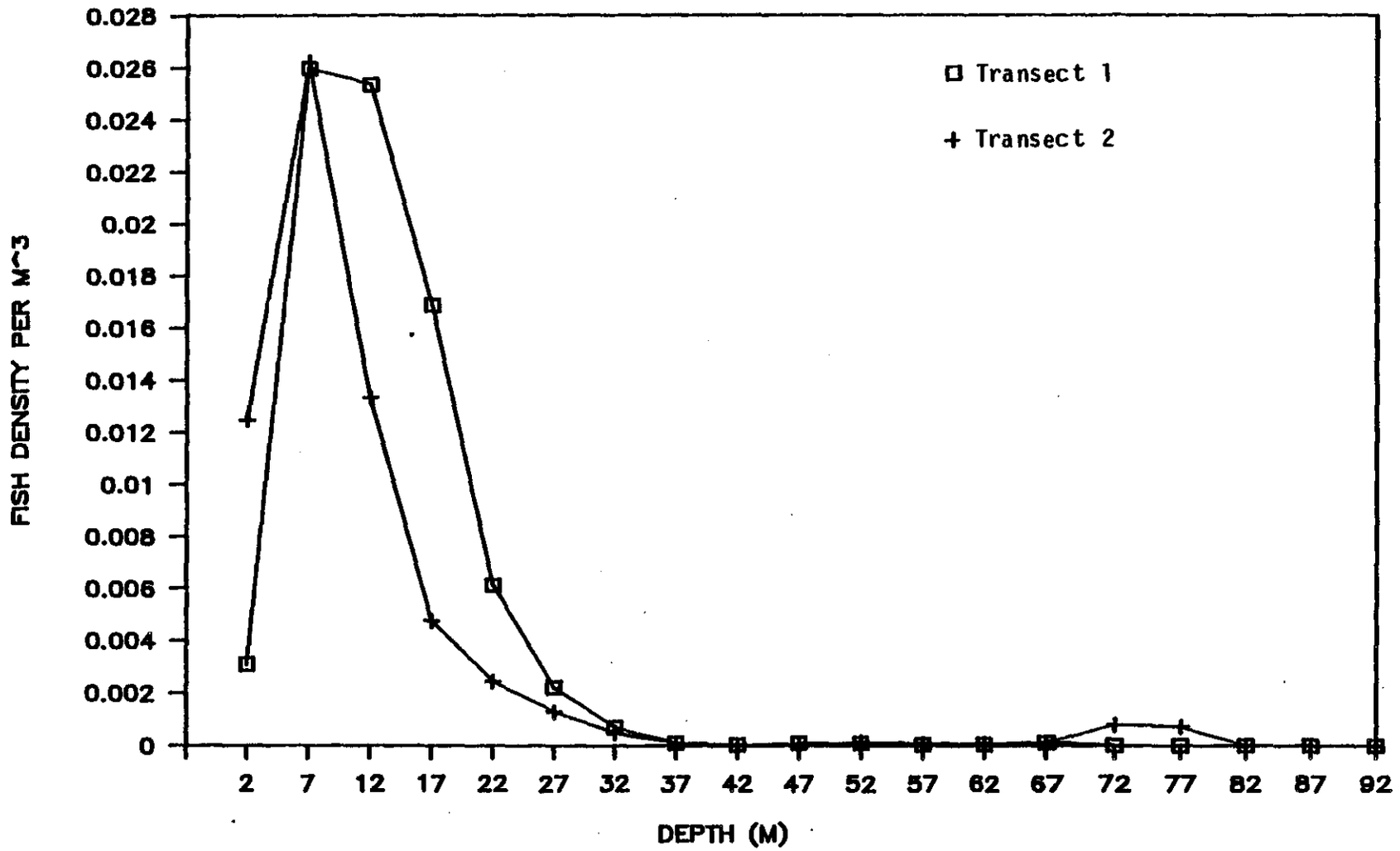


Figure 11. Vertical distribution of fish density measured during the hours of darkness in Skilak Lake, Alaska (Area 1: Transects 1 and 2) in October 1986.

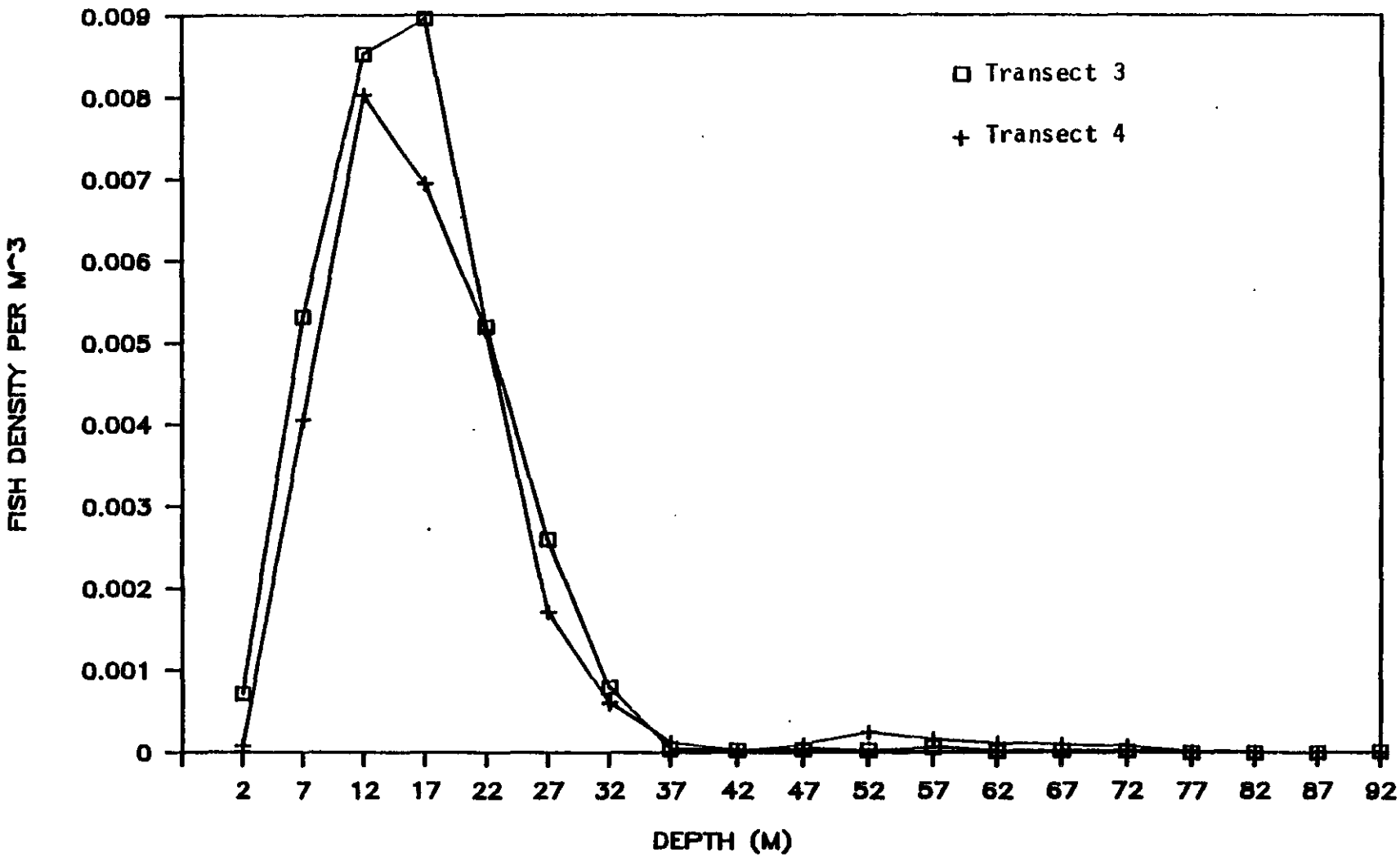


Figure 12. Vertical distribution of fish density measured during the hours of darkness in Skilak Lake, Alaska (Area 2: Transects 3 and 4) in October 1986.

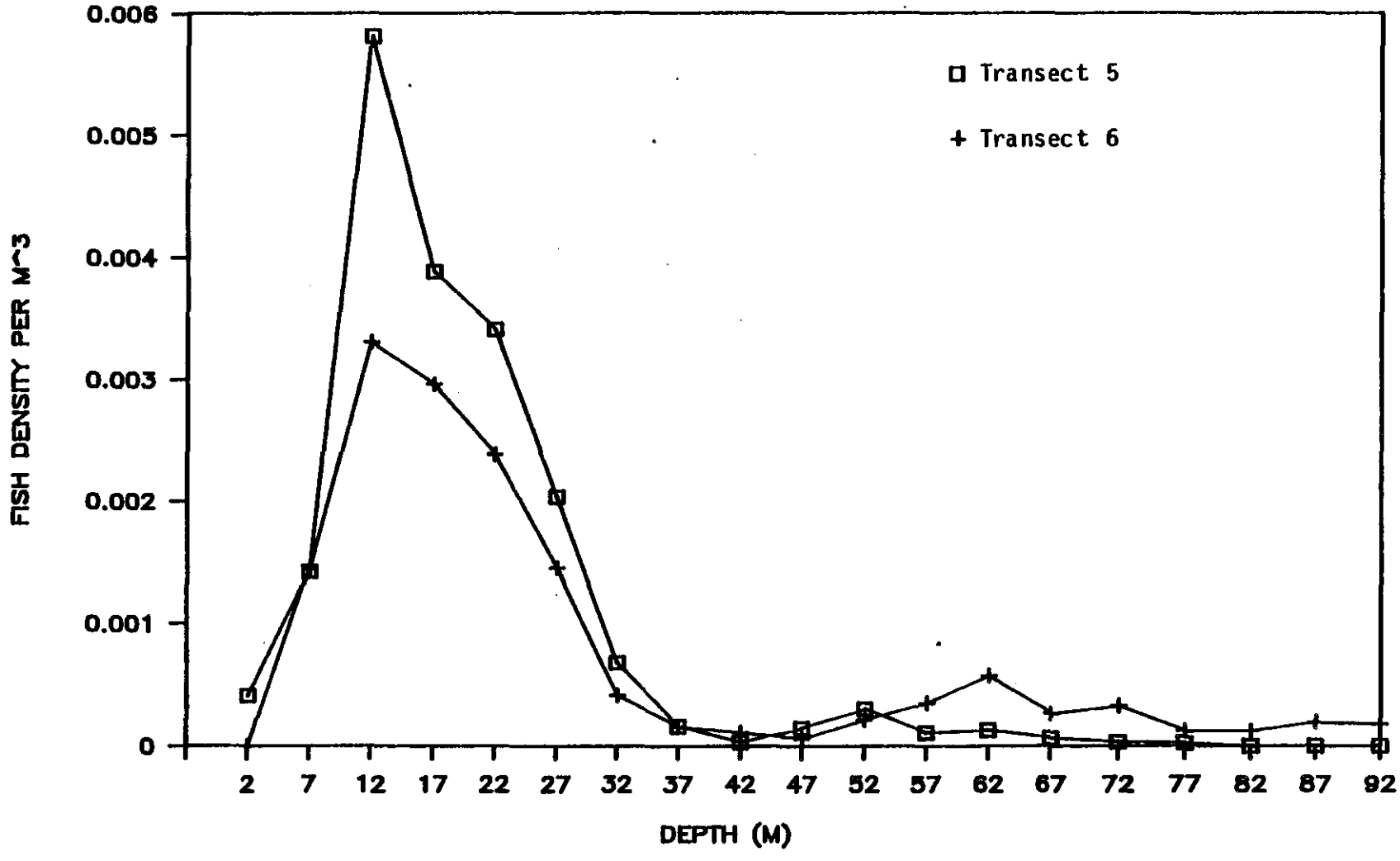


Figure 13. Vertical distribution of fish density measured during the hours of darkness in Skilak Lake, Alaska (Area 3: Transects 5 and 6) in October 1986.

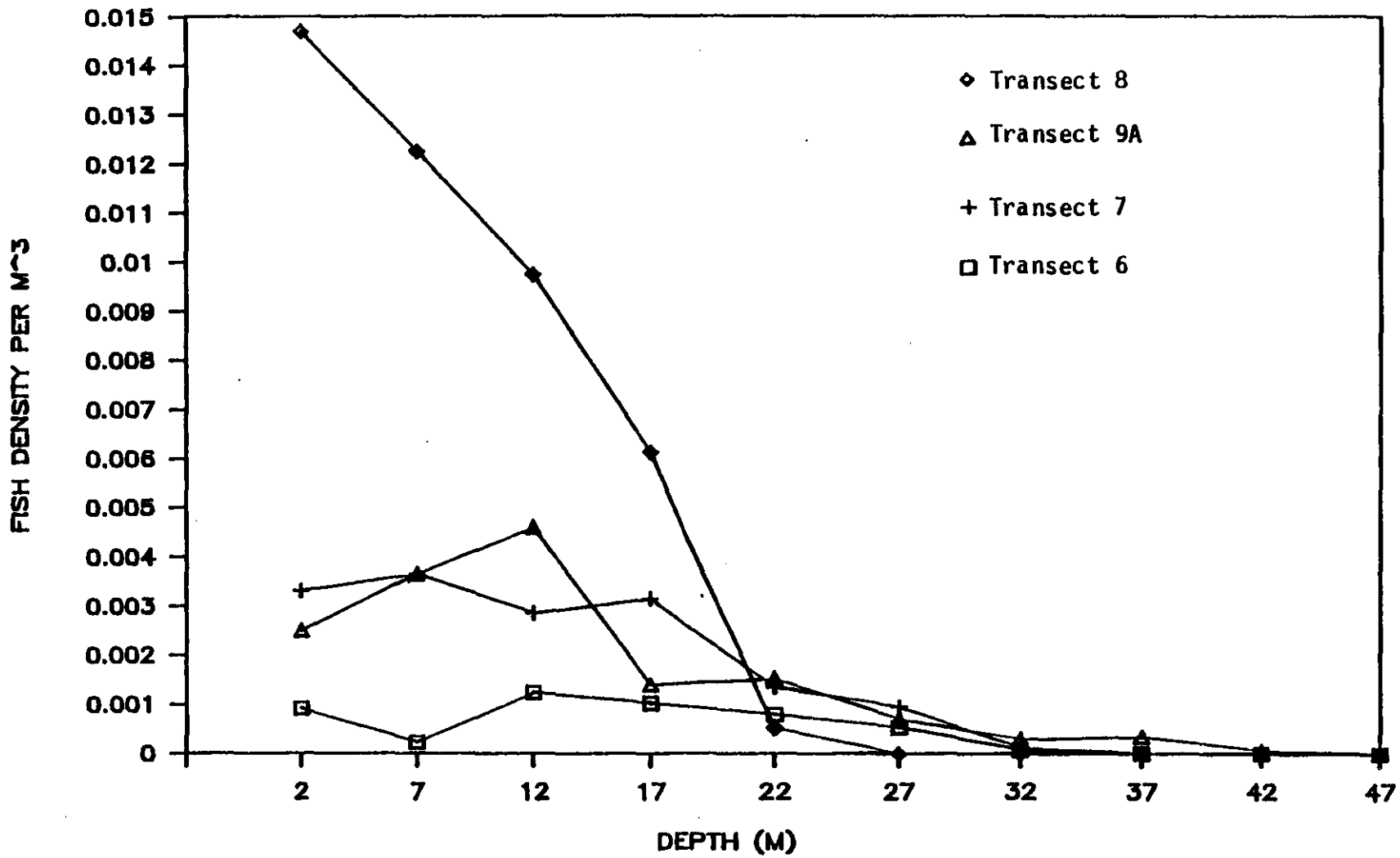


Figure 14. Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 1: Transects 6, 7, 8, 9A) in September 1986.

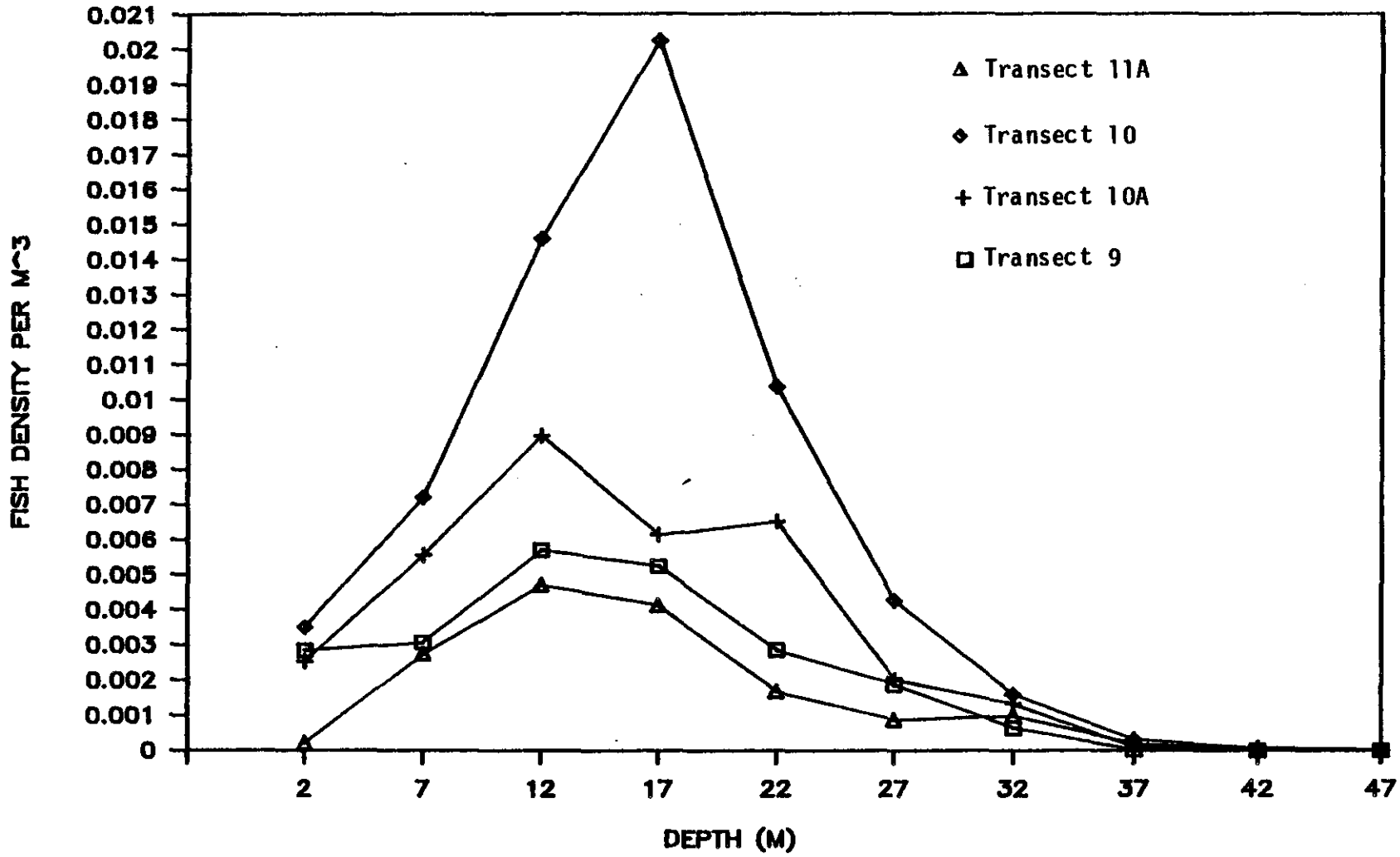


Figure 15. Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 2: Transects 9, 10A, 10, 11A) in September 1986.

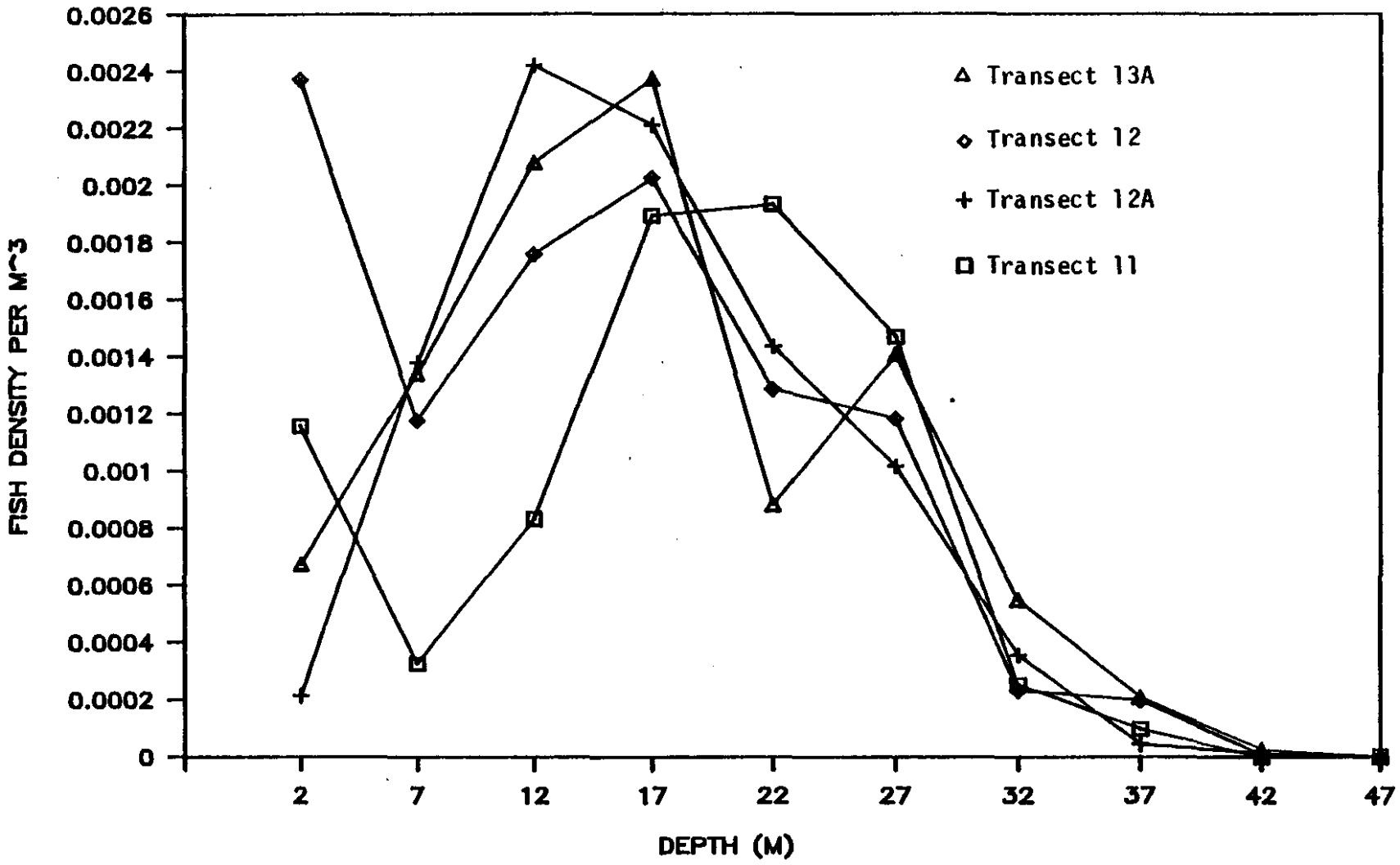


Figure 16. Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 3: Transects 11, 12A, 12, 13A) in September 1986.

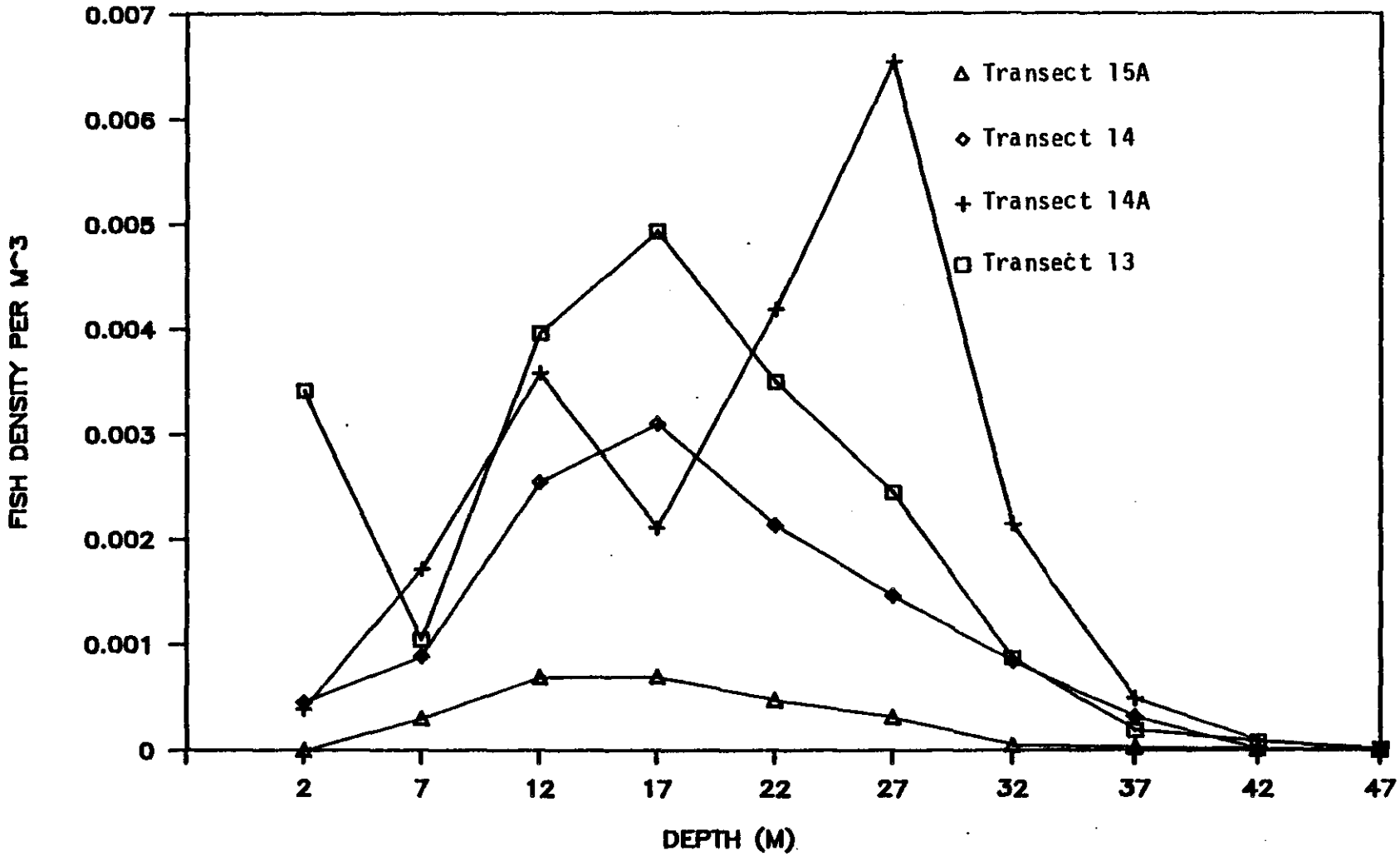


Figure 17. Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 4: Transects 13, 14A, 14, 15A) in September 1986.

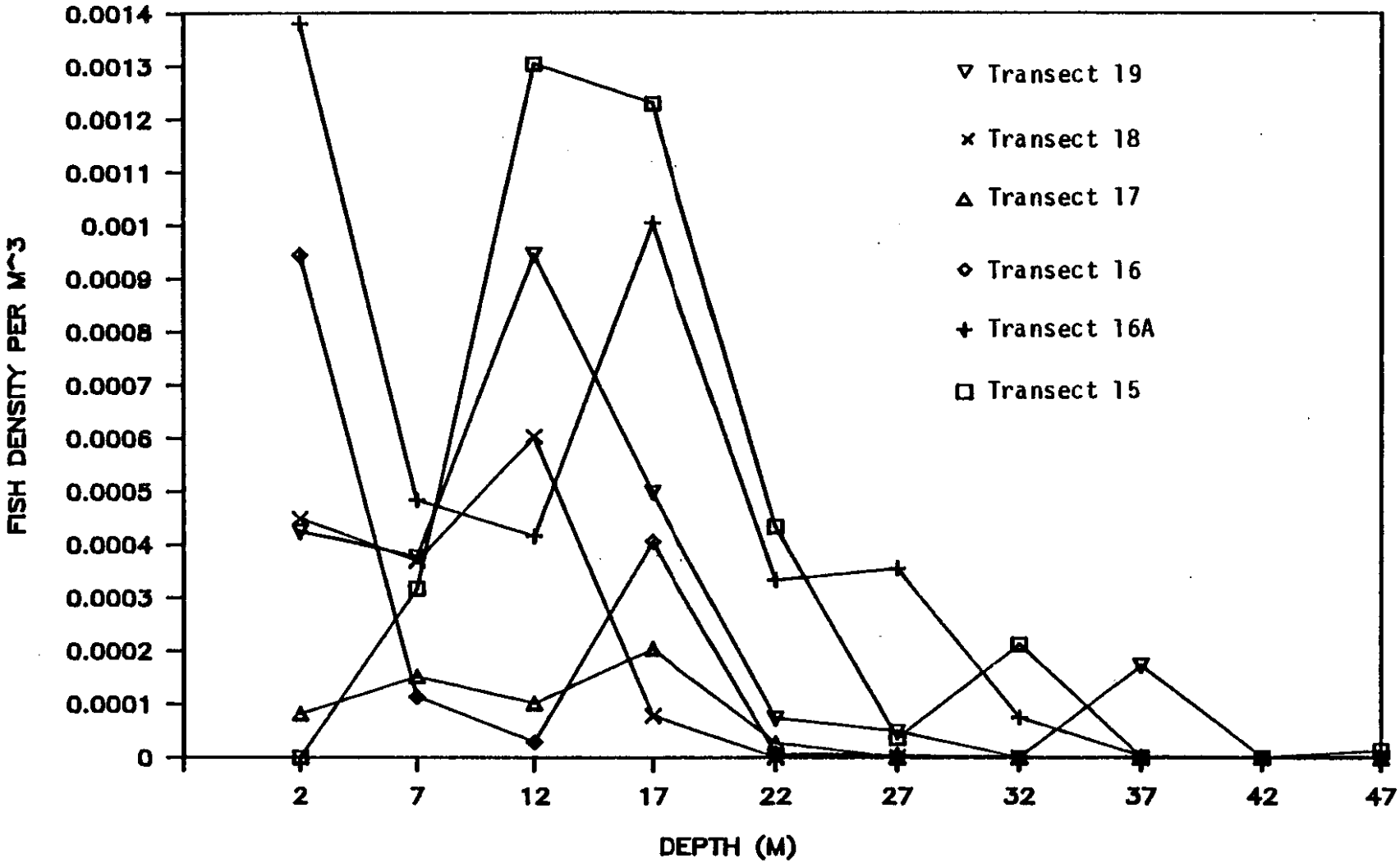


Figure 18. Vertical distribution of fish density measured during the hours of darkness in Kenai Lake, Alaska (Area 5: Transects 15, 16A, 16, 17, 18, 19) in September 1986.

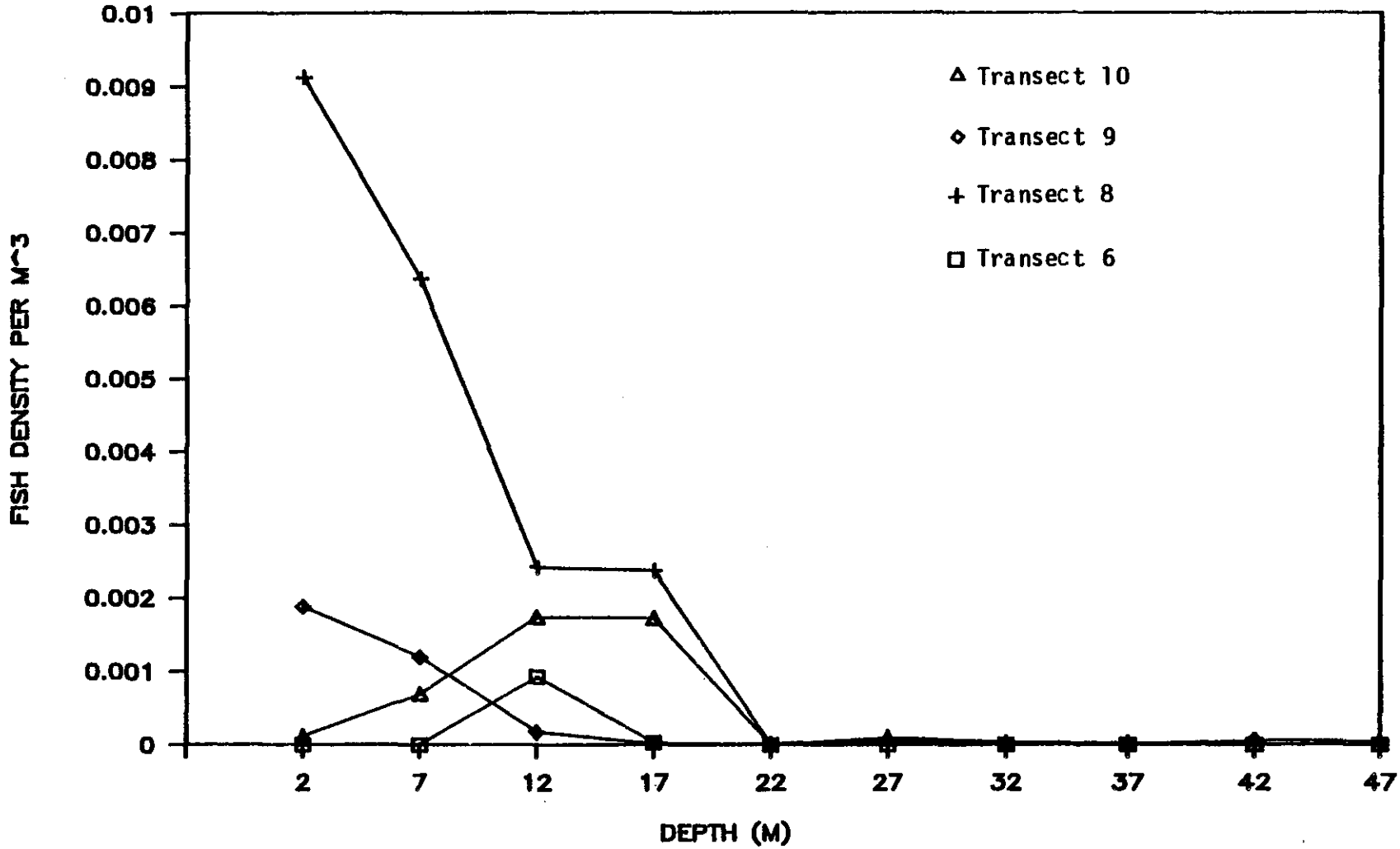


Figure 19. Vertical distribution of fish density measured during the hours of daylight in Kenai Lake, Alaska (Areas 1 and 2: Transects 6, 8, 9, 10) in September 1986.

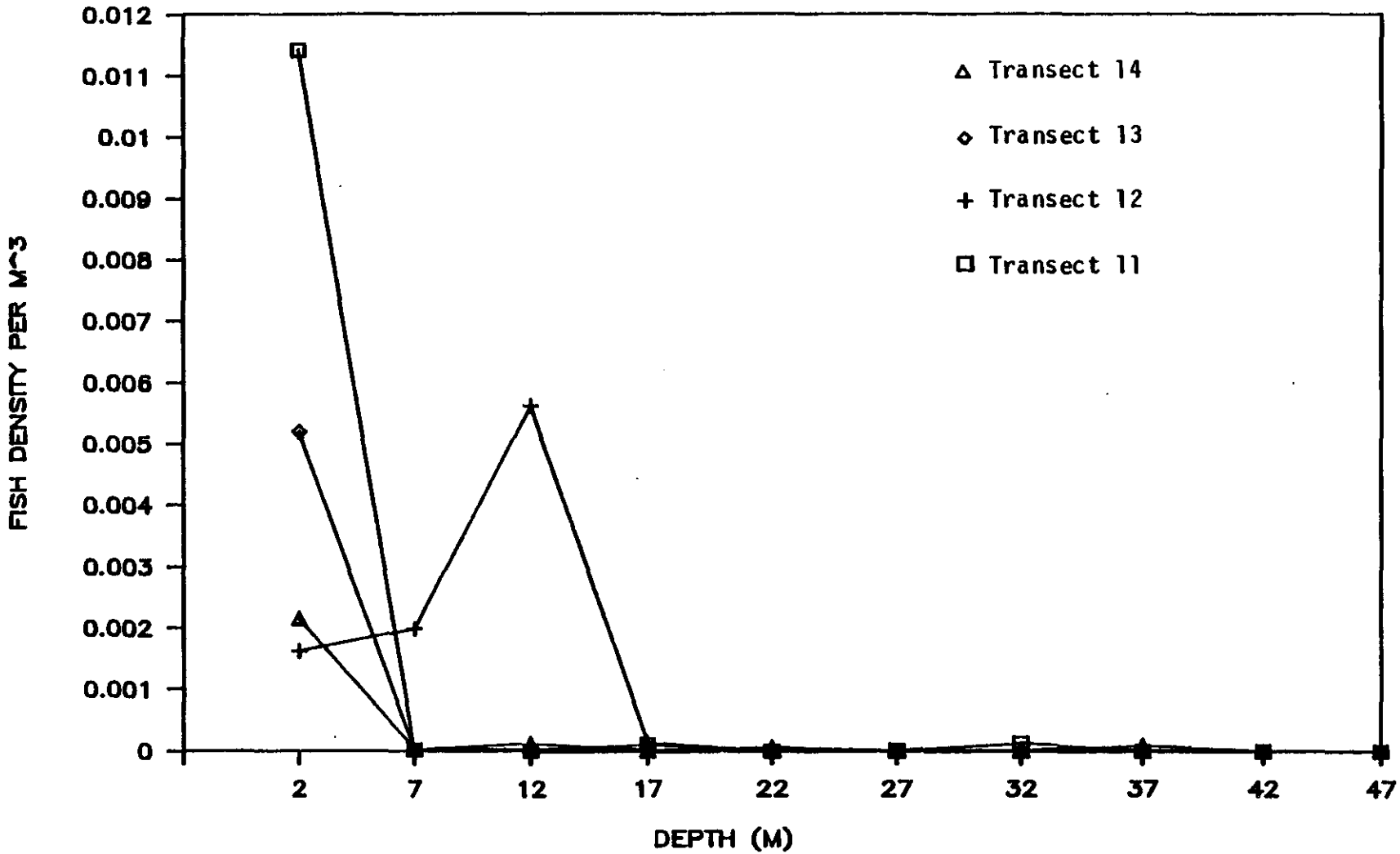


Figure 20. Vertical distribution of fish density measured during the hours of daylight in Kenai Lake, Alaska (Areas 3 and 4: Transects 11, 12, 13, 14) in September 1986.

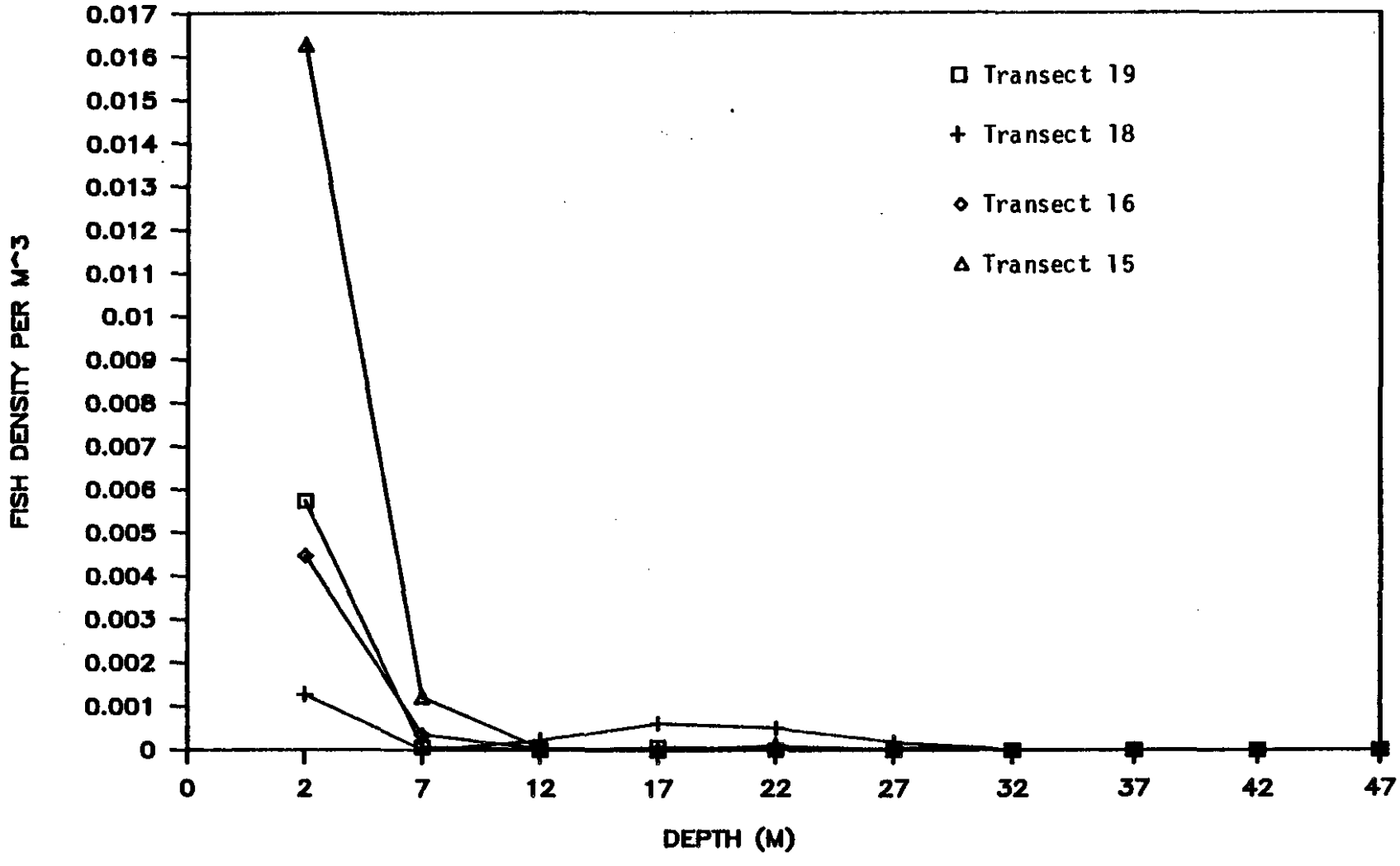


Figure 21. Vertical distribution of fish density measured during the hours of daylight in Kenai Lake, Alaska (Area 5: Transects 15, 16, 18, 19) in September 1986.

Appendix Table 1. Calibration and processing parameters used in collection and analysis of Kenai and Skilak Lakes, Alaska, 1986 hydroacoustic data.

Sounder	Receiving sensitivity (dB/uPa@1m)	Channel 1	40 log R =	-165.7 dB
			20 log R =	-158.1 dB
		Channel 2	40 log R =	-160.6 dB
			20 log R =	-152.6 dB
	Source level (dB/uPa@1m)			216.9 dB
	TVG Crossover			2.7 m
	Receiver gain			-6 dB
Transducer	Beam width	Narrow		6 degree
		Wide		15 degree
	Wide beam dropoff	"A" coefficient		1.186 dB
		"B" coefficient		0.471 dB
	Beam pattern factor	Average squared value	Narrow	0.001121 (-29.5dB)
Dual beam processor	Correction multiplier	Narrow beam		1.000 (0dB)
		Wide beam		0.556 (-5.1dB)
	Threshold	Narrow beam		98 mV (-70dB)
		Wide beam		98 mV (-70dB)
		Bottom		5000 mV (-36dB)
	Beam pattern threshold			(-4.1dB)
	Pulse width criteria	-18 dB	Maximum	.9334 mS
		-6 dB	Minimum	.2667 mS
		-6 dB	Maximum	.5334 mS
	Bottom window			2 meters
	Start depth			2 meters
Echo integrator	B constant value	Depth		
		2.0 - 7.0 m		0.3600
		7.0 - 12.0 m		0.0808
		12.0 - 17.0 m		0.0347
		17.0 - 22.0 m		0.0192
		22.0 - 27.0 m		0.0121
		27.0 - 32.0 m		0.0084
		32.0 - 37.0 m		0.0061
		37.0 - 42.0 m		0.0047
		42.0 - 47.0 m		0.0037
		47.0 - 72.0 m		0.0021

Appendix Table 2. Average backscattering cross section (sigma) and target strength data by depth strata for all transects combined, Kenai Lake, Alaska, 1986.

Depth Stratum (m)	Number of Targets	Sigma Mean	Sigma Standard Deviation	Target[1] Strength Mean (dB)	Target Strength Standard Deviation (dB)
2.0 - 7.0	177	1.050E-05	1.061E-05	-52.34	5.19
7.0 - 12.0	1258	1.115E-05	4.339E-05	-53.38	5.42
12.0 - 17.0	3306	6.476E-06	8.420E-06	-54.56	5.08
17.0 - 22.0	4648	5.261E-06	5.994E-06	-55.22	4.85
22.0 - 27.0	4383	4.486E-06	4.258E-06	-55.61	4.59
27.0 - 32.0	3789	4.100E-06	3.595E-06	-55.77	4.40
32.0 - 37.0	2695	3.724E-06	3.805E-06	-56.11	4.23
37.0 - 42.0	1101	3.460E-06	2.998E-06	-56.28	4.04
42.0 - 47.0	195	2.970E-06	2.089E-06	-56.57	3.66
47.0 - 72.0	57	1.969E-06	1.593E-06	-58.24	3.20
Total	21519	5.166E-06	1.188E-05	-55.35	4.74

[1] Target strength determined from dual beam data collected in situ.

Appendix Table 3. Average backscattering cross section (sigma) and target strength data by depth strata for all transects combined, Skilak Lake, Alaska, 1986.

Depth Stratum (m)	Number of Targets	Sigma Mean	Sigma Standard Deviation	Target[1] Strength Mean (dB)	Target Strength Standard Deviation (dB)
2.0 - 7.0	705	2.185E-05	1.310E-04	-50.63	5.23
7.0 - 12.0	2795	1.155E-05	1.228E-05	-51.77	5.02
12.0 - 17.0	4183	8.050E-06	8.370E-06	-53.20	4.80
17.0 - 22.0	4820	6.602E-06	6.190E-06	-53.90	4.67
22.0 - 27.0	4245	5.853E-06	6.096E-06	-54.32	4.45
27.0 - 32.0	3070	5.029E-06	4.378E-06	-54.71	4.21
32.0 - 37.0	1311	4.358E-06	3.863E-06	-55.18	4.01
37.0 - 42.0	274	4.368E-06	4.146E-06	-55.42	4.17
42.0 - 47.0	195	7.260E-06	1.518E-05	-55.05	5.31
47.0 - 72.0	3555	6.530E-06	3.119E-05	-54.37	4.23
Total	25157	7.354E-06	2.598E-05	-53.78	4.69

[1] Target strength determined from dual beam data collected in situ.

Appendix Table 4. Summary of analysis of variance of target strength data by depth strata for Kenai and Skilak Lakes, Alaska, 1986.[1]

Lake	Transect Number	Sample Size (N)	Number Strata (k)	Degrees of Freedom Groups	Degrees of Freedom Error	Calculated F Value	Table F Value	Degrees of Freedom Groups	Degrees of Freedom Error	Null Hypothesis
Kenai	19	135	6	5	129	4.42	2.29	5	125	reject
	18	28	3	2	25	4.51	3.38	2	25	reject
	17	48	4	3	44	2.57	2.82	3	44	accept
	16	46	6	5	40	1.71	2.45	5	40	accept
	16A	332	6	5	326	5.21	2.23	5	400	reject
	15	88	6	5	82	1.15	2.30	5	100	accept
	15A	303	7	6	296	5.23	2.13	6	300	reject
	14	662	7	6	655	6.58	2.10	6	1000	reject
	14A	2307	8	7	2299	14.38	2.01	7	infinity	reject
	13	1525	7	6	1518	8.89	2.09	6	infinity	reject
	13A	913	7	6	906	3.71	2.10	6	1000	reject
	12	381	9	8	372	6.81	1.96	8	400	reject
	12A	1360	7	6	1353	6.83	2.09	6	infinity	reject
	11	536	7	6	529	0.77	2.10	6	1000	accept
	11A	1736	7	6	1729	9.12	2.09	6	infinity	reject
	10	3229	7	6	3222	5.98	2.09	6	infinity	reject
	10A	3065	7	6	3058	6.47	2.09	6	infinity	reject
	9	1172	6	5	1166	12.18	2.09	6	infinity	reject
	9A	1460	7	6	1453	20.83	2.09	6	infinity	reject
	8	545	4	3	541	19.30	2.61	3	infinity	reject
	7	1403	5	4	1398	32.81	2.37	4	infinity	reject
	6	222	5	4	217	5.49	2.41	4	200	reject
Skilak	1	6240	10	9	6230	28.67	1.88	9	infinity	reject
	2	4156	10	9	4146	41.22	1.88	9	infinity	reject
	3	5690	10	9	5680	30.10	1.88	9	infinity	reject
	4	4547	10	9	4537	13.18	1.88	9	infinity	reject
	5	2344	10	9	2334	5.84	1.88	9	infinity	reject
	6	2132	10	9	2122	6.55	1.88	9	infinity	reject

[1] Sample size represents the number of echoes processed. Alpha is at 0.05 level.

Appendix Table 5. Hydroacoustic estimate of fish inhabiting Area 1, Skilak Lake, Alaska based on Transect 1 integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	1.8370E+08	4.4400E-05	181	2.5680E-04	5.8070E+01	5.3760E-05	53	2.2010E-10	3.1220E-03	5.7356E+05	8.5850E+10	5.7430E+05
7.0 - 12.0	1.5650E+08	1.0270E-05	1002	1.0830E-05	2.5100E+02	1.0350E-04	41	5.6130E-10	2.5980E-02	4.0658E+06	8.8450E+11	1.8430E+06
12.0 - 17.0	1.4150E+08	7.9000E-06	1694	8.7870E-06	3.2640E+02	7.7760E-05	38	3.6810E-10	2.5380E-02	3.5906E+06	7.9420E+11	1.7470E+06
17.0 - 22.0	1.1920E+08	7.0520E-06	1431	6.6980E-06	3.6560E+02	4.6180E-05	34	1.7220E-10	1.6890E-02	2.0125E+06	3.2960E+11	1.1250E+06
22.0 - 27.0	9.6650E+07	6.0220E-06	743	5.7650E-06	4.2810E+02	1.4320E-05	26	1.5360E-11	6.1330E-03	5.9271E+05	2.6730E+10	3.2040E+05
27.0 - 32.0	9.1260E+07	5.5520E-06	448	5.1520E-06	4.6440E+02	4.8190E-06	23	4.0180E-13	2.2380E-03	2.0422E+05	8.0170E+08	5.5500E+04
32.0 - 37.0	8.8340E+07	4.7210E-06	226	3.8010E-06	5.4610E+02	1.2910E-06	23	9.3610E-14	7.0520E-04	6.2300E+04	2.2900E+08	2.9660E+04
37.0 - 42.0	8.5450E+07	4.3680E-06	274	4.1460E-06	5.9020E+02	2.2290E-07	22	1.0880E-14	1.3160E-04	1.1241E+04	2.8090E+07	1.0390E+04
42.0 - 47.0	8.2590E+07	7.2600E-06	195	1.5180E-05	3.5510E+02	1.3290E-07	21	7.0390E-15	4.7200E-05	3.8980E+03	6.3960E+06	4.9570E+03
47.0 - 52.0	7.9230E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	2.2620E-07	21	2.6390E-14	1.2400E-04	9.8250E+03	5.0330E+07	1.3910E+04
52.0 - 57.0	7.5860E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	1.9550E-07	20	5.3270E-15	1.0720E-04	8.1309E+03	9.5870E+06	6.0690E+03
57.0 - 62.0	7.2790E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	1.0920E-07	19	3.2330E-15	5.9850E-05	4.3567E+03	5.2560E+06	4.4940E+03
62.0 - 67.0	6.9310E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	1.0400E-07	19	1.5220E-15	5.7050E-05	3.9542E+03	2.2860E+06	2.9630E+03
67.0 - 72.0	6.4170E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	2.5480E-07	18	7.6930E-15	1.3970E-04	8.9653E+03	9.9730E+06	6.1900E+03
72.0 - 77.0	5.9420E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	7.0780E-08	17	1.0310E-15	3.8810E-05	2.3062E+03	1.1240E+06	2.0780E+03
77.0 - 82.0	4.7960E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	3.2890E-08	15	1.7300E-16	1.8040E-05	8.6507E+02	1.2390E+05	6.8980E+02
82.0 - 87.0	2.3890E+07	4.7020E-06	426	7.2550E-06	5.4830E+02	6.3220E-08	9	3.6410E-15	3.4670E-05	8.2806E+02	6.2840E+05	1.5540E+03
87.0 - 92.0	2.1440E+06	4.7020E-06	426	7.2550E-06	5.4830E+02	1.9370E-08	5	3.7540E-16	1.0620E-05	2.2775E+01	5.2160E+02	4.4760E+01
92.0 - 97.0	0.0000E+00	4.7020E-06	426	7.2550E-06	5.4830E+02	0.0000E+00	0	1	0	0	0	0
TOTAL	1.5400E+09									1.1156E+07	+ OR -	2.8550E+06

[1] Lake surface area (meters squared) used to calculate stratum volume was 4.3030E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 6. Hydroacoustic estimate of fish inhabiting Area 1, Skilak Lake, Alaska based on Transect 2 integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	1.9460E+08	1.4170E-05	478	1.3610E-05	1.8190E+02	6.8620E-05	55	5.0660E-10	1.2490E-02	2.4294E+06	6.4630E+11	1.5760E+06
7.0 - 12.0	1.4840E+08	1.2660E-05	1245	1.3780E-05	2.0370E+02	1.2880E-04	50	7.2130E-10	2.6220E-02	3.8918E+06	6.7320E+11	1.6080E+06
12.0 - 17.0	1.0500E+08	9.3640E-06	713	1.0030E-05	2.7530E+02	4.8460E-05	33	1.9380E-10	1.3340E-02	1.4013E+06	1.6520E+11	7.9670E+05
17.0 - 22.0	9.1270E+07	6.8430E-06	474	6.5000E-06	3.7680E+02	1.2680E-05	26	8.1120E-12	4.7780E-03	4.3608E+05	9.9550E+09	1.9560E+05
22.0 - 27.0	8.2320E+07	7.1640E-06	390	6.3820E-06	3.5990E+02	6.8440E-06	23	9.3120E-13	2.4630E-03	2.0275E+05	9.0080E+08	5.8830E+04
27.0 - 32.0	7.3770E+07	5.1060E-06	271	4.3270E-06	5.0490E+02	2.5920E-06	21	5.2210E-13	1.3090E-03	9.6552E+04	7.4900E+08	5.3640E+04
32.0 - 37.0	7.1200E+07	4.3580E-06	1311	3.8630E-06	5.9160E+02	8.5680E-07	20	8.2630E-14	5.0690E-04	3.6091E+04	1.4740E+08	2.3790E+04
37.0 - 42.0	6.9930E+07	4.3680E-06	274	4.1460E-06	5.9020E+02	1.9030E-07	20	1.1270E-14	1.1230E-04	7.8543E+03	1.9410E+07	8.6350E+03
42.0 - 47.0	6.9200E+07	7.2600E-06	195	1.5180E-05	3.5510E+02	6.6220E-08	20	3.3400E-15	2.3520E-05	1.6275E+03	2.0770E+06	2.8240E+03
47.0 - 52.0	6.8530E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	9.0250E-08	19	4.1440E-15	4.4470E-05	3.0477E+03	4.7490E+06	4.2710E+03
52.0 - 57.0	6.7790E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	3.1690E-07	19	4.5010E-14	1.5610E-04	1.0585E+04	5.0510E+07	1.3930E+04
57.0 - 62.0	6.7080E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	2.3250E-07	19	1.4030E-14	1.1460E-04	7.6870E+03	1.5480E+07	7.7110E+03
62.0 - 67.0	6.6440E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	1.9570E-07	19	6.5890E-15	9.6430E-05	6.4067E+03	7.1640E+06	5.2460E+03
67.0 - 72.0	6.5560E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	3.2460E-07	18	1.9370E-14	1.6000E-04	1.0486E+04	2.0490E+07	8.8730E+03
72.0 - 77.0	6.3880E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	1.7000E-06	18	2.1850E-12	8.3780E-04	5.3522E+04	2.1720E+09	9.1350E+04
77.0 - 82.0	6.2670E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	1.5050E-06	18	2.0100E-12	7.4160E-04	4.6480E+04	1.9230E+09	8.5940E+04
82.0 - 87.0	6.0980E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	1.6830E-08	18	1.5660E-16	8.2950E-06	5.0582E+02	1.4210E+05	7.3880E+02
87.0 - 92.0	5.9220E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	5.3350E-09	17	1.2850E-17	2.6290E-06	1.5568E+02	1.1000E+04	2.0560E+02
92.0 - 97.0	5.8300E+07	5.2320E-06	440	5.4750E-06	4.9280E+02	8.2620E-10	17	6.8260E-19	4.0710E-07	2.3734E+01	5.6470E+02	4.6580E+01
TOTAL	1.5460E+09									8.6424E+06	+ OR -	2.4010E+06

[1] Lake surface area (meters squared) used to calculate stratum volume was 4.3030E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 7. Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska based on Transect 3 integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	1.6660E+08	2.1850E-05	705	1.3100E-04	1.1800E+02	6.0650E-06	56	2.6680E-12	7.1560E-04	1.1921E+05	1.7560E+09	8.2120E+04
7.0 - 12.0	1.6630E+08	1.2580E-05	282	1.0230E-05	2.0490E+02	2.5960E-05	56	7.5280E-12	5.3200E-03	8.8456E+05	1.0580E+10	2.0160E+05
12.0 - 17.0	1.6590E+08	8.5290E-06	754	7.5310E-06	3.0230E+02	2.8220E-05	56	1.0040E-11	8.5310E-03	1.4154E+06	2.7330E+10	3.2400E+05
17.0 - 22.0	1.6530E+08	6.6850E-06	1260	6.0340E-06	3.8570E+02	2.3250E-05	56	6.7690E-12	8.9660E-03	1.4823E+06	2.8940E+10	3.3340E+05
22.0 - 27.0	1.6420E+08	6.0360E-06	1311	5.8810E-06	4.2710E+02	1.2170E-05	55	2.0930E-12	5.1970E-03	8.5318E+05	1.0820E+10	2.0390E+05
27.0 - 32.0	1.6250E+08	5.3090E-06	1085	4.4770E-06	4.8560E+02	5.3510E-06	55	4.7200E-13	2.5990E-03	4.2237E+05	3.0580E+09	1.0840E+05
32.0 - 37.0	1.6020E+08	5.0770E-06	527	4.6850E-06	5.0780E+02	1.5630E-06	54	3.8680E-14	7.9380E-04	1.2717E+05	2.8220E+08	3.2920E+04
37.0 - 42.0	1.5640E+08	4.3680E-06	274	4.1460E-06	5.9020E+02	7.3450E-08	53	9.0890E-16	4.3360E-05	6.7796E+03	7.8940E+06	5.5070E+03
42.0 - 47.0	1.5460E+08	7.2600E-06	195	1.5180E-05	3.5510E+02	8.1410E-08	52	1.7710E-15	2.8910E-05	4.4690E+03	5.7850E+06	4.7140E+03
47.0 - 52.0	1.5330E+08	1.3290E-05	382	9.1650E-05	1.9400E+02	2.4210E-07	51	1.4450E-14	4.6970E-05	7.1995E+03	1.9230E+07	8.5950E+03
52.0 - 57.0	1.5160E+08	1.3290E-05	382	9.1650E-05	1.9400E+02	1.5450E-07	51	3.6460E-15	2.9970E-05	4.5435E+03	5.7250E+06	4.6900E+03
57.0 - 62.0	1.4840E+08	1.3290E-05	382	9.1650E-05	1.9400E+02	3.3340E-07	50	4.7150E-14	6.4680E-05	9.5995E+03	5.0560E+07	1.3940E+04
62.0 - 67.0	1.4150E+08	1.3290E-05	382	9.1650E-05	1.9400E+02	1.0570E-07	49	2.3860E-15	2.0510E-05	2.9007E+03	2.8440E+06	3.3050E+03
67.0 - 72.0	1.2970E+08	1.3290E-05	382	9.1650E-05	1.9400E+02	1.3750E-07	48	2.1520E-15	2.6680E-05	3.4611E+03	2.8540E+06	3.3110E+03
72.0 - 77.0	1.1380E+08	1.3290E-05	382	9.1650E-05	1.9400E+02	9.5730E-08	45	1.2740E-15	1.8570E-05	2.1127E+03	1.1760E+06	2.1260E+03
77.0 - 82.0	8.8760E+07	1.3290E-05	382	9.1650E-05	1.9400E+02	3.7570E-08	41	5.1180E-16	7.2890E-06	6.4699E+02	2.0390E+05	8.8490E+02
82.0 - 87.0	8.2760E+07	1.3290E-05	382	9.1650E-05	1.9400E+02	9.7810E-09	33	4.0600E-17	1.8970E-06	1.5703E+02	1.3540E+04	2.2800E+02
87.0 - 92.0	8.1230E+07	1.3290E-05	382	9.1650E-05	1.9400E+02	1.0390E-08	32	5.9880E-17	2.0160E-06	1.6377E+02	1.8210E+04	2.6450E+02
92.0 - 97.0	7.9000E+07	1.3290E-05	382	9.1650E-05	1.9400E+02	8.9900E-08	32	4.6000E-15	1.7440E-05	1.3779E+03	1.3170E+06	2.2490E+03
TOTAL	2.6321E+09									5.3476E+06	+ OR -	5.6420E+06

[1] Lake surface area (meters squared) used to calculate stratum volume was 3.3460E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 8. Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska based on Transect 4 integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	1.6710E+08	2.1850E-05	705	1.3100E-04	1.1800E+02	6.9740E-07	42	1.0340E-13	8.2290E-05	1.3751E+04	4.9840E+07	1.3840E+04
7.0 - 12.0	1.6650E+08	9.9770E-06	163	1.1770E-05	2.5840E+02	1.5710E-05	42	9.4200E-12	4.0610E-03	6.7609E+05	2.1340E+10	2.8630E+05
12.0 - 17.0	1.6480E+08	7.0430E-06	596	6.7630E-06	3.6610E+02	2.1930E-05	41	1.2220E-11	8.0270E-03	1.3228E+06	4.7180E+10	4.2570E+05
17.0 - 22.0	1.6220E+08	6.4760E-06	945	6.0930E-06	3.9810E+02	1.7450E-05	41	6.7500E-12	6.9480E-03	1.1270E+06	2.9340E+10	3.3570E+05
22.0 - 27.0	1.6070E+08	5.3250E-06	985	4.5850E-06	4.8420E+02	1.0640E-05	41	2.9650E-12	5.1520E-03	8.2806E+05	1.8470E+10	2.6640E+05
27.0 - 32.0	1.5960E+08	4.8320E-06	672	4.0300E-06	5.3360E+02	3.2150E-06	41	3.7680E-13	1.7150E-03	2.7382E+05	2.8120E+09	1.0390E+05
32.0 - 37.0	1.5870E+08	3.1990E-06	257	2.3040E-06	8.0590E+02	7.5520E-07	41	2.3460E-14	6.0870E-04	9.6581E+04	4.0260E+08	3.9320E+04
37.0 - 42.0	1.5760E+08	4.3680E-06	274	4.1460E-06	5.9020E+02	2.2560E-07	41	1.1500E-14	1.3320E-04	2.0985E+04	1.0100E+08	1.9700E+04
42.0 - 47.0	1.5650E+08	7.2600E-06	195	1.5180E-05	3.5510E+02	5.5600E-08	41	2.1410E-15	1.9740E-05	3.0893E+03	6.8240E+06	5.1200E+03
47.0 - 52.0	1.5540E+08	5.0600E-06	818	4.4110E-06	5.0950E+02	2.0350E-07	40	1.7690E-14	1.0370E-04	1.6117E+04	1.1120E+08	2.0670E+04
52.0 - 57.0	1.5440E+08	5.0600E-06	818	4.4110E-06	5.0950E+02	4.9610E-07	39	1.1070E-13	2.5280E-04	3.9024E+04	6.8640E+08	5.1350E+04
57.0 - 62.0	1.5170E+08	5.0600E-06	818	4.4110E-06	5.0950E+02	3.1430E-07	39	5.5870E-15	1.6010E-04	2.4298E+04	3.3950E+07	1.1420E+04
62.0 - 67.0	1.4370E+08	5.0600E-06	818	4.4110E-06	5.0950E+02	2.2940E-07	39	1.0360E-14	1.1690E-04	1.6794E+04	5.5800E+07	1.4640E+04
67.0 - 72.0	1.3760E+08	5.0600E-06	818	4.4110E-06	5.0950E+02	2.0070E-07	38	6.1610E-15	1.0230E-04	1.4074E+04	3.0480E+07	1.0820E+04
72.0 - 77.0	1.2970E+08	5.0600E-06	818	4.4110E-06	5.0950E+02	1.6090E-07	36	3.1880E-15	8.2000E-05	1.0638E+04	1.4030E+07	7.3420E+03
77.0 - 82.0	8.0520E+07	5.0600E-06	818	4.4110E-06	5.0950E+02	3.8080E-08	35	9.1260E-16	1.9410E-05	1.5625E+03	1.5380E+06	2.4310E+03
82.0 - 87.0	4.6630E+07	5.0600E-06	818	4.4110E-06	5.0950E+02	1.5180E-08	15	1.2960E-16	7.7360E-06	3.6072E+02	7.3280E+04	5.3060E+02
87.0 - 92.0	4.4490E+07	5.0600E-06	818	4.4110E-06	5.0950E+02	0.0000E+00	15	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	4.0680E+07	5.0600E-06	818	4.4110E-06	5.0950E+02	0.0000E+00	14	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	2.5385E+09									4.4850E+06	+ OR -	6.8070E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 3.3460E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 9. Hydroacoustic estimate of fish inhabiting Area 3, Skilak Lake, Alaska based on Transect 5 integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	1.1230E+08	2.1850E-05	705	1.3100E-04	1.1800E+02	3.4900E-06	28	3.0480E-12	4.1180E-04	4.6265E+04	6.4480E+08	4.9770E+04
7.0 - 12.0	1.1240E+08	1.1550E-05	2795	1.2280E-05	2.2320E+02	6.4030E-06	28	4.7420E-12	1.4290E-03	1.6064E+05	2.9950E+09	1.0730E+05
12.0 - 17.0	1.1240E+08	6.9700E-06	236	6.4780E-06	3.6990E+02	1.5720E-05	28	1.4810E-11	5.8140E-03	6.5350E+05	2.7170E+10	3.2310E+05
17.0 - 22.0	1.1240E+08	5.4390E-06	378	4.9610E-06	4.7400E+02	8.1960E-06	28	2.6520E-12	3.8850E-03	4.3657E+05	7.9450E+09	1.7470E+05
22.0 - 27.0	1.1210E+08	4.8940E-06	496	4.7760E-06	5.2680E+02	6.4730E-06	28	1.2050E-12	3.4100E-03	3.8235E+05	4.4850E+09	1.3130E+05
27.0 - 32.0	1.1180E+08	4.1410E-06	391	3.4700E-06	6.2260E+02	3.2740E-06	28	3.0940E-13	2.0390E-03	2.2801E+05	1.5940E+09	7.8250E+04
32.0 - 37.0	1.1150E+08	4.3580E-06	1311	3.8630E-06	5.9160E+02	1.1530E-06	28	1.7560E-13	6.8220E-04	7.6065E+04	7.6740E+08	5.4300E+04
37.0 - 42.0	1.1100E+08	4.3680E-06	274	4.1460E-06	5.9020E+02	2.7140E-07	28	2.3370E-14	1.6020E-04	1.7773E+04	1.0130E+08	1.9730E+04
42.0 - 47.0	1.1070E+08	7.2600E-06	195	1.5180E-05	3.5510E+02	8.7760E-08	28	2.2010E-15	3.1170E-05	3.4497E+03	3.6670E+06	3.7530E+03
47.0 - 52.0	1.1040E+08	5.8970E-06	598	1.4040E-05	4.3720E+02	3.4090E-07	28	2.3250E-14	1.4900E-04	1.6451E+04	5.6710E+07	1.4760E+04
52.0 - 57.0	1.0940E+08	5.8970E-06	598	1.4040E-05	4.3720E+02	6.9320E-07	28	7.6900E-14	3.0310E-04	3.3156E+04	1.8630E+08	2.6750E+04
57.0 - 62.0	1.0620E+08	5.8970E-06	598	1.4040E-05	4.3720E+02	2.5150E-07	27	6.6050E-15	1.0990E-04	1.1673E+04	1.5520E+07	7.7220E+03
62.0 - 67.0	9.3680E+07	5.8970E-06	598	1.4040E-05	4.3720E+02	2.9710E-07	25	7.0280E-15	1.2990E-04	1.2168E+04	1.3190E+07	7.1190E+03
67.0 - 72.0	5.9740E+07	5.8970E-06	598	1.4040E-05	4.3720E+02	1.5210E-07	24	2.4740E-15	6.6480E-05	3.9714E+03	1.8370E+06	2.6570E+03
72.0 - 77.0	4.1880E+07	5.8970E-06	598	1.4040E-05	4.3720E+02	8.0890E-08	16	2.0920E-15	3.5370E-05	1.4811E+03	7.2220E+05	1.6660E+03
77.0 - 82.0	4.0190E+07	5.8970E-06	598	1.4040E-05	4.3720E+02	6.0470E-08	13	8.0860E-16	2.6440E-05	1.0624E+03	2.6030E+05	1.0000E+03
82.0 - 87.0	3.9470E+07	5.8970E-06	598	1.4040E-05	4.3720E+02	2.0470E-09	13	4.1910E-18	8.9510E-07	3.5331E+01	1.2600E+03	6.9580E+01
87.0 - 92.0	3.7780E+07	5.8970E-06	598	1.4040E-05	4.3720E+02	0.0000E+00	13	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	3.5780E+07	5.8970E-06	598	1.4040E-05	4.3720E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	1.6811E+09									2.0846E+06	+ OR -	4.2030E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 2.2500E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 10. Hydroacoustic estimate of fish inhabiting Area 3, Skilak Lake, Alaska based on Transect 6 integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	1.1230E+08	2.1850E-05	705	1.3100E-04	1.1800E+02	0.0000E+00	28	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.0 - 12.0	1.1230E+08	1.1550E-05	2795	1.2280E-05	2.2320E+02	6.5080E-06	28	2.7580E-12	1.4530E-03	1.6320E+05	1.7450E+09	8.1880E+04
12.0 - 17.0	1.1220E+08	7.0470E-06	190	6.6370E-06	3.6590E+02	9.0490E-06	28	3.0810E-12	3.3110E-03	3.7147E+05	5.8360E+09	1.4970E+05
17.0 - 22.0	1.1150E+08	5.6810E-06	332	5.2860E-06	4.5380E+02	6.5300E-06	28	1.2740E-12	2.9640E-03	3.3038E+05	3.5450E+09	1.1670E+05
22.0 - 27.0	1.1090E+08	6.2210E-06	320	1.0970E-05	4.1440E+02	5.7590E-06	28	1.6500E-12	2.3870E-03	2.6460E+05	4.1640E+09	1.2650E+05
27.0 - 32.0	1.1050E+08	4.6430E-06	204	4.4400E-06	5.5530E+02	2.6260E-06	28	1.5620E-13	1.4580E-03	1.6111E+05	7.0420E+08	5.2010E+04
32.0 - 37.0	1.0970E+08	4.3580E-06	1311	3.8630E-06	5.9160E+02	7.0170E-07	28	2.8780E-14	4.1510E-04	4.5559E+04	1.2260E+08	2.1700E+04
37.0 - 42.0	1.0770E+08	4.3680E-06	274	4.1460E-06	5.9020E+02	2.6650E-07	28	2.2640E-14	1.5730E-04	1.6937E+04	9.2440E+07	1.8840E+04
42.0 - 47.0	1.0660E+08	7.2600E-06	195	1.5180E-05	3.5510E+02	3.1800E-07	27	3.0430E-14	1.1290E-04	1.2036E+04	4.6830E+07	1.3410E+04
47.0 - 52.0	1.0200E+08	6.9180E-06	892	8.5390E-06	3.7270E+02	1.6630E-07	27	5.2850E-15	6.2000E-05	6.3226E+03	7.7030E+06	5.4400E+03
52.0 - 57.0	9.8400E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	5.8080E-07	26	3.7900E-14	2.1650E-04	2.1299E+04	5.1750E+07	1.4100E+04
57.0 - 62.0	9.7070E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	9.5250E-07	25	7.8750E-14	3.5500E-04	3.4457E+04	1.0510E+08	2.0090E+04
62.0 - 67.0	9.5140E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	1.5490E-06	25	1.8730E-13	5.7720E-04	5.4917E+04	2.4060E+08	3.0400E+04
67.0 - 72.0	9.3980E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	7.1580E-07	25	4.7100E-14	2.6680E-04	2.5069E+04	5.8850E+07	1.5040E+04
72.0 - 77.0	8.8970E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	8.8350E-07	25	2.0550E-13	3.2920E-04	2.9294E+04	2.2740E+08	2.9550E+04
77.0 - 82.0	8.5440E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	3.3600E-07	25	1.8290E-14	1.2520E-04	1.0700E+04	1.8750E+07	8.4860E+03
82.0 - 87.0	8.2240E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	3.3090E-07	25	4.6060E-14	1.2330E-04	1.0142E+04	4.3450E+07	1.2920E+04
87.0 - 92.0	7.6200E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	5.2180E-07	24	3.9040E-14	1.9450E-04	1.4819E+04	3.1860E+07	1.1060E+04
92.0 - 97.0	6.7100E+07	6.9180E-06	892	8.5390E-06	3.7270E+02	4.7120E-07	22	4.4370E-14	1.7560E-04	1.1782E+04	2.7980E+07	1.0370E+04
TOTAL	1.8802E+09									1.5841E+06	+ OR -	2.5610E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 2.2500E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 11. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 6 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	3.8580E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	3.7110E-06	10	1.8790E-12	9.1120E-04	3.5157E+04	1.7580E+08	2.5990E+04
7.0 - 12.0	3.8600E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.0010E-06	10	7.8380E-13	2.3140E-04	8.9335E+03	6.3400E+07	1.5610E+04
12.0 - 17.0	3.8600E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	3.1170E-06	10	1.7300E-12	1.2410E-03	4.7904E+04	4.0980E+08	3.9680E+04
17.0 - 22.0	3.8460E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	2.0760E-06	10	1.0310E-12	1.0170E-03	3.9127E+04	3.6670E+08	3.7530E+04
22.0 - 27.0	3.7030E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	1.3730E-06	10	3.9200E-13	7.8940E-04	2.9233E+04	1.7770E+08	2.6130E+04
27.0 - 32.0	3.4450E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	8.4000E-07	10	2.4330E-13	5.2820E-04	1.8199E+04	1.1420E+08	2.0950E+04
32.0 - 37.0	2.5230E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	1.0820E-07	9	1.1710E-14	7.4900E-05	1.8898E+03	3.5730E+06	3.7050E+03
37.0 - 42.0	6.2400E+06	3.4600E-06	1011	2.9980E-06	7.4510E+02	0.0000E+00	4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	0.0000E+00	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	0.0000E+00	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	2.5719E+08									1.8044E+05	+ OR -	7.0970E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 7.7200E+06

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 12. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 7 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	3.8580E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.3510E-05	19	3.8880E-11	3.3160E-03	1.2794E+05	3.5830E+09	1.1730E+05
7.0 - 12.0	3.8590E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.5810E-05	19	5.3530E-11	3.6560E-03	1.4109E+05	4.5030E+09	1.3150E+05
12.0 - 17.0	3.8590E+07	7.9780E-06	262	1.9390E-05	3.2320E+02	8.8440E-06	19	2.1390E-11	2.8580E-03	1.1031E+05	3.6020E+09	1.1760E+05
17.0 - 22.0	3.8290E+07	4.3720E-06	395	4.5970E-06	5.8970E+02	5.3390E-06	19	1.1470E-12	3.1480E-03	1.2055E+05	6.2570E+08	4.9030E+04
22.0 - 27.0	3.6950E+07	3.5280E-06	256	3.6210E-06	7.3080E+02	1.8460E-06	19	3.4000E-13	1.3490E-03	4.9843E+04	2.5810E+08	3.1490E+04
27.0 - 32.0	3.3580E+07	4.0000E-06	282	3.5180E-06	6.4460E+02	1.4730E-06	19	1.7680E-13	9.4920E-04	3.1874E+04	8.5620E+07	1.8140E+04
32.0 - 37.0	2.5570E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	1.6810E-07	16	1.9340E-14	1.1640E-04	2.9762E+03	6.0650E+06	4.8270E+03
37.0 - 42.0	9.4170E+06	3.4600E-06	1011	2.9980E-06	7.4510E+02	1.0590E-08	12	1.1220E-16	7.8940E-06	7.4335E+01	5.5300E+03	1.4580E+02
42.0 - 47.0	0.0000E+00	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	0.0000E+00	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	2.5957E+08									5.8466E+05	+ OR -	2.2060E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 7.7200E+06

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 13. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 8 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	3.7690E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	5.9870E-05	7	7.8660E-10	1.4700E-02	5.5414E+05	6.9160E+10	5.1540E+05
7.0 - 12.0	3.4620E+07	1.4020E-05	166	3.9960E-05	1.8390E+02	6.6610E-05	6	2.6140E-10	1.2250E-02	4.2412E+05	1.9400E+10	2.7300E+05
12.0 - 17.0	2.9780E+07	6.8700E-06	183	7.5590E-06	3.7530E+02	2.5950E-05	6	7.9260E-11	9.7390E-03	2.9005E+05	1.0460E+10	2.0050E+05
17.0 - 22.0	2.2460E+07	3.2640E-06	155	3.6670E-06	7.8990E+02	7.7580E-06	5	1.9340E-11	6.1280E-03	1.3767E+05	6.2450E+09	1.5490E+05
22.0 - 27.0	1.4130E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	8.9190E-07	4	3.0010E-13	5.1260E-04	7.2419E+03	1.9800E+07	8.7210E+03
27.0 - 32.0	2.5620E+05	4.1000E-06	3789	3.5950E-06	6.2880E+02	0.0000E+00	2	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	0.0000E+00	3.7240E-06	2695	3.8050E-06	6.9230E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	0.0000E+00	3.4600E-06	1011	2.9980E-06	7.4510E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	0.0000E+00	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	0.0000E+00	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	1.3894E+08									1.4132E+06	+ OR -	6.3600E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 7.7200E+06.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 14. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 9A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	3.8510E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.0210E-05	23	3.4320E-11	2.5070E-03	9.6528E+04	3.1220E+09	1.0950E+05
7.0 - 12.0	3.8230E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.5830E-05	23	3.1390E-11	3.6590E-03	1.3989E+05	2.6880E+09	1.0160E+05
12.0 - 17.0	3.7170E+07	7.1520E-06	345	6.6730E-06	3.6050E+02	1.2760E-05	23	8.5030E-12	4.5990E-03	1.7092E+05	1.6000E+09	7.8410E+04
17.0 - 22.0	3.5380E+07	4.3100E-06	231	4.9430E-06	5.9820E+02	2.3450E-06	22	4.0700E-13	1.4020E-03	4.9615E+04	1.9630E+08	2.7460E+04
22.0 - 27.0	3.2080E+07	4.5690E-06	286	4.8830E-06	5.6430E+02	2.7050E-06	21	5.2710E-13	1.5260E-03	4.8959E+04	1.8230E+08	2.6460E+04
27.0 - 32.0	2.9000E+07	3.7150E-06	185	3.3550E-06	6.9400E+02	1.0040E-06	19	8.3460E-14	6.9670E-04	2.0204E+04	3.5610E+07	1.1700E+04
32.0 - 37.0	2.6260E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	4.2670E-07	18	3.0280E-14	2.9540E-04	7.7590E+03	1.0030E+07	6.2080E+03
37.0 - 42.0	2.3600E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	4.6640E-07	16	3.0800E-14	3.4750E-04	8.2016E+03	9.5740E+06	6.0640E+03
42.0 - 47.0	1.9690E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	6.5250E-08	16	4.1730E-15	5.6640E-05	1.1154E+03	1.2220E+06	2.1670E+03
47.0 - 52.0	1.2820E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	2.3830E-09	12	3.0030E-18	3.1200E-06	3.9996E+01	8.6430E+02	5.7620E+01
TOTAL	2.9274E+08									5.4323E+05	+ OR -	1.7360E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 7.7200E+06

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 15. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 9 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.9380E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.1600E-05	15	2.1920E-11	2.8490E-03	1.6918E+05	4.8250E+09	1.3610E+05
7.0 - 12.0	5.8710E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.3320E-05	15	7.1340E-12	3.0810E-03	1.8088E+05	1.7090E+09	8.1020E+04
12.0 - 17.0	5.7520E+07	5.1970E-06	241	4.8620E-06	4.9610E+02	1.1490E-05	15	6.2210E-12	5.6980E-03	3.2775E+05	5.4550E+09	1.4480E+05
17.0 - 22.0	4.9470E+07	5.4590E-06	337	5.5660E-06	4.7230E+02	1.1100E-05	15	8.4640E-12	5.2410E-03	2.5930E+05	4.8280E+09	1.3620E+05
22.0 - 27.0	4.1160E+07	4.1970E-06	190	3.6370E-06	6.1430E+02	4.6410E-06	12	1.8930E-12	2.8510E-03	1.1735E+05	1.2650E+09	6.9700E+04
27.0 - 32.0	3.9290E+07	4.2920E-06	185	3.3030E-06	6.0070E+02	3.1300E-06	11	1.6440E-12	1.8800E-03	7.3872E+04	9.3310E+08	5.9870E+04
32.0 - 37.0	3.7850E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	9.2510E-07	10	1.3860E-13	6.4040E-04	2.4243E+04	9.5410E+07	1.9140E+04
37.0 - 42.0	3.7060E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	3.1040E-08	10	3.3320E-16	2.3130E-05	8.5722E+02	2.5460E+05	9.8900E+02
42.0 - 47.0	3.6240E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	3.5530E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	4.5221E+08									1.1534E+06	+ OR -	2.7100E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.1910E+07

[2] depth measured below transducer, which was 1 m from surface.

Appendix Table 16. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 10A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.9530E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.0320E-05	22	1.8890E-11	2.5340E-03	1.5084E+05	4.1660E+09	1.2650E+05
7.0 - 12.0	5.9540E+07	6.9020E-06	165	7.9920E-06	3.7350E+02	1.4900E-05	22	6.4940E-12	5.5680E-03	3.3147E+05	4.1050E+09	1.2560E+05
12.0 - 17.0	5.9390E+07	5.8930E-06	519	6.4230E-06	4.3750E+02	2.0520E-05	22	1.7750E-11	8.9800E-03	5.3331E+05	1.2640E+10	2.2030E+05
17.0 - 22.0	5.9180E+07	5.3370E-06	480	5.0280E-06	4.8310E+02	1.2710E-05	22	6.5080E-12	6.1420E-03	3.6348E+05	5.5630E+09	1.4620E+05
22.0 - 27.0	5.8930E+07	4.8860E-06	837	4.6760E-06	5.2770E+02	1.2370E-05	22	8.6650E-12	6.5300E-03	3.8481E+05	8.5410E+09	1.8110E+05
27.0 - 32.0	5.8690E+07	4.2590E-06	514	3.8720E-06	6.0540E+02	3.3450E-06	21	4.2680E-13	2.0250E-03	1.1882E+05	5.6140E+08	4.6440E+04
32.0 - 37.0	5.8420E+07	3.7910E-06	421	3.7090E-06	6.8010E+02	1.9350E-06	21	3.0290E-13	1.3160E-03	7.6866E+04	4.9170E+08	4.3460E+04
37.0 - 42.0	5.8230E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	1.4800E-07	21	3.6600E-15	1.1030E-04	6.4208E+03	6.9210E+06	5.1560E+03
42.0 - 47.0	5.8130E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	1.0960E-07	21	5.8630E-15	9.5130E-05	5.5297E+03	1.5010E+07	7.5930E+03
47.0 - 52.0	5.7840E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	2.0280E-08	21	4.1110E-16	2.6550E-05	1.5357E+03	2.3850E+06	3.0270E+03
TOTAL	5.8788E+08									1.9731E+06	+ OR -	3.7230E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.1910E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 17. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 10 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.9510E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.4260E-05	20	1.6210E-11	3.5020E-03	2.0840E+05	3.7130E+09	1.1940E+05
7.0 - 12.0	5.9540E+07	6.2090E-06	150	7.4080E-06	4.1520E+02	1.7360E-05	20	1.5590E-11	7.2090E-03	4.2922E+05	1.1280E+10	2.0810E+05
12.0 - 17.0	5.9420E+07	5.8740E-06	575	6.4520E-06	4.3890E+02	3.3240E-05	20	4.9710E-11	1.4590E-02	8.6682E+05	3.5390E+10	3.6870E+05
17.0 - 22.0	5.9250E+07	5.8730E-06	878	5.6210E-06	4.3900E+02	4.6140E-05	20	7.1960E-11	2.0250E-02	1.2001E+06	5.0190E+10	4.3910E+05
22.0 - 27.0	5.8960E+07	4.3480E-06	693	4.2600E-06	5.9300E+02	1.7470E-05	20	2.2250E-11	1.0360E-02	6.1079E+05	2.7710E+10	3.2620E+05
27.0 - 32.0	5.8600E+07	4.2130E-06	441	3.1860E-06	6.1200E+02	6.9700E-06	20	3.4050E-12	4.2650E-03	2.4996E+05	4.4600E+09	1.3090E+05
32.0 - 37.0	5.8360E+07	3.6930E-06	344	2.7120E-06	6.9810E+02	2.2740E-06	20	8.5830E-14	1.5880E-03	9.2661E+04	1.5600E+08	2.4480E+04
37.0 - 42.0	5.8010E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	4.3360E-07	20	1.9790E-14	3.2310E-04	1.8742E+04	3.7250E+07	1.1960E+04
42.0 - 47.0	5.7300E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	6.5410E-08	20	2.8000E-15	5.6780E-05	3.2538E+03	6.9560E+06	5.1690E+03
47.0 - 52.0	3.9460E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	19	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	5.6841E+08									3.6799E+06	+ OR -	7.1460E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.1910E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 18. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 11A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.9240E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	8.8380E-07	26	2.9800E-13	2.1700E-04	1.2856E+04	6.3990E+07	1.5680E+04
7.0 - 12.0	5.9100E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.1890E-05	26	8.8820E-12	2.7490E-03	1.6245E+05	1.9760E+09	8.7130E+04
12.0 - 17.0	5.8930E+07	6.1810E-06	304	6.1560E-06	4.1710E+02	1.1280E-05	26	5.4780E-12	4.7070E-03	2.7738E+05	3.5610E+09	1.1700E+05
17.0 - 22.0	5.8780E+07	4.4710E-06	459	5.3620E-06	5.7670E+02	7.1550E-06	25	2.0600E-12	4.1260E-03	2.4253E+05	2.5510E+09	9.8990E+04
22.0 - 27.0	5.8570E+07	4.5810E-06	270	3.9830E-06	5.6280E+02	3.0070E-06	25	1.2380E-12	1.6920E-03	9.9127E+04	1.3730E+09	7.2610E+04
27.0 - 32.0	5.8370E+07	4.2650E-06	210	3.3310E-06	6.0450E+02	1.4470E-06	25	2.0210E-13	8.7480E-04	5.1068E+04	2.5920E+08	3.1560E+04
32.0 - 37.0	5.8180E+07	4.1290E-06	282	3.9290E-06	6.2440E+02	1.5900E-06	25	3.9770E-13	9.9270E-04	5.7761E+04	5.3570E+08	4.5360E+04
37.0 - 42.0	5.7990E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	2.6190E-07	25	9.6110E-15	1.9520E-04	1.1318E+04	1.8040E+07	8.3250E+03
42.0 - 47.0	5.7790E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	1.4970E-10	25	2.2420E-20	1.3000E-07	7.5123E+00	5.6580E+01	1.4740E+01
47.0 - 52.0	3.4440E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	1.0880E-09	25	1.1840E-18	1.4250E-06	4.9067E+01	2.4350E+03	9.6720E+01
TOTAL	5.6139E+08									9.1455E+05	+ OR -	1.9930E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.1910E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 19. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 11 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.2680E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	4.7200E-06	12	2.2280E-11	1.1590E-03	6.1050E+04	3.7490E+09	1.2000E+05
7.0 - 12.0	5.2700E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.4180E-06	12	6.6900E-13	3.2790E-04	1.7280E+04	1.0290E+08	1.9890E+04
12.0 - 17.0	5.2700E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	2.0970E-06	12	6.2570E-13	8.3470E-04	4.3987E+04	2.7640E+08	3.2590E+04
17.0 - 22.0	5.2700E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	3.8650E-06	12	1.7240E-12	1.8940E-03	9.9820E+04	1.1530E+09	6.6550E+04
22.0 - 27.0	5.2700E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	3.3680E-06	12	7.8110E-13	1.9360E-03	1.0202E+05	7.1860E+08	5.2540E+04
27.0 - 32.0	5.2660E+07	3.8980E-06	178	3.6360E-06	6.6140E+02	2.2240E-06	12	1.2520E-12	1.4710E-03	7.7454E+04	1.5490E+09	7.7130E+04
32.0 - 37.0	5.2410E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	3.6400E-07	12	3.0040E-14	2.5200E-04	1.3208E+04	3.9610E+07	1.2340E+04
37.0 - 42.0	5.2070E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	1.3080E-07	12	6.2880E-15	9.7450E-05	5.0740E+03	9.4850E+06	6.0360E+03
42.0 - 47.0	5.1710E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	5.1230E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	4.6250E-09	11	2.1390E-17	6.0560E-06	3.1025E+02	9.7360E+04	6.1160E+02
TOTAL	5.2356E+08									4.2020E+05	+ OR -	1.7080E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0540E+07
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 20. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 12A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.2650E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	8.7800E-07	28	6.6030E-13	2.1560E-04	1.1351E+04	1.1110E+08	2.0660E+04
7.0 - 12.0	5.2350E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	5.9780E-06	28	4.9460E-12	1.3820E-03	7.2363E+04	7.8770E+08	5.5010E+04
12.0 - 17.0	5.1790E+07	6.6990E-06	178	7.0620E-06	3.8490E+02	6.2940E-06	28	1.6930E-12	2.4220E-03	1.2547E+05	7.7100E+08	5.4420E+04
17.0 - 22.0	5.0930E+07	4.7390E-06	275	5.2820E-06	5.4400E+02	4.0640E-06	28	5.2640E-13	2.2110E-03	1.1259E+05	4.6140E+08	4.2100E+04
22.0 - 27.0	4.9310E+07	4.3610E-06	264	3.8150E-06	5.9120E+02	2.4330E-06	28	2.9020E-13	1.4380E-03	7.0920E+04	2.6120E+08	3.1680E+04
27.0 - 32.0	4.8190E+07	4.5640E-06	308	3.6840E-06	5.6490E+02	1.8020E-06	28	2.0500E-13	1.0180E-03	4.9063E+04	1.5700E+08	2.4560E+04
32.0 - 37.0	4.7340E+07	4.3990E-06	190	2.9150E-06	5.8610E+02	6.0760E-07	27	2.6750E-14	3.5610E-04	1.6860E+04	2.1250E+07	9.0350E+03
37.0 - 42.0	4.6280E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	6.1010E-08	27	5.9220E-16	4.5460E-05	2.1037E+03	7.0740E+05	1.6490E+03
42.0 - 47.0	4.2870E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	1.5370E-08	26	1.2860E-16	1.3340E-05	5.7211E+02	1.7890E+05	8.2910E+02
47.0 - 52.0	3.8540E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	25	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	4.8025E+08									4.6129E+05	+ OR -	9.9390E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0540E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 21. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 12 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.2670E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	9.6620E-06	15	2.1060E-11	2.3720E-03	1.2497E+05	3.6140E+09	1.1780E+05
7.0 - 12.0	5.2500E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	5.0950E-06	15	3.5560E-12	1.1780E-03	6.1844E+04	5.7010E+08	4.6800E+04
12.0 - 17.0	5.2250E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	4.4180E-06	15	2.4530E-12	1.7590E-03	9.1901E+04	1.0660E+09	6.3990E+04
17.0 - 22.0	5.2010E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	4.1370E-06	15	1.2660E-12	2.0280E-03	1.0545E+05	8.2560E+08	5.6320E+04
22.0 - 27.0	5.1830E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	2.2400E-06	15	5.0350E-13	1.2870E-03	6.6717E+04	4.4780E+08	4.1480E+04
27.0 - 32.0	5.1430E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	1.8840E-06	15	3.5850E-13	1.1850E-03	6.0939E+04	3.7570E+08	3.7990E+04
32.0 - 37.0	5.1050E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	3.3580E-07	15	1.8220E-14	2.3250E-04	1.1869E+04	2.2810E+07	9.3610E+03
37.0 - 42.0	5.0670E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	2.6540E-07	15	5.6820E-15	1.9780E-04	1.0021E+04	8.1760E+06	5.6040E+03
42.0 - 47.0	5.0280E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	8.5080E-09	15	4.9040E-17	7.3850E-06	3.7135E+02	9.3790E+04	6.0020E+02
47.0 - 52.0	2.9080E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	15	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	4.9377E+08									5.3408E+05	+ OR -	1.6320E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0540E+07
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 22. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 13A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.2660E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	2.7470E-06	21	1.8460E-12	6.7450E-04	3.5518E+04	3.1590E+08	3.4840E+04
7.0 - 12.0	5.2680E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	5.8030E-06	21	3.0890E-12	1.3420E-03	7.0680E+04	5.1850E+08	4.4630E+04
12.0 - 17.0	5.2680E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	5.2260E-06	21	3.1950E-12	2.0810E-03	1.0960E+05	1.4110E+09	7.3640E+04
17.0 - 22.0	5.2660E+07	6.1620E-06	188	5.9770E-06	4.1840E+02	5.6760E-06	21	6.4720E-12	2.3750E-03	1.2508E+05	3.2210E+09	1.1120E+05
22.0 - 27.0	5.2420E+07	6.1940E-06	164	5.0470E-06	4.1620E+02	2.1230E-06	21	3.9920E-13	8.8360E-04	4.6313E+04	1.9870E+08	2.7630E+04
27.0 - 32.0	5.1490E+07	3.8570E-06	201	3.0930E-06	6.6840E+02	2.1090E-06	21	4.0310E-13	1.4090E-03	7.2575E+04	4.9440E+08	4.3580E+04
32.0 - 37.0	5.0160E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	7.9300E-07	21	4.3270E-14	5.4900E-04	2.7537E+04	5.2470E+07	1.4200E+04
37.0 - 42.0	4.9520E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	2.8130E-07	20	1.6100E-14	2.0960E-04	1.0381E+04	2.2000E+07	9.1940E+03
42.0 - 47.0	4.8780E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	3.2650E-08	20	5.3290E-16	2.8340E-05	1.3825E+03	9.6050E+05	1.9210E+03
47.0 - 52.0	4.8220E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	20	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	5.1127E+08									4.9907E+05	+ OR -	1.5480E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0540E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 23. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 13 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	7.1710E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.3900E-05	15	3.3650E-11	3.4130E-03	2.4472E+05	1.0780E+10	2.0350E+05
7.0 - 12.0	7.1390E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	4.5290E-06	15	3.6850E-12	1.0470E-03	7.4761E+04	1.0710E+09	6.4150E+04
12.0 - 17.0	7.1030E+07	7.5770E-06	159	7.1590E-06	3.4030E+02	1.1640E-05	15	8.6480E-12	3.9600E-03	2.8128E+05	5.4950E+09	1.4530E+05
17.0 - 22.0	7.0660E+07	4.6100E-06	320	4.5010E-06	5.5930E+02	8.8160E-06	15	2.8800E-12	4.9300E-03	3.4835E+05	4.8580E+09	1.3660E+05
22.0 - 27.0	7.0200E+07	3.8050E-06	342	3.8920E-06	6.7760E+02	5.1570E-06	15	6.7240E-13	3.4950E-03	2.4532E+05	1.7060E+09	8.0940E+04
27.0 - 32.0	6.9560E+07	3.7880E-06	396	3.9920E-06	6.8060E+02	3.5970E-06	15	7.1300E-13	2.4480E-03	1.7028E+05	1.6800E+09	8.0320E+04
32.0 - 37.0	6.8910E+07	2.9540E-06	177	2.7870E-06	8.7280E+02	9.9910E-07	15	1.1280E-13	8.7200E-04	6.0082E+04	4.2630E+08	4.0470E+04
37.0 - 42.0	6.8290E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	2.5790E-07	15	1.9630E-14	1.9220E-04	1.3123E+04	5.0950E+07	1.3990E+04
42.0 - 47.0	6.7770E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	1.0070E-07	15	9.6240E-15	8.7440E-05	5.9262E+03	3.3400E+07	1.1330E+04
47.0 - 52.0	6.7330E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	1.1050E-08	15	1.2210E-16	1.4470E-05	9.7414E+02	9.5980E+05	1.9200E+03
TOTAL	6.9685E+08									1.4448E+06	+ OR -	3.1670E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.4370E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 24. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 14A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	7.1790E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.5800E-06	24	1.5470E-12	3.8800E-04	2.7852E+04	4.8500E+08	4.3160E+04
7.0 - 12.0	7.1590E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	7.4360E-06	24	1.3030E-11	1.7190E-03	1.2309E+05	3.7530E+09	1.2010E+05
12.0 - 17.0	7.1190E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	9.0010E-06	24	4.4700E-12	3.5830E-03	2.5511E+05	3.6240E+09	1.1800E+05
17.0 - 22.0	7.0930E+07	5.7720E-06	299	6.0400E-06	4.4670E+02	4.7310E-06	24	1.4120E-12	2.1130E-03	1.4991E+05	1.5000E+09	7.5920E+04
22.0 - 27.0	7.0780E+07	4.9470E-06	444	4.0820E-06	5.2120E+02	8.0320E-06	24	4.9850E-12	4.1860E-03	2.9626E+05	6.9180E+09	1.6300E+05
27.0 - 32.0	7.0620E+07	3.8320E-06	510	3.4800E-06	6.7280E+02	9.7190E-06	23	1.8380E-11	6.5390E-03	4.6179E+05	4.1850E+10	4.0100E+05
32.0 - 37.0	7.0450E+07	3.4450E-06	625	2.9490E-06	7.4840E+02	2.8680E-06	23	1.4060E-13	2.1460E-03	1.5119E+05	4.1760E+08	4.0050E+04
37.0 - 42.0	7.0260E+07	3.5500E-06	219	3.0050E-06	7.2630E+02	6.8060E-07	23	2.1250E-14	4.9430E-04	3.4727E+04	5.9260E+07	1.5090E+04
42.0 - 47.0	6.9960E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	1.0840E-07	23	2.4340E-15	9.4140E-05	6.5862E+03	9.0880E+06	5.9090E+03
47.0 - 52.0	3.8830E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	1.1370E-09	23	1.2930E-18	1.4890E-06	5.7819E+01	3.3810E+03	1.1400E+02
TOTAL	6.7640E+08									1.5066E+06	+ OR -	4.7450E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.4370E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 25. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 14 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	7.1800E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.8450E-06	13	1.0330E-12	4.5320E-04	3.2538E+04	3.2730E+08	3.5460E+04
7.0 - 12.0	7.1640E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	3.8440E-06	13	8.1580E-12	8.8890E-04	6.3675E+04	2.2870E+09	9.3730E+04
12.0 - 17.0	7.1540E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	6.3930E-06	13	5.0070E-12	2.5450E-03	1.8209E+05	4.0790E+09	1.2520E+05
17.0 - 22.0	7.1350E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	6.3210E-06	13	2.5770E-12	3.0980E-03	2.2100E+05	3.1630E+09	1.1020E+05
22.0 - 27.0	7.1140E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	3.7130E-06	13	2.6930E-12	2.1340E-03	1.5182E+05	4.5060E+09	1.3160E+05
27.0 - 32.0	7.0920E+07	3.7240E-06	157	4.0550E-06	6.9230E+02	2.1120E-06	13	4.7260E-13	1.4620E-03	1.0368E+05	1.2210E+09	6.8480E+04
32.0 - 37.0	7.0700E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	1.2170E-06	13	2.1650E-13	8.4270E-04	5.9581E+04	5.2010E+08	4.4700E+04
37.0 - 42.0	7.0430E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	4.2700E-07	13	3.1470E-14	3.1820E-04	2.2408E+04	8.7050E+07	1.8290E+04
42.0 - 47.0	6.9880E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	1.2930E-08	13	1.6710E-16	1.1220E-05	7.8413E+02	6.1640E+05	1.5390E+03
47.0 - 52.0	4.4350E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	6.6310E-09	13	4.3970E-17	8.6820E-06	3.8503E+02	1.5000E+05	7.5900E+02
TOTAL	6.8375E+08									8.3796E+05	+ OR -	2.4940E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.4370E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 26. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 15A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	7.1810E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	0.0000E+00	27	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.0 - 12.0	7.1690E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.3140E-06	27	6.0290E-13	3.0390E-04	2.1784E+04	1.7140E+08	2.5660E+04
12.0 - 17.0	7.1590E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	1.7380E-06	27	1.1910E-12	6.9190E-04	4.9531E+04	9.6890E+08	6.1010E+04
17.0 - 22.0	7.1450E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	1.4240E-06	27	4.1200E-13	6.9780E-04	4.9856E+04	5.0590E+08	4.4080E+04
22.0 - 27.0	7.1290E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	8.2900E-07	27	6.2060E-14	4.7650E-04	3.3968E+04	1.0440E+08	2.0030E+04
27.0 - 32.0	7.1100E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	4.9920E-07	27	2.7370E-14	3.1390E-04	2.2320E+04	5.4820E+07	1.4510E+04
32.0 - 37.0	7.0720E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	7.2060E-08	26	2.0110E-15	4.9890E-05	3.5284E+03	4.8270E+06	4.3060E+03
37.0 - 42.0	7.0460E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	3.9830E-08	26	6.3840E-16	2.9680E-05	2.0911E+03	1.7630E+06	2.6030E+03
42.0 - 47.0	7.0230E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	1.8190E-08	26	3.3080E-16	1.5790E-05	1.1089E+03	1.2330E+06	2.1760E+03
47.0 - 52.0	4.7530E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	26	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	6.8787E+08									1.8419E+05	+ OR -	8.3460E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.4370E+07
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 27. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 15 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4390E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.0 - 12.0	5.4320E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.3740E-06	11	5.8350E-13	3.1760E-04	1.7255E+04	9.5650E+07	1.9170E+04
12.0 - 17.0	5.4050E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	3.2760E-06	11	3.0370E-12	1.3040E-03	7.0496E+04	1.4090E+09	7.3570E+04
17.0 - 22.0	5.3730E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	2.5070E-06	11	1.1460E-12	1.2290E-03	6.6005E+04	7.9590E+08	5.5300E+04
22.0 - 27.0	5.3210E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	7.5610E-07	11	2.0890E-13	4.3450E-04	2.3122E+04	1.9550E+08	2.7400E+04
27.0 - 32.0	5.2550E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	5.7610E-08	11	3.1740E-15	3.6220E-05	1.9037E+03	3.4670E+06	3.6490E+03
32.0 - 37.0	5.2100E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	3.0790E-07	10	2.7740E-14	2.1320E-04	1.1108E+04	3.6140E+07	1.1780E+04
37.0 - 42.0	5.1660E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	1.3380E-09	10	1.7910E-18	9.9720E-07	5.1516E+01	2.6560E+03	1.0100E+02
42.0 - 47.0	5.1080E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	3.5460E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	1.1080E-08	10	1.2270E-16	1.4500E-05	5.1420E+02	2.6740E+05	1.0140E+03
TOTAL	5.1255E+08									1.9046E+05	+ OR -	9.8700E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 28. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 16A (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4620E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	5.6240E-06	33	4.1750E-12	1.3810E-03	7.5426E+04	7.8370E+08	5.4870E+04
7.0 - 12.0	5.4640E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	2.0970E-06	33	8.4060E-13	4.8480E-04	2.6488E+04	1.4260E+08	2.3410E+04
12.0 - 17.0	5.2220E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	1.0450E-06	33	1.8830E-13	4.1590E-04	2.1718E+04	8.1630E+07	1.7710E+04
17.0 - 22.0	5.0320E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	2.0510E-06	32	5.7470E-13	1.0050E-03	5.0576E+04	3.5020E+08	3.6680E+04
22.0 - 27.0	4.9390E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	5.8170E-07	32	4.5720E-14	3.3430E-04	1.6510E+04	3.6890E+07	1.1900E+04
27.0 - 32.0	4.7680E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	5.6710E-07	31	7.5660E-14	3.5660E-04	1.7004E+04	6.8070E+07	1.6170E+04
32.0 - 37.0	4.6620E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	1.0960E-07	30	2.9510E-15	7.5860E-05	3.5361E+03	3.0780E+06	3.4390E+03
37.0 - 42.0	4.5680E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	3.2770E-09	30	1.0740E-17	2.4420E-06	1.1156E+02	1.2450E+04	2.1870E+02
42.0 - 47.0	4.4170E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	29	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	3.0800E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	2.5850E-10	29	6.6830E-20	3.3850E-07	1.0424E+01	1.0990E+02	2.0550E+01
TOTAL	4.7614E+08									2.1138E+05	+ OR -	7.5050E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 29. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 16 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4620E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	3.8490E-06	10	1.4820E-11	9.4510E-04	5.1624E+04	2.6800E+09	1.0150E+05
7.0 - 12.0	5.3950E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	4.9240E-07	10	1.4570E-13	1.1380E-04	6.1423E+03	2.3130E+07	9.4260E+03
12.0 - 17.0	5.2120E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	7.2840E-08	10	2.6170E-15	2.9000E-05	1.5114E+03	1.1280E+06	2.0820E+03
17.0 - 22.0	4.9330E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	8.2760E-07	10	5.3690E-13	4.0560E-04	2.0009E+04	3.1390E+08	3.4730E+04
22.0 - 27.0	4.6850E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	1.0780E-08	9	7.3660E-17	6.1960E-06	2.9026E+02	5.3420E+04	4.5300E+02
27.0 - 32.0	4.4550E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	6.6010E-09	9	4.3580E-17	4.1510E-06	1.8495E+02	3.4210E+04	3.6250E+02
32.0 - 37.0	4.3410E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	4.2430E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	4.1200E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	4.0170E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	4.6863E+08									7.9762E+04	+ OR -	1.0770E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 30. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 17 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4630E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	3.3540E-07	11	7.1010E-14	8.2340E-05	4.4983E+03	1.2890E+07	7.0380E+03
7.0 - 12.0	5.4650E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	6.6120E-07	11	3.3770E-13	1.5290E-04	8.3554E+03	5.4770E+07	1.4510E+04
12.0 - 17.0	5.4650E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	2.5620E-07	11	2.5560E-14	1.0200E-04	5.5746E+03	1.2120E+07	6.8230E+03
17.0 - 22.0	5.4650E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	4.1920E-07	11	7.1180E-14	2.0540E-04	1.1226E+04	5.1090E+07	1.4010E+04
22.0 - 27.0	5.4650E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	4.7300E-08	11	2.2370E-15	2.7180E-05	1.4856E+03	2.2070E+06	2.9120E+03
27.0 - 32.0	5.4650E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	5.4650E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	5.4650E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	5.4650E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	5.4650E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	5.4648E+08									3.1140E+04	+ OR -	2.2610E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 31. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 18 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4630E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.8300E-06	8	2.7370E-12	4.4930E-04	2.4544E+04	4.9600E+08	4.3650E+04
7.0 - 12.0	5.4640E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.5980E-06	8	2.1630E-12	3.6960E-04	2.0195E+04	3.5020E+08	3.6680E+04
12.0 - 17.0	5.4240E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	1.5160E-06	8	7.7570E-13	6.0350E-04	3.2733E+04	3.6220E+08	3.7300E+04
17.0 - 22.0	5.3260E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	1.6030E-07	8	2.5700E-14	7.8560E-05	4.1845E+03	1.7520E+07	8.2030E+03
22.0 - 27.0	5.2320E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
27.0 - 32.0	4.8810E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	4.2930E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	0.0000E+00	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	3.9720E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	0.0000E+00	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	3.6330E+07	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	3.4360E+07	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	4.7124E+08									8.1657E+04	+ OR -	6.8630E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 32. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 19 (night survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4540E+07	1.0500E-05	177	1.0610E-05	2.4550E+02	1.7290E-06	10	1.2920E-12	4.2450E-04	2.3154E+04	2.3490E+08	3.0040E+04
7.0 - 12.0	5.4130E+07	1.1150E-05	1258	4.3390E-05	2.3120E+02	1.6340E-06	10	9.6900E-13	3.7790E-04	2.0457E+04	1.5690E+08	2.4550E+04
12.0 - 17.0	5.3610E+07	6.4760E-06	3306	8.4200E-06	3.9810E+02	2.3750E-06	10	2.4630E-12	9.4540E-04	5.0683E+04	1.1230E+09	6.5690E+04
17.0 - 22.0	5.3140E+07	5.2610E-06	4648	5.9940E-06	4.9010E+02	1.0180E-06	10	2.2330E-13	4.9880E-04	2.6504E+04	1.5160E+08	2.4140E+04
22.0 - 27.0	5.2090E+07	4.4860E-06	4383	4.2580E-06	5.7470E+02	1.2800E-07	10	1.1720E-14	7.3580E-05	3.8327E+03	1.0510E+07	6.3530E+03
27.0 - 32.0	4.8250E+07	4.1000E-06	3789	3.5950E-06	6.2880E+02	7.8020E-08	10	2.8070E-15	4.9060E-05	2.3672E+03	2.5850E+06	3.1510E+03
32.0 - 37.0	3.3800E+07	3.7240E-06	2695	3.8050E-06	6.9230E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	2.2310E+07	3.4600E-06	1011	2.9980E-06	7.4510E+02	2.3270E-07	6	5.4130E-14	1.7340E-04	3.8685E+03	1.4980E+07	7.5850E+03
42.0 - 47.0	5.1060E+06	2.9700E-06	195	2.0890E-06	8.6810E+02	0.0000E+00	4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	0.0000E+00	1.9690E-06	57	1.5930E-06	1.3090E+03	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	3.7698E+08									1.3087E+05	+ OR -	8.0690E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 33. Hydroacoustic estimate of the number of fish per 1000 square meters in Skilak Lake, Alaska, October 1986.

			Integrator Output					Density Estimate and 95% Confidence Interval			
Transect Number	Sequence Group	Sequence Number	Mean Output	Variance	Sample Size	Standard Deviation	A Constant	Mean Density	Standard Deviation	Lower Bound	Upper Bound
1	1	51-53	2.3490E-05	1.6560E-09	3	4.0694E-05	3.085E+02	7	13	-18	32
	2	46-50	6.9740E-04	7.9540E-07	5	8.9185E-04	3.085E+02	215	275	-335	765
	3	41-45	4.4100E-03	1.9680E-06	5	1.4029E-03	3.085E+02	1360	433	495	2226
	4	36-40	3.4050E-04	2.8920E-08	5	1.7006E-04	3.085E+02	105	52	0	210
	5	31-35	2.5230E-04	6.2650E-09	5	7.9152E-05	3.085E+02	78	24	29	127
	6	26-30	2.8030E-04	5.9580E-09	5	7.7188E-05	3.085E+02	86	24	39	134
	7	21-25	4.0240E-04	1.7540E-08	5	1.3244E-04	3.085E+02	124	41	42	206
	8	16-20	4.9960E-04	1.0660E-07	5	3.2650E-04	3.085E+02	154	101	-47	356
	9	11-15	2.3880E-03	2.0090E-06	5	1.4174E-03	3.085E+02	737	437	-138	1611
	10	6-10	6.3920E-04	8.0040E-07	5	8.9465E-04	3.085E+02	197	276	-355	749
	11	1-5	1.3580E-04	4.1270E-08	5	2.0315E-04	3.085E+02	42	63	-83	167
2	1	1-5	1.9400E-04	3.4500E-09	5	5.8737E-05	2.720E+02	53	16	21	85
	2	6-10	1.9430E-04	2.8420E-09	5	5.3310E-05	2.720E+02	53	15	24	82
	3	11-15	3.3400E-04	2.2670E-08	5	1.5057E-04	2.720E+02	91	41	9	173
	4	16-20	2.0550E-04	1.3250E-08	5	1.1515E-04	2.720E+02	56	31	-7	119
	5	21-25	2.9290E-04	1.2770E-07	5	3.5735E-04	2.720E+02	80	97	-115	274
	6	26-30	1.1230E-03	3.4360E-06	5	1.8536E-03	2.720E+02	305	504	-703	1314
	7	31-35	8.5550E-04	3.6700E-07	5	6.0581E-04	2.720E+02	233	165	-97	562
	8	36-40	7.5010E-04	4.6420E-07	5	6.8132E-04	2.720E+02	204	185	-167	575
	9	41-45	2.2240E-03	8.7250E-07	5	9.3408E-04	2.720E+02	605	254	97	1113
	10	46-50	2.1460E-03	1.8210E-06	5	1.3494E-03	2.720E+02	584	367	-150	1318
	11	51-55	8.5570E-04	1.4910E-06	5	1.2211E-03	2.720E+02	233	332	-432	897
3	1	51-56	2.0858E-04	2.1940E-08	6	1.4812E-04	3.626E+02	76	54	-32	183
	2	46-50	3.5030E-04	1.1060E-08	5	1.0517E-04	3.626E+02	127	38	51	203
	3	41-45	3.2620E-04	2.8350E-08	5	1.6837E-04	3.626E+02	118	61	-4	240
	4	36-40	3.9200E-04	4.2350E-09	5	6.5077E-05	3.626E+02	142	24	95	189
	5	31-35	1.8920E-04	1.9260E-08	5	1.3878E-04	3.626E+02	69	50	-32	169
	6	26-30	8.0610E-04	1.0200E-07	5	3.1937E-04	3.626E+02	292	116	61	524
	7	21-25	6.3980E-04	9.8620E-09	5	9.9308E-05	3.626E+02	232	36	160	304
	8	16-20	6.4870E-04	9.3620E-08	5	3.0597E-04	3.626E+02	235	111	13	457
	9	11-15	6.7260E-04	5.0020E-09	5	7.0725E-05	3.626E+02	244	26	193	295
	10	6-10	5.3130E-04	9.9570E-09	5	9.9785E-05	3.626E+02	193	36	120	265
	11	1-5	6.8280E-04	4.4190E-08	5	2.1021E-04	3.626E+02	248	76	95	400

Continued

Appendix Table 33, continued. Hydroacoustic estimate of the number of fish per 1000 square meters in Skilak Lake, October, 1986.

			Integrator Output					Density Estimate and 95% Confidence Interval			
Transect Number	Sequence Group	Sequence Number	Mean Output	Variance	Sample Size	Standard Deviation	A Constant	Mean Density	Standard Deviation	Lower Bound	Upper Bound
4	1	1-5	8.0680E-05	3.0000E-09	5	5.4772E-05	4,525E+02	37	25	-13	86
	2	6-10	1.1210E-04	4.0690E-09	5	6.3789E-05	4.525E+02	51	29	-7	108
	3	11-15	1.2660E-04	5.9830E-09	5	7.7350E-05	4.525E+02	57	35	-13	127
	4	16-20	2.0750E-04	1.2620E-08	5	1.1234E-04	4.525E+02	94	51	-8	196
	5	21-25	3.1580E-04	6.1860E-08	5	2.4872E-04	4.525E+02	143	113	-82	368
	6	26-30	4.6180E-04	1.9520E-08	5	1.3971E-04	4.525E+02	209	63	83	335
	7	31-35	7.2370E-04	4.3640E-08	5	2.0890E-04	4.525E+02	327	95	138	517
	8	36-40	5.5170E-04	2.7530E-08	5	1.6592E-04	4.525E+02	250	75	99	400
	9	41-42	7.8450E-04	1.1460E-06	2	1.0705E-03	4.525E+02	355	484	-614	1324
5	1	26-28	3.4330E-04	5.8620E-08	3	2.4212E-04	4.740E+02	163	115	-67	392
	2	21-25	1.6020E-04	5.0820E-09	5	7.1288E-05	4.740E+02	76	34	8	144
	3	16-20	2.4710E-04	1.4960E-08	5	1.2231E-04	4.740E+02	117	58	1	233
	4	11-15	3.2290E-04	3.6080E-08	5	1.8995E-04	4.740E+02	153	90	-27	333
	5	6-10	1.8180E-04	2.6880E-09	5	5.1846E-05	4.740E+02	86	25	37	135
	6	1-5	1.3210E-04	8.8150E-09	5	9.3888E-05	4.740E+02	63	45	-26	152
6	1	1-5	1.4830E-04	4.3070E-09	5	6.5628E-05	3.941E+02	58	26	7	110
	2	6-10	1.8080E-04	7.5800E-09	5	8.7063E-05	3.941E+02	71	34	3	140
	3	11-15	1.6280E-04	1.9480E-08	5	1.3957E-04	3.941E+02	64	55	-46	174
	4	16-20	1.9730E-04	1.0330E-08	5	1.0164E-04	3.941E+02	78	40	-2	158
	5	21-25	2.4170E-04	1.5530E-09	5	3.9408E-05	3.941E+02	95	16	64	126
	6	26-28	1.8760E-04	4.0740E-08	3	2.0184E-04	3.941E+02	74	80	-85	233

Appendix Table 34. Hydroacoustic estimate of the number of fish per 1000 square meters in Kenai Lake, Alaska, September 1986.

			Integrator Output					Density Estimate and 95% Confidence Interval			
Transect Number	Sequence Group	Sequence Number	Mean Output	Variance	Sample Size	Standard Deviation	A Constant	Mean Density	Standard Deviation	Lower Bound	Upper Bound
19	1	6-10	5.4746E-05	4.6918E-09	5	6.8497E-05	4.452E+02	24	30	-37	85
	2	1-5	1.0164E-05	1.6714E-10	5	1.2928E-05	4.452E+02	5	6	-7	16
18	1	1-5	3.3660E-05	1.3718E-09	5	3.7038E-05	2.876E+02	10	11	-12	31
	2	6-10	0.0000E+00	0.0000E+00	5	0.0000E+00	2.876E+02	0	0	0	0
17	1	6-11	9.4062E-06	1.8011E-10	5	1.3421E-05	7.040E+02	7	9	-12	26
	2	1-5	6.5063E-06	8.2793E-11	5	9.0991E-06	7.040E+02	5	6	-8	17
16	1	1-5	2.9807E-05	3.8237E-09	5	6.1836E-05	4.158E+02	12	26	-39	64
	2	6-10	1.0931E-05	5.2957E-10	5	2.3012E-05	4.158E+02	5	10	-15	24
16A	1	31-35	2.5904E-06	4.7527E-12	5	2.1801E-06	4.375E+02	1	1	-1	3
	2	26-30	9.8182E-05	6.9470E-09	5	8.3349E-05	4.375E+02	43	36	-30	116
	3	21-25	1.0435E-04	9.5956E-09	5	9.7957E-05	4.375E+02	46	43	-40	131
	4	16-20	4.6485E-05	2.4943E-09	5	4.9943E-05	4.375E+02	20	22	-23	64
	5	11-15	3.2207E-05	6.9258E-10	5	2.6317E-05	4.375E+02	14	12	-9	37
	6	6-10	1.8990E-05	1.1013E-09	5	3.3186E-05	4.375E+02	8	15	-21	37
	7	1-5	4.5242E-05	4.8777E-09	5	6.9841E-05	4.375E+02	20	31	-41	81
15	1	1-5	5.1858E-05	1.4641E-09	5	3.8264E-05	4.801E+02	25	18	-12	62
	2	6-11	2.9300E-05	1.0641E-09	6	3.2621E-05	4.801E+02	14	16	-17	45
15A	1	21-27	5.3764E-05	2.4331E-09	7	4.9326E-05	5.247E+02	28	26	-24	80
	2	16-20	4.8873E-06	1.7880E-11	5	4.2285E-06	5.247E+02	3	2	-2	7
	3	11-15	1.2505E-05	1.5140E-10	5	1.2304E-05	5.247E+02	7	6	-6	19
	4	6-10	1.7494E-05	7.0934E-10	5	2.6633E-05	5.247E+02	9	14	-19	37
	5	1-5	4.7315E-05	6.3584E-09	5	7.9740E-05	5.247E+02	25	42	-59	109
14	1	1-5	1.1351E-04	7.2967E-09	5	8.5421E-05	5.163E+02	59	44	-30	147
	2	6-10	1.1130E-04	1.9516E-09	5	4.4177E-05	5.163E+02	57	23	12	103
	3	11-15	1.7769E-04	1.6233E-08	5	1.2741E-04	5.163E+02	92	66	-40	223
14A	1	21-24	1.8034E-04	1.7578E-08	4	1.3258E-04	4.865E+02	88	65	-41	217
	2	16-20	1.1920E-04	1.7392E-09	5	4.1704E-05	4.865E+02	58	20	17	99
	3	11-15	2.7635E-04	1.8058E-08	5	1.3438E-04	4.865E+02	134	65	4	265
	4	6-10	1.5508E-04	4.7436E-09	5	6.8874E-05	4.865E+02	75	34	8	142
	5	1-5	3.2431E-04	5.4172E-08	5	2.3275E-04	4.865E+02	158	113	-69	384
13	1	1-5	2.2961E-04	1.7995E-08	5	1.3415E-04	5.852E+02	134	79	-23	291
	2	6-10	2.2792E-04	3.4309E-09	5	5.8574E-05	5.852E+02	133	34	65	202
	3	11-15	2.0781E-04	2.7683E-08	5	1.6638E-04	5.852E+02	122	97	-73	316

Continued

Appendix Table 34, continued. Hydroacoustic estimate of the number of fish per 1000 square meters in Kenai Lake, September, 1986.

			Integrator Output					Density Estimate and 95% Confidence Interval			
Transect Number	Sequence Group	Sequence Number	Mean Output	Variance	Sample Size	Standard Deviation	A Constant	Mean Density	Standard Deviation	Lower Bound	Upper Bound
13A	1	16-21	1.5090E-04	1.7405E-08	6	1.3193E-04	5.047E+02	76	67	-57	209
	2	11-15	1.2300E-04	8.6556E-09	5	9.3035E-05	5.047E+02	62	47	-32	156
	3	6-10	7.9751E-05	2.0611E-09	5	4.5399E-05	5.047E+02	40	23	-6	86
	4	1-5	1.2328E-04	1.6743E-08	5	1.2939E-04	5.047E+02	62	65	-68	193
12	1	1-5	1.1166E-04	1.0341E-08	5	1.0169E-04	5.294E+02	59	54	-49	167
	2	6-10	1.7105E-04	3.7209E-09	5	6.0999E-05	5.294E+02	91	32	26	155
	3	11-15	9.1493E-05	8.7173E-09	5	9.3366E-05	5.294E+02	48	49	-50	147
12A	1	26-28	7.9238E-05	4.7921E-09	3	6.9225E-05	5.221E+02	41	36	-31	114
	2	21-25	7.4502E-05	2.6294E-09	5	5.1278E-05	5.221E+02	39	27	-15	92
	3	16-20	1.0360E-04	4.7451E-09	5	6.8885E-05	5.221E+02	54	36	-18	126
	4	11-15	7.6933E-05	1.7995E-09	5	4.2421E-05	5.221E+02	40	22	-4	84
	5	6-10	1.1252E-04	3.2386E-09	5	5.6909E-05	5.221E+02	59	30	-1	118
	6	1-5	2.0592E-04	3.1732E-08	5	1.7813E-04	5.221E+02	108	93	-78	294
11	1	1-5	1.0605E-04	4.9437E-09	5	7.0311E-05	5.947E+02	63	42	-21	147
	2	6-10	6.3564E-05	7.2822E-10	5	2.6986E-05	5.947E+02	38	16	6	70
	3	11-12	7.0822E-05	6.0783E-10	2	2.4654E-05	5.947E+02	42	15	13	71
11A	1	21-25	4.5493E-04	1.9967E-08	5	1.4130E-04	5.172E+02	235	73	89	381
	2	16-20	7.7324E-05	4.2253E-09	5	6.5002E-05	5.172E+02	40	34	-27	107
	3	11-15	1.8621E-04	3.0183E-09	5	5.4939E-05	5.172E+02	96	28	39	153
	4	6-10	1.7539E-04	1.4977E-08	5	1.2238E-04	5.172E+02	91	63	-36	217
	5	1-5	4.6788E-05	1.3249E-08	5	1.1510E-04	5.172E+02	24	60	-95	143
10	1	1-5	2.8512E-04	9.3777E-09	5	9.6839E-05	5.123E+02	146	50	47	245
	2	6-10	8.4697E-04	4.8935E-08	5	2.2121E-04	5.123E+02	434	113	207	661
	3	11-15	9.2905E-04	3.3883E-08	5	1.8407E-04	5.123E+02	476	94	287	665
	4	16-20	5.9921E-04	2.8581E-07	5	5.3461E-04	5.123E+02	307	274	-241	855
10A	1	21-22	2.4709E-04	1.8345E-08	2	1.3544E-04	5.203E+02	129	70	-12	270
	2	16-20	4.9313E-04	1.8345E-08	5	1.3544E-04	5.203E+02	257	70	116	398
	3	11-15	5.6857E-04	3.2342E-09	5	5.6870E-05	5.203E+02	296	30	237	355
	4	6-10	2.7357E-04	2.6969E-08	5	1.6422E-04	5.203E+02	142	85	-29	313
	5	1-5	1.5529E-04	2.4596E-09	5	4.9594E-05	5.203E+02	81	26	29	132
9	1	1-5	2.3036E-04	1.6376E-08	5	1.2797E-04	5.047E+02	116	65	-13	245
	2	6-10	2.0848E-04	1.6145E-08	5	1.2706E-04	5.047E+02	105	64	-23	233
	3	11-15	2.7603E-04	6.5877E-09	5	8.1165E-05	5.047E+02	139	41	57	221

Continued

Appendix Table 34, continued. Hydroacoustic estimate of the number of fish per 1000 square meters in Kenai Lake, September, 1986.

			Integrator Output					Density Estimate and 95% Confidence Interval			
Transect Number	Sequence Group	Sequence Number	Mean Output	Variance	Sample Size	Standard Deviation	A Constant	Mean Density	Standard Deviation	Lower Bound	Upper Bound
9A	1	21-23	8.7342E-05	5.4911E-09	3	7.4102E-05	4.468E+02	39	33	-27	105
	2	16-20	1.4898E-04	3.3055E-09	5	5.7493E-05	4.468E+02	67	26	15	118
	3	11-15	9.0975E-05	6.1671E-09	5	7.8531E-05	4.468E+02	41	35	-30	111
	4	6-10	2.1843E-04	3.8711E-08	5	1.9675E-04	4.468E+02	98	88	-78	273
	5	1-5	3.9513E-04	2.5028E-08	5	1.5820E-04	4.468E+02	177	71	35	318
8	1	1-5	6.5651E-04	2.1084E-07	5	4.5917E-04	3.306E+02	217	152	-87	521
	2	6-7	5.2333E-04	4.1209E-07	2	6.4194E-04	3.306E+02	173	212	-251	597
7	1	1-5	1.5853E-04	1.9797E-08	5	1.4070E-04	4.622E+02	73	65	-57	203
	2	6-10	1.3986E-04	3.7561E-09	5	6.1287E-05	4.622E+02	65	28	8	121
	3	11-15	5.7957E-05	1.9519E-09	5	4.4180E-05	4.622E+02	27	20	-14	68
	4	16-20	5.7167E-04	3.3821E-07	5	5.8156E-04	4.622E+02	264	269	-273	802
6	2	1-5	5.9310E-05	3.3175E-10	5	1.8214E-05	4.615E+02	27	8	11	44
	1	6-10	5.0317E-05	2.3433E-09	5	4.8408E-05	4.615E+02	23	22	-21	68

Appendix Table 35. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 6 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	3.8520E+07	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
7.0 - 12.0	3.7560E+07	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
12.0 - 17.0	3.4890E+07	5.5870E-06	222	4.7730E-06	4.6150E+02	2.0120E-06	7	4.0050E-12	9.2860E-04	3.2397E+04	1.0420E+09	6.3250E+04
17.0 - 22.0	2.9980E+07	5.5870E-06	222	4.7730E-06	4.6150E+02	5.4830E-08	7	3.0060E-15	2.5300E-05	7.5863E+02	5.7740E+05	1.4890E+03
22.0 - 27.0	2.3380E+07	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
27.0 - 32.0	7.1730E+06	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	0.0000E+00	5.5870E-06	222	4.7730E-06	4.6150E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	1.7150E+08									3.3156E+04	+ OR -	6.3270E+04

[1] Lake surface area (meters squared) used to calculate stratum volume was 7.7200E+06.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 36. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska based on Transect 8 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	3.6900E+07	7.7980E-06	549	2.2880E-05	3.3060E+02	2.7620E-05	5	3.4680E-10	9.1320E-03	3.3701E+05	5.3410E+10	4.5300E+05
7.0 - 12.0	3.3760E+07	7.7980E-06	549	2.2880E-05	3.3060E+02	1.9270E-05	5	1.3890E-10	6.3720E-03	2.1511E+05	1.8030E+10	2.6320E+05
12.0 - 17.0	2.8150E+07	7.7980E-06	549	2.2880E-05	3.3060E+02	7.3190E-06	5	2.2130E-11	2.4200E-03	6.8122E+04	1.9900E+09	8.7430E+04
17.0 - 22.0	2.0100E+07	7.7980E-06	549	2.2880E-05	3.3060E+02	7.1760E-06	4	4.1570E-11	2.3720E-03	4.7688E+04	1.8710E+09	8.4790E+04
22.0 - 27.0	9.1220E+06	7.7980E-06	549	2.2880E-05	3.3060E+02	4.1940E-08	3	1.7590E-15	1.3870E-05	1.2648E+02	1.6250E+04	2.4980E+02
27.0 - 32.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	0.0000E+00	7.7980E-06	549	2.2880E-05	3.3060E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	1.2803E+08									6.6806E+05	+ OR -	5.3780E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 7.7200E+06.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 37. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 9 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.9240E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	3.7210E-06	12	1.1060E-11	1.8780E-03	1.1127E+05	9.8980E+09	1.9500E+05
7.0 - 12.0	5.7500E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	2.3580E-06	12	5.3710E-12	1.1900E-03	6.8450E+04	4.5290E+09	1.3190E+05
12.0 - 17.0	5.3530E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	3.5040E-07	12	3.7080E-14	1.7690E-04	9.4683E+03	2.7150E+07	1.0210E+04
17.0 - 22.0	4.6990E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	2.0170E-08	10	4.0690E-16	1.0180E-05	4.7841E+02	2.2910E+05	9.3810E+02
22.0 - 27.0	4.2120E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	3.6570E-08	9	1.1540E-15	1.8460E-05	7.7745E+02	5.2240E+05	1.4170E+03
27.0 - 32.0	3.9290E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	1.2770E-07	9	5.5640E-15	6.4440E-05	2.5318E+03	2.1930E+06	2.9030E+03
32.0 - 37.0	3.8000E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	2.8150E-08	8	2.8180E-16	1.4210E-05	5.3996E+02	1.0390E+05	6.3180E+02
37.0 - 42.0	3.6540E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	3.5490E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	1.1820E-07	8	1.3510E-14	5.9680E-05	2.1181E+03	4.3400E+06	4.0830E+03
47.0 - 52.0	3.4480E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	7.6260E-08	8	5.6220E-15	3.8490E-05	1.3270E+03	1.7040E+06	2.5590E+03
52.0 - 57.0	3.3990E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	3.3790E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	1.4910E-09	8	2.2220E-18	7.5250E-07	2.5426E+01	6.4710E+02	4.9860E+01
62.0 - 67.0	3.2340E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	3.1040E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	0.0000E+00	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	3.0320E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	1.0910E-09	7	1.1910E-18	5.5080E-07	1.6701E+01	2.7920E+02	3.2750E+01
77.0 - 82.0	2.9380E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	1.7570E-10	7	3.0860E-20	8.8660E-08	2.6046E+00	6.7900E+00	5.1070E+00
82.0 - 87.0	2.6290E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	3.0810E-10	6	9.4950E-20	1.5550E-07	4.0882E+00	1.6730E+01	8.0160E+00
87.0 - 92.0	2.2100E+07	5.1080E-06	1172	5.2050E-06	5.0470E+02	0.0000E+00	5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	2.0690E+06	5.1080E-06	1172	5.2050E-06	5.0470E+02	0.0000E+00	5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	6.8450E+08									1.9701E+05	+ OR -	2.3570E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.1910E+08.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 38. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska based on Transect 10 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.9290E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	2.2980E-07	13	2.8560E-14	1.1770E-04	6.9795E+03	2.6360E+07	1.0060E+04
7.0 - 12.0	5.9200E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	1.3590E-06	13	7.9420E-13	6.9610E-04	4.1205E+04	7.3080E+08	5.2980E+04
12.0 - 17.0	5.7840E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	3.3960E-06	13	6.2330E-12	1.7400E-03	1.0064E+05	5.4750E+09	1.4500E+05
17.0 - 22.0	5.6570E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	3.3720E-06	13	1.1290E-11	1.7270E-03	9.7718E+04	9.4810E+09	1.9080E+05
22.0 - 27.0	5.5660E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	6.3290E-09	13	2.7060E-17	3.2420E-06	1.8045E+02	2.2010E+04	2.9080E+02
27.0 - 32.0	5.4820E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	2.0130E-07	12	3.9640E-14	1.0310E-04	5.6527E+03	3.1270E+07	1.0960E+04
32.0 - 37.0	5.3830E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	6.0320E-08	12	1.3180E-15	3.0900E-05	1.6631E+03	1.0030E+06	1.9630E+03
37.0 - 42.0	5.3070E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	5.8260E-08	12	2.9770E-15	2.9850E-05	1.5840E+03	2.2010E+06	2.9080E+03
42.0 - 47.0	5.2240E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	5.1270E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	5.0170E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	4.9180E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	4.7270E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	4.4230E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	4.3570E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	4.2590E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	4.0800E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	3.5180E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	3.3700E+07	5.0330E-06	3229	5.1250E-06	5.1230E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	9.4048E+08									2.5562E+05	+ OR -	2.4600E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.1910E+08

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 39. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 11 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.1200E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	1.9200E-05	10	2.4940E-10	1.1420E-02	5.8463E+05	2.3200E+11	9.4400E+05
7.0 - 12.0	5.0400E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	4.4290E-08	10	1.9610E-15	2.6340E-05	1.3274E+03	1.7660E+06	2.6040E+03
12.0 - 17.0	4.9690E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	2.2840E-08	10	5.2150E-16	1.3580E-05	6.7485E+02	4.5630E+05	1.3240E+03
17.0 - 22.0	4.9240E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	1.8020E-07	10	2.8320E-14	1.0720E-04	5.2788E+03	2.4340E+07	9.6710E+03
22.0 - 27.0	4.8940E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
27.0 - 32.0	4.8640E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	2.5990E-08	10	2.2490E-16	1.5460E-05	7.5202E+02	1.8930E+05	8.5280E+02
32.0 - 37.0	4.7970E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	2.2050E-07	10	4.8610E-14	1.3110E-04	6.2903E+03	3.9650E+07	1.2340E+04
37.0 - 42.0	4.7410E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	4.3950E-09	10	1.9310E-17	2.6140E-06	1.2393E+02	1.5390E+04	2.4310E+02
42.0 - 47.0	4.6840E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	4.6380E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	4.5880E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	4.4920E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	4.4270E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	4.3800E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	4.3140E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	4.2650E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	4.1870E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	4.0390E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	3.9610E+07	4.3350E-06	536	4.4310E-06	5.9470E+02	9.5250E-10	8	6.5590E-19	5.6650E-07	2.2437E+01	3.6490E+02	3.7440E+01
TOTAL	8.7324E+08									5.9910E+05	+ OR -	9.4410E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0540E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 40. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska based on Transect 12 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.2660E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	3.0780E-06	12	3.5270E-12	1.6290E-03	8.5808E+04	2.7660E+09	1.0310E+05
7.0 - 12.0	5.2670E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	3.7730E-06	12	7.1160E-12	1.9970E-03	1.0519E+05	5.5690E+09	1.4630E+05
12.0 - 17.0	5.2390E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	1.0610E-05	12	1.1270E-10	5.6200E-03	2.9443E+05	8.6970E+10	5.7800E+05
17.0 - 22.0	5.2130E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	2.7980E-07	12	7.0280E-14	1.4810E-04	7.7221E+03	5.3730E+07	1.4370E+04
22.0 - 27.0	5.1870E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
27.0 - 32.0	5.1640E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	1.9370E-08	12	2.1070E-16	1.0250E-05	5.2954E+02	1.5840E+05	7.8010E+02
32.0 - 37.0	5.1390E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	5.1180E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	5.0900E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	5.0540E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	4.4050E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	2.1490E-10	11	4.6200E-20	1.1380E-07	5.0120E+00	2.5200E+01	9.8390E+00
57.0 - 62.0	4.0320E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	3.9840E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	3.9500E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	3.9120E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	3.8730E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	3.8390E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	3.8180E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	3.7820E+07	4.8700E-06	381	5.4300E-06	5.2940E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	8.7332E+08									4.9368E+05	+ OR -	6.0530E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0540E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 41. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 13 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	7.1800E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	8.8920E-06	11	3.5520E-11	5.2030E-03	3.7358E+05	6.2810E+10	4.9120E+05
7.0 - 12.0	7.1830E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	3.6410E-08	11	1.3260E-15	2.1310E-05	1.5303E+03	2.3440E+06	3.0010E+03
12.0 - 17.0	7.1370E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
17.0 - 22.0	7.0960E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
22.0 - 27.0	6.9870E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
27.0 - 32.0	6.8850E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	6.7900E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	2.7840E-09	11	7.7490E-18	1.6290E-06	1.1061E+02	1.2250E+04	2.1690E+02
37.0 - 42.0	6.6790E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	6.5540E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	6.4320E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	6.3170E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	6.1990E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	5.9690E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	5.8230E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	5.6740E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	9	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	5.4350E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	5.3470E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	5.2830E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	4.7160E-10	8	2.2240E-19	2.7600E-07	1.4578E+01	2.1270E+02	2.8590E+01
92.0 - 97.0	5.2430E+07	4.4060E-06	1525	4.8950E-06	5.8520E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	1.2021E+09									3.7524E+05	+ OR -	4.9120E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.4370E+07

[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 42. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska based on Transect 14 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	7.1780E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	4.1820E-06	11	1.2620E-11	2.1590E-03	1.5496E+05	1.7380E+10	2.5840E+05
7.0 - 12.0	7.1360E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	6.1030E-08	11	2.9210E-15	3.1510E-05	2.2481E+03	3.9740E+06	3.9070E+03
12.0 - 17.0	7.0770E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	2.4520E-07	11	6.0120E-14	1.2660E-04	8.9578E+03	8.0390E+07	1.7570E+04
17.0 - 22.0	7.0650E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	1.4360E-08	11	1.2490E-16	7.4110E-06	5.2359E+02	1.6670E+05	8.0030E+02
22.0 - 27.0	7.0510E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	1.3050E-07	11	1.7030E-14	6.7360E-05	4.7496E+03	2.2600E+07	9.3180E+03
27.0 - 32.0	7.0400E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	4.1280E-09	11	1.7040E-17	2.1310E-06	1.5003E+02	2.2550E+04	2.9430E+02
32.0 - 37.0	7.0260E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	1.0950E-08	11	1.1980E-16	5.6510E-06	3.9703E+02	1.5790E+05	7.7890E+02
37.0 - 42.0	7.0140E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	1.7910E-07	11	3.0820E-14	9.2460E-05	6.4853E+03	4.0490E+07	1.2470E+04
42.0 - 47.0	7.0010E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	6.9870E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	6.9370E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	6.9160E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	6.8660E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	6.7990E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	6.7410E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	6.6830E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	6.5890E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	6.5070E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	6.4260E+07	4.9940E-06	662	5.5290E-06	5.1630E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	1.3104E+09									1.7847E+05	+ OR -	2.5950E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.4370E+07.
[2] Depth measured by transducer, which was 1 m from surface.

Appendix Table 43. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 15 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4580E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	3.3930E-05	8	2.5340E-10	1.6290E-02	8.8927E+05	1.8510E+11	8.4320E+05
7.0 - 12.0	5.4600E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	2.5380E-06	8	5.5720E-12	1.2190E-03	6.6546E+04	3.8910E+09	1.2230E+05
12.0 - 17.0	5.4590E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	9.0660E-08	8	5.0140E-15	4.3530E-05	2.3760E+03	3.5220E+06	3.6790E+03
17.0 - 22.0	5.4140E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
22.0 - 27.0	5.3500E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	2.3380E-07	8	2.3520E-14	1.1230E-04	6.0061E+03	1.6030E+07	7.8460E+03
27.0 - 32.0	5.2830E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	5.2170E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	5.1550E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	1.2110E-08	8	1.4670E-16	5.8150E-06	2.9974E+02	9.1100E+04	5.9160E+02
42.0 - 47.0	5.0980E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	5.0360E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	1.8230E-09	8	3.3220E-18	8.7510E-07	4.4069E+01	1.9690E+03	8.6970E+01
52.0 - 57.0	4.9530E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	4.8830E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	4.7920E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	4.6750E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	4.5670E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	4.4700E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	4.3110E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	4.1670E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	3.4510E-07	8	1.1910E-13	1.6570E-04	6.9042E+03	4.8330E+07	1.3630E+04
92.0 - 97.0	4.0570E+07	5.3700E-06	88	5.9470E-06	4.8010E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	9.3805E+08									9.7145E+05	+ OR -	8.5220E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 44. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 16 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4610E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	1.0740E-05	10	3.4420E-11	4.4670E-03	2.4393E+05	2.5900E+10	3.1540E+05
7.0 - 12.0	5.4630E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	8.5920E-07	10	3.2910E-13	3.5720E-04	1.9516E+04	2.2190E+08	2.9200E+04
12.0 - 17.0	5.4650E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	7.4290E-08	10	5.5190E-15	3.0890E-05	1.6880E+03	3.2400E+06	3.5280E+03
17.0 - 22.0	5.4330E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
22.0 - 27.0	5.4330E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
27.0 - 32.0	5.4330E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	1.1420E-07	10	9.6240E-15	4.7480E-05	2.5799E+03	5.8230E+06	4.7300E+03
32.0 - 37.0	5.4330E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	2.5420E-08	10	6.4630E-16	1.0570E-05	5.7430E+02	3.7500E+05	1.2000E+03
37.0 - 42.0	5.4330E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	5.4330E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	5.4330E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	5.4120E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	5.3600E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	5.3210E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	5.2820E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	5.2430E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	5.1990E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	5.1520E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	5.1150E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	5.0700E+07	6.2010E-06	48	1.5900E-05	4.1580E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	1.0157E+09									2.6829E+05	+ OR -	3.1680E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 45. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 18 (day survey) integrator output.[1]

Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4520E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	4.4330E-06	8	9.3950E-12	1.2750E-03	6.9511E+04	2.6130E+09	1.0020E+05
7.0 - 12.0	5.3070E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
12.0 - 17.0	5.2010E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	8.1530E-07	8	2.8590E-13	2.3450E-04	1.2197E+04	7.3330E+07	1.6780E+04
17.0 - 22.0	5.1400E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	2.1680E-06	8	1.4520E-12	6.2360E-04	3.2052E+04	3.8170E+08	3.8290E+04
22.0 - 27.0	5.0630E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	1.7710E-06	8	1.1730E-12	5.0930E-04	2.5786E+04	2.9040E+08	3.3400E+04
27.0 - 32.0	4.9500E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	6.4270E-07	8	4.1310E-13	1.8490E-04	9.1501E+03	8.8980E+07	1.8490E+04
32.0 - 37.0	4.7780E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	8	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	4.6290E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	4.4620E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	4.2970E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	1.0830E-08	7	1.1740E-16	3.1160E-06	1.3389E+02	1.9050E+04	2.7050E+02
52.0 - 57.0	4.0680E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	7	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	3.8200E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	3.5980E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	3.3360E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	2.7880E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	1.7310E+07	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	4.1660E+06	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	2	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	0.0000E+00	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	0.0000E+00	8.9640E-06	28	1.1880E-05	2.8760E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	6.9037E+08									1.4883E+05	+ OR -	1.1510E+05

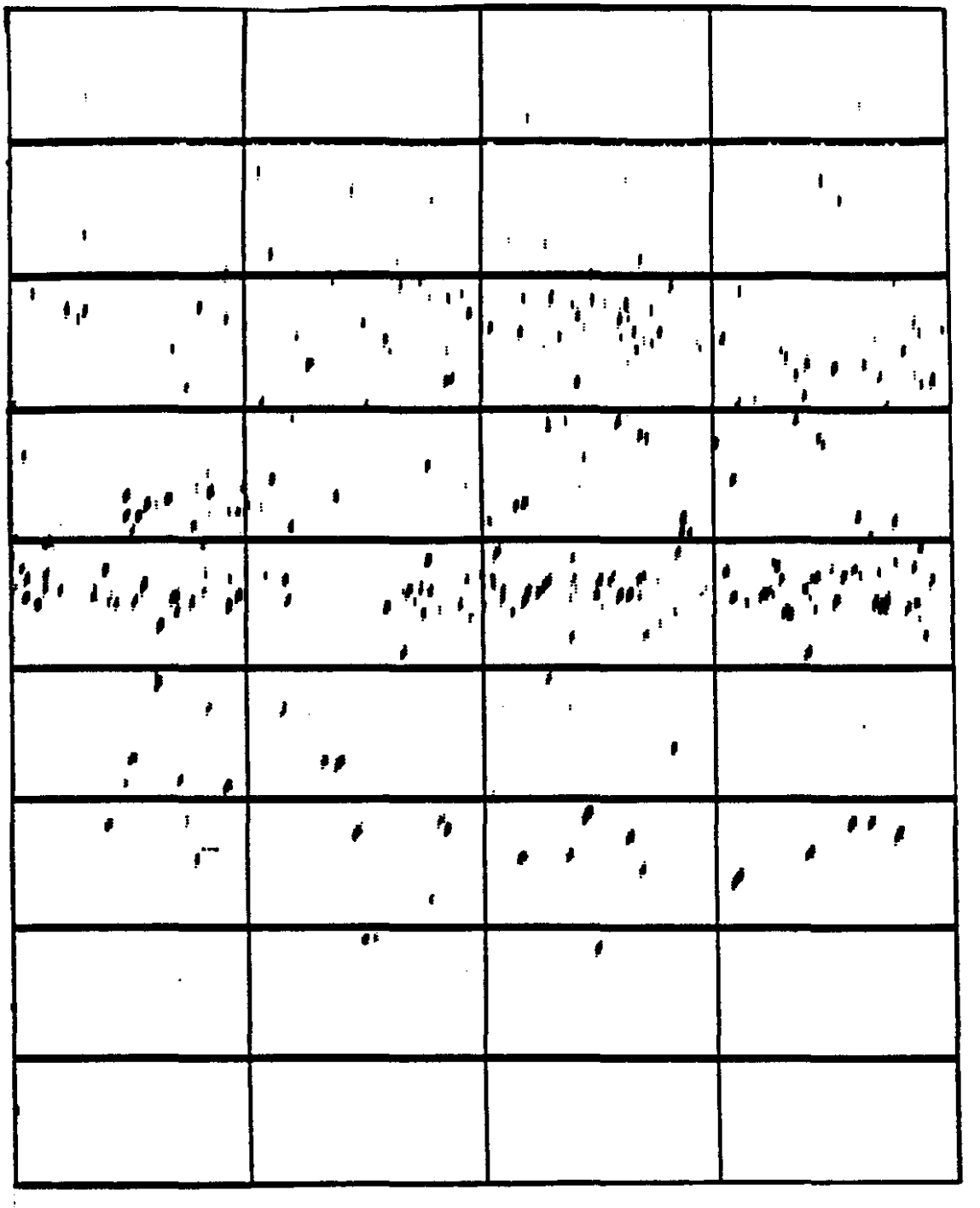
[1] Lake surface area (meters squared) used to calculate stratum volume was 1.09030E+07.
[2] Depth measured below transducer, which was 1 m from surface.

Appendix Table 46. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska based on Transect 19 (day survey) integrator output.[1]

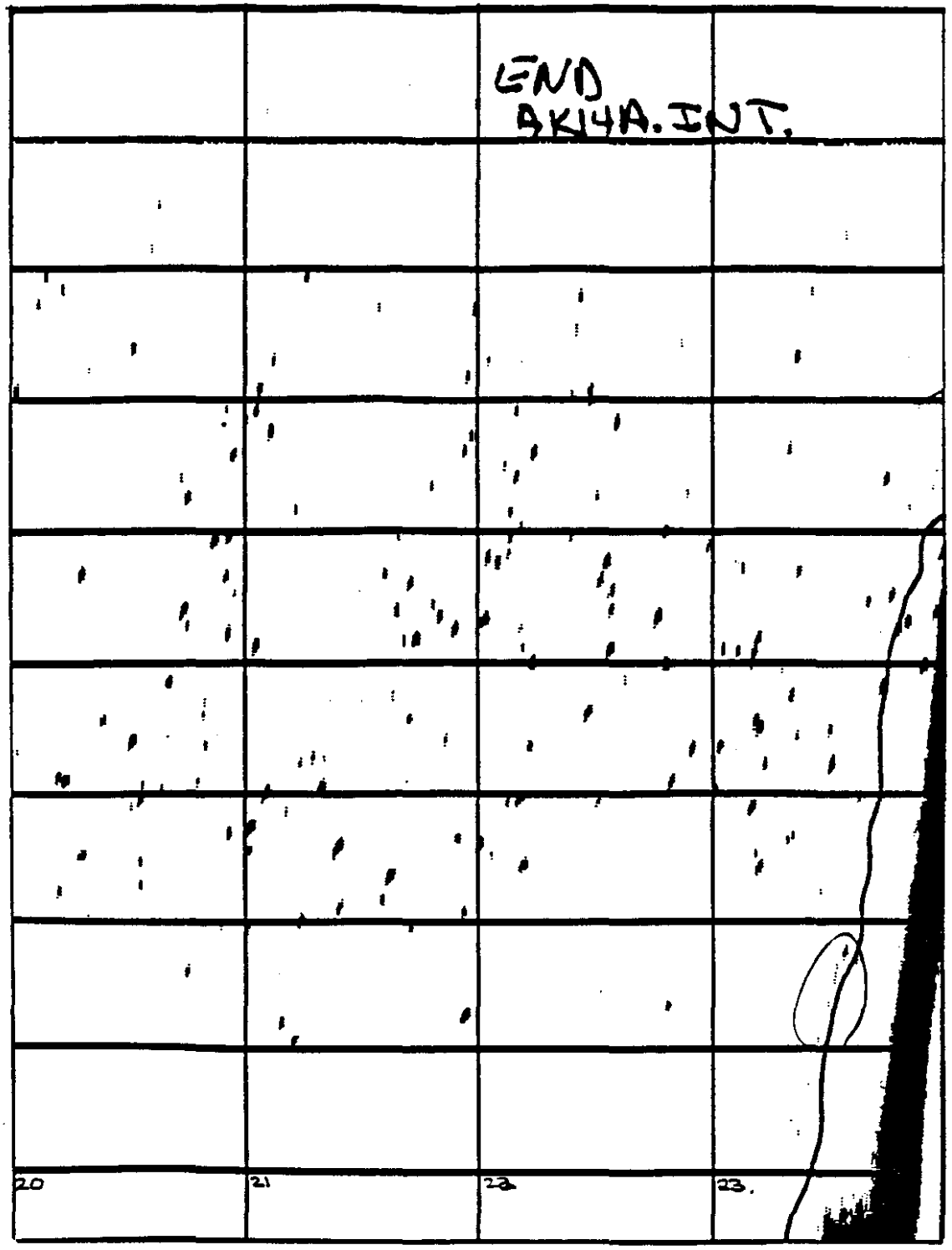
Depth[2] Stratum (m)	Stratum Volume (m^3)	Mean Sigma	Number Echoes Used	Standard Deviation Sigma	A Constant	Integrator Output	Number of Sequences	Mean Integrator Variance	Fish Density (no./m^3)	Estimated Number of Fish	Variance	Confidence Limits (95%)
2.0 - 7.0	5.4630E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	1.2880E-05	12	4.7750E-11	5.7360E-03	3.1334E+05	2.9320E+10	3.3560E+05
7.0 - 12.0	5.4560E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	1.4980E-07	12	2.2440E-14	6.6690E-05	3.6387E+03	1.3390E+07	7.1710E+03
12.0 - 17.0	5.3950E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	12	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
17.0 - 22.0	5.0850E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	1.7060E-07	12	1.5220E-14	7.5970E-05	3.8633E+03	7.9670E+06	5.5320E+03
22.0 - 27.0	4.7630E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	2.7700E-08	11	4.8110E-16	1.2330E-05	5.8731E+02	2.2010E+05	9.1950E+02
27.0 - 32.0	4.2370E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	11	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
32.0 - 37.0	2.9230E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	10	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
37.0 - 42.0	1.7750E+07	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
42.0 - 47.0	7.8480E+05	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	3	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
47.0 - 52.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
52.0 - 57.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
57.0 - 62.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
62.0 - 67.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
67.0 - 72.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
72.0 - 77.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
77.0 - 82.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
82.0 - 87.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
87.0 - 92.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
92.0 - 97.0	0.0000E+00	5.7910E-06	135	7.0500E-06	4.4520E+02	0.0000E+00	0	1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
TOTAL	3.5175E+08									3.2143E+05	+ OR -	3.3570E+05

[1] Lake surface area (meters squared) used to calculate stratum volume was 1.0930E+07

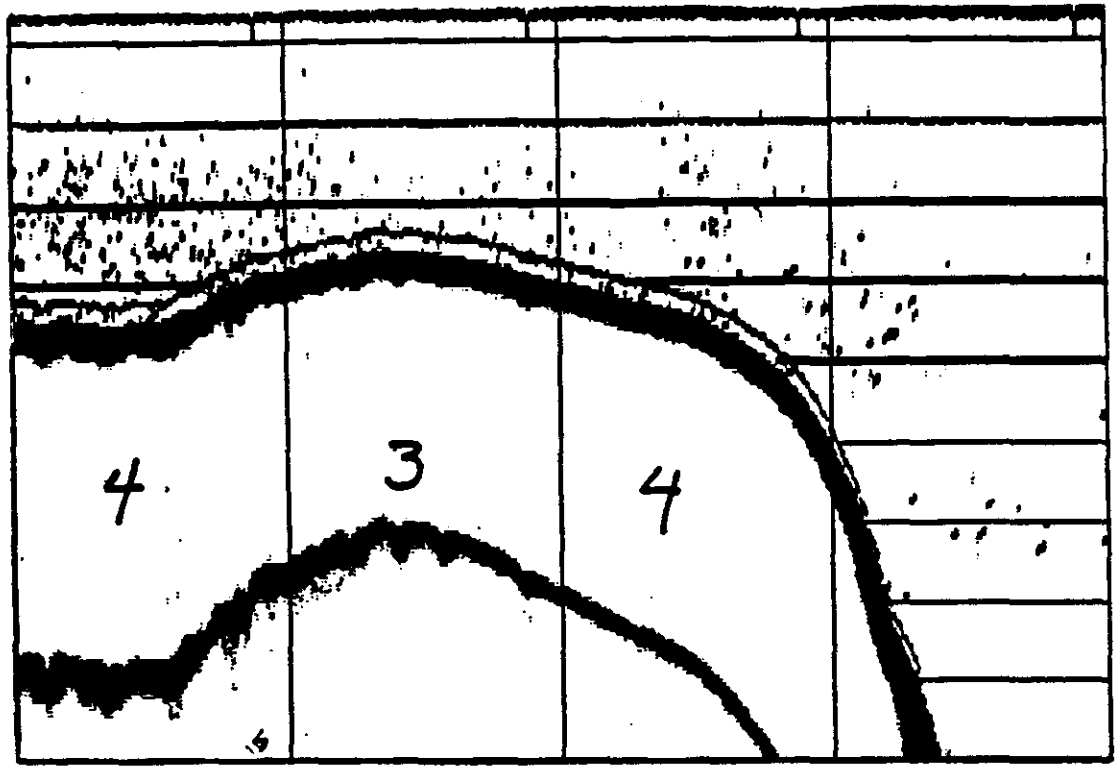
[2] Depth measured below transducer, which was 1 m from surface.



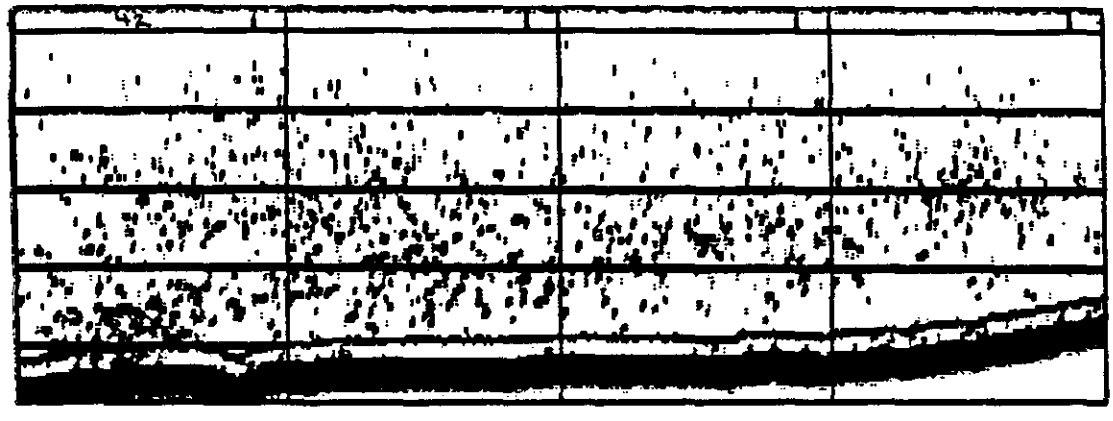
Appendix Figure 1. Echogram of transect 10A (one minute segments 9-12, depth interval 5m) in Kenai Lake (night survey), Alaska, September 1986.



Appendix Figure 2. Echogram of transect 14A (one minute segments 20-23, depth interval 5m) in Kenai Lake (night survey), Alaska, September 1986.



Segments 15 to 17



Segments 42 to 45

Appendix Figure 3. Echogram of transect 1 (one minute segments 15-18 and 42-45, depth interval 5m) in Skilak Lake (night survey), Alaska, October 1986.

Appendix Figure 4. Echogram of transect 4 (one minute segments 33-35, depth interval 5m) in Skilak Lake (night survey), Alaska, October 1986.