# AN ESTIMATE OF JUVENILE FISH DENSITIES IN SKILAK AND KENAI LAKES, ALASKA THROUGH THE USE OF DUAL BEAM HYDROACOUSTIC TECHNIQUES IN 1989

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## INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) initiated investigations in 1972 to assess juvenile sockeye salmon (*Onchorhynchus nerka*) populations rearing in the major lakes of the Kenai River drainage (Figures 1 and 2, Davis et al. 1973). As part of these investigations, juvenile sockeye salmon were collected from Skilak and Kenai Lakes using tow nets to estimate relative abundance, age structure, and growth (Davis et al. 1974, Namtvedt and Friese 1976). However, the limited sampling power of tow netting restricted the usefulness of these data for abundance estimates (Waltemyer 1981). Therefore, in 1986 ADF&G began developing new methodologies using hydroacoustic techniques to assess the rearing success of sockeye salmon in the glacial lake systems of the Kenai River drainage (Tarbox and King 1988a and 1988b).

Since 1986, annual fall hydroacoustic surveys have been conducted in Kenai and Skilak Lakes to develop a time series of juvenile sockeye salmon population estimates. Specific objectives for 1989 field investigation were to: (1) estimate the number and spatial distribution of sockeye salmon juveniles in Kenai and Skilak Lakes; and (2) determine the target strength distribution in both lakes using dual beam hydroacoustic techniques.

## METHODS

Hydroacoustic surveys of Skilak and Kenai Lakes were conducted in late September/October 1989 to assess the number of rearing sockeye salmon that had survived the summer. Since previous investigations of glacial lake systems on the Kenai Peninsula have shown that most sockeye salmon juveniles occur near the surface during daylight hours (Tarbox and King 1988a, Thorne 1981), surveys were conducted at night to maximize targets available to the gear.

A stratified random sampling design was used for 1989 surveys to disperse sampling effort and provide an acceptable means of calculating sampling error (H. Gieger, ADF&G, Comm. Fish., Juneau, personal communication). Each lake was divided into subbasins or areas and survey transects were randomly selected within each area. The total sampling effort in each lake was limited to the number of transects which could be made during the hours of darkness on one night. Because of the size of Skilak Lake, a total of 12 transects could be surveyed within three areas (Figure 3). In Kenai Lake, a total of 20 transects could be surveyed within five areas (Figure 4). Due to adverse weather conditions the Skilak Lake survey took more than a single night to complete and was conducted on 22 and 24 October. The Kenai Lake survey was completed on 28 September.

The hydroacoustic equipment used for 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 pulse repetition rate was 5 pulses/second. Additional acoustic parameters used during data collection and



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processing are presented in Appendix A.1. The system was calibrated by *Biosonics, Inc.* prior to and following the surveys. The entire system was powered by 12 volt batteries, and the equipment was housed in a 6.7 m vessel powered by a 150 hp outboard motor. Vessel speed along each transect was estimated at 2.5 m/s. Both ends of each transect were marked with flashing lights prior to darkness. The towed body remained approximately 1 m below the water surface during surveys.

Dual beam data recorded on video cassette tape were processed through a *Biosonics, Inc.* Model 181 dual beam processor (King and Tarbox 1988). A returning pulse was accepted as a valid target if the amplitude was either below the bottom threshold of 5000 (mV) (-39.3 dB) or above the counting threshold of 200 mV (-67.3 dB). Single targets were separated from multiple targets if the pulse width was within 20% of the transmitted pulse width at -6 dB and -18 dB. The maximum half angle selected was 4°.

Data generated by the dual beam processor were transferred to microcomputer data files for analysis using a *Biosonics, Inc.* software program named TS112 (version 1.116). Computation of mean target strengths and backscattering cross sections were made from individual echoes and printed out by 5 m depth intervals.

Estimates of fish density were made for each transect by echo integration using a *Biosonics, Inc.* Model 120 echo integrator. Correction from the 40 log(R) setting used during data collection to 20 log(R) used for data processing was accomplished by adjusting the B constant value for each depth stratum (Appendix A.1). The TVG crossover for the system was at 13.0 m. Data were stratified by depth for analysis by 5 m increments starting 2 m below the transducer (3 m below the water surface). Data were accepted for processing to a maximum depth of 102 m below the transducer in Kenai and Skilak Lakes because visual examination of oscilloscope traces and chart recordings indicated that few fish were present below this depth.

The echo integrator compiled data in 1 min. sequences along each transect and sent the resultant outputs to computer files for further reduction and analysis using *Biosonics, Inc.* software entitled Crunch (verson 2.45). Raw integrator outputs were edited to remove data which resulted from false bottom echoes. Where this occurred, the missing fish density estimates for the strata were estimated using the average of adjacent sequences. Overall fish density was obtained by calculating the average edited integrator output value across the transect for each depth strata, and then multiplying these averages by the integrator scaling factor derived from the mean backscattering cross section value (obtained from the TS112 program). Mean backscattering cross section values were calculated for each depth strata using data for all transects combined from Kenai or Skilak Lake.

Total fish abundance in each lake was the sum of the estimated abundance for each of the individual areas (Figures 3 and 4). Transects located within the same area were treated as replicates to calculate the mean and variance of fish density for each area. The total number of fish per transect consisted of the number of fish counted by hydroacoustic equipment plus an estimate of fish unavailable to the hydroacoustic gear because of their location within the water column. Additions for fish within 3 m of the surface were estimated from measured fish densities in the 2-7 m depth strata. Numbers of fish near the bottom were estimated by multiplying average fish densities measured just above



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the bottom times the volume of water not sampled. A bottom window of 2 m was selected during data processing for these calculations.

In an effort to quantify species composition of measured fish targets, a mid-water trawl sampling program was conducted in Skilak Lake on 26 September and and 12 October, 1989. A similar program was conducted in Kenai Lake on 13 and 17 October 1989. The trawl mouth opening was 6.1 m by 3.1 m, and trawl length was 14.9 m. Mesh size decreased from 7.62 cm at the mouth to 0.32 cm at the cod end liner. A total of 310 and 195 minutes of sampling was completed for Skilak and Kenai Lakes, respectively. Sampling efforts were concentrated in areas which hydroacoustic surveys showed to have relatively high fish abundance. All fish captured were enumerated and identified, and preserved in 10% formalin. In the laboratory, specimens were measured to the nearest mm (fork length), weighed to the nearest 0.1 g, and aged from scale samples using criteria outlined by Mosher (1969).

## RESULTS

During the survey a total of 13,319 and 23,804 echoes were used to estimate target strength distributions in Kenai and Skilak Lakes, respectively. Mean target strength for Kenai Lake was -57.31 dB. As in past years, calculated mean target strengths decreased with depth (Appendix A.2). Near surface measurements were -53.75 dB in contrast to -59.23 dB at a depth of 47 m. In Skilak Lake the mean target strength was -56.81 dB with the near surface mean of -52.99 dB decreasing to -58.19 dB at 47 m. However, at depths greater than 47 m target strengths were within one dB of the mean and most similar to those in the upper strata (Appendix A.3).

Individual transect data and estimated numbers of fish for each area surveyed by hydroacoustic techniques are presented in Appendix A.4 to A.35 and summarized in Table 1. Estimates of fish abundance in surface (Table 2) and bottom areas (Tables 3 and 4) not available to the hydroacoustic gear contributed up to 41% of an individual transect estimate (Kenai Lake Area 1, transect 1). However, in most cases the surface and bottom estimates contributed less than 20% to the total transect estimate. The total estimated number of fish in both lakes was 26,050,300 fish (Table 5). Approximately 13%, or 3,405,300 fish were found in Kenai Lake while the remaining 22,645,000 fish inhabited Skilak Lake.

Approximately 55.5% of the fish in Skilak Lake were located in the western end of the lake (Area 1) which comprised 26.7% of the lake volume (Table 6). Within Kenai Lake 55.3% of the fish were located in Areas 2 and 3 which comprised 44.8% of the lake volume. Lower densities were observed at the upper ends of both lakes.

The depth distribution of fish between and within transects was variable in Kenai Lake (Figures 5 -9). The maximum density of fish observed in Kenai Lake was .017 fish/$m^3$ and occurred at depths between 32 m and 37 m along transect 1 within Area 1 (Figure 5). Only transect 1 within Area 5 indicated decreasing fish density from the surface with depth (Figure 9). Maximum density of fish observed varied from the 7 m - 12 m strata to the 32 m - 37 m strata along the remaining transects (Figures 6 - 8).



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The maximum fish density observed in Skilak Lake was .038 fish/$m^3$ and occurred at depths between 17 m and 22 m along transect 1a within Area 1 (Figure 10). Maximum densities of fish were recorded in the 22 m to 27 m depth range for six of the 12 transects. Three transects had maximum densities deeper and three shallower in the water column. There was no indication that maximum density occurred near the surface (Figures 10 -12).

A total of 855 and 118 fish were captured during netting operations in Skilak and Kenai Lakes, respectively (Appendix A.36). Sockeye salmon dominated catches and represented 96.5% and 94.1% of the total catches for Skilak and Kenai Lake, respectively.

Age-0 sockeye salmon made up 57.9% of the Skilak Lake sample, while age-1 sockeye comprised 42.1%. In Kenai Lake age-1 sockeye salmon made up 58.9% of the sample while age-0 comprised 41.1%. Length and weight frequencies for each age class were well defined in both lakes (Figures 13 and 14). In general, the size of both age classes were small with the mean length and weight of age-0 sockeye salmon in Skilak Lake recorded at 51 mm and 1.2 g, respectively. Age-1 fish in Skilak Lake in October were measured at 67 mm and 2.6 g. Kenai Lake sockeye salmon were generally smaller at age than those collected in Skilak Lake (Table 7).

Based on species and age composition data from trawl samples, the number of juvenile sockeye salmon in both lakes was estimated to be 25,057,000. Of this total, 13,970,000 were age-0 sockeye salmon produced by the 1988 spawning population while 11,087,000 were age-1 sockeye salmon produced by the 1987 spawning population (Table 8).

## DISCUSSION

The 1989 hydroacoustic survey of juvenile sockeye salmon rearing in Skilak and Kenai Lakes represents the fourth year production in these systems was examined. The study period includes the greatest historical adult sockeye salmon spawning escapement (1.4 million in 1987) as well as the third greatest escapement (0.85 million fish in 1988). Juvenile sockeye salmon production from both of these escapements was very different. The 1987 brood year produced about 37 million age-0 juveniles. Many of these juveniles remained a second year in freshwater prior to smolting (11 million fish of the 25 million juvenile sockeye rearing in the fall of 1989 were age-1 sockeye salmon). In contrast, only 14 million juvenile sockeye salmon were produced from the 1988 escapement. This is the second lowest estimate of age-0 production measured during the four years of the study (Figure 15).

Tarbox and King (1989) noted that the size of juvenile sockeye salmon rearing in Kenai and Skilak Lakes in 1988 was relatively small, and expressed concern that significant over-winter mortality might occur. However, over-winter mortality was low since 24 million age-1 smolt were produced by the 1987 brood year (King, ADF&G, Soldotna, personal communication). The combined over-winter survival from the 1987 brood year was about 95% (24 million smolt and 11 million age-1 juveniles rearing in freshwater). However, since a few systems (e.g. Russian River lakes) which contributed to the total smolt estimate were not



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included in the juvenile work, the total number of rearing juvenile sockeye salmon in the Kenai River system was actually greater than 37 million. Historical records of adult returns would suggest that in most years these systems produce between 5 and 20% of the total sockeye salmon adult return (King and Tarbox 1989).

The size of age-0 juvenile sockeye salmon rearing in Kenai and Skilak Lakes in 1989 was similar to 1988. However, examination of data collected for these lake systems in the late 70's (Davis et al. 1973, Davis et al. 1974, Namtvedt and Friese 1976, and Waltemyer 1981) indicated that the 1988 and 1989 average length was approximately 10 mm smaller and the average weight 0.7 g lower than observed in previous studies (Figures 16 and 17). It is possible, based on the size data collected for the 1987 brood year, that a significant portion of the 1988 brood year production could rear a second year in freshwater.

Hydroacoustic studies of juvenile sockeye salmon rearing in the Kenai River system will enhance our ability to define or predict long term production potential. It is possible that large spawning escapements (i.e., in excess of 1 million spawners) such as those observed in 1987, 1988, and 1989 may produce more fry than can be supported by the rearing environments of Kenai and Skilak Lakes. Possible implications for sockeye salmon fry are reduced growth, increased freshwater mortality, reduced size of smolt, increased juvenile carryover percentage, and increased marine mortality. Impacts of high fry densities on limited food resources could extend over several years and affect survival of juveniles from subsequent brood years (commonly termed "brood year interactions"). Carpenter et al. (1985) presents a general discussion of this concept of cascading trophic interactions. However, Koenings and Burkett (1987) have provided some evidence for the occurrence of density independent factors on sockeye salmon fry survival and growth in glacial lake systems which resulted in similar responses. Therefore, any speculation regarding the mechanisms influencing survival and condition of rearing juvenile sockeye salmon in Kenai and Skilak Lakes would be premature. Koenings (ADF&G, F.R.E.D., Soldotna, pers. comm.) has collected liminological data on Skilak and Kenai Lakes, but further examination of this issue must await completion of these analyses.

Results of hydroacoustic surveys also need to be more fully examined. For example, the decrease in target strength with depth noted in 1989 was also present in data collected during previous years. Some reasons for this trend have been discussed in previous reports (Tarbox and King 1988a and 1988b). Measurements of a standard target deployed at increasing depths are planned for 1990 to resolve this issue.



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Table 1. Estimated number of fish available to the hydroacoustic equipment in Skilak and Kenai Lakes, Alaska in the fall of 1989.

| Lake | Area | Transect | Estimated Number of Fish |
|---|---|---|---|
| Skilak | 1 | 1 | 9.2061E+06 |
| | | 2 | 9.7652E+06 |
| | | 3 | 8.9331E+06 |
| | | 1a | 1.3759E+07 |
| | 2 | 0 | 5.8136E+06 |
| | | 1 | 5.0389E+06 |
| | | 2 | 6.6589E+06 |
| | | 3 | 5.2249E+06 |
| | 3 | 1 | 6.0751E+06 |
| | | 2 | 4.1977E+06 |
| | | 3 | 2.8011E+06 |
| | | 4 | 2.2269E+06 |
| Kenai | 1 | 1 | 4.1567E+05 |
| | | 2 | 5.9272E+05 |
| | | 3 | 2.8812E+05 |
| | | 4 | 3.1089E+05 |
| | 2 | 1 | 1.1229E+06 |
| | | 2 | 1.1264E+06 |
| | | 3 | 7.4035E+05 |
| | | 4 | 9.7395E+05 |
| | 3 | 1 | 9.5741E+05 |
| | | 2 | 6.8316E+05 |
| | | 3 | 9.2824E+05 |
| | | 4 | 7.0837E+05 |
| | 4 | 1 | 4.8614E+05 |
| | | 2 | 5.7193E+05 |
| | | 3 | 5.7576E+05 |
| | | 4 | 9.3654E+05 |
| | 5 | 1 | 4.2524E+05 |
| | | 2 | 2.0784E+05 |
| | | 3 | 4.2345E+05 |
| | | 4 | 1.8162E+05 |



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Table 2. Estimated number of fish not available to the hydroacoustic equipment because of surface orientation in Skilak and Kenai Lakes, Alaska during the fall of 1989.

| Lake | Area | Transect | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| Skilak | 1 | 1 | 2.1810E-03 | 1.2909E+08 | 2.8155E+05 |
| | | 2 | 4.1450E-03 | 1.2909E+08 | 5.3508E+05 |
| | | 3 | 1.1480E-02 | 1.2909E+08 | 1.4820E+06 |
| | | 1a | 7.0970E-03 | 1.2909E+08 | 9.1615E+05 |
| | 2 | 0 | 6.1900E-04 | 1.0038E+08 | 6.2135E+04 |
| | | 1 | 4.2590E-04 | 1.0038E+08 | 4.2752E+04 |
| | | 2 | 7.5610E-04 | 1.0038E+08 | 7.5897E+04 |
| | | 3 | 1.2520E-03 | 1.0038E+08 | 1.2568E+05 |
| | 3 | 1 | 2.6550E-03 | 6.7500E+07 | 1.7921E+05 |
| | | 2 | 8.8490E-04 | 6.7500E+07 | 5.9731E+04 |
| | | 3 | 1.3410E-03 | 6.7500E+07 | 9.0518E+04 |
| | | 4 | 4.1920E-04 | 6.7500E+07 | 2.8296E+04 |
| Kenai | 1 | 1 | 1.7010E-03 | 2.3160E+07 | 3.9395E+04 |
| | | 2 | 5.1640E-05 | 2.3160E+07 | 1.1960E+03 |
| | | 3 | 7.4160E-05 | 2.3160E+07 | 1.7175E+03 |
| | | 4 | 0.0000E+00 | 2.3160E+07 | 0.0000E+00 |
| | 2 | 1 | 1.4310E-03 | 3.5730E+07 | 5.1130E+04 |
| | | 2 | 8.5000E-04 | 3.5730E+07 | 3.0371E+04 |
| | | 3 | 1.0430E-03 | 3.5730E+07 | 3.7266E+04 |
| | | 4 | 1.0210E-04 | 3.5730E+07 | 3.6480E+03 |
| | 3 | 1 | 9.1160E-04 | 3.1620E+07 | 2.8825E+04 |
| | | 2 | 8.7990E-04 | 3.1620E+07 | 2.7822E+04 |
| | | 3 | 1.1430E-03 | 3.1620E+07 | 3.6142E+04 |
| | | 4 | 2.4240E-03 | 3.1620E+07 | 7.6647E+04 |
| | 4 | 1 | 2.4550E-04 | 4.3110E+07 | 1.0584E+04 |
| | | 2 | 7.3170E-04 | 4.3110E+07 | 3.1544E+04 |
| | | 3 | 2.6290E-04 | 4.3110E+07 | 1.1334E+04 |
| | | 4 | 1.0650E-03 | 4.3110E+07 | 4.5912E+04 |
| | 5 | 1 | 2.3120E-03 | 3.2790E+07 | 7.5810E+04 |
| | | 2 | 2.7690E-04 | 3.2790E+07 | 9.0796E+03 |
| | | 3 | 1.5890E-05 | 3.2790E+07 | 5.2103E+02 |
| | | 4 | 4.4340E-05 | 3.2790E+07 | 1.4539E+03 |



ACE 6208348

Table 3 . Estimated number of fish not available to the hydroacoustic equipment because of bottom orientation in Skilak Lake,Alaska during the fall of 1989.

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 1 | 1 | 2-7 | 2.1810E-03 | 1.8933E+07 | 4.1293E+04 |
| | | 7-12 | 7.0290E-03 | 2.4097E+07 | 1.6938E+05 |
| | | 12-17 | 1.4980E-02 | 3.2703E+07 | 4.8989E+05 |
| | | 17-22 | 2.2350E-02 | 1.5491E+07 | 3.4622E+05 |
| | | 22-27 | 2.3160E-02 | 3.4424E+06 | 7.9726E+04 |
| | | 27-32 | 1.1930E-02 | 3.4424E+06 | 4.1068E+04 |
| | | 32-37 | 6.6550E-03 | 3.4424E+06 | 2.2909E+04 |
| | | 37-42 | 1.5640E-03 | 3.4424E+06 | 5.3839E+03 |
| | | 42-47 | 6.4430E-04 | 3.4424E+06 | 2.2179E+03 |
| | | 47-52 | 1.8300E-04 | 5.1636E+06 | 9.4494E+02 |
| | | 52-57 | 1.7920E-04 | 3.4424E+06 | 6.1688E+02 |
| | | 57-62 | 4.2420E-05 | 3.4424E+06 | 1.4603E+02 |
| | | 62-67 | 9.6430E-05 | 3.4424E+06 | 3.3195E+02 |
| | | 67-72 | 8.7630E-05 | 5.1636E+06 | 4.5249E+02 |
| | | 72-77 | 5.7060E-05 | 3.4424E+06 | 1.9642E+02 |
| | | 77-82 | 5.9980E-05 | 3.4424E+06 | 2.0648E+02 |
| | | 82-87 | 2.6540E-05 | 3.4424E+06 | 9.1361E+01 |
| | | 87-92 | 1.7080E-05 | 5.1636E+06 | 8.8194E+01 |
| | | 92-97 | 4.3560E-06 | 8.6060E+06 | 3.7488E+01 |
| | | 97-102 | 4.3770E-07 | 1.8933E+07 | 8.2871E+00 |
| | | TOTAL | | | 1.2012E+06 |
| 1 | 2 | 2-7 | 4.1450E-03 | 2.1515E+07 | 8.9180E+04 |
| | | 7-12 | 6.5430E-03 | 2.1515E+07 | 1.4077E+05 |
| | | 12-17 | 7.5220E-03 | 5.3788E+06 | 4.0459E+04 |
| | | 17-22 | 1.0250E-02 | 5.3788E+06 | 5.5132E+04 |
| | | 22-27 | 1.6380E-02 | 2.6894E+06 | 4.4052E+04 |
| | | 27-32 | 1.4440E-02 | 5.3788E+06 | 7.7669E+04 |
| | | 32-37 | 6.3810E-03 | 5.3788E+06 | 3.4322E+04 |
| | | 37-42 | 3.2880E-03 | 2.6894E+06 | 8.8427E+03 |
| | | 42-47 | 1.0140E-03 | 5.3788E+06 | 5.4541E+03 |
| | | 47-52 | 2.3630E-04 | 5.3788E+06 | 1.2710E+03 |
| | | 52-57 | 1.1000E-04 | 5.3788E+06 | 5.9166E+02 |
| | | 57-62 | 6.7170E-05 | 8.0681E+06 | 5.4194E+02 |
| | | 62-67 | 1.1110E-04 | 8.0681E+06 | 8.9637E+02 |
| | | 67-72 | 2.3030E-04 | 1.0758E+07 | 2.4775E+03 |
| | | 72-77 | 1.1810E-04 | 1.0758E+07 | 1.2705E+03 |
| | | 77-82 | 0.0001107 | 1.3447E+07 | 1.4886E+03 |
| | | 82-87 | 2.2400E-04 | 1.6136E+07 | 3.6145E+03 |
| | | 87-92 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 92-97 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 97-102 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | TOTAL | | | 5.0804E+05 |

- Continued -



ACE 6208349

Table 3. (p 2 of 6)

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 1 | 3 | 2-7 | 1.1480E-02 | 2.1515E+07 | 2.4699E+05 |
| | | 7-12 | 1.0850E-02 | 3.2273E+07 | 3.5016E+05 |
| | | 12-17 | 1.6450E-02 | 2.1515E+07 | 3.5392E+05 |
| | | 17-22 | 3.7020E-02 | 3.7651E+07 | 1.3938E+06 |
| | | 22-27 | 1.9600E-02 | 0.0000E+00 | 0.0000E+00 |
| | | 27-32 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 32-37 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 37-42 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 42-47 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 47-52 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 52-57 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 57-62 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 62-67 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 67-72 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 72-77 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 77-82 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 82-87 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 87-92 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 92-97 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 97-102 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | TOTAL | | | 2.3449E+06 |
| 1 | a | 2-7 | 7.0970E-03 | 2.0773E+07 | 1.4743E+05 |
| | | 7-12 | 9.5530E-03 | 2.0773E+07 | 1.9845E+05 |
| | | 12-17 | 1.4190E-02 | 8.9028E+06 | 1.2633E+05 |
| | | 17-22 | 3.8230E-02 | 1.4838E+07 | 5.6725E+05 |
| | | 22-27 | 1.7360E-02 | 8.9028E+06 | 1.5455E+05 |
| | | 27-32 | 9.7160E-03 | 1.1870E+07 | 1.1533E+05 |
| | | 32-37 | 2.5110E-03 | 5.9352E+06 | 1.4903E+04 |
| | | 37-42 | 1.5760E-03 | 1.1870E+07 | 1.8708E+04 |
| | | 42-47 | 5.6520E-04 | 5.9352E+06 | 3.3546E+03 |
| | | 47-52 | 4.7860E-04 | 8.9028E+06 | 4.2609E+03 |
| | | 52-57 | 6.1790E-04 | 8.9028E+06 | 5.5010E+03 |
| | | 57-62 | 2.1220E-04 | 2.3741E+07 | 5.0378E+03 |
| | | 62-67 | 5.9650E-05 | 0.0000E+00 | 0.0000E+00 |
| | | 67-72 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 72-77 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 77-82 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 82-87 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 87-92 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 92-97 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 97-102 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | TOTAL | | | 1.3611E+06 |

- Continued -



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Table 3. (p 3 of 6)

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 2 | 1 | 2-7 | 4.2590E-04 | 2.0279E+06 | 8.6367E+02 |
| | | 7-12 | 6.0660E-04 | 2.0279E+06 | 1.2301E+03 |
| | | 12-17 | 2.7670E-03 | 2.0279E+06 | 5.6111E+03 |
| | | 17-22 | 5.8490E-03 | 2.0279E+06 | 1.1861E+04 |
| | | 22-27 | 7.1840E-03 | 2.0279E+06 | 1.4568E+04 |
| | | 27-32 | 6.1580E-03 | 1.0139E+07 | 6.2438E+04 |
| | | 32-37 | 4.2610E-03 | 1.0139E+07 | 4.3204E+04 |
| | | 37-42 | 1.9720E-03 | 8.1115E+06 | 1.5996E+04 |
| | | 42-47 | 9.2550E-04 | 8.1115E+06 | 7.5072E+03 |
| | | 47-52 | 2.4910E-04 | 6.0836E+06 | 1.5154E+03 |
| | | 52-57 | 1.2240E-04 | 4.0558E+06 | 4.9642E+02 |
| | | 57-62 | 9.2290E-05 | 4.0558E+06 | 3.7431E+02 |
| | | 62-67 | 1.1040E-04 | 4.0558E+06 | 4.4776E+02 |
| | | 67-72 | 6.6910E-05 | 4.0558E+06 | 2.7137E+02 |
| | | 72-77 | 7.1420E-05 | 4.0558E+06 | 2.8966E+02 |
| | | 77-82 | 2.9370E-05 | 4.0558E+06 | 1.1912E+02 |
| | | 82-87 | 8.2270E-06 | 6.0836E+06 | 5.0050E+01 |
| | | 87-92 | 4.8950E-06 | 6.0836E+06 | 2.9779E+01 |
| | | 92-97 | 2.9670E-06 | 6.0836E+06 | 1.8050E+01 |
| | | 97-102 | 5.4970E-06 | 6.0836E+06 | 3.3442E+01 |
| | | TOTAL | | | 1.6693E+05 |
| 2 | 2 | 2-7 | 7.5610E-04 | 1.4871E+06 | 1.1244E+03 |
| | | 7-12 | 2.0860E-03 | 1.4871E+06 | 3.1021E+03 |
| | | 12-17 | 4.8720E-03 | 1.4871E+06 | 7.2452E+03 |
| | | 17-22 | 9.1320E-03 | 1.0410E+07 | 9.5062E+04 |
| | | 22-27 | 9.9760E-03 | 8.9227E+06 | 8.9013E+04 |
| | | 27-32 | 9.5070E-03 | 5.9484E+06 | 5.6552E+04 |
| | | 32-37 | 4.8720E-03 | 5.9484E+06 | 2.8981E+04 |
| | | 37-42 | 2.7080E-03 | 5.9484E+06 | 1.6108E+04 |
| | | 42-47 | 7.7720E-04 | 4.4613E+06 | 3.4673E+03 |
| | | 47-52 | 1.7620E-04 | 5.9484E+06 | 1.0481E+03 |
| | | 52-57 | 1.5560E-04 | 7.4356E+06 | 1.1570E+03 |
| | | 57-62 | 1.0590E-04 | 4.4613E+06 | 4.7246E+02 |
| | | 62-67 | 2.4710E-04 | 5.9484E+06 | 1.4699E+03 |
| | | 67-72 | 1.2850E-04 | 4.4613E+06 | 5.7328E+02 |
| | | 72-77 | 7.5510E-05 | 7.4356E+06 | 5.6146E+02 |
| | | 77-82 | 6.6860E-05 | 5.9484E+06 | 3.9771E+02 |
| | | 82-87 | 1.0240E-05 | 5.9484E+06 | 6.0912E+01 |
| | | 87-92 | 4.7110E-06 | 2.9742E+06 | 1.4012E+01 |
| | | 92-97 | 1.5200E-06 | 2.9742E+06 | 4.5208E+00 |
| | | 97-102 | 1.9670E-06 | 2.9742E+06 | 5.8503E+00 |
| | | TOTAL | | | 3.0642E+05 |

- Continued -



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Table 3. (p 4 of 6)

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 2 | 3 | 2-7 | 1.2520E-03 | 3.1126E+06 | 3.8969E+03 |
| | | 7-12 | 2.1580E-03 | 7.7814E+06 | 1.6792E+04 |
| | | 12-17 | 3.7360E-03 | 3.1126E+06 | 1.1629E+04 |
| | | 17-22 | 8.5340E-03 | 3.1126E+06 | 2.6563E+04 |
| | | 22-27 | 8.3370E-03 | 6.2251E+06 | 5.1899E+04 |
| | | 27-32 | 5.3510E-03 | 7.7814E+06 | 4.1638E+04 |
| | | 32-37 | 2.8180E-03 | 9.3377E+06 | 2.6314E+04 |
| | | 37-42 | 1.2290E-03 | 6.2251E+06 | 7.6507E+03 |
| | | 42-47 | 5.7670E-04 | 1.2450E+07 | 7.1800E+03 |
| | | 47-52 | 1.2150E-04 | 6.2251E+06 | 7.5635E+02 |
| | | 52-57 | 7.6590E-05 | 3.1126E+06 | 2.3839E+02 |
| | | 57-62 | 6.0260E-05 | 4.6688E+06 | 2.8134E+02 |
| | | 62-67 | 1.0510E-04 | 4.6688E+06 | 4.9069E+02 |
| | | 67-72 | 5.5330E-05 | 4.6688E+06 | 2.5833E+02 |
| | | 72-77 | 6.7340E-05 | 4.6688E+06 | 3.1440E+02 |
| | | 77-82 | 1.4030E-05 | 4.6688E+06 | 6.5504E+01 |
| | | 82-87 | 1.4200E-05 | 6.2251E+06 | 8.8397E+01 |
| | | 87-92 | 4.8860E-06 | 6.2251E+06 | 3.0416E+01 |
| | | 92-97 | 4.8580E-06 | 6.2251E+06 | 3.0242E+01 |
| | | 97-102 | 1.7930E-06 | 7.7814E+06 | 1.3952E+01 |
| | | TOTAL | | | 1.9613E+05 |
| 2 | 0 | 2-7 | 6.1900E-04 | 1.9565E+06 | 1.2111E+03 |
| | | 7-12 | 3.8550E-03 | 3.9130E+06 | 1.5085E+04 |
| | | 12-17 | 3.9320E-03 | 3.9130E+06 | 1.5386E+04 |
| | | 17-22 | 7.0860E-03 | 3.9130E+06 | 2.7728E+04 |
| | | 22-27 | 8.1130E-03 | 3.9130E+06 | 3.1747E+04 |
| | | 27-32 | 5.3700E-03 | 3.9130E+06 | 2.1013E+04 |
| | | 32-37 | 3.1670E-03 | 5.8696E+06 | 1.8589E+04 |
| | | 37-42 | 1.6760E-03 | 3.9130E+06 | 6.5583E+03 |
| | | 42-47 | 8.2630E-04 | 3.9130E+06 | 3.2333E+03 |
| | | 47-52 | 2.6260E-04 | 5.8696E+06 | 1.5413E+03 |
| | | 52-57 | 2.7880E-04 | 3.9130E+06 | 1.0910E+03 |
| | | 57-62 | 1.0310E-03 | 3.9130E+06 | 4.0343E+03 |
| | | 62-67 | 1.4140E-04 | 3.9130E+06 | 5.5330E+02 |
| | | 67-72 | 1.1720E-04 | 5.8696E+06 | 6.8791E+02 |
| | | 72-77 | 1.5920E-05 | 3.9130E+06 | 6.2296E+01 |
| | | 77-82 | 5.4400E-05 | 3.9130E+06 | 2.1287E+02 |
| | | 82-87 | 2.7550E-05 | 5.8696E+06 | 1.6171E+02 |
| | | 87-92 | 5.1960E-06 | 5.8696E+06 | 3.0498E+01 |
| | | 92-97 | 3.7090E-08 | 5.8696E+06 | 2.1770E-01 |
| | | 97-102 | 4.1280E-07 | 3.9130E+06 | 1.6153E+00 |
| | | TOTAL | | | 1.4893E+05 |

- Continued -



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Table 3. (p 5 of 6)

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 3 | 1 | 2-7 | 2.6550E-03 | 0.0000E+00 | 0.0000E+00 |
| | | 7-12 | 2.0700E-03 | 0.0000E+00 | 0.0000E+00 |
| | | 12-17 | 3.2920E-03 | 0.0000E+00 | 0.0000E+00 |
| | | 17-22 | 3.9240E-03 | 4.2857E+06 | 1.6817E+04 |
| | | 22-27 | 7.4210E-03 | 4.2857E+06 | 3.1804E+04 |
| | | 27-32 | 1.6840E-02 | 4.2857E+06 | 7.2171E+04 |
| | | 32-37 | 8.0390E-03 | 4.2857E+06 | 3.4453E+04 |
| | | 37-42 | 4.6190E-03 | 4.2857E+06 | 1.9796E+04 |
| | | 42-47 | 1.8720E-03 | 4.2857E+06 | 8.0229E+03 |
| | | 47-52 | 9.8690E-04 | 4.2857E+06 | 4.2296E+03 |
| | | 52-57 | 6.3420E-04 | 4.2857E+06 | 2.7180E+03 |
| | | 57-62 | 7.7460E-04 | 8.5714E+06 | 6.6394E+03 |
| | | 62-67 | 6.2430E-04 | 8.5714E+06 | 5.3511E+03 |
| | | 67-72 | 4.7790E-04 | 1.2857E+07 | 6.1444E+03 |
| | | 72-77 | 3.1270E-04 | 1.2857E+07 | 4.0204E+03 |
| | | 77-82 | 3.0070E-04 | 1.2857E+07 | 3.8661E+03 |
| | | 82-87 | 7.6220E-05 | 1.2857E+07 | 9.7997E+02 |
| | | 87-92 | 3.8710E-05 | 1.5000E+07 | 5.8065E+02 |
| | | 92-97 | 1.9840E-05 | 1.7143E+07 | 3.4011E+02 |
| | | 97-102 | 1.4190E-05 | 1.5000E+07 | 2.1285E+02 |
| | | TOTAL | | | 2.1815E+05 |
| 3 | 2 | 2-7 | 8.8490E-04 | 0.0000E+00 | 0.0000E+00 |
| | | 7-12 | 3.5270E-04 | 6.4286E+06 | 2.2674E+03 |
| | | 12-17 | 2.6940E-03 | 6.4286E+06 | 1.7319E+04 |
| | | 17-22 | 6.7180E-03 | 6.4286E+06 | 4.3187E+04 |
| | | 22-27 | 7.8410E-03 | 6.4286E+06 | 5.0406E+04 |
| | | 27-32 | 5.0080E-03 | 6.4286E+06 | 3.2194E+04 |
| | | 32-37 | 9.8370E-03 | 9.6429E+06 | 9.4857E+04 |
| | | 37-42 | 2.9660E-03 | 9.6429E+06 | 2.8601E+04 |
| | | 42-47 | 1.2400E-03 | 6.4286E+06 | 7.9714E+03 |
| | | 47-52 | 3.6430E-04 | 9.6429E+06 | 3.5129E+03 |
| | | 52-57 | 1.9000E-04 | 6.4286E+06 | 1.2214E+03 |
| | | 57-62 | 3.9480E-04 | 6.4286E+06 | 2.5380E+03 |
| | | 62-67 | 4.7510E-04 | 6.4286E+06 | 3.0542E+03 |
| | | 67-72 | 2.0200E-04 | 6.4286E+06 | 1.2986E+03 |
| | | 72-77 | 6.2150E-05 | 6.4286E+06 | 3.9954E+02 |
| | | 77-82 | 4.8350E-05 | 6.4286E+06 | 3.1082E+02 |
| | | 82-87 | 2.7160E-05 | 6.4286E+06 | 1.7460E+02 |
| | | 87-92 | 1.4150E-05 | 9.6429E+06 | 1.3645E+02 |
| | | 92-97 | 2.0330E-06 | 6.4286E+06 | 1.3069E+01 |
| | | 97-102 | 1.0330E-06 | 6.4286E+06 | 6.6407E+00 |
| | | TOTAL | | | 2.8947E+05 |

- Continued -



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Table 3. (p 6 of 6)

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 3 | 3 | 2-7 | 1.3410E-0 | 2.5000E+06 | 3.3525E+03 |
| | | 7-12 | 1.6860E-03 | 5.0000E+06 | 8.4300E+03 |
| | | 12-17 | 1.6810E-03 | 7.5000E+06 | 1.2608E+04 |
| | | 17-22 | 3.0530E-03 | 5.0000E+06 | 1.5265E+04 |
| | | 22-27 | 4.2740E-03 | 5.0000E+06 | 2.1370E+04 |
| | | 27-32 | 6.3760E-03 | 5.0000E+06 | 3.1880E+04 |
| | | 32-37 | 3.5230E-03 | 7.5000E+06 | 2.6423E+04 |
| | | 37-42 | 2.4480E-03 | 5.0000E+06 | 1.2240E+04 |
| | | 42-47 | 1.1860E-03 | 5.0000E+06 | 5.9300E+03 |
| | | 47-52 | 4.6130E-04 | 5.0000E+06 | 2.3065E+03 |
| | | 52-57 | 2.9050E-04 | 5.0000E+06 | 1.4525E+03 |
| | | 57-62 | 2.0780E-04 | 5.0000E+06 | 1.0390E+03 |
| | | 62-67 | 3.3190E-04 | 5.0000E+06 | 1.6595E+03 |
| | | 67-72 | 3.3100E-04 | 5.0000E+06 | 1.6550E+03 |
| | | 72-77 | 1.5480E-04 | 5.0000E+06 | 7.7400E+02 |
| | | 77-82 | 9.0450E-05 | 5.0000E+06 | 4.5225E+02 |
| | | 82-87 | 6.7130E-05 | 7.5000E+06 | 5.0348E+02 |
| | | 87-92 | 2.1270E-05 | 5.0000E+06 | 1.0635E+02 |
| | | 92-97 | 1.3190E-05 | 5.0000E+06 | 6.5950E+01 |
| | | 97-102 | 3.2790E-06 | 7.5000E+06 | 2.4593E+01 |
| | | TOTAL | | | 1.4754E+05 |
| 3 | 4 | 2-7 | 4.1920E-04 | 5.0000E+06 | 2.0960E+03 |
| | | 7-12 | 1.9940E-03 | 5.0000E+06 | 9.9700E+03 |
| | | 12-17 | 1.3710E-03 | 5.0000E+06 | 6.8550E+03 |
| | | 17-22 | 3.1300E-03 | 5.0000E+06 | 1.5650E+04 |
| | | 22-27 | 4.4840E-03 | 5.0000E+06 | 2.2420E+04 |
| | | 27-32 | 4.0190E-03 | 5.0000E+06 | 2.0095E+04 |
| | | 32-37 | 1.7030E-03 | 5.0000E+06 | 8.5150E+03 |
| | | 37-42 | 1.6840E-03 | 5.0000E+06 | 8.4200E+03 |
| | | 42-47 | 8.2340E-04 | 5.0000E+06 | 4.1170E+03 |
| | | 47-52 | 3.8370E-04 | 5.0000E+06 | 1.9185E+03 |
| | | 52-57 | 3.5110E-04 | 7.5000E+06 | 2.6333E+03 |
| | | 57-62 | 3.4140E-04 | 5.0000E+06 | 1.7070E+03 |
| | | 62-67 | 4.3500E-04 | 5.0000E+06 | 2.1750E+03 |
| | | 67-72 | 2.7750E-04 | 5.0000E+06 | 1.3875E+03 |
| | | 72-77 | 1.8480E-04 | 5.0000E+06 | 9.2400E+02 |
| | | 77-82 | 1.0540E-04 | 5.0000E+06 | 5.2700E+02 |
| | | 82-87 | 5.4070E-05 | 5.0000E+06 | 2.7035E+02 |
| | | 87-92 | 1.7910E-05 | 5.0000E+06 | 8.9550E+01 |
| | | 92-97 | 3.1710E-06 | 5.0000E+06 | 1.5855E+01 |
| | | 97-102 | 1.2480E-05 | 7.5000E+06 | 9.3600E+01 |
| | | TOTAL | | | 1.0988E+05 |

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Table 4 . Estimated number of fish not available to the hydroacoustic equipment because of bottom orientation in Kenai Lake, Alaska during the fall of 1989.

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 1 | 1 | 2-7 | 1.7010E-03 | 1.0293E+07 | 1.7509E+04 |
| | | 7-12 | 1.3850E-03 | 1.0293E+07 | 1.4256E+04 |
| | | 12-17 | 3.9140E-03 | 1.0293E+07 | 4.0288E+04 |
| | | 17-22 | 1.0870E-03 | 1.0293E+07 | 1.1189E+04 |
| | | 22-27 | 2.9420E-03 | 1.0293E+07 | 3.0283E+04 |
| | | 27-32 | 2.7920E-03 | 1.5440E+07 | 4.3108E+04 |
| | | 32-37 | 1.7160E-02 | 5.1467E+06 | 8.8317E+04 |
| | | 37-42 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 42-47 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 47-52 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 52-57 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 57-62 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 62-67 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 67-72 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 72-77 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 77-82 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 82-87 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 87-92 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 92-97 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 97-102 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | TOTAL | | | 2.4495E+05 |
| 1 | 2 | 2-7 | 5.1640E-05 | 4.4114E+06 | 2.2781E+02 |
| | | 7-12 | 2.4990E-03 | 4.4114E+06 | 1.1024E+04 |
| | | 12-17 | 2.0190E-03 | 4.4114E+06 | 8.9067E+03 |
| | | 17-22 | 6.9210E-03 | 4.4114E+06 | 3.0531E+04 |
| | | 22-27 | 7.4120E-03 | 6.6171E+06 | 4.9046E+04 |
| | | 27-32 | 1.8740E-03 | 6.6171E+06 | 1.2401E+04 |
| | | 32-37 | 3.7090E-06 | 8.8229E+06 | 3.2724E+01 |
| | | 37-42 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 42-47 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 47-52 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 52-57 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 57-62 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 62-67 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 67-72 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 72-77 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 77-82 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 82-87 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 87-92 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 92-97 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 97-102 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | TOTAL | | | 1.1217E+05 |

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Table 4. (p 2 of 2)

| Area | Transect | Bottom Depth(m) | Estimated Fish Density (number/m^3) | Estimated Volume (m^3) | Estimated Number of Fish |
|---|---|---|---|---|---|
| 1 | 3 | 2-7 | 7.4160E-05 | 3.4311E+06 | 2.5445E+02 |
| | | 7-12 | 3.8700E-04 | 3.4311E+06 | 1.3278E+03 |
| | | 12-17 | 7.3750E-04 | 3.4311E+06 | 2.5304E+03 |
| | | 17-22 | 2.7570E-03 | 5.1467E+06 | 1.4189E+04 |
| | | 22-27 | 2.2680E-03 | 3.4311E+06 | 7.7818E+03 |
| | | 27-32 | 1.7280E-03 | 3.4311E+06 | 5.9290E+03 |
| | | 32-37 | 2.3350E-04 | 5.1467E+06 | 1.2017E+03 |
| | | 37-42 | 7.6750E-04 | 1.2009E+07 | 9.2168E+03 |
| | | 42-47 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 47-52 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 52-57 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 57-62 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 62-67 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 67-72 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 72-77 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 77-82 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 82-87 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 87-92 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 92-97 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 97-102 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | TOTAL | | | 4.2431E+04 |
| 1 | 4 | 2-7 | 0.0000E+00 | 1.7156E+06 | 0.0000E+00 |
| | | 7-12 | 2.4670E-03 | 3.4311E+06 | 8.4646E+03 |
| | | 12-17 | 1.7320E-03 | 3.4311E+06 | 5.9427E+03 |
| | | 17-22 | 2.4420E-03 | 5.1467E+06 | 1.2568E+04 |
| | | 22-27 | 2.2910E-03 | 3.4311E+06 | 7.8607E+03 |
| | | 27-32 | 1.8760E-03 | 5.1467E+06 | 9.6551E+03 |
| | | 32-37 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 37-42 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 42-47 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 47-52 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 52-57 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 57-62 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 62-67 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 67-72 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 72-77 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 77-82 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 82-87 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 87-92 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 92-97 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | 97-102 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| | | TOTAL | | | 4.4491E+04 |



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Table 5 . Estimated number of fish in Skilak and Kenai Lakes, Alaska in the fall of 1989.

| Lake | Area | Transect | Estimated Number of Fish: Surface | Midwater | Bottom | Total | Area Mean | Variance |
|---|---|---|---|---|---|---|---|---|
| Skilak | 1 | 1 | 2.8155E+05 | 9.2061E+06 | 1.2012E+06 | 1.0689E+07 | | |
| | | 2 | 5.3508E+05 | 9.7652E+06 | 5.0804E+05 | 1.0808E+07 | | |
| | | 3 | 1.4820E+06 | 8.9331E+06 | 2.3449E+06 | 1.2760E+07 | 1.2573E+07 | 6.2311E+12 |
| | | a | 9.1615E+05 | 1.3759E+07 | 1.3611E+06 | 1.6036E+07 | | |
| | 2 | 0 | 6.2135E+04 | 5.8136E+06 | 1.4893E+05 | 6.0247E+06 | | |
| | | 1 | 4.2752E+04 | 5.0389E+06 | 1.6693E+05 | 5.2486E+06 | 5.9653E+06 | 6.1667E+11 |
| | | 2 | 7.5897E+04 | 6.6589E+06 | 3.0642E+05 | 7.0412E+06 | | |
| | | 3 | 1.2568E+05 | 5.2249E+06 | 1.9613E+05 | 5.5467E+06 | | |
| | 3 | 1 | 1.7921E+05 | 6.0751E+06 | 2.1815E+05 | 6.4725E+06 | | |
| | | 2 | 5.9731E+04 | 4.1977E+06 | 2.8947E+05 | 4.5469E+06 | 4.1059E+06 | 3.3212E+12 |
| | | 3 | 9.0518E+04 | 2.8011E+06 | 1.4754E+05 | 3.0392E+06 | | |
| | | 4 | 2.8296E+04 | 2.2269E+06 | 1.0988E+05 | 2.3651E+06 | | |
| | TOTAL | | | | | | 2.2645E+07 | 1.0169E+13 |
| Kenai | 1 | 1 | 3.9395E+04 | 4.1567E+05 | 2.4495E+05 | 7.0002E+05 | | |
| | | 2 | 1.1960E+03 | 5.9272E+05 | 1.1217E+05 | 7.0609E+05 | | |
| | | 3 | 1.7175E+03 | 2.8812E+05 | 4.2431E+04 | 3.3227E+05 | 5.2344E+05 | 4.3110E+10 |
| | | 4 | 0.0000E+00 | 3.1089E+05 | 4.4491E+04 | 3.5538E+05 | | |
| | 2 | 1 | 5.1130E+04 | 1.1229E+06 | 0.0000E+00 | 1.1740E+06 | | |
| | | 2 | 3.0371E+04 | 1.1264E+06 | 0.0000E+00 | 1.1568E+06 | | |
| | | 3 | 3.7266E+04 | 7.4035E+05 | 0.0000E+00 | 7.7762E+05 | 1.0215E+06 | 3.4323E+10 |
| | | 4 | 3.6480E+03 | 9.7395E+05 | 0.0000E+00 | 9.7760E+05 | | |
| | 3 | 1 | 2.8825E+04 | 9.5741E+05 | 0.0000E+00 | 9.8624E+05 | | |
| | | 2 | 2.7822E+04 | 6.8316E+05 | 0.0000E+00 | 7.1098E+05 | | |
| | | 3 | 3.6142E+04 | 9.2824E+05 | 0.0000E+00 | 9.6438E+05 | 8.6165E+05 | 1.8216E+10 |
| | | 4 | 7.6647E+04 | 7.0837E+05 | 0.0000E+00 | 7.8502E+05 | | |
| | 4 | 1 | 1.0584E+04 | 4.8614E+05 | 0.0000E+00 | 4.9672E+05 | | |
| | | 2 | 3.1544E+04 | 5.7193E+05 | 0.0000E+00 | 6.0347E+05 | | |
| | | 3 | 1.1334E+04 | 5.7576E+05 | 0.0000E+00 | 5.8709E+05 | 6.6744E+05 | 4.6308E+10 |
| | | 4 | 4.5912E+04 | 9.3654E+05 | 0.0000E+00 | 9.8245E+05 | | |

- Continued -



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Table 5. (p 2 of 2)

| Lake | Area | Transect | Estimated Number of Fish: Surface | Midwater | Bottom | Total | Area Mean | Variance |
|---|---|---|---|---|---|---|---|---|
| | 5 | 1 | 7.5810E+04 | 4.2524E+05 | 0.0000E+00 | 5.0105E+05 | | |
| | | 2 | 9.0796E+03 | 2.0784E+05 | 0.0000E+00 | 2.1692E+05 | 3.3125E+05 | 2.4152E+10 |
| | | 3 | 5.2103E+02 | 4.2345E+05 | 0.0000E+00 | 4.2397E+05 | | |
| | | 4 | 1.4539E+03 | 1.8162E+05 | 0.0000E+00 | 1.8307E+05 | | |
| | TOTAL | | | | | | 3.4053E+06 | 1.6611E+11 |
| | TOTAL FOR BOTH LAKES | | | | | | 2.6050E+07 | 1.0335E+13 |



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Table 6. Area ($m^2 \times 10^6$) and volumes ($m^3 \times 10^6$) used for fish density estimates in Kenai and Skilak Lakes, Alaska 1989.

| | Skilak Lake | | |
|---|---|---|---|
| Area | Surface Area | Volume | Density of Fish(%) |
| 1 | 43.03 (43.5%) | 1697.8 (26.7%) | 55.5 |
| 2 | 33.46 (33.8%) | 2683.2 (42.3%) | 26.3 |
| 3 | 22.50 (22.7%) | 1967.0 (31.0%) | 18.2 |
| Total | 98.99 (100.0%) | 6348.0 (100.0%) | 100.0 |

| | Kenai Lake | | |
|---|---|---|---|
| Area | Surface Area | Volume | Density of Fish(%) |
| 1 | 7.72 (13.9%) | 207.4 (5.0%) | 15.4 |
| 2 | 11.91 (21.5%) | 921.2 (22.5%) | 30.0 |
| 3 | 10.54 (19.0%) | 915.8 (22.3%) | 25.3 |
| 4 | 14.37 (25.9%) | 1300.5 (31.7%) | 19.6 |
| 5 | 10.93 (19.7%) | 753.9 (18.5%) | 9.7 |
| Total | 55.47 (100.0%) | 4098.8 (100.0%) | 100.0 |



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Table 7. Age, length, and weight of sockeye salmon collected in Skilak and Kenai Lakes, Alaska in the fall of 1989.

| | | Age-0 | | | | | Age-1 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Date | Mean Length (mm) | Standard Deviation (mm) | Mean Weight (g) | Standard Deviation (g) | Number | Mean Length (mm) | Standard Deviation (mm) | Mean Weight (g) | Standard Deviation (g) | Number |
| Skilak Lake | | | | | | | | | | | |
| | 9/26/89 | 50.0 | 3.3 | 1.2 | 0.3 | 136 | 64.0 | 6.0 | 2.8 | 0.7 | 126 |
| | 10/12/89 | 51.0 | 4.9 | 1.1 | 0.6 | 330 | 67.0 | 3.1 | 2.6 | 0.4 | 212 |
| Kenai Lake | | | | | | | | | | | |
| | 10/13-17/89 | 48.0 | 4.5 | 1.0 | 0.2 | 38 | 64.0 | 4.6 | 2.5 | 0.6 | 56 |



ACE 6208360

Table 8. Estimated contribution of age-0 and age-1 sockeye salmon to the total fish population in Kenai and Skilak lakes, Alaska, in the fall of 1989.

| Location | Total Fish | Estimated Sockeye Salmon | Age-0 Percent | Age-0 Number | Age-1 Percent | Age-1 Number |
|---|---|---|---|---|---|---|
| Skilak Lake | 22,645,000 | 21,852,425 | 57.9 | 12,652,554 | 42.1 | 9,199,871 |
| Kenai Lake | 3,405,300 | 3,204,387 | 41.1 | 1,317,003 | 58.9 | 1,887,384 |
| Total | 26,050,300 | 25,056,812 | 100.0 | 13,969,557 | 100.0 | 11,087,255 |



ACE 6208361

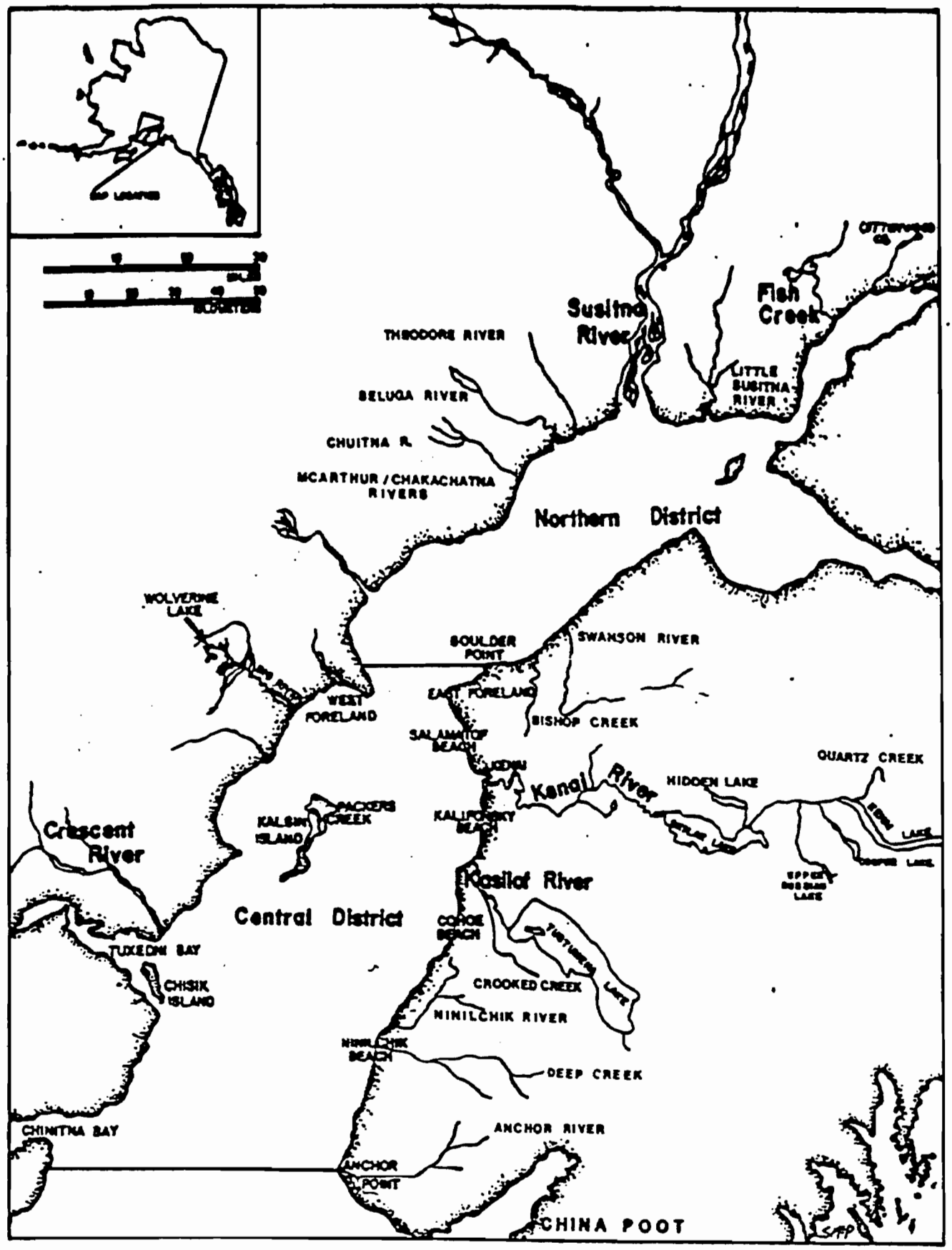
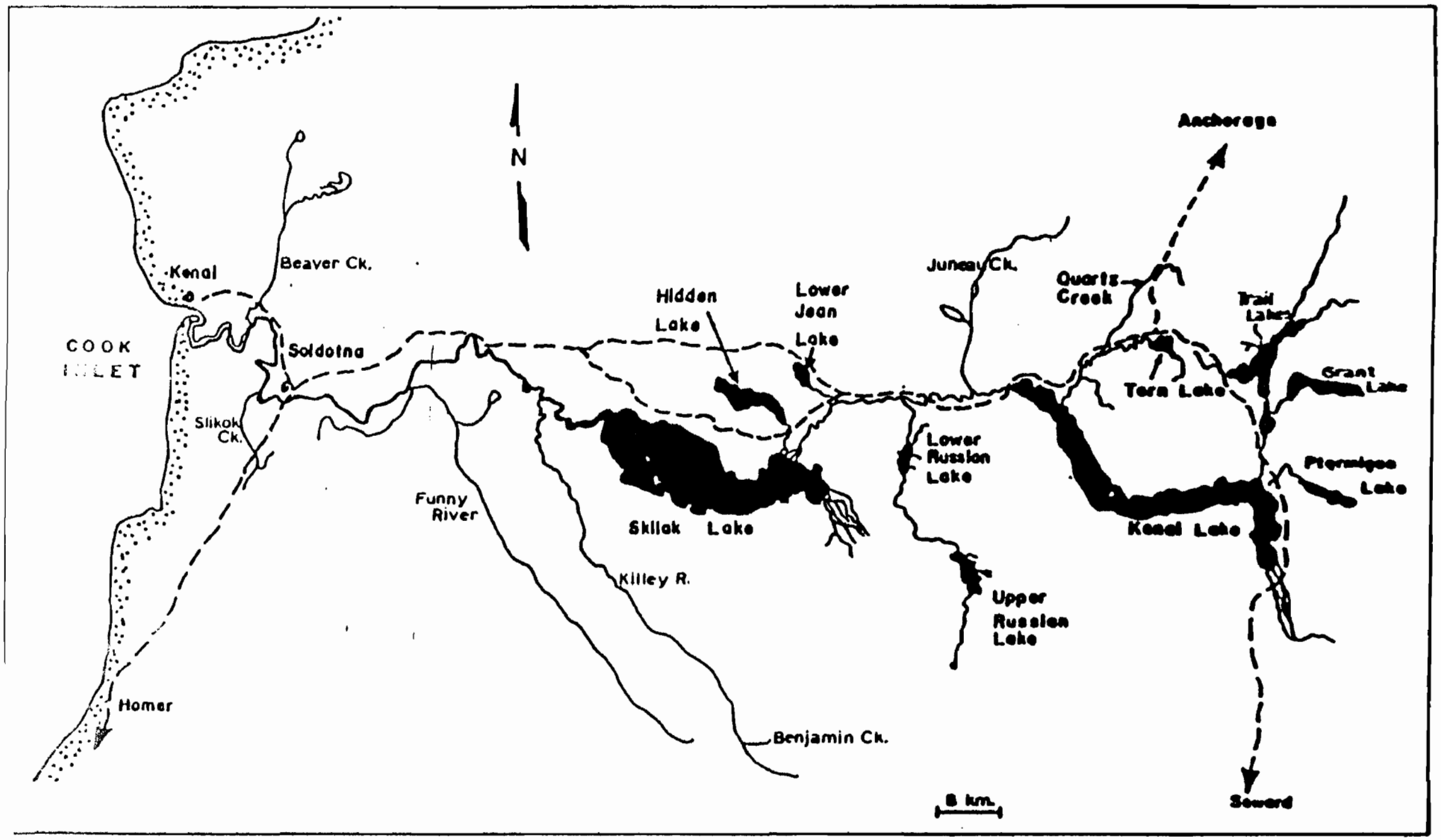



Figure 1. The Upper Cook Inlet area showing the locations of the Northern and Central Districts and the major sockeye salmon spawning drainages.



ACE 6208362




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



ACE 6208363

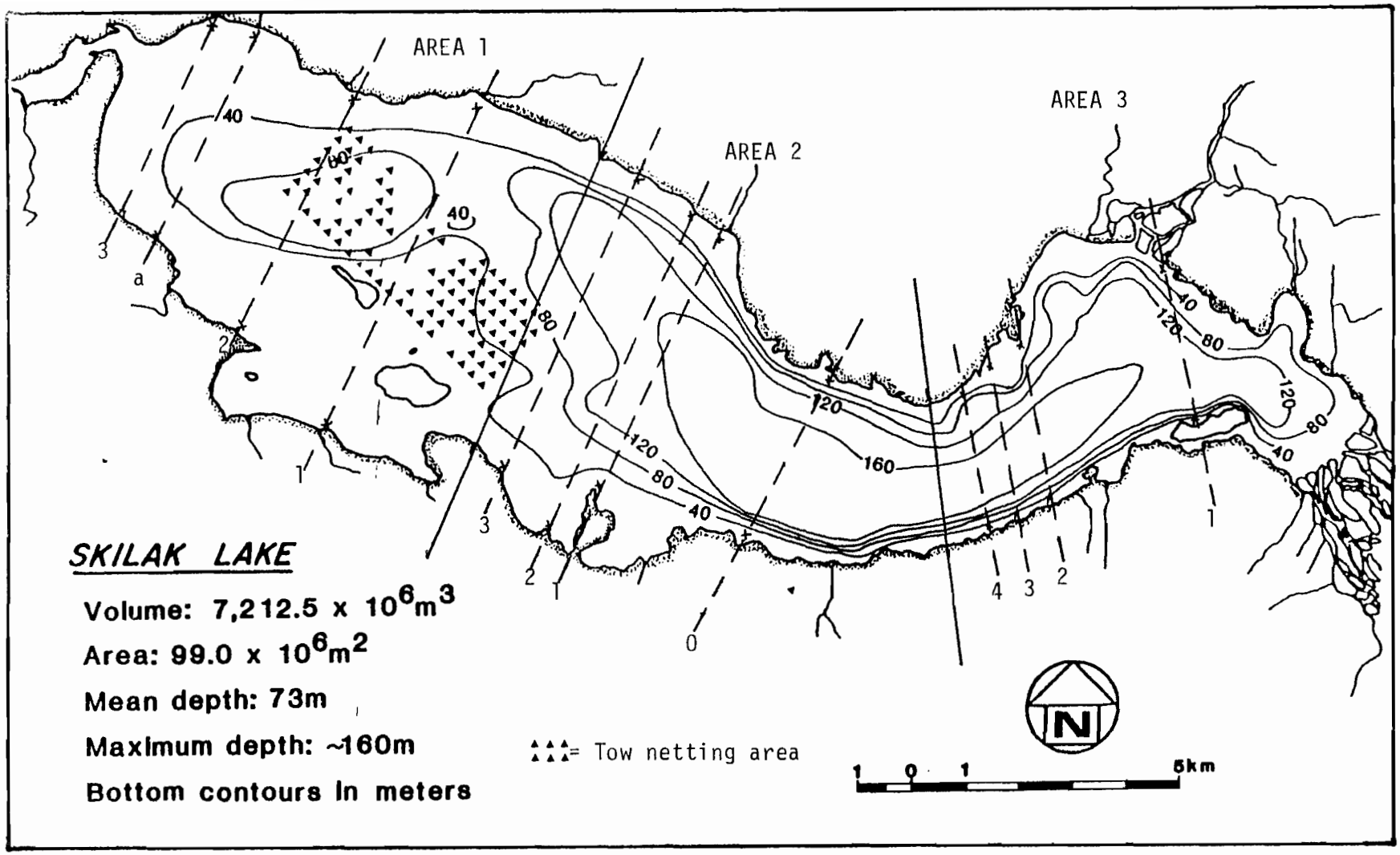



Figure 3. Skilak Lake, Alaska area designations, hydroacoustic transect locations, and tow netting stations, 1989.



ACE 6208364

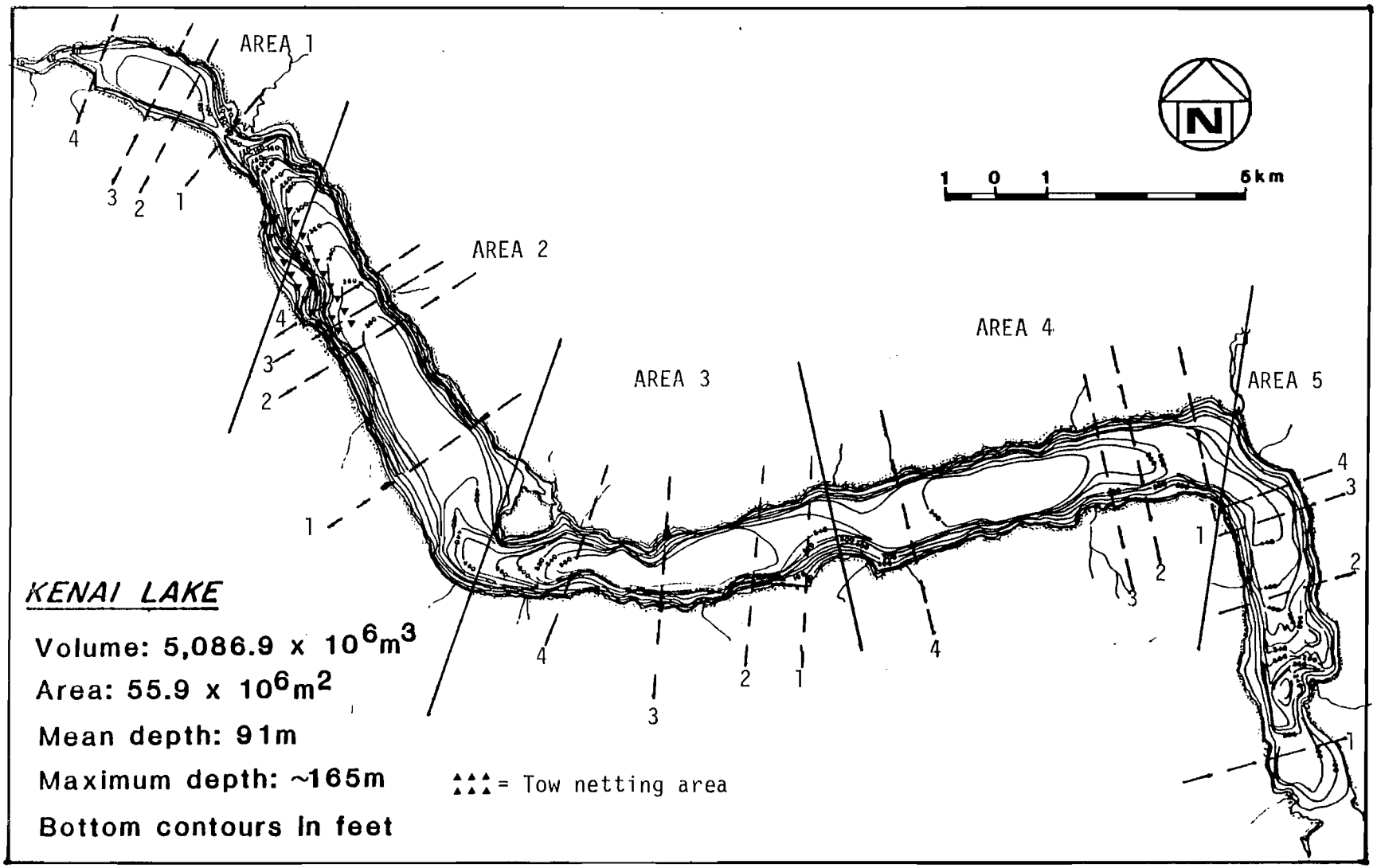



Figure 4. Kenai Lake, Alaska area designations, hydroacoustic transect locations, and tow netting stations, 1989.



ACE 6208365

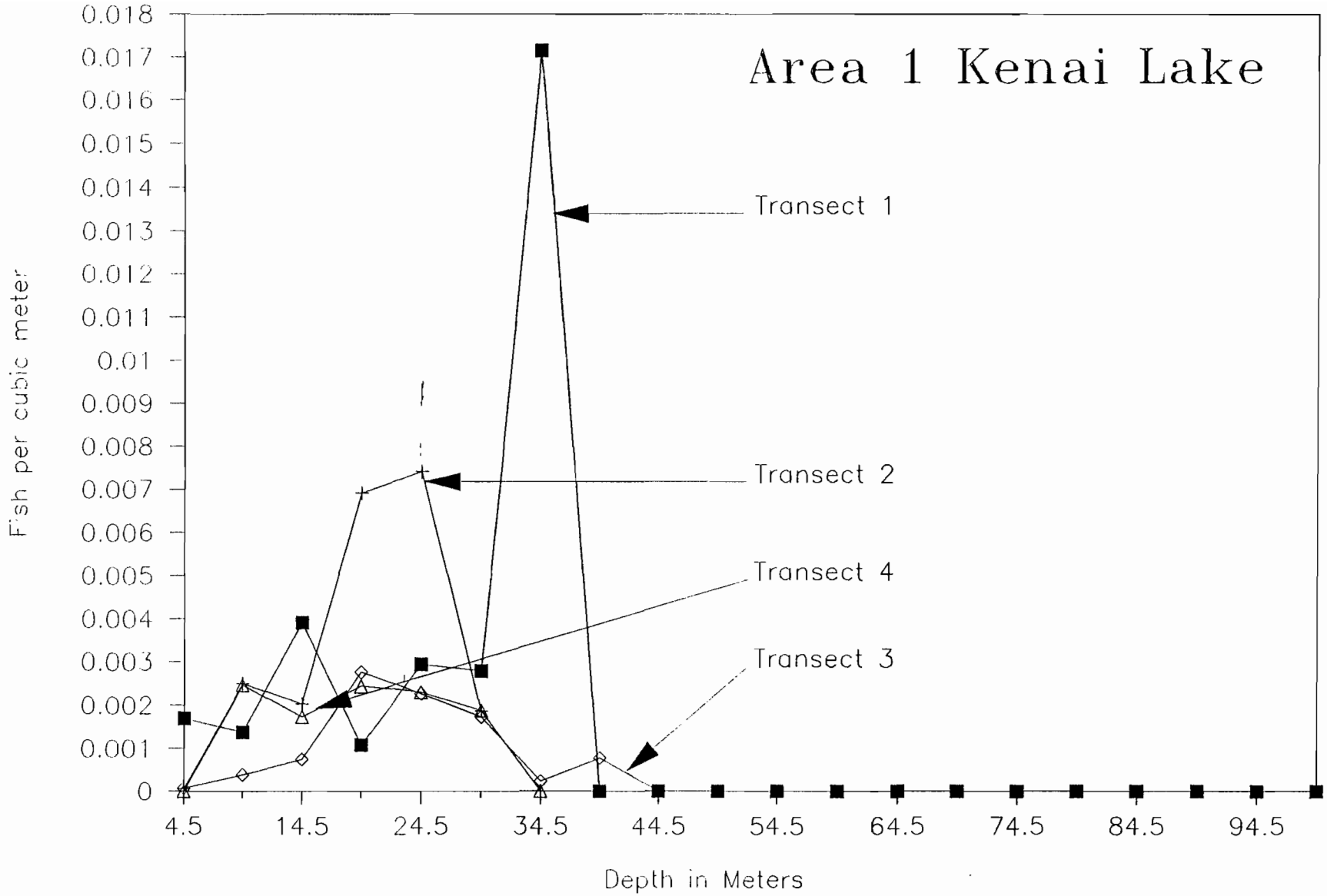



Figure 5. Fish density measured by depth for Area 1, Kenai Lake, Alaska. 1989.



ACE 6208366

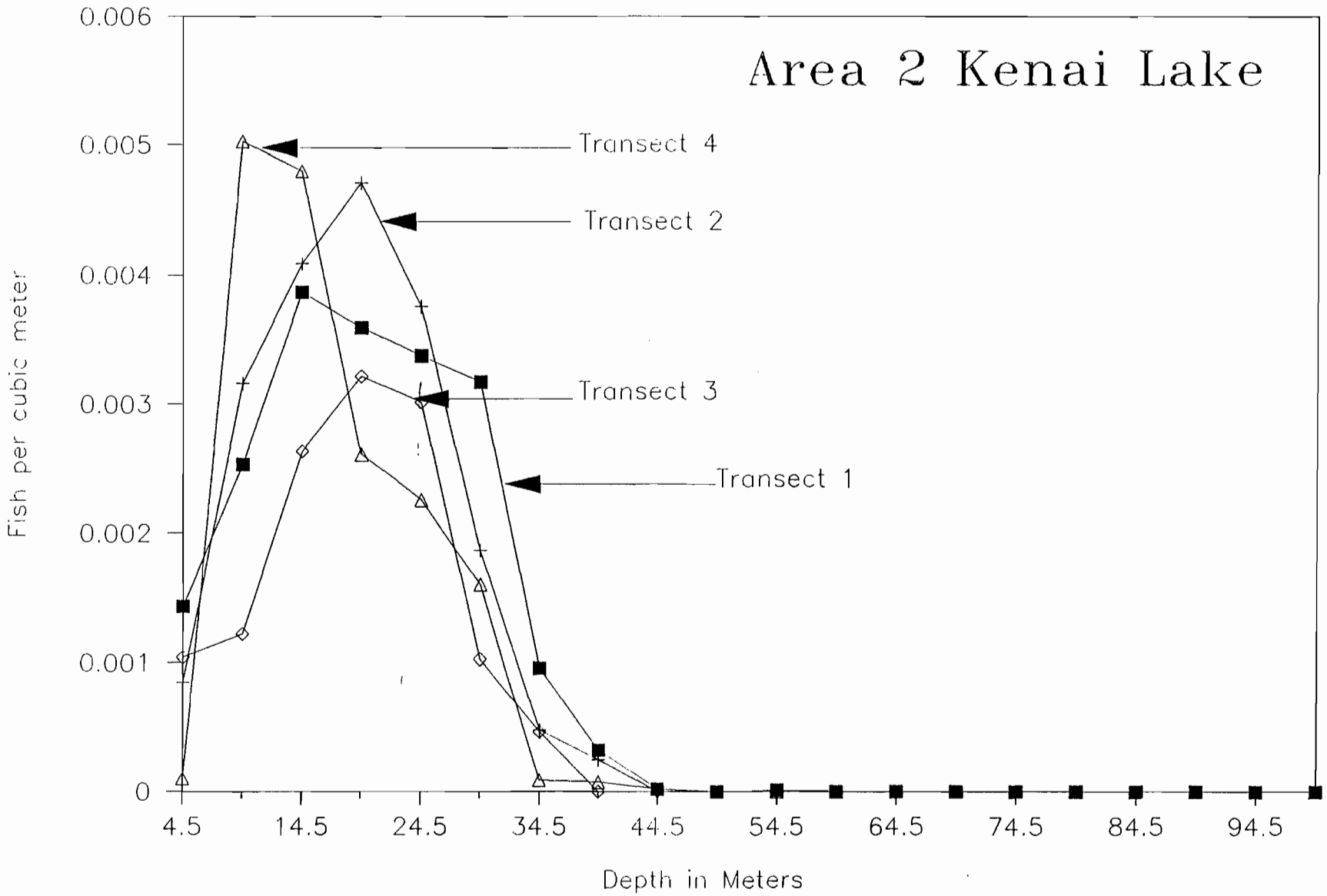



Figure 6. Fish density measured by depth for Area 2, Kenai Lake, Alaska. 1989.



ACE 6208367

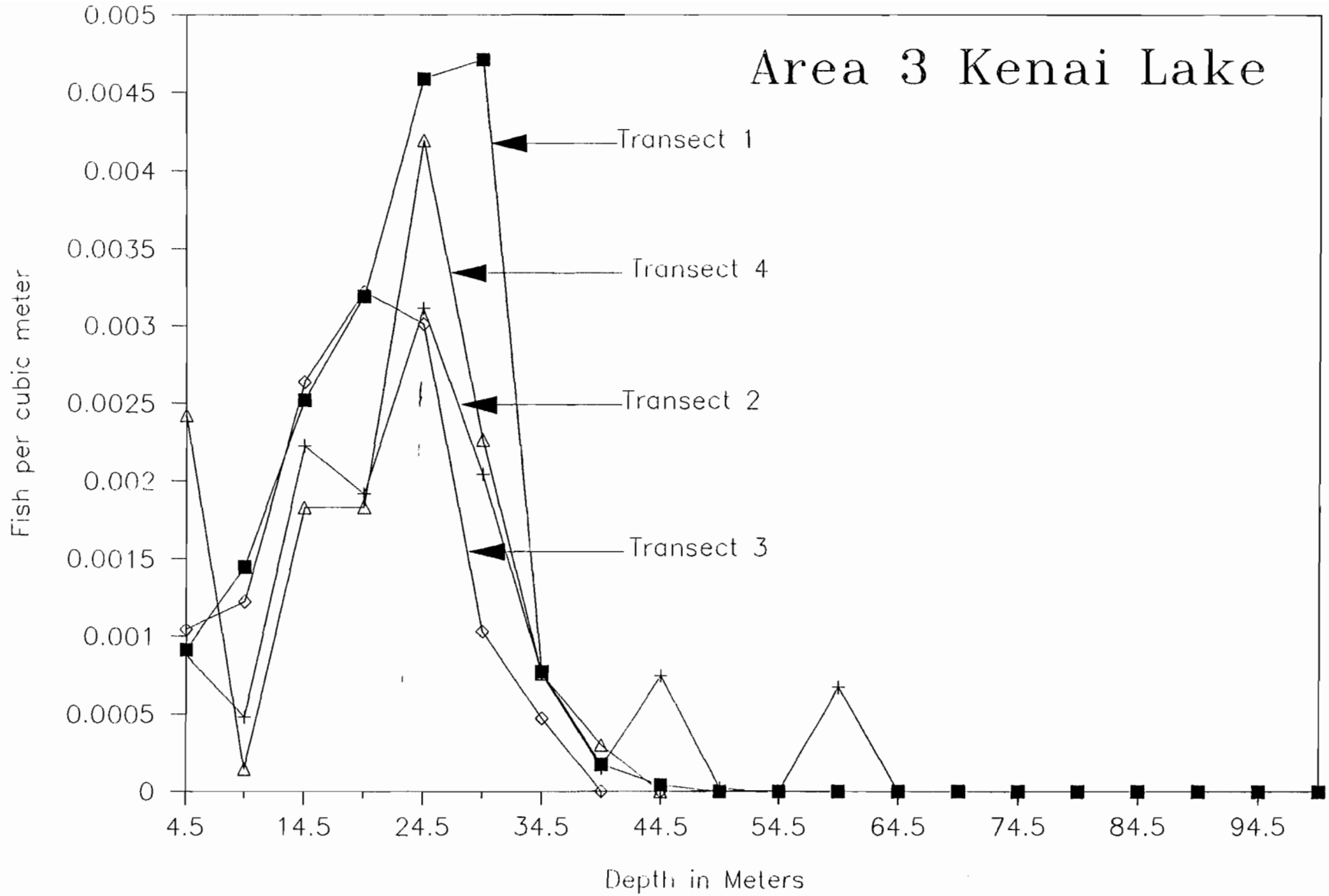



Figure 7. Fish density measured by depth for Area 3, Kenai Lake, Alaska. 1989.



ACE 6208368

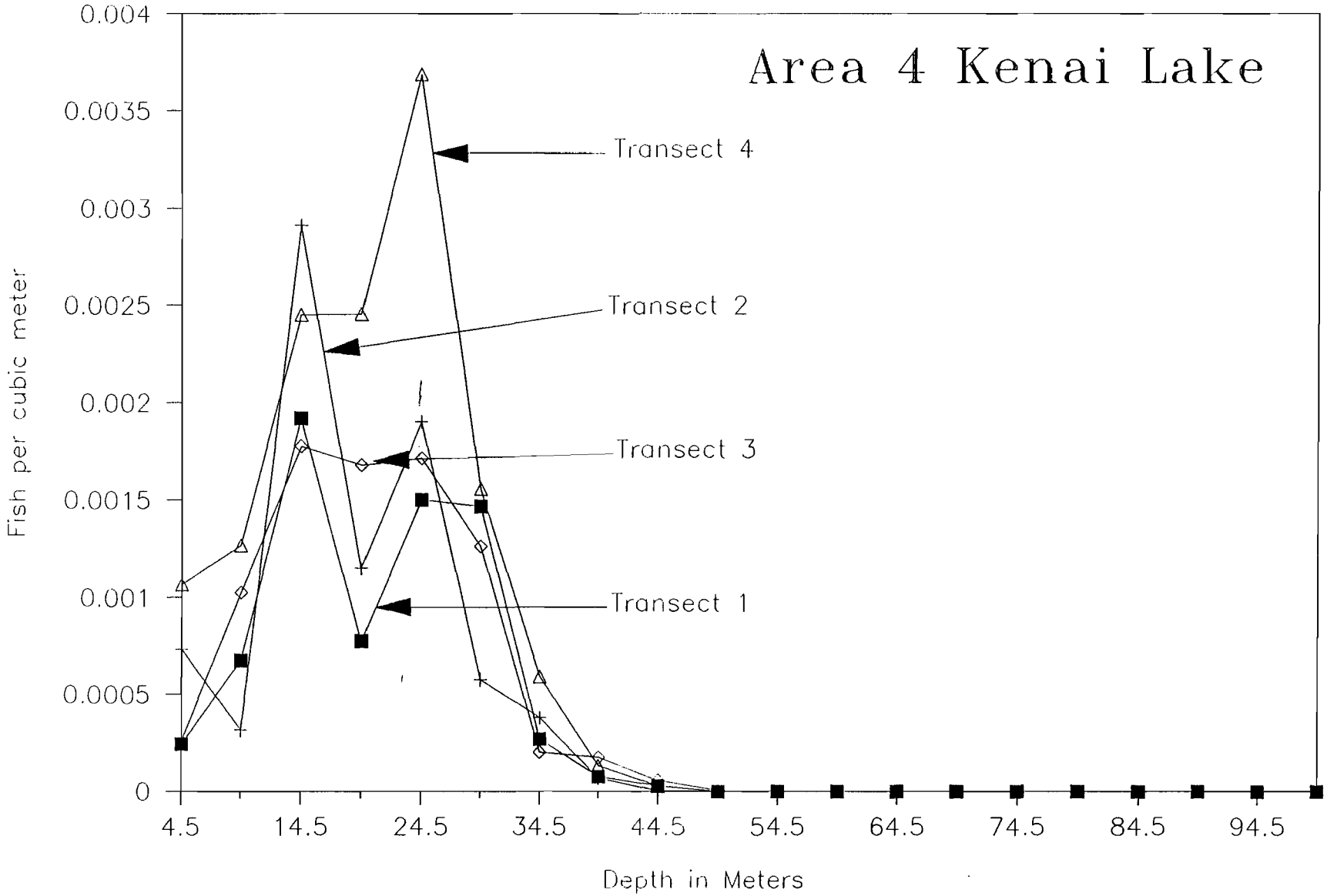



Figure 8. Fish density measured by depth for Area 4, Kenai Lake, Alaska. 1989.



ACE 6208369

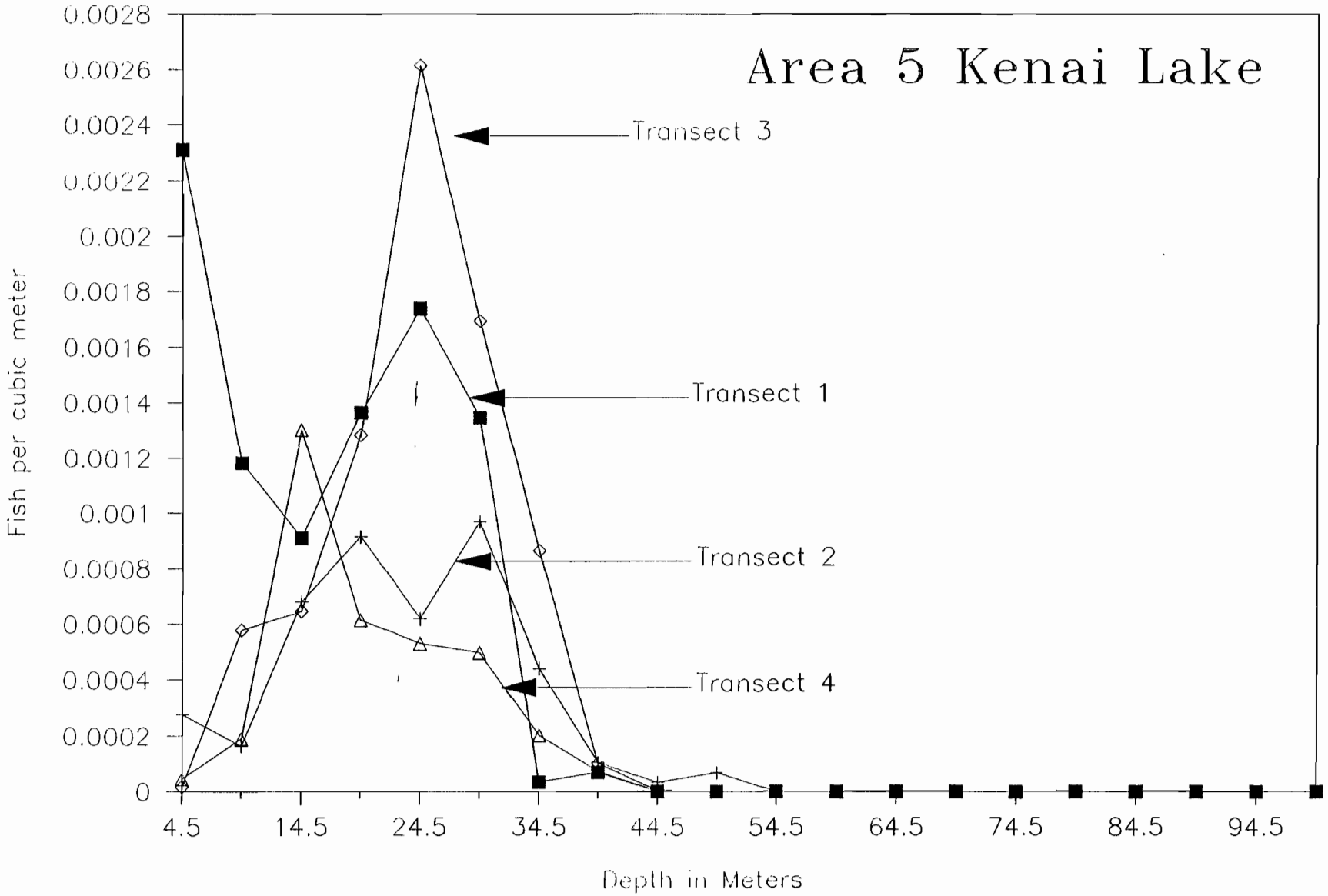



Figure 9. Fish density measured by depth for Area 5, Kenai Lake, Alaska. 1989.



ACE 6208370

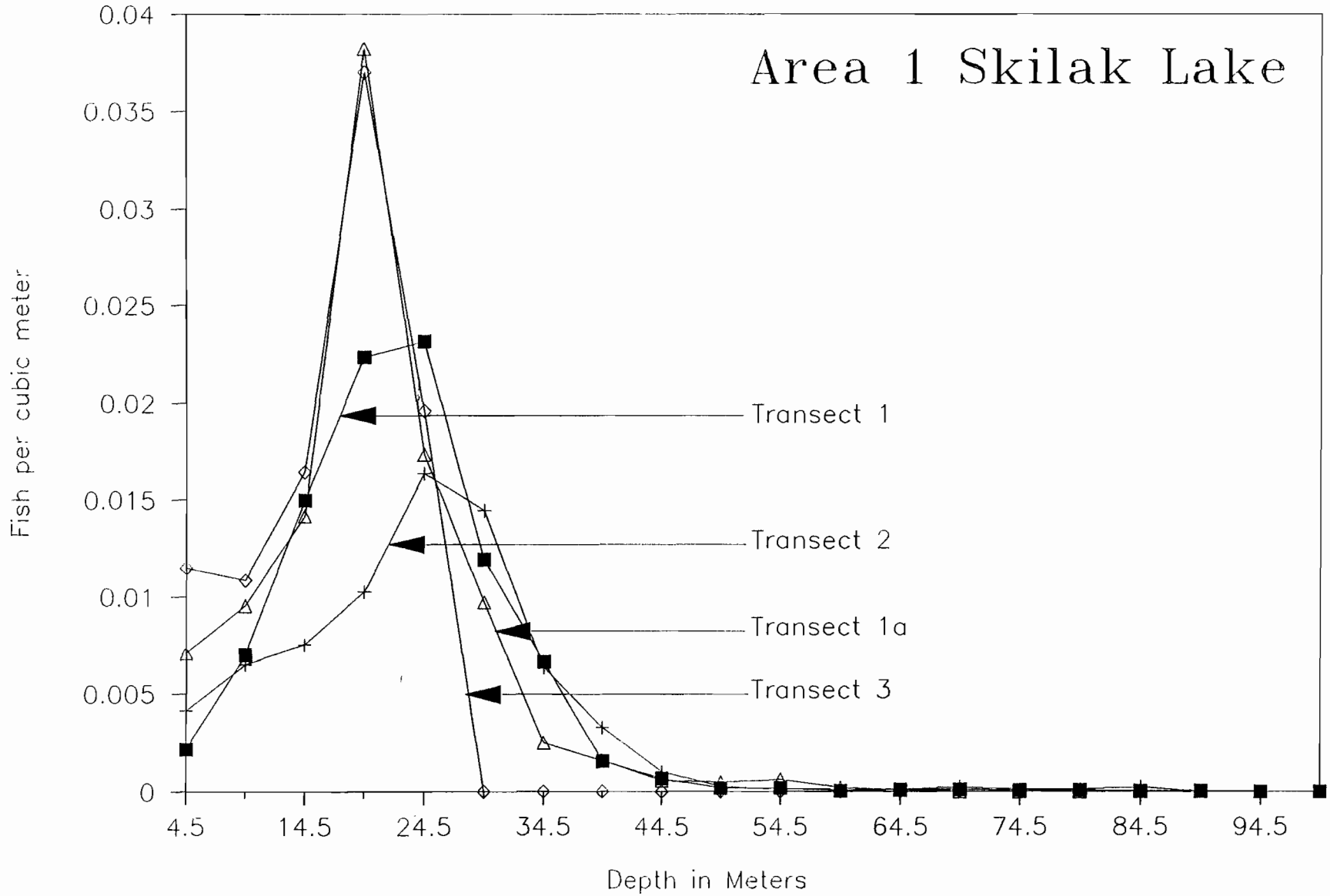



Figure 10. Fish density measured by depth for Area 1, Skilak Lake, Alaska.1989



ACE 6208371

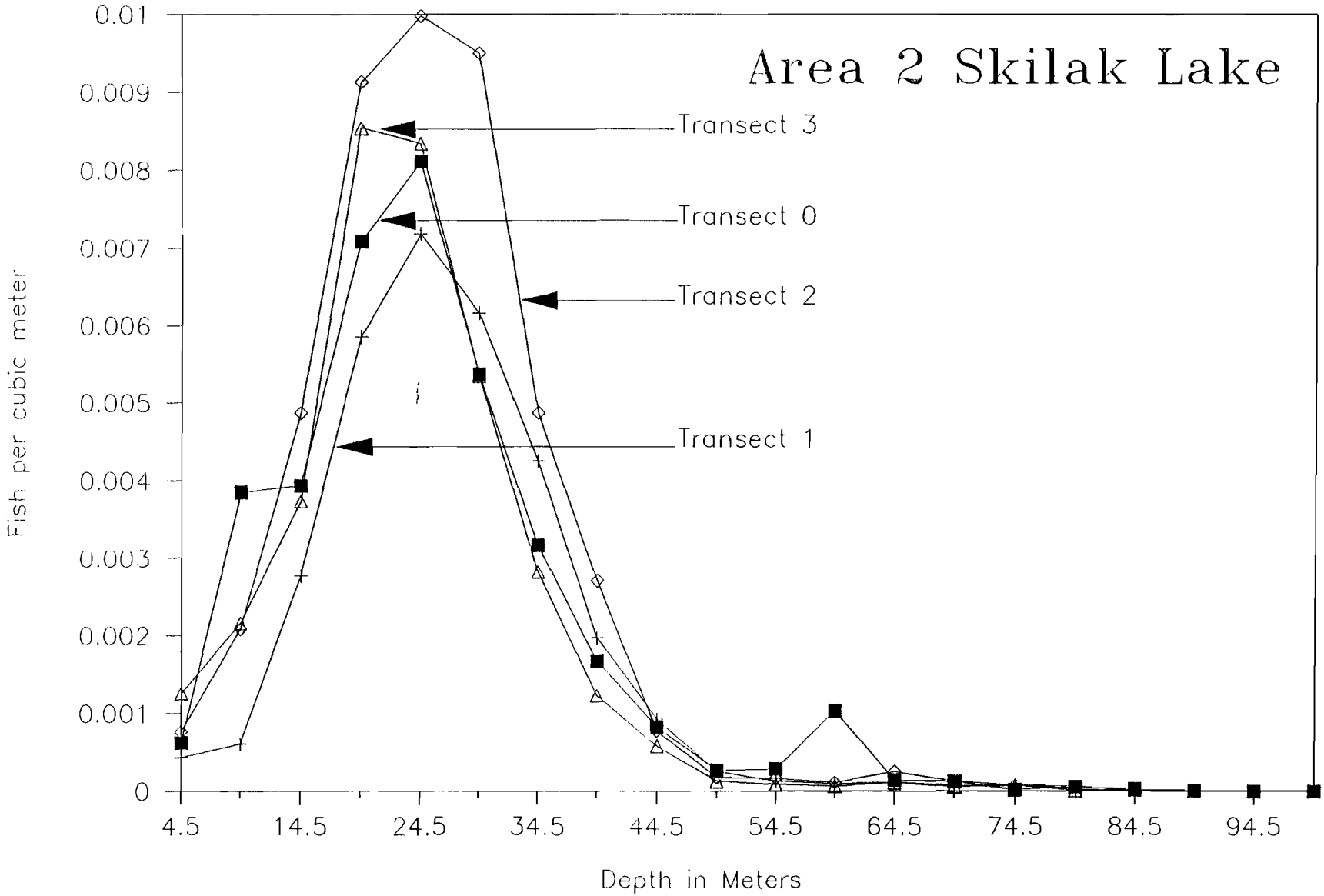



Figure 11. Fish density measured by depth for Area 2, Skilak Lake, Alaska.1989



ACE 6208372

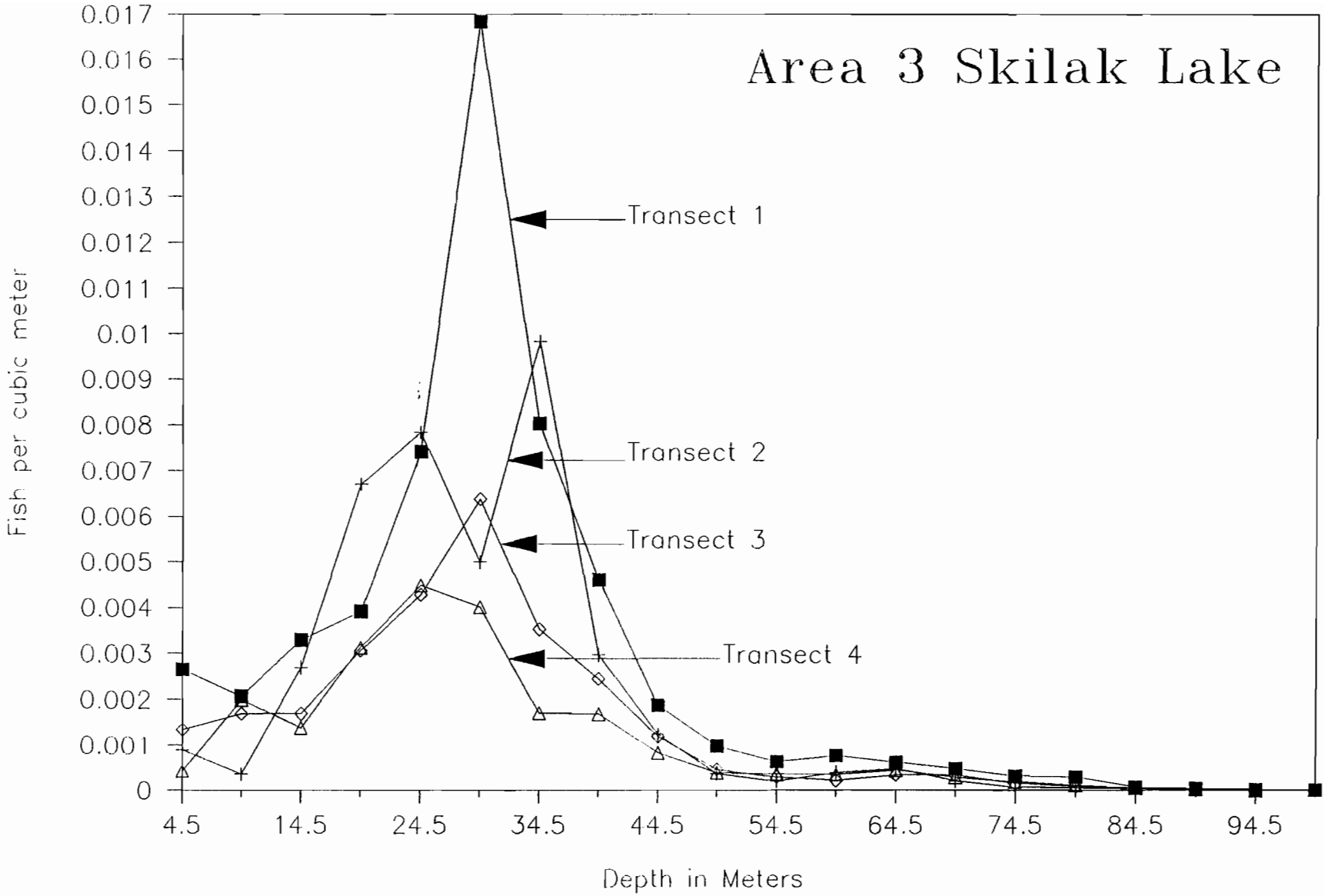
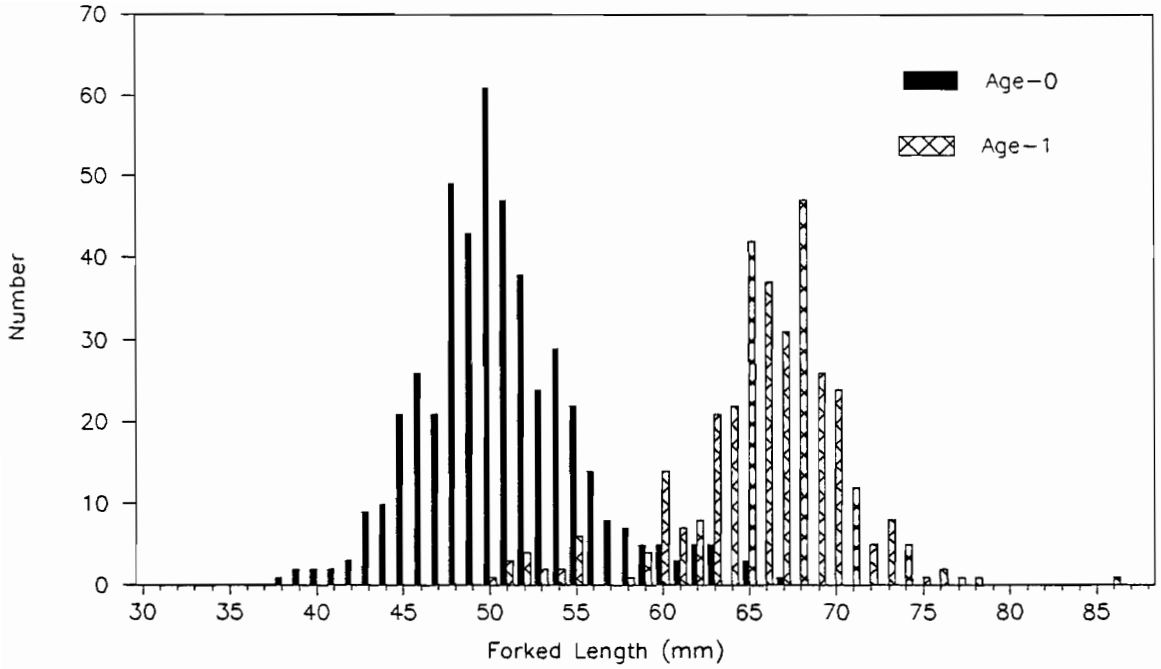



Figure 12. Fish density measured by depth for Area 3, Skilak Lake, Alaska.1989



ACE 6208373



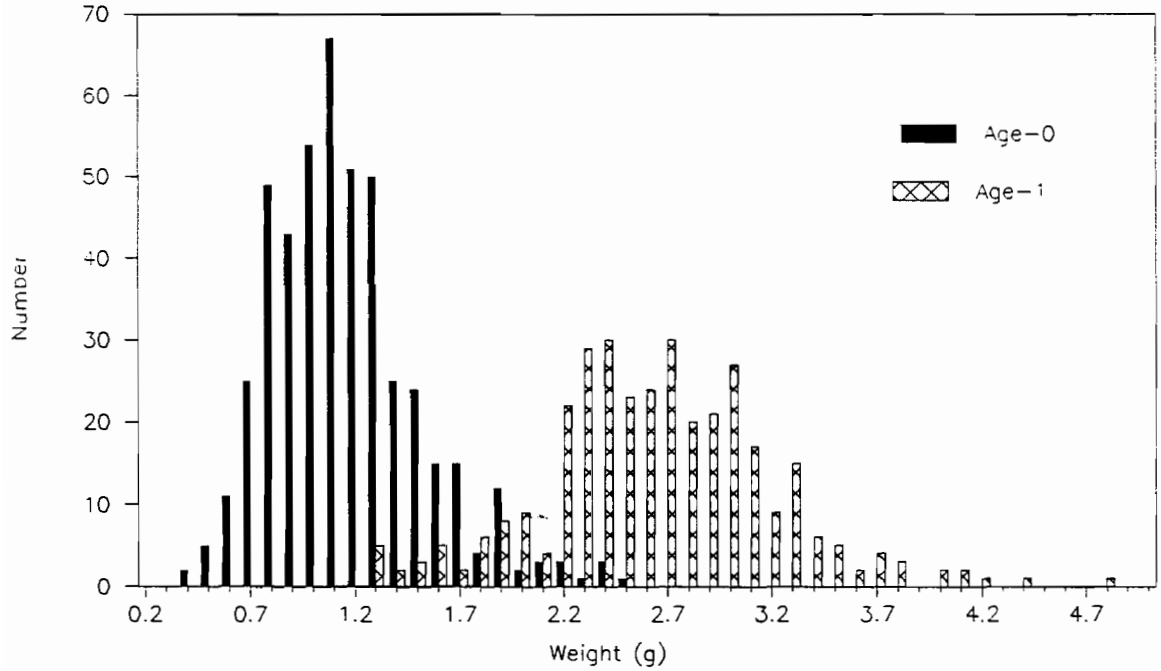




Figure 13. Length and weight of sockeye salmon in Skilak Lake, Alaska, 1989 (N = 464 age-0, N = 338 age-1)



ACE 6208374

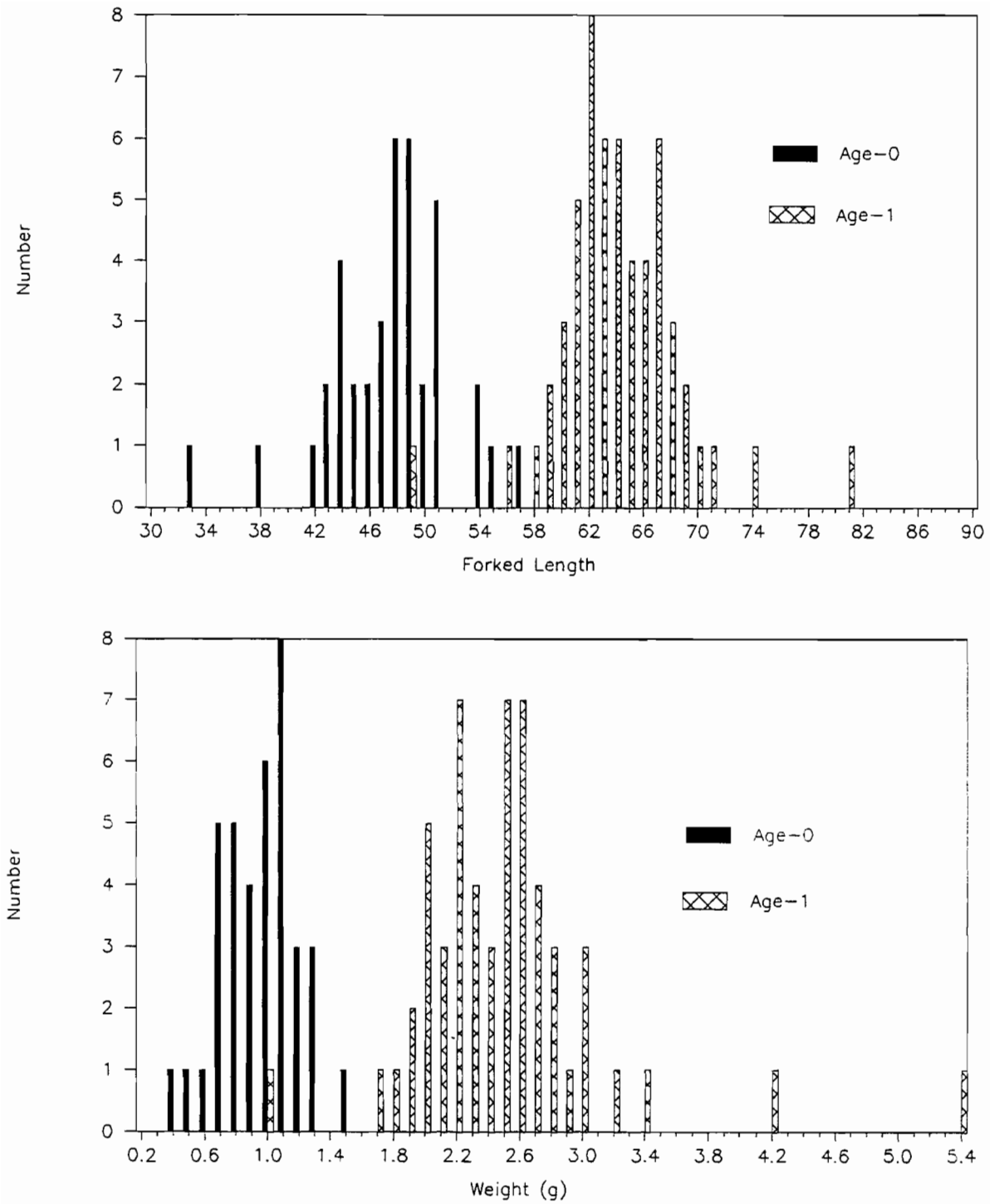



Figure 14. Lenght and weight of sockeye salmon in Kenai Lake, Alaska in 1989 (N = 38 age-0, N = 56 age-1).



ACE 6208375

# KENAI RIVER SOCKEYE SALMON

## Estimated Fry Production

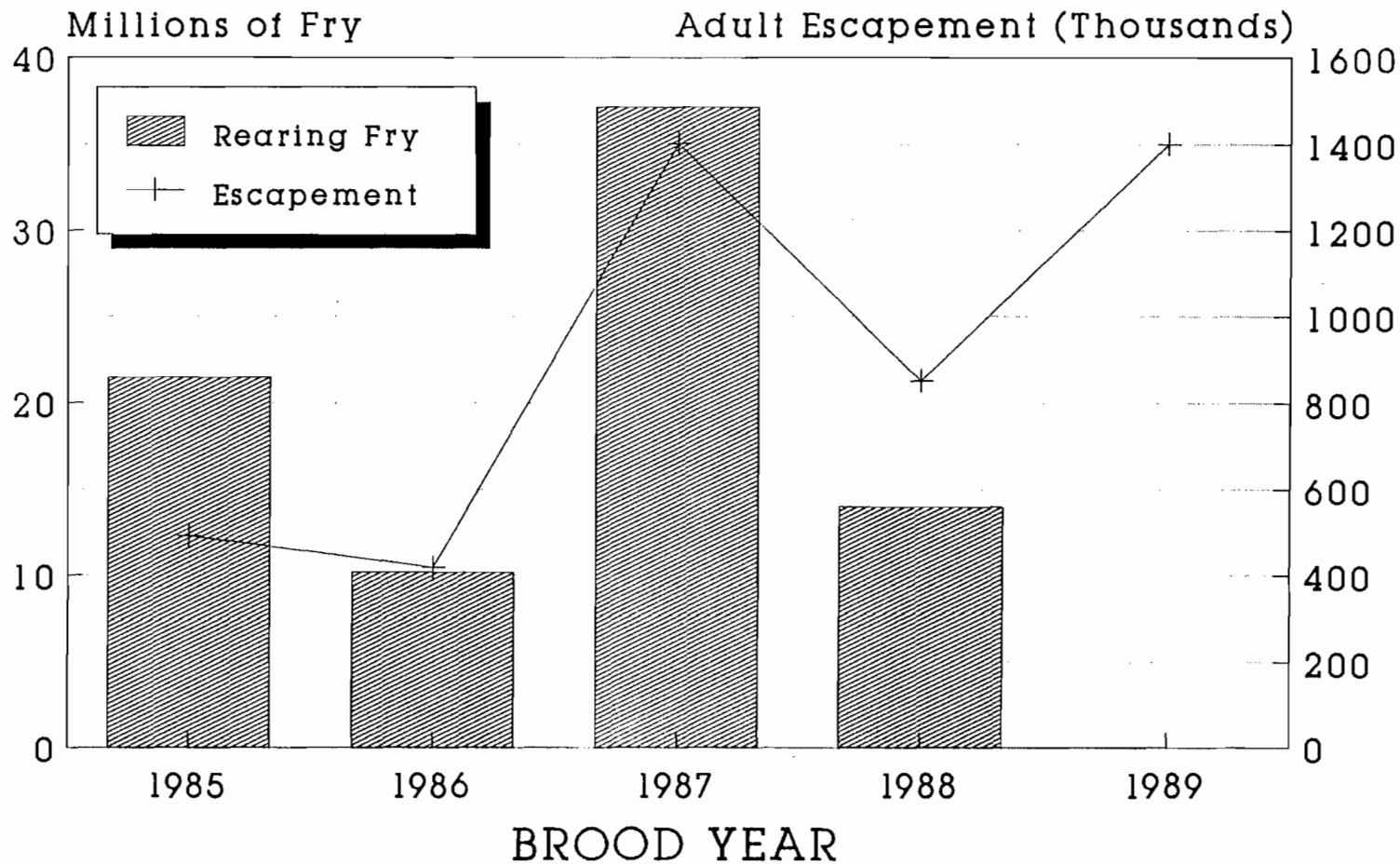



Figure 15. Estimated number of age-0 sockeye salmon rearing in Kenai and Skilak lakes, Alaska by brood year.



ACE 6208376

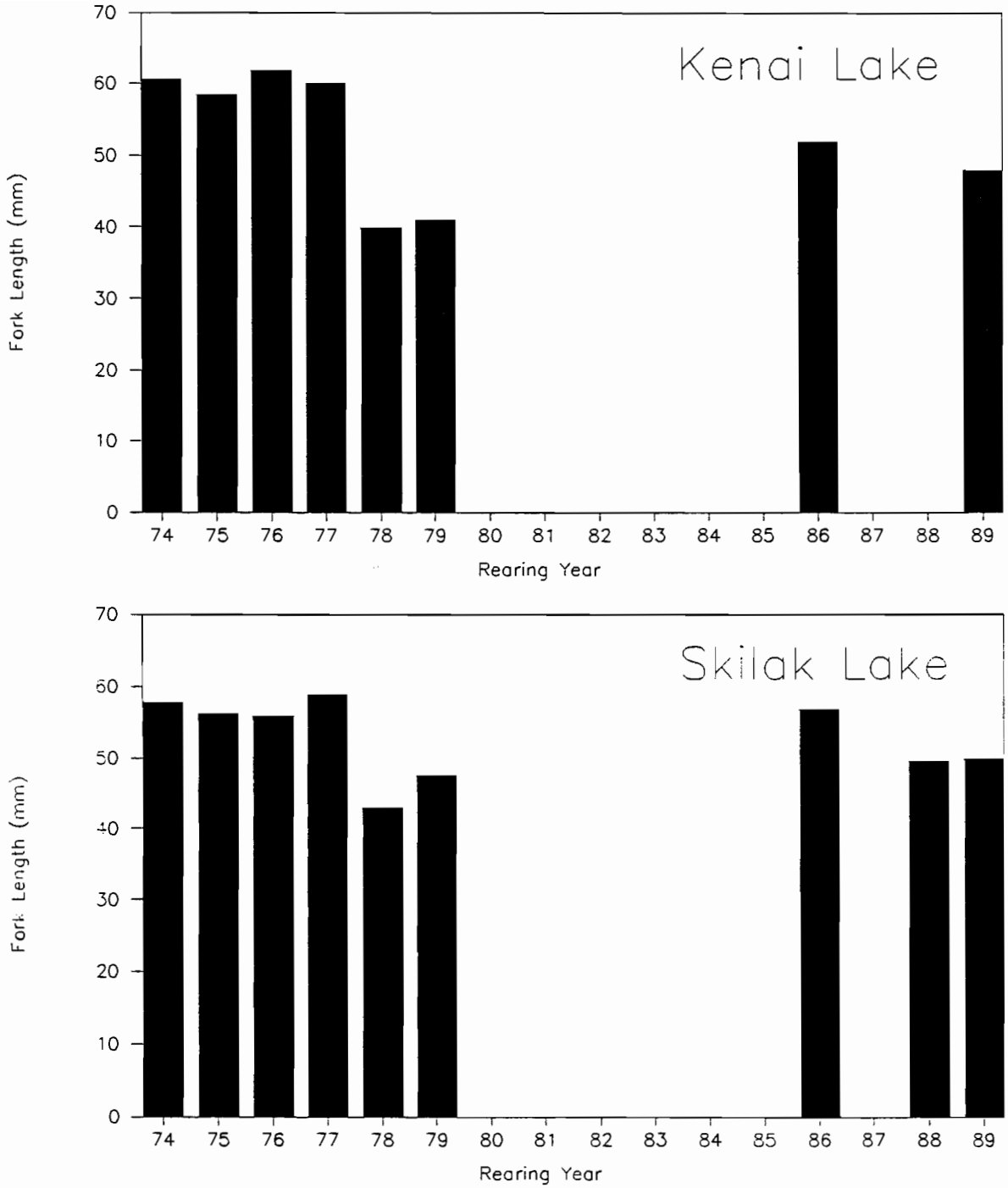



Figure 16. Length of age-0 sockeye salmon collected in Kenai and Skilak lakes, Alaska (sample period usually September/October).



ACE 6208377

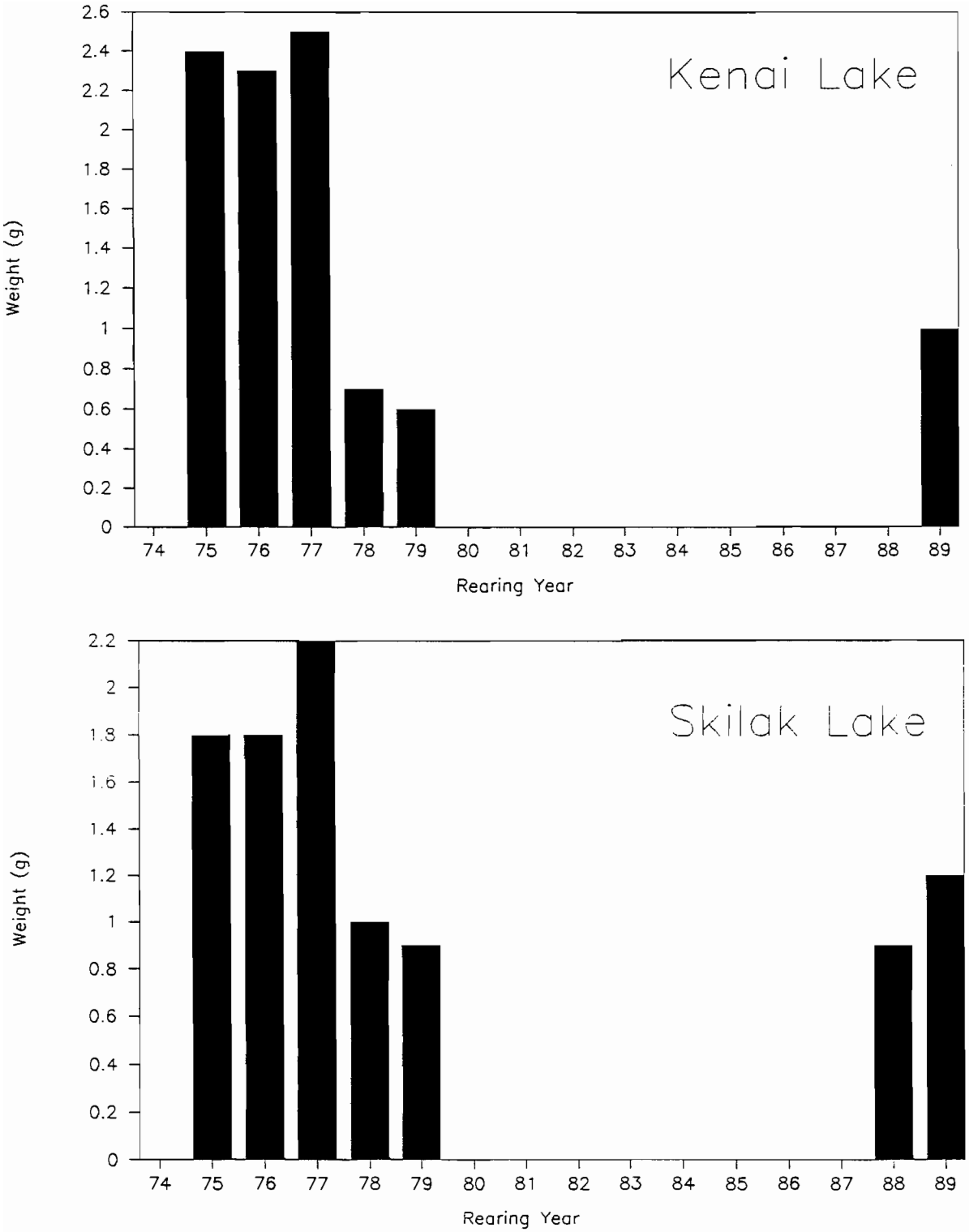



Figure 17. Weight of age-0 sockeye salmon collected in Kenai and Skilak lakes, Alaska (sample period usually September/October).



ACE 6208378

Appendix A1. Calibration and processing parameters used in collection and analysis of Kenai and Skilak Lakes, Alaska, 1989 hydroacoustic data.

| | | | | |
|---|---|---|---|---|
| Sounder | Receiving sensitivity (dB/uP@1m) | Channel 1 | 40 log R = | -164.54 dB |
| | | | 20 log R = | -144.94 dB |
| | | Channel 2 | 40 log R = | -164.64 dB |
| | | | 20 log R = | -142.54 dB |
| | Source level (dB/uP@1m) | | | 217.84dB |
| | TVG Crossover | | | 13.0 m |
| | Receiver gain | | | 0 dB |
| Transducer | Beam width | Narrow | | 6 degree |
| | | Wide | | 15 degree |
| | Wide beam dropoff | "A" coefficient | | 1.607 dB |
| | | "B" coefficient | | 0.500 dB |
| | Beam pattern factor | Average squared value | Narrow | .0009521 |
| Dual beam processor | Correction multiplier | Narrow beam | | 1.000 (0dB) |
| | | Wide beam | | 1.012 (dB) |
| | Threshold | Narrow beam | | 200 mV (-67.3 dB) |
| | | Wide beam | | 200 mV (-67.4 dB) |
| | | Bottom | | 5000 mV (-39.3 dB) |
| | Maximum half angle | | | 4° |
| | Pulse width criteria | -18 dB | Maximum | .9478 mS |
| | | -6 dB | Minimum | .2668 mS |
| | | -6 dB | Maximum | .5336 mS |
| | Bottom window | | | 2.0 meters |
| | Start depth | | | 2.0 meters |
| | | Depth | | |
| Echo integrator | B constant value | 2.0 - 7.0 m | | 8.3 |
| | | 7.0 - 12.0 m | | 1.9 |
| | | 12.0 - 17.0 m | | 0.8 |
| | | 17.0 - 22.0 m | | 0.44 |
| | | 22.0 - 27.0 m | | 0.28 |
| | | 27.0 - 32.0 m | | 0.19 |
| | | 32.0 - 37.0 m | | 0.14 |
| | | 37.0 - 42.0 m | | 0.11 |
| | | 42.0 - 47.0 m | | 0.09 |
| | | 47.0 - 52.0 m | | 0.07 |
| | | 52.0 - 57.0 m | | 0.06 |
| | | 57.0 - 62.0 m | | 0.05 |
| | | 62.0 - 67.0 m | | 0.04 |
| | | 67.0 - 72.0 m | | 0.04 |
| | | 72.0 - 77.0 m | | 0.03 |
| | | 77.0 - 82.0 m | | 0.03 |
| | | 82.0 - 97.0 m | | 0.02 |



ACE 6208379

Appendix A.2. Average backscattering cross section (sigma) and target strength data by depth strata for all transects combined, Kenai Lake, Alaska, 1989.

| Depth Stratum (m) | Number of Targets | Sigma Mean | Sigma Standard Deviation | Target[a] Strength Mean (dB) | Target Strength Standard Deviation (dB) |
|---|---|---|---|---|---|
| 2.0 - 7.0 | 71 | .9479E-05 | .1998E-04 | -53.75 | 5.92 |
| 7.0 - 12.0 | 420 | .4889E-05 | .4761E-05 | -55.13 | 4.57 |
| 12.0 - 17.0 | 1340 | .4780E-05 | .8032E-05 | -55.70 | 4.86 |
| 17.0 - 22.0 | 2755 | .3704E-05 | .1188E-04 | -56.96 | 4.59 |
| 22.0 - 27.0 | 3655 | .2886E-05 | .8587E-05 | -57.48 | 4.28 |
| 27.0 - 32.0 | 3141 | .2378E-05 | .1903E-05 | -57.78 | 3.94 |
| 32.0 - 37.0 | 1337 | .1986E-05 | .1455E-05 | -58.37 | 3.71 |
| 37.0 - 42.0 | 430 | .1841E-05 | .1370E-05 | -58.71 | 3.74 |
| 42.0 - 47.0 | 70 | .1562E-05 | .1116E-05 | -59.23 | 3.38 |
| 47.0 -102.0 | 100 | .3637E-05 | .8233E-05 | -58.35 | 5.08 |
| Total | 13319 | .3099E-05 | .7834E-05 | -57.31 | 4.37 |

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



ACE 6208380

Appendix A.3. Average backscattering cross section (sigma) and target strength data by depth strata for all transects combined, Skilak Lake, Alaska, 1989.

| Depth Stratum (m) | Number of Targets | Sigma Mean | Sigma Standard Deviation | Target[a] Strength Mean (dB) | Target Strength Standard Deviation (dB) |
|---|---|---|---|---|---|
| 2.0 - 7.0 | 138 | 1.052E-05 | 1.641E-06 | -52.99 | 5.53 |
| 7.0 - 12.0 | 525 | 6.405E-06 | 7.428E-06 | -54.71 | 5.38 |
| 12.0 - 17.0 | 1662 | 5.650E-06 | 2.029E-05 | -55.44 | 5.09 |
| 17.0 - 22.0 | 3322 | 3.995E-06 | 3.805E-06 | -56.09 | 4.71 |
| 22.0 - 27.0 | 4082 | 3.424E-06 | 3.324E-06 | -56.54 | 4.38 |
| 27.0 - 32.0 | 4009 | 3.024E-06 | 3.185E-06 | -56.92 | 4.11 |
| 32.0 - 37.0 | 3312 | 3.054E-06 | 6.403E-06 | -57.10 | 4.12 |
| 37.0 - 42.0 | 1982 | 2.523E-06 | 8.336E-06 | -57.81 | 3.90 |
| 42.0 - 47.0 | 1290 | 2.130E-06 | 1.820E-06 | -58.19 | 3.73 |
| 47.0 -102.0 | 3482 | 2.648E-06 | 2.586E-06 | -57.46 | 3.92 |
| Total | 23804 | 3.389E-06 | 7.135E-06 | -56.81 | 4.37 |

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



ACE 6208381

Appendix A.4. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 3.8120E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 8.6460E-04 | 3 | 7.4740E-07 | 1.7010E-03 | 6.4843E+04 | 4.4680E+09 | 1.3100E+05 |
| " 7.0 - 12.0" | 3.6600E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 3.6300E-04 | 3 | 6.5400E-08 | 1.3850E-03 | 5.0686E+04 | 1.2810E+09 | 7.0150E+04 |
| " 12.0 - 17.0" | 3.4210E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 1.0030E-03 | 3 | 6.3000E-07 | 3.9140E-03 | 1.3390E+05 | 1.1260E+10 | 2.0800E+05 |
| " 17.0 - 22.0" | 3.1580E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 2.1590E-04 | 3 | 2.0270E-08 | 1.0870E-03 | 3.4336E+04 | 5.1680E+08 | 4.4560E+04 |
| " 22.0 - 27.0" | 2.7900E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 4.5520E-04 | 3 | 1.6790E-07 | 2.9420E-03 | 8.2097E+04 | 5.4770E+09 | 1.4500E+05 |
| " 27.0 - 32.0" | 1.5340E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 3.5600E-04 | 3 | 4.6440E-08 | 2.7920E-03 | 4.2823E+04 | 6.7240E+08 | 5.0820E+04 |
| " 32.0 - 37.0" | 4.0730E+05 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 1.8270E-03 | 1 | 0.0000E+00 | 1.7160E-02 | 6.9884E+03 | 1.9610E+04 | 2.7440E+02 |
| " 37.0 - 42.0" | 0.0000E+00 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 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 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.8410E+08 | | | | | | | | | 4.1567E+05 | "+ or -" | 3.0160E+05 |



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Appendix A.5. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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" | 3.8080E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 2.6240E-05 | 7 | 3.0300E-10 | 5.1640E-05 | 1.9667E+03 | 1.9440E+06 | 2.7330E+03 |
| " 7.0 - 12.0" | 3.6600E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 6.5510E-04 | 7 | 9.1910E-08 | 2.4990E-03 | 9.1489E+04 | 1.8110E+09 | 8.3420E+04 |
| " 12.0 - 17.0" | 3.3750E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 5.1740E-04 | 7 | 3.2600E-08 | 2.0190E-03 | 6.8133E+04 | 5.7520E+08 | 4.7010E+04 |
| " 17.0 - 22.0" | 3.0140E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 1.3740E-03 | 6 | 2.6580E-07 | 6.9210E-03 | 2.0861E+05 | 6.2850E+09 | 1.5540E+05 |
| " 22.0 - 27.0" | 2.5080E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 1.1470E-03 | 6 | 4.4100E-07 | 7.4120E-03 | 1.8590E+05 | 1.1670E+10 | 2.1170E+05 |
| " 27.0 - 32.0" | 1.9520E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.3900E-04 | 5 | 7.2530E-09 | 1.8740E-03 | 3.6591E+04 | 1.7030E+08 | 2.5580E+04 |
| " 32.0 - 37.0" | 8.5140E+06 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 3.9490E-07 | 4 | 1.5590E-13 | 3.7090E-06 | 3.1577E+01 | 9.9750E+02 | 6.1900E+01 |
| " 37.0 - 42.0" | 0.0000E+00 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 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 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.9170E+08 | | | | | | | | | 5.9272E+05 | "+ or -" | 2.8070E+05 |



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Appendix A.6. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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" | 3.8260E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 3.7680E-05 | 9 | 8.6780E-10 | 7.4160E-05 | 2.8370E+03 | 5.4220E+06 | 4.5640E+03 |
| " 7.0 - 12.0" | 3.7590E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 1.0140E-04 | 9 | 7.2880E-09 | 3.8700E-04 | 1.4550E+04 | 1.5040E+08 | 2.4040E+04 |
| " 12.0 - 17.0" | 3.6470E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 1.8900E-04 | 9 | 6.3730E-09 | 7.3750E-04 | 2.6898E+04 | 1.3060E+08 | 2.2400E+04 |
| " 17.0 - 22.0" | 3.5460E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 5.4750E-04 | 9 | 1.6790E-08 | 2.7570E-03 | 9.7777E+04 | 5.7110E+08 | 4.6840E+04 |
| " 22.0 - 27.0" | 3.3530E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 3.5090E-04 | 8 | 8.6350E-09 | 2.2680E-03 | 7.6021E+04 | 4.1940E+08 | 4.0140E+04 |
| " 27.0 - 32.0" | 3.1960E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.2030E-04 | 8 | 4.1940E-09 | 1.7280E-03 | 5.5236E+04 | 2.6420E+08 | 3.1860E+04 |
| " 32.0 - 37.0" | 2.7030E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 2.4860E-05 | 8 | 2.3550E-10 | 2.3350E-04 | 6.3093E+03 | 1.5190E+07 | 7.6390E+03 |
| " 37.0 - 42.0" | 1.1070E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 7.5750E-05 | 7 | 5.7040E-09 | 7.6750E-04 | 8.4939E+03 | 7.1820E+07 | 1.6610E+04 |
| " 42.0 - 47.0" | 0.0000E+00 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 2.5140E+08 | | | | | | | | | 2.8812E+05 | "+ or -" | 7.9090E+04 |



ACE 6208384

Appendix A.7. Hydroacoustic estimate of fish inhabiting Area 1, Kenai Lake, Alaska in 1989 based on transect 4 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 3.8450E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 0.0000E+00 | 4 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 7.0 - 12.0" | 3.6900E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 6.4670E-04 | 4 | 2.1500E-07 | 2.4670E-03 | 9.1038E+04 | 4.2800E+09 | 1.2820E+05 |
| " 12.0 - 17.0" | 3.5030E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 4.4390E-04 | 4 | 5.3280E-08 | 1.7320E-03 | 6.0680E+04 | 1.0030E+09 | 6.2080E+04 |
| " 17.0 - 22.0" | 3.3680E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 4.8490E-04 | 4 | 6.9470E-08 | 2.4420E-03 | 8.2239E+04 | 2.0240E+09 | 8.8170E+04 |
| " 22.0 - 27.0" | 2.9490E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 3.5450E-04 | 3 | 5.4360E-08 | 2.2910E-03 | 6.7584E+04 | 1.9860E+09 | 8.7350E+04 |
| " 27.0 - 32.0" | 4.9820E+06 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.3920E-04 | 3 | 1.1970E-08 | 1.8760E-03 | 9.3492E+03 | 1.8300E+07 | 8.3850E+03 |
| " 32.0 - 37.0" | 0.0000E+00 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 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 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 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 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.7850E+08 | | | | | | | | | 3.1089E+05 | "+ or -" | 1.8910E+05 |



ACE 6208385

Appendix A.8. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.9530E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 7.2700E-04 | 12 | 1.8200E-07 | 1.4310E-03 | 8.5161E+04 | 2.9520E+09 | 1.0650E+05 |
| " 7.0 - 12.0" | 5.9390E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 6.6470E-04 | 12 | 3.3570E-08 | 2.5360E-03 | 1.5060E+05 | 1.7740E+09 | 8.2560E+04 |
| " 12.0 - 17.0" | 5.9120E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 9.9110E-04 | 12 | 8.3890E-08 | 3.8680E-03 | 2.2865E+05 | 4.5750E+09 | 1.3260E+05 |
| " 17.0 - 22.0" | 5.8670E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 7.1430E-04 | 12 | 7.4300E-09 | 3.5970E-03 | 2.1103E+05 | 8.1480E+08 | 5.5950E+04 |
| " 22.0 - 27.0" | 5.7890E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 5.2220E-04 | 12 | 1.5110E-08 | 3.3750E-03 | 1.9541E+05 | 2.2070E+09 | 9.2090E+04 |
| " 27.0 - 32.0" | 5.6590E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 4.0450E-04 | 12 | 8.0640E-09 | 3.1730E-03 | 1.7955E+05 | 1.5960E+09 | 7.8290E+04 |
| " 32.0 - 37.0" | 5.5390E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 1.0240E-04 | 12 | 1.3520E-09 | 9.6220E-04 | 5.3300E+04 | 3.6700E+08 | 3.7550E+04 |
| " 37.0 - 42.0" | 5.4290E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 3.2390E-05 | 12 | 2.0060E-10 | 3.2820E-04 | 1.7820E+04 | 6.1120E+07 | 1.5320E+04 |
| " 42.0 - 47.0" | 5.3140E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 1.3350E-06 | 12 | 1.7830E-12 | 1.5950E-05 | 8.4735E+02 | 7.2320E+05 | 1.6670E+03 |
| " 47.0 - 52.0" | 5.2260E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 5.0990E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.9080E-06 | 11 | 3.6420E-12 | 9.7880E-06 | 4.9903E+02 | 2.6180E+05 | 1.0030E+03 |
| " 57.0 - 62.0" | 4.9680E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 4.8040E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 4.6750E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 72.0 - 77.0" | 4.5200E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.3870E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 4.2120E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 3.3000E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 2.8770E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 2.6340E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 9.8100E+08 | | | | | | | | | 1.1229E+06 | "+ or -" | 2.3480E+05 |



ACE 6208386

Appendix A.9. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.9550E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 4.3200E-04 | 12 | 7.2020E-08 | 8.5000E-04 | 5.0618E+04 | 1.1490E+09 | 6.6440E+04 |
| " 7.0 - 12.0" | 5.9550E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 8.2880E-04 | 12 | 9.9050E-08 | 3.1620E-03 | 1.8831E+05 | 5.1930E+09 | 1.4120E+05 |
| " 12.0 - 17.0" | 5.9430E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 1.0490E-03 | 12 | 7.2930E-08 | 4.0920E-03 | 2.4320E+05 | 4.0470E+09 | 1.2470E+05 |
| " 17.0 - 22.0" | 5.9100E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 9.3500E-04 | 12 | 3.6130E-08 | 4.7090E-03 | 2.7827E+05 | 3.4890E+09 | 1.1580E+05 |
| " 22.0 - 27.0" | 5.8360E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 5.8080E-04 | 12 | 1.5860E-08 | 3.7540E-03 | 2.1910E+05 | 2.3730E+09 | 9.5480E+04 |
| " 27.0 - 32.0" | 5.7230E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.3800E-04 | 12 | 2.0410E-09 | 1.8670E-03 | 1.0683E+05 | 4.1360E+08 | 3.9860E+04 |
| " 32.0 - 37.0" | 5.5210E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 5.1270E-05 | 12 | 7.9100E-10 | 4.8160E-04 | 2.6585E+04 | 2.1290E+08 | 2.8600E+04 |
| " 37.0 - 42.0" | 5.3930E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 2.4700E-05 | 12 | 2.3720E-10 | 2.5030E-04 | 1.3497E+04 | 7.1040E+07 | 1.6520E+04 |
| " 42.0 - 47.0" | 5.2390E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 47.0 - 52.0" | 5.1210E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 4.9980E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.6030E-08 | 11 | 6.7730E-16 | 1.3350E-07 | 6.6706E+00 | 4.6780E+01 | 1.3410E+01 |
| " 57.0 - 62.0" | 4.8310E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 4.6870E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 4.5860E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.8900E-08 | 11 | 3.5730E-16 | 9.6940E-08 | 4.4462E+00 | 2.0780E+01 | 8.9350E+00 |
| " 72.0 - 77.0" | 4.4860E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.3930E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 4.3660E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 4.3070E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 4.2420E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 4.1100E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.0160E+09 | | | | | | | | | 1.1264E+06 | "+ or -" | 2.5520E+05 |



ACE 6208387

Appendix A.10. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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" | 5.9550E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 5.3010E-04 | 12 | 1.7050E-07 | 1.0430E-03 | 6.2116E+04 | 2.5820E+09 | 9.9600E+04 |
| " 7.0 - 12.0" | 5.9500E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 3.2050E-04 | 12 | 1.8650E-08 | 1.2230E-03 | 7.2765E+04 | 9.7270E+08 | 6.1130E+04 |
| " 12.0 - 17.0" | 5.9210E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 6.7510E-04 | 12 | 4.6110E-08 | 2.6340E-03 | 1.5597E+05 | 2.5130E+09 | 9.8250E+04 |
| " 17.0 - 22.0" | 5.8660E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 6.3850E-04 | 12 | 3.0120E-08 | 3.2150E-03 | 1.8860E+05 | 2.7610E+09 | 1.0300E+05 |
| " 22.0 - 27.0" | 5.8180E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 4.6560E-04 | 12 | 2.0170E-08 | 3.0090E-03 | 1.7508E+05 | 2.9260E+09 | 1.0600E+05 |
| " 27.0 - 32.0" | 5.7490E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 1.3110E-04 | 12 | 2.0000E-09 | 1.0280E-03 | 5.9115E+04 | 4.0740E+08 | 3.9560E+04 |
| " 32.0 - 37.0" | 5.6450E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 4.9950E-05 | 12 | 5.5580E-10 | 4.6920E-04 | 2.6481E+04 | 1.5650E+08 | 2.4520E+04 |
| " 37.0 - 42.0" | 5.5500E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 8.8140E-08 | 12 | 3.5310E-15 | 8.9300E-07 | 4.9564E+01 | 1.1200E+03 | 6.5590E+01 |
| " 42.0 - 47.0" | 5.4650E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 47.0 - 52.0" | 5.3810E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 5.3180E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 6.0190E-07 | 12 | 3.6230E-13 | 3.0870E-06 | 1.6418E+02 | 2.8340E+04 | 3.2990E+02 |
| " 57.0 - 62.0" | 5.1820E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 5.0290E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 4.9490E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 72.0 - 77.0" | 4.8670E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.6910E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 4.5750E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 4.3960E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 4.1900E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 3.9080E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.0440E+09 | | | | | | | | | 7.4035E+05 | "+ or -" | 2.1750E+05 |



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Appendix A.11. Hydroacoustic estimate of fish inhabiting Area 2, Kenai Lake, Alaska in 1989 based on transect 4 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.9550E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 5.1870E-05 | 12 | 2.6910E-09 | 1.0210E-04 | 6.0783E+03 | 3.9260E+07 | 1.2280E+04 |
| " 7.0 - 12.0" | 5.9440E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 1.3180E-03 | 12 | 3.7610E-07 | 5.0280E-03 | 2.9891E+05 | 1.9550E+10 | 2.7400E+05 |
| " 12.0 - 17.0" | 5.9310E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 1.2300E-03 | 12 | 1.1890E-07 | 4.8000E-03 | 2.8470E+05 | 6.5410E+09 | 1.5850E+05 |
| " 17.0 - 22.0" | 5.9040E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 5.1800E-04 | 12 | 1.4190E-08 | 2.6090E-03 | 1.5402E+05 | 1.3430E+09 | 7.1820E+04 |
| " 22.0 - 27.0" | 5.7450E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 3.4870E-04 | 12 | 2.8370E-09 | 2.2540E-03 | 1.2948E+05 | 4.3170E+08 | 4.0720E+04 |
| " 27.0 - 32.0" | 5.6530E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.0440E-04 | 12 | 2.1720E-09 | 1.6030E-03 | 9.0625E+04 | 4.2870E+08 | 4.0580E+04 |
| " 32.0 - 37.0" | 5.5760E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 9.5070E-06 | 12 | 1.7180E-11 | 8.9290E-05 | 4.9787E+03 | 4.7200E+06 | 4.2580E+03 |
| " 37.0 - 42.0" | 5.5050E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 7.1630E-06 | 12 | 5.1300E-11 | 7.2570E-05 | 3.9948E+03 | 1.5980E+07 | 7.8350E+03 |
| " 42.0 - 47.0" | 5.4270E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 1.7780E-06 | 12 | 2.2190E-12 | 2.1230E-05 | 1.1522E+03 | 9.4150E+05 | 1.9020E+03 |
| " 47.0 - 52.0" | 5.3240E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 5.2070E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 5.0580E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 4.9720E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 4.7730E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 5.5010E-08 | 11 | 3.0260E-15 | 2.8210E-07 | 1.3467E+01 | 1.9070E+02 | 2.7060E+01 |
| " 72.0 - 77.0" | 4.6290E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.5640E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 4.4220E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 4.3690E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 4.2450E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 3.9570E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.2130E-08 | 9 | 4.8950E-16 | 1.1350E-07 | 4.4899E+00 | 2.1190E+01 | 9.0230E+00 |
| "TOTAL" | 1.0320E+09 | | | | | | | | | 9.7395E+05 | "+ or -" | 3.3000E+05 |



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Appendix A.12. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 4.6330E-04 | 13 | 1.3110E-07 | 9.1160E-04 | 4.8007E+04 | 1.5530E+09 | 7.7230E+04 |
| " 7.0 - 12.0" | 5.2590E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 3.7920E-04 | 13 | 1.4590E-08 | 1.4470E-03 | 7.6084E+04 | 6.0040E+08 | 4.8030E+04 |
| " 12.0 - 17.0" | 5.2580E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 6.4610E-04 | 13 | 2.1040E-08 | 2.5210E-03 | 1.3257E+05 | 9.2280E+08 | 5.9540E+04 |
| " 17.0 - 22.0" | 5.2380E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 6.3300E-04 | 13 | 3.2400E-08 | 3.1880E-03 | 1.6697E+05 | 2.3580E+09 | 9.5180E+04 |
| " 22.0 - 27.0" | 5.2140E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 7.0990E-04 | 13 | 2.1440E-08 | 4.5880E-03 | 2.3920E+05 | 2.5730E+09 | 9.9410E+04 |
| " 27.0 - 32.0" | 5.1780E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 6.0070E-04 | 13 | 2.4600E-08 | 4.7120E-03 | 2.4399E+05 | 4.0710E+09 | 1.2510E+05 |
| " 32.0 - 37.0" | 5.1370E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 8.2390E-05 | 13 | 4.7640E-10 | 7.7380E-04 | 3.9754E+04 | 1.1160E+08 | 2.0700E+04 |
| " 37.0 - 42.0" | 5.0870E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 1.6970E-05 | 13 | 7.0090E-11 | 1.7190E-04 | 8.7458E+03 | 1.8720E+07 | 8.4800E+03 |
| " 42.0 - 47.0" | 5.0470E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 3.4300E-06 | 13 | 1.1760E-11 | 4.0950E-05 | 2.0670E+03 | 4.3040E+06 | 4.0660E+03 |
| " 47.0 - 52.0" | 4.9440E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 4.7340E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.1490E-07 | 13 | 1.3210E-14 | 5.8950E-07 | 2.7908E+01 | 8.1880E+02 | 5.6080E+01 |
| " 57.0 - 62.0" | 4.6400E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 4.5730E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 4.5120E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 72.0 - 77.0" | 4.4720E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.4250E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 4.3920E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 4.3560E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 4.2970E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 4.1740E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 9.6210E+08 | | | | | | | | | 9.5741E+05 | "+ or -" | 2.1660E+05 |



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Appendix A.13. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.2700E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 4.4720E-04 | 10 | 1.1210E-07 | 8.7990E-04 | 4.6371E+04 | 1.3410E+09 | 7.1760E+04 |
| " 7.0 - 12.0" | 5.2700E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 1.2590E-04 | 10 | 2.7060E-09 | 4.8030E-04 | 2.5313E+04 | 1.1090E+08 | 2.0640E+04 |
| " 12.0 - 17.0" | 5.2700E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 5.7050E-04 | 10 | 1.8640E-08 | 2.2260E-03 | 1.1733E+05 | 8.1740E+08 | 5.6040E+04 |
| " 17.0 - 22.0" | 5.2670E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 3.8040E-04 | 10 | 4.9050E-09 | 1.9150E-03 | 1.0089E+05 | 3.8310E+08 | 3.8360E+04 |
| " 22.0 - 27.0" | 5.2560E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 4.8140E-04 | 10 | 2.4320E-08 | 3.1110E-03 | 1.6355E+05 | 2.8720E+09 | 1.0500E+05 |
| " 27.0 - 32.0" | 5.2560E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.6040E-04 | 10 | 9.5560E-09 | 2.0430E-03 | 1.0738E+05 | 1.6270E+09 | 7.9060E+04 |
| " 32.0 - 37.0" | 5.2520E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 8.0900E-05 | 10 | 1.0210E-09 | 7.5980E-04 | 3.9903E+04 | 2.4900E+08 | 3.0930E+04 |
| " 37.0 - 42.0" | 5.2260E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 1.5040E-05 | 10 | 2.1610E-10 | 1.5240E-04 | 7.9653E+03 | 6.0670E+07 | 1.5270E+04 |
| " 42.0 - 47.0" | 5.2090E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 6.2670E-05 | 10 | 3.5850E-09 | 7.4830E-04 | 3.8979E+04 | 1.3980E+09 | 7.3290E+04 |
| " 47.0 - 52.0" | 5.1850E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 3.6000E-06 | 10 | 1.2960E-11 | 1.8460E-05 | 9.5722E+02 | 9.6320E+05 | 1.9240E+03 |
| " 52.0 - 57.0" | 5.1520E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 5.1300E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.3110E-04 | 10 | 1.7190E-08 | 6.7260E-04 | 3.4503E+04 | 1.2510E+09 | 6.9320E+04 |
| " 62.0 - 67.0" | 5.0910E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 5.0620E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 72.0 - 77.0" | 5.0270E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.9870E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 4.9560E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 4.9350E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.0000E-08 | 10 | 1.0010E-16 | 5.1300E-08 | 2.5318E+00 | 6.7380E+00 | 5.0880E+00 |
| " 92.0 - 97.0" | 4.8220E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 4.6800E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 3.1620E-08 | 9 | 1.0000E-15 | 1.6220E-07 | 7.5904E+00 | 6.0570E+01 | 1.5250E+01 |
| "TOTAL" | 1.0230E+09 | | | | | | | | | 6.8316E+05 | "+ or -" | 1.9710E+05 |



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Appendix A.14. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.2670E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 5.8100E-04 | 10 | 1.5710E-07 | 1.1430E-03 | 6.0218E+04 | 1.9140E+09 | 8.5750E+04 |
| " 7.0 - 12.0" | 5.2570E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 7.5920E-04 | 10 | 7.9080E-08 | 2.8960E-03 | 1.5227E+05 | 3.2340E+09 | 1.1150E+05 |
| " 12.0 - 17.0" | 5.2460E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 7.6460E-04 | 10 | 4.4640E-08 | 2.9840E-03 | 1.5652E+05 | 1.9220E+09 | 8.5930E+04 |
| " 17.0 - 22.0" | 5.2160E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 9.5110E-04 | 10 | 1.2520E-08 | 4.7900E-03 | 2.4984E+05 | 1.0970E+09 | 6.4900E+04 |
| " 22.0 - 27.0" | 5.0800E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 3.7500E-04 | 10 | 1.0210E-09 | 2.4240E-03 | 1.2311E+05 | 1.4680E+08 | 2.3750E+04 |
| " 27.0 - 32.0" | 4.9620E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.9720E-04 | 10 | 6.7330E-09 | 2.3310E-03 | 1.1566E+05 | 1.0230E+09 | 6.2680E+04 |
| " 32.0 - 37.0" | 4.8250E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 1.3250E-04 | 10 | 2.1790E-09 | 1.2440E-03 | 6.0043E+04 | 4.4890E+08 | 4.1530E+04 |
| " 37.0 - 42.0" | 4.7190E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 2.0740E-05 | 10 | 6.1050E-11 | 2.1010E-04 | 9.9166E+03 | 1.4090E+07 | 7.3560E+03 |
| " 42.0 - 47.0" | 4.5820E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 47.0 - 52.0" | 4.4710E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.3020E-06 | 10 | 5.3010E-12 | 1.1810E-05 | 5.2796E+02 | 2.9300E+05 | 1.0610E+03 |
| " 52.0 - 57.0" | 4.3680E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 4.2950E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 4.0910E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 3.6440E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 72.0 - 77.0" | 3.3960E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 3.2490E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 7 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 3.1600E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 7 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 3.0630E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 6 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 2.9710E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 9.1220E-07 | 6 | 8.3200E-13 | 4.6780E-06 | 1.3897E+02 | 2.0300E+04 | 2.7930E+02 |
| " 97.0 -102.0" | 2.9030E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 6 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 8.4770E+08 | | | | | | | | | 9.2824E+05 | "+ or -" | 1.9400E+05 |



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Appendix A.15. Hydroacoustic estimate of fish inhabiting Area 3, Kenai Lake, Alaska in 1989 based on transect 4 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.2700E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 1.2320E-03 | 9 | 4.9050E-07 | 2.4240E-03 | 1.2776E+05 | 6.2960E+09 | 1.5550E+05 |
| " 7.0 - 12.0" | 5.2580E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 3.7380E-05 | 9 | 4.3340E-10 | 1.4260E-04 | 7.4979E+03 | 1.7570E+07 | 8.2150E+03 |
| " 12.0 - 17.0" | 5.2310E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 4.6890E-04 | 9 | 9.3350E-09 | 1.8300E-03 | 9.5726E+04 | 4.0830E+08 | 3.9610E+04 |
| " 17.0 - 22.0" | 5.1980E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 3.6310E-04 | 9 | 3.6100E-08 | 1.8290E-03 | 9.5043E+04 | 2.5070E+09 | 9.8130E+04 |
| " 22.0 - 27.0" | 5.1390E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 6.4840E-04 | 9 | 3.7080E-08 | 4.1900E-03 | 2.1533E+05 | 4.2020E+09 | 1.2710E+05 |
| " 27.0 - 32.0" | 5.0750E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.8860E-04 | 9 | 2.0440E-09 | 2.2640E-03 | 1.1487E+05 | 3.2660E+08 | 3.5420E+04 |
| " 32.0 - 37.0" | 4.9560E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 8.0800E-05 | 9 | 9.2890E-10 | 7.5890E-04 | 3.7613E+04 | 2.0190E+08 | 2.7850E+04 |
| " 37.0 - 42.0" | 4.8620E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 2.9270E-05 | 9 | 7.7340E-11 | 2.9660E-04 | 1.4422E+04 | 1.9040E+07 | 8.5520E+03 |
| " 42.0 - 47.0" | 4.7740E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 47.0 - 52.0" | 4.6760E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 4.4140E-07 | 9 | 1.9480E-13 | 2.2640E-06 | 1.0584E+02 | 1.1780E+04 | 2.1270E+02 |
| " 52.0 - 57.0" | 4.5320E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 4.4270E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 4.2610E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 4.1890E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 72.0 - 77.0" | 4.1110E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.0210E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 3.9310E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 7 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 3.8710E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 7 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 3.8000E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.4110E-08 | 7 | 1.9900E-16 | 7.2350E-08 | 2.7493E+00 | 7.9460E+00 | 5.5250E+00 |
| " 97.0 -102.0" | 3.7320E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 7 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 9.1310E+08 | | | | | | | | | 7.0837E+05 | "+ or -" | 2.3170E+05 |



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Appendix A.16. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 7.1720E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 1.2470E-04 | 14 | 5.8810E-09 | 2.4550E-04 | 1.7603E+04 | 1.3650E+08 | 2.2900E+04 |
| " 7.0 - 12.0" | 7.1430E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 1.7700E-04 | 14 | 1.0780E-08 | 6.7550E-04 | 4.8249E+04 | 8.0600E+08 | 5.5640E+04 |
| " 12.0 - 17.0" | 7.0780E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 4.9170E-04 | 14 | 3.9930E-08 | 1.9190E-03 | 1.3583E+05 | 3.0860E+09 | 1.0890E+05 |
| " 17.0 - 22.0" | 7.0000E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 1.5410E-04 | 14 | 3.7010E-09 | 7.7610E-04 | 5.4326E+04 | 4.7100E+08 | 4.2540E+04 |
| " 22.0 - 27.0" | 6.9250E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 2.3240E-04 | 14 | 1.2660E-08 | 1.5020E-03 | 1.0402E+05 | 2.5620E+09 | 9.9210E+04 |
| " 27.0 - 32.0" | 6.8480E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 1.8740E-04 | 14 | 9.6110E-09 | 1.4700E-03 | 1.0067E+05 | 2.7750E+09 | 1.0330E+05 |
| " 32.0 - 37.0" | 6.7560E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 2.8990E-05 | 14 | 4.2670E-10 | 2.7230E-04 | 1.8394E+04 | 1.7190E+08 | 2.5700E+04 |
| " 37.0 - 42.0" | 6.6340E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 7.5690E-06 | 14 | 5.7290E-11 | 7.6680E-05 | 5.0871E+03 | 2.5910E+07 | 9.9770E+03 |
| " 42.0 - 47.0" | 6.5910E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 2.2410E-06 | 14 | 5.0200E-12 | 2.6760E-05 | 1.7634E+03 | 3.1320E+06 | 3.4690E+03 |
| " 47.0 - 52.0" | 6.5550E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 14 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 6.4370E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 6.3190E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 6.1890E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 3.0300E-08 | 12 | 9.1840E-16 | 1.5540E-07 | 9.6181E+00 | 9.7250E+01 | 1.9330E+01 |
| " 67.0 - 72.0" | 6.1270E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 3.0600E-08 | 12 | 4.2560E-16 | 1.5690E-07 | 9.6154E+00 | 4.6760E+01 | 1.3400E+01 |
| " 72.0 - 77.0" | 6.0630E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 8.1160E-08 | 12 | 1.3080E-15 | 4.1630E-07 | 2.5238E+01 | 1.5910E+02 | 2.4720E+01 |
| " 77.0 - 82.0" | 6.0070E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.1700E-07 | 12 | 2.0420E-15 | 6.0030E-07 | 3.6059E+01 | 2.6050E+02 | 3.1630E+01 |
| " 82.0 - 87.0" | 5.8830E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 7.1670E-08 | 12 | 7.0910E-16 | 3.6760E-07 | 2.1624E+01 | 8.8520E+01 | 1.8440E+01 |
| " 87.0 - 92.0" | 5.7640E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 8.9410E-08 | 12 | 2.5160E-15 | 4.5850E-07 | 2.6430E+01 | 2.5560E+02 | 3.1340E+01 |
| " 92.0 - 97.0" | 5.5020E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 6.8130E-08 | 12 | 2.2690E-15 | 3.4940E-07 | 1.9225E+01 | 1.9960E+02 | 2.7690E+01 |
| " 97.0 -102.0" | 5.2990E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.7690E-07 | 11 | 5.9960E-15 | 9.0740E-07 | 4.8081E+01 | 5.6130E+02 | 4.6430E+01 |
| "TOTAL" | 1.2830E+09 | | | | | | | | | 4.8614E+05 | "+ or -" | 1.9640E+05 |



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Appendix A.17. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 7.1800E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 3.7180E-04 | 12 | 1.3100E-07 | 7.3170E-04 | 5.2534E+04 | 2.7880E+09 | 1.0350E+05 |
| " 7.0 - 12.0" | 7.1640E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 8.3930E-05 | 12 | 6.6070E-10 | 3.2020E-04 | 2.2939E+04 | 5.0540E+07 | 1.3930E+04 |
| " 12.0 - 17.0" | 7.1480E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 7.4620E-04 | 12 | 1.4240E-07 | 2.9120E-03 | 2.0812E+05 | 1.1170E+10 | 2.0720E+05 |
| " 17.0 - 22.0" | 7.1210E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 2.2840E-04 | 12 | 3.1840E-09 | 1.1500E-03 | 8.1889E+04 | 4.3450E+08 | 4.0860E+04 |
| " 22.0 - 27.0" | 7.0710E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 2.9410E-04 | 12 | 4.2340E-09 | 1.9010E-03 | 1.3441E+05 | 9.2820E+08 | 5.9710E+04 |
| " 27.0 - 32.0" | 6.9780E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 7.3670E-05 | 12 | 5.5770E-10 | 5.7790E-04 | 4.0323E+04 | 1.6740E+08 | 2.5360E+04 |
| " 32.0 - 37.0" | 6.8960E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 4.0630E-05 | 12 | 2.2890E-10 | 3.8160E-04 | 2.6319E+04 | 9.6310E+07 | 1.9230E+04 |
| " 37.0 - 42.0" | 6.7980E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 6.9210E-06 | 12 | 4.7900E-11 | 7.0120E-05 | 4.7670E+03 | 2.2750E+07 | 9.3490E+03 |
| " 42.0 - 47.0" | 6.6140E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 1.0660E-07 | 12 | 1.1370E-14 | 1.2730E-06 | 8.4225E+01 | 7.1460E+03 | 1.6570E+02 |
| " 47.0 - 52.0" | 6.2890E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 6.1870E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 6.0010E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.1790E-08 | 11 | 4.7490E-16 | 1.1180E-07 | 6.7065E+00 | 4.7280E+01 | 1.3480E+01 |
| " 62.0 - 67.0" | 5.8820E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.7760E-08 | 11 | 3.1550E-16 | 9.1100E-08 | 5.3578E+00 | 3.0180E+01 | 1.0770E+01 |
| " 67.0 - 72.0" | 5.7950E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 9.0240E-08 | 11 | 1.6940E-15 | 4.6280E-07 | 2.6819E+01 | 1.8650E+02 | 2.6770E+01 |
| " 72.0 - 77.0" | 5.6820E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 4.1420E-08 | 11 | 1.7150E-15 | 2.1240E-07 | 1.2068E+01 | 1.5310E+02 | 2.4250E+01 |
| " 77.0 - 82.0" | 5.5920E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.1040E-07 | 11 | 1.2670E-14 | 1.0790E-06 | 6.0343E+01 | 1.2290E+03 | 6.8700E+01 |
| " 82.0 - 87.0" | 5.4780E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.1460E-07 | 11 | 3.3000E-15 | 5.8760E-07 | 3.2189E+01 | 3.1360E+02 | 3.4710E+01 |
| " 87.0 - 92.0" | 5.3460E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 3.3260E-07 | 10 | 3.0870E-14 | 1.7060E-06 | 9.1180E+01 | 2.7460E+03 | 1.0270E+02 |
| " 92.0 - 97.0" | 5.2780E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 4.8560E-07 | 9 | 1.3940E-14 | 2.4900E-06 | 1.3143E+02 | 1.9060E+03 | 8.5580E+01 |
| " 97.0 -102.0" | 5.1560E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 6.3900E-07 | 9 | 2.8920E-14 | 3.2770E-06 | 1.6898E+02 | 3.4860E+03 | 1.1570E+02 |
| "TOTAL" | 1.2570E+09 | | | | | | | | | 5.7193E+05 | "+ or -" | 2.4530E+05 |



ACE 6208395

Appendix A.18. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 7.1850E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 1.3360E-04 | 18 | 1.1460E-08 | 2.6290E-04 | 1.8893E+04 | 2.5140E+08 | 3.1080E+04 |
| " 7.0 - 12.0" | 7.1770E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 2.6840E-04 | 18 | 1.2960E-08 | 1.0240E-03 | 7.3485E+04 | 9.8420E+08 | 6.1490E+04 |
| " 12.0 - 17.0" | 7.1310E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 4.5550E-04 | 18 | 3.3180E-08 | 1.7780E-03 | 1.2677E+05 | 2.6030E+09 | 1.0000E+05 |
| " 17.0 - 22.0" | 7.0680E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 3.3380E-04 | 18 | 9.6890E-09 | 1.6810E-03 | 1.1880E+05 | 1.2800E+09 | 7.0130E+04 |
| " 22.0 - 27.0" | 7.0030E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 2.6530E-04 | 18 | 7.8380E-09 | 1.7150E-03 | 1.2007E+05 | 1.6410E+09 | 7.9390E+04 |
| " 27.0 - 32.0" | 6.9400E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 1.6080E-04 | 18 | 5.6600E-09 | 1.2620E-03 | 8.7547E+04 | 1.6790E+09 | 8.0300E+04 |
| " 32.0 - 37.0" | 6.8690E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 2.1530E-05 | 18 | 9.1350E-11 | 2.0220E-04 | 1.3887E+04 | 3.8100E+07 | 1.2100E+04 |
| " 37.0 - 42.0" | 6.8050E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 1.7380E-05 | 17 | 1.4150E-10 | 1.7610E-04 | 1.1982E+04 | 6.7440E+07 | 1.6100E+04 |
| " 42.0 - 47.0" | 6.7200E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 4.7690E-06 | 17 | 1.2980E-11 | 5.6950E-05 | 3.8267E+03 | 8.4670E+06 | 5.7030E+03 |
| " 47.0 - 52.0" | 6.6220E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 7.2580E-07 | 17 | 2.6630E-13 | 3.7220E-06 | 2.4650E+02 | 3.3830E+04 | 3.6050E+02 |
| " 52.0 - 57.0" | 6.5460E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 17 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 6.4350E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.4040E-08 | 17 | 1.9720E-16 | 7.2030E-08 | 4.6349E+00 | 2.2580E+01 | 9.3140E+00 |
| " 62.0 - 67.0" | 6.3680E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 5.6760E-08 | 16 | 1.5720E-15 | 2.9110E-07 | 1.8538E+01 | 1.8530E+02 | 2.6680E+01 |
| " 67.0 - 72.0" | 6.3010E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.4100E-07 | 16 | 1.5930E-14 | 1.2360E-06 | 7.7866E+01 | 1.9740E+03 | 8.7090E+01 |
| " 72.0 - 77.0" | 6.2440E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.6040E-08 | 16 | 6.7830E-16 | 1.3360E-07 | 8.3403E+00 | 7.3130E+01 | 1.6760E+01 |
| " 77.0 - 82.0" | 6.1970E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.6240E-08 | 16 | 6.8860E-16 | 1.3460E-07 | 8.3403E+00 | 7.3130E+01 | 1.6760E+01 |
| " 82.0 - 87.0" | 6.1510E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 8.8170E-08 | 16 | 2.8360E-15 | 4.5220E-07 | 2.7813E+01 | 3.2180E+02 | 3.5160E+01 |
| " 87.0 - 92.0" | 6.1110E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.7750E-08 | 16 | 1.6560E-16 | 9.1010E-08 | 5.5619E+00 | 1.7850E+01 | 8.2820E+00 |
| " 92.0 - 97.0" | 6.0570E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 8.9520E-08 | 16 | 1.0990E-15 | 4.5910E-07 | 2.7808E+01 | 1.4570E+02 | 2.3660E+01 |
| " 97.0 -102.0" | 6.0000E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.3500E-07 | 16 | 2.8960E-14 | 1.2050E-06 | 7.2304E+01 | 3.0100E+03 | 1.0750E+02 |
| "TOTAL" | 1.3190E+09 | | | | | | | | | 5.7576E+05 | "+ or -" | 1.8130E+05 |



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Appendix A.19. Hydroacoustic estimate of fish inhabiting Area 4, Kenai Lake, Alaska in 1989 based on transect 4 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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" | 7.1850E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 5.4110E-04 | 14 | 9.5160E-08 | 1.0650E-03 | 7.6502E+04 | 2.2690E+09 | 9.3350E+04 |
| " 7.0 - 12.0" | 7.1740E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 3.3280E-04 | 14 | 5.7590E-08 | 1.2700E-03 | 9.1094E+04 | 4.3330E+09 | 1.2900E+05 |
| " 12.0 - 17.0" | 7.1590E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 6.2810E-04 | 14 | 2.3750E-08 | 2.4510E-03 | 1.7546E+05 | 1.9190E+09 | 8.5850E+04 |
| " 17.0 - 22.0" | 7.1060E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 4.8790E-04 | 14 | 2.2470E-08 | 2.4570E-03 | 1.7458E+05 | 2.9910E+09 | 1.0720E+05 |
| " 22.0 - 27.0" | 7.0310E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 5.7090E-04 | 14 | 1.4480E-08 | 3.6900E-03 | 2.5944E+05 | 3.1520E+09 | 1.1000E+05 |
| " 27.0 - 32.0" | 6.9390E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 1.9850E-04 | 14 | 2.4360E-09 | 1.5570E-03 | 1.0803E+05 | 7.2400E+08 | 5.2740E+04 |
| " 32.0 - 37.0" | 6.8530E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 6.3150E-05 | 14 | 2.2560E-10 | 5.9310E-04 | 4.0650E+04 | 9.4120E+07 | 1.9010E+04 |
| " 37.0 - 42.0" | 6.7710E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 1.3180E-05 | 14 | 1.3030E-10 | 1.3360E-04 | 9.0432E+03 | 6.1420E+07 | 1.5360E+04 |
| " 42.0 - 47.0" | 6.6970E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 2.1820E-06 | 14 | 4.7600E-12 | 2.6050E-05 | 1.7447E+03 | 3.0660E+06 | 3.4320E+03 |
| " 47.0 - 52.0" | 6.6050E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 14 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 6.5000E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 6.4080E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 6.3240E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 13 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 6.2070E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 72.0 - 77.0" | 6.1420E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 6.0910E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 82.0 - 87.0" | 6.0430E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 6.0030E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 5.9640E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 5.9010E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 12 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.3110E+09 | | | | | | | | | 9.3654E+05 | "+ or -" | 2.4440E+05 |



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Appendix A.20. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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" | 5.4650E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 1.1750E-03 | 7 | 4.8560E-07 | 2.3120E-03 | 1.2632E+05 | 6.6140E+09 | 1.5940E+05 |
| " 7.0 - 12.0" | 5.3870E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 3.1030E-04 | 7 | 5.9590E-08 | 1.1840E-03 | 6.3777E+04 | 2.5270E+09 | 9.8520E+04 |
| " 12.0 - 17.0" | 5.1460E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 2.3340E-04 | 7 | 1.4530E-08 | 9.1100E-04 | 4.6877E+04 | 5.9050E+08 | 4.7630E+04 |
| " 17.0 - 22.0" | 4.5700E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 2.7100E-04 | 7 | 8.2310E-09 | 1.3650E-03 | 6.2368E+04 | 4.5050E+08 | 4.1600E+04 |
| " 22.0 - 27.0" | 4.2130E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 2.6900E-04 | 7 | 8.5430E-09 | 1.7390E-03 | 7.3254E+04 | 6.4630E+08 | 4.9830E+04 |
| " 27.0 - 32.0" | 3.8410E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 1.7180E-04 | 6 | 7.4370E-09 | 1.3480E-03 | 5.1765E+04 | 6.7550E+08 | 5.0940E+04 |
| " 32.0 - 37.0" | 2.2260E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 3.6000E-06 | 5 | 4.9870E-12 | 3.3820E-05 | 7.5288E+02 | 2.1830E+05 | 9.1570E+02 |
| " 37.0 - 42.0" | 1.7130E+06 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 6.8920E-06 | 3 | 4.7500E-11 | 6.9830E-05 | 1.1964E+02 | 1.4330E+04 | 2.3460E+02 |
| " 42.0 - 47.0" | 0.0000E+00 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 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 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 3.1020E+08 | | | | | | | | | 4.2524E+05 | "+ or -" | 2.1020E+05 |



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Appendix A.21. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.3130E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 1.4070E-04 | 12 | 6.6690E-09 | 2.7690E-04 | 1.4712E+04 | 8.6450E+07 | 1.8220E+04 |
| " 7.0 - 12.0" | 5.0300E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 4.3260E-05 | 12 | 8.4230E-10 | 1.6510E-04 | 8.3015E+03 | 3.1170E+07 | 1.0940E+04 |
| " 12.0 - 17.0" | 4.9590E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 1.7400E-04 | 11 | 6.0330E-09 | 6.7910E-04 | 3.3676E+04 | 2.2830E+08 | 2.9620E+04 |
| " 17.0 - 22.0" | 4.9150E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 1.8210E-04 | 11 | 8.1510E-09 | 9.1680E-04 | 4.5067E+04 | 5.0700E+08 | 4.4130E+04 |
| " 22.0 - 27.0" | 4.8580E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 9.5800E-05 | 11 | 2.0740E-09 | 6.1920E-04 | 3.0082E+04 | 2.0670E+[illegible] | 2.8180E+04 |
| " 27.0 - 32.0" | 4.7460E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 1.2370E-04 | 11 | 2.0820E-09 | 9.6990E-04 | 4.6036E+04 | 2.8910E+[illegible] | 3.3320E+04 |
| " 32.0 - 37.0" | 4.6200E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 4.7140E-05 | 11 | 6.7460E-10 | 4.4270E-04 | 2.0452E+04 | 1.2710E+08 | 2.2100E+04 |
| " 37.0 - 42.0" | 4.5670E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 1.0390E-05 | 11 | 2.9630E-11 | 1.0520E-04 | 4.8071E+03 | 6.3750E+[illegible] | 4.9490E+03 |
| " 42.0 - 47.0" | 4.5200E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 2.5860E-06 | 11 | 3.4710E-12 | 3.0880E-05 | 1.3957E+03 | 1.0260E+0[illegible] | 1.9850E+03 |
| " 47.0 - 52.0" | 4.4530E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.3230E-05 | 11 | 1.7510E-10 | 6.7870E-05 | 3.0225E+03 | 9.6030E+06 | 6.0740E+03 |
| " 52.0 - 57.0" | 4.3650E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 4.3150E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.2140E-07 | 11 | 1.4730E-14 | 6.2240E-07 | 2.6855E+01 | 7.5820E+0[illegible] | 5.3970E+01 |
| " 62.0 - 67.0" | 4.2530E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 4.7260E-07 | 9 | 2.2340E-13 | 2.4240E-06 | 1.0309E+02 | 1.1170E+04 | 2.0720E+02 |
| " 67.0 - 72.0" | 4.1840E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 6.0070E-08 | 9 | 1.8050E-15 | 3.0810E-07 | 1.2892E+01 | 9.1620E+01 | 1.8760E+01 |
| " 72.0 - 77.0" | 4.0520E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 3.1000E-08 | 9 | 4.2050E-16 | 1.5900E-07 | 6.4435E+00 | 2.0290E+01 | 8.8290E+00 |
| " 77.0 - 82.0" | 3.9670E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.5830E-07 | 9 | 7.5890E-15 | 8.1210E-07 | 3.2213E+01 | 3.6720E+02 | 3.7560E+01 |
| " 82.0 - 87.0" | 3.8210E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 4.3850E-08 | 9 | 1.1110E-15 | 2.2490E-07 | 8.5923E+00 | 4.6460E+01 | 1.3360E+01 |
| " 87.0 - 92.0" | 3.6670E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.1700E-07 | 9 | 8.0600E-15 | 1.1130E-06 | 4.0814E+01 | 3.7050E+[illegible] | 3.7730E+01 |
| " 92.0 - 97.0" | 3.4170E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.2260E-07 | 9 | 3.8690E-15 | 6.2860E-07 | 2.1481E+01 | 1.4250E+02 | 2.3390E+01 |
| " 97.0 -102.0" | 2.6930E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.6430E-07 | 8 | 5.2160E-15 | 1.3560E-06 | 3.6516E+01 | 1.6790E+[illegible] | 2.5390E+01 |
| "TOTAL" | 8.6720E+08 | | | | | | | | | 2.0784E+05 | "+ or -" | 7.5730E+04 |



ACE 6208399

Appendix A.22. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.4530E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 8.0760E-06 | 9 | 6.5220E-11 | 1.5890E-05 | 8.6653E+02 | 7.9790E+05 | 1.7510E+03 |
| " 7.0 - 12.0" | 5.4500E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 1.5160E-04 | 9 | 1.5880E-08 | 5.7850E-04 | 3.1530E+04 | 6.8880E+08 | 5.1440E+04 |
| " 12.0 - 17.0" | 5.4500E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 1.6570E-04 | 9 | 2.3010E-08 | 6.4660E-04 | 3.5241E+04 | 1.0430E+09 | 6.3310E+04 |
| " 17.0 - 22.0" | 5.4500E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 2.5520E-04 | 9 | 1.0640E-08 | 1.2850E-03 | 7.0036E+04 | 8.1980E+08 | 5.6120E+04 |
| " 22.0 - 27.0" | 5.4390E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 4.0450E-04 | 9 | 1.6220E-08 | 2.6140E-03 | 1.4217E+05 | 2.0530E+09 | 8.8820E+04 |
| " 27.0 - 32.0" | 5.3880E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 2.1620E-04 | 9 | 1.3060E-08 | 1.6960E-03 | 9.1374E+04 | 2.3340E+09 | 9.4690E+04 |
| " 32.0 - 37.0" | 5.3650E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 9.2090E-05 | 9 | 3.2930E-09 | 8.6490E-04 | 4.6399E+04 | 8.3680E+08 | 5.6700E+04 |
| " 37.0 - 42.0" | 5.3380E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 1.0110E-05 | 9 | 6.0630E-11 | 1.0240E-04 | 5.4682E+03 | 1.7770E+07 | 8.2630E+03 |
| " 42.0 - 47.0" | 5.2540E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 2.2710E-07 | 9 | 5.1570E-14 | 2.7120E-06 | 1.4249E+02 | 2.0450E+04 | 2.8030E+02 |
| " 47.0 - 52.0" | 5.2020E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 52.0 - 57.0" | 5.1800E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 5.1480E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 2.5760E-08 | 9 | 6.6360E-16 | 1.3210E-07 | 6.8014E+00 | 4.8630E+01 | 1.3670E+01 |
| " 62.0 - 67.0" | 5.1090E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 5.8120E-07 | 9 | 2.8640E-13 | 2.9810E-06 | 1.5226E+02 | 2.0840E+04 | 2.8300E+02 |
| " 67.0 - 72.0" | 5.0670E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 6.2700E-08 | 9 | 1.9640E-15 | 3.2160E-07 | 1.6293E+01 | 1.4620E+02 | 2.3700E+01 |
| " 72.0 - 77.0" | 5.0320E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 3.1630E-08 | 9 | 1.0000E-15 | 1.6220E-07 | 8.1623E+00 | 7.0040E+01 | 1.6400E+01 |
| " 77.0 - 82.0" | 4.9880E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.2750E-07 | 9 | 7.6800E-15 | 6.5380E-07 | 3.2612E+01 | 5.5700E+02 | 4.6260E+01 |
| " 82.0 - 87.0" | 4.3320E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 87.0 - 92.0" | 4.8530E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 9 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 92.0 - 97.0" | 4.7940E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 8 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 4.4970E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 7.0850E-09 | 8 | 5.0190E-17 | 3.6330E-08 | 1.6340E+00 | 2.8070E+00 | 3.2840E+00 |
| "TOTAL" | 1.0280E+09 | | | | | | | | | 4.2345E+05 | "+ or -" | 1.7300E+05 |



ACE 6208400

Appendix A.23. Hydroacoustic estimate of fish inhabiting Area 5, Kenai Lake, Alaska in 1989 based on transect 4 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 5.4650E+07 | 9.4790E-06 | 71 | 1.9980E-05 | 1.9680E+00 | 2.2530E-05 | 12 | 5.0770E-10 | 4.4340E-05 | 2.4232E+03 | 6.2390E+06 | 4.8960E+03 |
| " 7.0 - 12.0" | 5.4290E+07 | 4.8890E-06 | 420 | 4.7610E-06 | 3.8150E+00 | 5.0430E-05 | 12 | 1.5880E-09 | 1.9240E-04 | 1.0446E+04 | 6.8370E+07 | 1.6210E+04 |
| " 12.0 - 17.0" | 5.3490E+07 | 4.7800E-06 | 1340 | 8.0320E-06 | 3.9020E+00 | 3.3380E-04 | 12 | 4.1780E-08 | 1.3020E-03 | 6.9660E+04 | 1.8300E+09 | 8.3850E+04 |
| " 17.0 - 22.0" | 5.2620E+07 | 3.7040E-06 | 2755 | 1.1880E-05 | 5.0360E+00 | 1.2200E-04 | 12 | 7.3110E-09 | 6.1430E-04 | 3.2322E+04 | 5.1720E+08 | 4.4570E+04 |
| " 22.0 - 27.0" | 5.1740E+07 | 2.8860E-06 | 3655 | 8.5870E-06 | 6.4630E+00 | 8.1900E-05 | 12 | 1.1220E-09 | 5.2940E-04 | 2.7391E+04 | 1.2730E+08 | 2.2110E+04 |
| " 27.0 - 32.0" | 5.1050E+07 | 2.3780E-06 | 3141 | 1.9030E-06 | 7.8440E+00 | 6.3580E-05 | 12 | 1.4610E-09 | 4.9870E-04 | 2.5460E+04 | 2.3450E+08 | 3.0010E+04 |
| " 32.0 - 37.0" | 5.0480E+07 | 1.9860E-06 | 1337 | 1.4550E-06 | 9.3920E+00 | 2.1610E-05 | 12 | 1.5860E-10 | 2.0300E-04 | 1.0246E+04 | 3.5700E+07 | 1.1710E+04 |
| " 37.0 - 42.0" | 4.9670E+07 | 1.8410E-06 | 430 | 1.3700E-06 | 1.0130E+01 | 7.0880E-06 | 11 | 5.0240E-11 | 7.1810E-05 | 3.5670E+03 | 1.2740E+07 | 6.9960E+03 |
| " 42.0 - 47.0" | 4.8860E+07 | 1.5620E-06 | 70 | 1.1160E-06 | 1.1940E+01 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 47.0 - 52.0" | 4.8070E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 6.1730E-08 | 11 | 3.8110E-15 | 3.1660E-07 | 1.5219E+01 | 2.4350E+02 | 3.0580E+01 |
| " 52.0 - 57.0" | 4.7400E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 57.0 - 62.0" | 4.6780E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 11 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 62.0 - 67.0" | 4.6160E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 67.0 - 72.0" | 4.5410E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.8670E-08 | 10 | 3.4850E-16 | 9.5740E-08 | 4.3472E+00 | 1.9870E+01 | 8.7360E+00 |
| " 72.0 - 77.0" | 4.4750E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 0.0000E+00 | 10 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 77.0 - 82.0" | 4.3990E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 8.6710E-08 | 10 | 1.9490E-15 | 4.4470E-07 | 1.9560E+01 | 1.1880E+02 | 2.1360E+01 |
| " 82.0 - 87.0" | 4.3190E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 9.7800E-09 | 10 | 9.5640E-17 | 5.0160E-08 | 2.1661E+00 | 4.9320E+00 | 4.3530E+00 |
| " 87.0 - 92.0" | 4.1870E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.0120E-07 | 10 | 3.1880E-15 | 5.1910E-07 | 2.1736E+01 | 1.7120E+02 | 2.5650E+01 |
| " 92.0 - 97.0" | 4.0500E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 5.2330E-08 | 10 | 1.0340E-15 | 2.6840E-07 | 1.0868E+01 | 5.0660E+01 | 1.3950E+01 |
| " 97.0 -102.0" | 3.8270E+07 | 3.6370E-06 | 100 | 8.2330E-06 | 5.1290E+00 | 1.4400E-07 | 9 | 1.4390E-14 | 7.3870E-07 | 2.8267E+01 | 5.9530E+02 | 4.7820E+01 |
| "TOTAL" | 9.5320E+08 | | | | | | | | | 1.8162E+05 | "+ or -" | 1.0430E+05 |



ACE 6208401

Appendix A.24. Hydroacoustic estimate of fish inhabiting Area 1, Skilak Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.9240E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 1.2300E-03 | 50 | 8.4110E-08 | 2.1810E-03 | 4.1952E+05 | 9.8150E+09 | 1.9420E+05 |
| " 7.0 - 12.0" | 1.6690E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 2.4140E-03 | 47 | 1.5710E-07 | 7.0290E-03 | 1.1733E+06 | 4.0660E+10 | 3.9520E+05 |
| " 12.0 - 17.0" | 1.3310E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 4.5380E-03 | 40 | 8.1330E-07 | 1.4980E-02 | 1.9941E+06 | 1.8790E+11 | 8.4950E+05 |
| " 17.0 - 22.0" | 9.2790E+07 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 4.7860E-03 | 27 | 1.0630E-06 | 2.2350E-02 | 2.0737E+06 | 2.0070E+11 | 8.7810E+05 |
| " 22.0 - 27.0" | 8.0540E+07 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 4.2520E-03 | 19 | 8.1670E-07 | 2.3160E-02 | 1.8655E+06 | 1.5800E+11 | 7.7910E+05 |
| " 27.0 - 32.0" | 7.9190E+07 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 1.9340E-03 | 19 | 1.2410E-07 | 1.1930E-02 | 9.4458E+05 | 2.9850E+10 | 3.3860E+05 |
| " 32.0 - 37.0" | 7.7370E+07 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 1.0900E-03 | 19 | 9.0480E-08 | 6.6550E-03 | 5.1485E+05 | 2.0550E+10 | 2.8100E+05 |
| " 37.0 - 42.0" | 7.5960E+07 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 2.1150E-04 | 19 | 8.8130E-10 | 1.5640E-03 | 1.1880E+05 | 3.5570E+08 | 3.6960E+04 |
| " 42.0 - 47.0" | 7.5120E+07 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 7.3570E-05 | 19 | 3.0000E-10 | 6.4430E-04 | 4.8395E+04 | 1.3110E+08 | 2.2440E+04 |
| " 47.0 - 52.0" | 7.4140E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.5980E-05 | 19 | 4.3860E-11 | 1.8300E-04 | 1.3565E+04 | 1.2010E+07 | 6.7930E+03 |
| " 52.0 - 57.0" | 7.3610E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.5440E-05 | 17 | 4.8450E-11 | 1.7920E-04 | 1.3191E+04 | 1.3070E+07 | 7.0870E+03 |
| " 57.0 - 62.0" | 7.2950E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.0220E-06 | 17 | 1.2910E-11 | 4.2420E-05 | 3.0948E+03 | 3.4110E+06 | 3.6200E+03 |
| " 62.0 - 67.0" | 7.0370E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.3690E-05 | 17 | 9.3180E-12 | 9.6430E-05 | 6.7855E+03 | 2.3020E+06 | 2.9740E+03 |
| " 67.0 - 72.0" | 6.8160E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.2440E-05 | 17 | 1.8700E-11 | 8.7630E-05 | 5.9733E+03 | 4.3200E+06 | 4.0740E+03 |
| " 72.0 - 77.0" | 6.6560E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 8.1000E-06 | 16 | 5.7370E-12 | 5.7060E-05 | 3.7977E+03 | 1.2650E+06 | 2.2040E+03 |
| " 77.0 - 82.0" | 6.4950E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 8.5150E-06 | 16 | 1.4610E-11 | 5.9980E-05 | 3.8959E+03 | 3.0630E+06 | 3.4300E+03 |
| " 82.0 - 87.0" | 6.3700E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.7670E-06 | 16 | 3.6380E-12 | 2.6540E-05 | 1.6904E+03 | 7.3330E+05 | 1.6780E+03 |
| " 87.0 - 92.0" | 6.2420E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.4250E-06 | 16 | 2.7350E-12 | 1.7080E-05 | 1.0662E+03 | 5.2920E+05 | 1.4260E+03 |
| " 92.0 - 97.0" | 5.6440E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.1840E-07 | 15 | 1.3830E-13 | 4.3560E-06 | 2.4585E+02 | 2.1870E+04 | 2.8990E+02 |
| " 97.0 -102.0" | 3.6630E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.2140E-08 | 13 | 8.4030E-16 | 4.3770E-07 | 1.6034E+01 | 5.6020E+01 | 1.4670E+01 |
| "TOTAL" | 1.6830E+09 | | | | | | | | | 9.2061E+06 | "+ or -" | 1.5780E+06 |



ACE 6208402

Appendix A.25. Hydroacoustic estimate of fish inhabiting Area 1, Skilak lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 2.1020E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 2.3380E-03 | 32 | 8.4740E-07 | 4.1450E-03 | 8.7109E+05 | 1.1780E+11 | 6.7280E+05 |
| " 7.0 - 12.0" | 1.6330E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 2.2470E-03 | 30 | 4.5590E-07 | 6.5430E-03 | 1.0683E+06 | 1.0600E+11 | 6.3810E+05 |
| " 12.0 - 17.0" | 1.4340E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 2.2790E-03 | 23 | 1.6310E-07 | 7.5220E-03 | 1.0787E+06 | 4.5580E+10 | 4.1840E+05 |
| " 17.0 - 22.0" | 1.3830E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 2.1950E-03 | 21 | 7.2370E-08 | 1.0250E-02 | 1.4172E+06 | 3.0720E+10 | 3.4350E+05 |
| " 22.0 - 27.0" | 1.3070E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 3.0070E-03 | 20 | 2.9170E-07 | 1.6380E-02 | 2.1410E+06 | 1.4890E+11 | 7.5630E+05 |
| " 27.0 - 32.0" | 1.2720E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 2.3410E-03 | 20 | 1.0760E-07 | 1.4440E-02 | 1.8371E+06 | 6.7200E+10 | 5.0810E+05 |
| " 32.0 - 37.0" | 1.2010E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 1.0450E-03 | 19 | 3.2410E-08 | 6.3810E-03 | 7.6631E+05 | 1.8210E+10 | 2.6450E+05 |
| " 37.0 - 42.0" | 1.1710E+08 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 4.4470E-04 | 18 | 4.0110E-08 | 3.2880E-03 | 3.8518E+05 | 3.0900E+10 | 3.4450E+05 |
| " 42.0 - 47.0" | 1.1300E+08 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 1.1580E-04 | 18 | 1.1320E-09 | 1.0140E-03 | 1.1457E+05 | 1.1150E+09 | 6.5460E+04 |
| " 47.0 - 52.0" | 1.0690E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.3540E-05 | 17 | 1.2780E-10 | 2.3630E-04 | 2.5249E+04 | 7.2560E+07 | 1.6700E+04 |
| " 52.0 - 57.0" | 1.0010E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.5620E-05 | 16 | 2.4920E-11 | 1.1000E-04 | 1.1010E+04 | 1.2420E+07 | 6.9070E+03 |
| " 57.0 - 62.0" | 8.8600E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 9.5360E-06 | 15 | 1.2080E-11 | 6.7170E-05 | 5.9517E+03 | 4.7170E+06 | 4.2570E+03 |
| " 62.0 - 67.0" | 8.5770E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.5770E-05 | 14 | 2.9390E-11 | 1.1110E-04 | 9.5289E+03 | 1.0750E+07 | 6.4270E+03 |
| " 67.0 - 72.0" | 7.9270E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.2700E-05 | 13 | 1.3060E-10 | 2.3030E-04 | 1.8258E+04 | 4.0810E+07 | 1.2520E+04 |
| " 72.0 - 77.0" | 5.7010E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.6770E-05 | 11 | 1.0820E-10 | 1.1810E-04 | 6.7350E+03 | 1.7470E+07 | 8.1920E+03 |
| " 77.0 - 82.0" | 4.4010E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.5710E-05 | 9 | 7.4670E-11 | 1.1070E-04 | 4.8697E+03 | 7.1820E+06 | 5.2530E+03 |
| " 82.0 - 87.0" | 1.8470E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.1800E-05 | 6 | 2.0810E-10 | 2.2400E-04 | 4.1380E+03 | 3.5290E+06 | 3.6820E+03 |
| " 87.0 - 92.0" | 0.0000E+00 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.8430E+09 | | | | | | | | | 9.7652E+06 | "+ or -" | 1.4750E+06 |



ACE 6208403

Appendix A.26. Hydroacoustic estimate of fish inhabiting Area 1, Skilak Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.8750E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 6.4740E-03 | 16 | 4.5310E-06 | 1.1480E-02 | 2.1523E+06 | 5.0160E+11 | 1.3880E+06 |
| " 7.0 - 12.0" | 1.6380E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 3.7250E-03 | 13 | 1.6090E-06 | 1.0850E-02 | 1.7764E+06 | 3.7400E+11 | 1.1990E+06 |
| " 12.0 - 17.0" | 1.0840E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 4.9820E-03 | 10 | 2.4820E-06 | 1.6450E-02 | 1.7833E+06 | 3.4270E+11 | 1.1470E+06 |
| " 17.0 - 22.0" | 8.1240E+07 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 7.9280E-03 | 8 | 4.1790E-06 | 3.7020E-02 | 3.0071E+06 | 6.0370E+11 | 1.5230E+06 |
| " 22.0 - 27.0" | 1.0910E+07 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 3.5980E-03 | 3 | 7.6660E-06 | 1.9600E-02 | 2.1384E+05 | 2.7090E+10 | 3.2260E+05 |
| " 27.0 - 32.0" | 0.0000E+00 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 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 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 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 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 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 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 5.5180E+08 | | | | | | | | | 8.9331E+06 | "+ or -" | 2.6650E+06 |



ACE 6208404

Appendix A.27. Hydroacoustic estimate of fish inhabiting Area 1, Skilak Lake, Alaska in 1989 based on transect 1a integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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" | 2.0500E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 4.0030E-03 | 29 | 1.8630E-06 | 7.0970E-03 | 1.4547E+06 | 2.4650E+11 | 9.7320E+05 |
| " 7.0 - 12.0" | 1.7110E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 3.2800E-03 | 27 | 5.3450E-07 | 9.5530E-03 | 1.6341E+06 | 1.3950E+11 | 7.3200E+05 |
| " 12.0 - 17.0" | 1.5350E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 4.2980E-03 | 22 | 6.0500E-07 | 1.4190E-02 | 2.1777E+06 | 1.9210E+11 | 8.5900E+05 |
| " 17.0 - 22.0" | 1.3140E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 8.1880E-03 | 21 | 2.6950E-06 | 3.8230E-02 | 5.0250E+06 | 1.0220E+12 | 1.9810E+06 |
| " 22.0 - 27.0" | 1.1490E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 3.1870E-03 | 17 | 5.6330E-07 | 1.7360E-02 | 1.9959E+06 | 2.2180E+11 | 9.2310E+05 |
| " 27.0 - 32.0" | 1.0290E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 1.5750E-03 | 15 | 9.3560E-08 | 9.7160E-03 | 9.9962E+05 | 3.7960E+10 | 3.8190E+05 |
| " 32.0 - 37.0" | 8.7290E+07 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 4.1110E-04 | 13 | 1.2140E-08 | 2.5110E-03 | 2.1915E+05 | 3.5140E+09 | 1.1620E+05 |
| " 37.0 - 42.0" | 8.3970E+07 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 2.1320E-04 | 13 | 6.5640E-09 | 1.5760E-03 | 1.3232E+05 | 2.6260E+09 | 1.0040E+05 |
| " 42.0 - 47.0" | 7.8480E+07 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 6.4540E-05 | 11 | 3.9740E-10 | 5.6520E-04 | 4.4357E+04 | 1.8880E+08 | 2.6930E+04 |
| " 47.0 - 52.0" | 6.9730E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.7950E-05 | 11 | 8.1060E-10 | 4.7860E-04 | 3.3378E+04 | 1.9590E+08 | 2.7430E+04 |
| " 52.0 - 57.0" | 5.8700E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 8.7720E-05 | 9 | 9.3560E-10 | 6.1790E-04 | 3.6273E+04 | 1.6030E+08 | 2.4820E+04 |
| " 57.0 - 62.0" | 2.7830E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.0130E-05 | 8 | 1.9040E-10 | 2.1220E-04 | 5.9074E+03 | 7.3300E+06 | 5.3070E+03 |
| " 62.0 - 67.0" | 3.0790E+05 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 8.4680E-06 | 1 | 0.0000E+00 | 5.9650E-05 | 1.8368E+01 | 9.2410E-02 | 5.9580E-01 |
| " 67.0 - 72.0" | 0.0000E+00 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 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 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| " 97.0 -102.0" | 0.0000E+00 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 0.0000E+00 | 0 | 1.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| "TOTAL" | 1.2850E+09 | | | | | | | | | 1.3759E+07 | "+ or -" | 2.6780E+06 |



ACE 6208405

Appendix A.28. Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska in 1989 based on transect 0 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.6680E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 3.4910E-04 | 23 | 2.6340E-08 | 6.1900E-04 | 1.0324E+05 | 2.3050E+09 | 9.4110E+04 |
| " 7.0 - 12.0" | 1.6550E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 1.3240E-03 | 23 | 6.9480E-07 | 3.8550E-03 | 6.3784E+05 | 1.6240E+11 | 7.8970E+05 |
| " 12.0 - 17.0" | 1.6400E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 1.1910E-03 | 23 | 1.5180E-07 | 3.9320E-03 | 6.4493E+05 | 4.7750E+10 | 4.2830E+05 |
| " 17.0 - 22.0" | 1.6180E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 1.5180E-03 | 23 | 9.0600E-08 | 7.0860E-03 | 1.1463E+06 | 5.2040E+10 | 4.4710E+05 |
| " 22.0 - 27.0" | 1.5960E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 1.4890E-03 | 23 | 7.3920E-08 | 8.1130E-03 | 1.2951E+06 | 5.6290E+10 | 4.6500E+05 |
| " 27.0 - 32.0" | 1.5800E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 8.7060E-04 | 23 | 3.9790E-08 | 5.3700E-03 | 8.4856E+05 | 3.8000E+10 | 3.8210E+05 |
| " 32.0 - 37.0" | 1.5390E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 5.1850E-04 | 22 | 6.4640E-09 | 3.1670E-03 | 4.8725E+05 | 6.0240E+09 | 1.5210E+05 |
| " 37.0 - 42.0" | 1.4940E+08 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 2.2680E-04 | 21 | 1.2760E-09 | 1.6760E-03 | 2.5052E+05 | 1.9030E+09 | 8.5500E+04 |
| " 42.0 - 47.0" | 1.4820E+08 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 9.4350E-05 | 21 | 2.0050E-10 | 8.2630E-04 | 1.2245E+05 | 3.4610E+08 | 3.6470E+04 |
| " 47.0 - 52.0" | 1.4650E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.7280E-05 | 21 | 1.1350E-10 | 2.6260E-04 | 3.8461E+04 | 1.2130E+08 | 2.1580E+04 |
| " 52.0 - 57.0" | 1.4500E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.9580E-05 | 20 | 1.6800E-10 | 2.7880E-04 | 4.0413E+04 | 1.7560E+08 | 2.5970E+04 |
| " 57.0 - 62.0" | 1.4380E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.4640E-04 | 20 | 1.5730E-08 | 1.0310E-03 | 1.4834E+05 | 1.6150E+10 | 2.4910E+05 |
| " 62.0 - 67.0" | 1.4210E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.0070E-05 | 20 | 4.4130E-11 | 1.4140E-04 | 2.0095E+04 | 4.4330E+07 | 1.3050E+04 |
| " 67.0 - 72.0" | 1.3930E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.6640E-05 | 20 | 3.9710E-11 | 1.1720E-04 | 1.6329E+04 | 3.8310E+07 | 1.2130E+04 |
| " 72.0 - 77.0" | 1.3620E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.2610E-06 | 19 | 8.4290E-13 | 1.5920E-05 | 2.1686E+03 | 7.7700E+05 | 1.7280E+03 |
| " 77.0 - 82.0" | 1.3380E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 7.7230E-06 | 19 | 4.7500E-11 | 5.4400E-05 | 7.2775E+03 | 4.2200E+07 | 1.2730E+04 |
| " 82.0 - 87.0" | 1.3190E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.9110E-06 | 19 | 2.7410E-12 | 2.7550E-05 | 3.6328E+03 | 2.3680E+06 | 3.0160E+03 |
| " 87.0 - 92.0" | 1.2590E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 7.3760E-07 | 19 | 2.1370E-13 | 5.1960E-06 | 6.5432E+02 | 1.6830E+05 | 8.0400E+02 |
| " 92.0 - 97.0" | 1.2340E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 5.2660E-09 | 18 | 2.7730E-17 | 3.7090E-08 | 4.5766E+00 | 2.0950E+01 | 8.9710E+00 |
| " 97.0 -102.0" | 1.2190E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 5.8610E-08 | 17 | 3.4350E-15 | 4.1280E-07 | 5.0344E+01 | 2.5350E+03 | 9.8690E+01 |
| "TOTAL" | 2.9170E+09 | | | | | | | | | 5.8136E+06 | "+ or -" | 1.2140E+06 |



ACE 6208406

Appendix A.29. Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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" | 1.6720E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 2.4020E-04 | 33 | 1.2090E-08 | 4.2590E-04 | 7.1212E+04 | 1.0630E+09 | 6.3920E+04 |
| " 7.0 - 12.0" | 1.6720E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 2.0830E-04 | 33 | 5.2480E-09 | 6.0660E-04 | 1.0140E+05 | 1.2700E+09 | 6.9850E+04 |
| " 12.0 - 17.0" | 1.6700E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 8.3800E-04 | 33 | 1.9400E-08 | 2.7670E-03 | 4.6210E+05 | 7.5550E+09 | 1.7040E+05 |
| " 17.0 - 22.0" | 1.6680E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 1.2530E-03 | 33 | 3.7940E-08 | 5.8490E-03 | 9.7540E+05 | 2.3260E+10 | 2.9890E+05 |
| " 22.0 - 27.0" | 1.6670E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 1.3190E-03 | 33 | 2.0090E-08 | 7.1840E-03 | 1.1977E+06 | 1.6900E+10 | 2.5480E+05 |
| " 27.0 - 32.0" | 1.6460E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 9.9830E-04 | 33 | 3.7500E-08 | 6.1580E-03 | 1.0135E+06 | 3.8930E+10 | 3.8670E+05 |
| " 32.0 - 37.0" | 1.5740E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 6.9760E-04 | 33 | 1.5910E-08 | 4.2610E-03 | 6.7068E+05 | 1.5300E+10 | 2.4240E+05 |
| " 37.0 - 42.0" | 1.5240E+08 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 2.6670E-04 | 32 | 1.9790E-09 | 1.9720E-03 | 3.0051E+05 | 3.0100E+09 | 1.0750E+05 |
| " 42.0 - 47.0" | 1.4790E+08 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 1.0570E-04 | 32 | 3.7200E-10 | 9.2550E-04 | 1.3683E+05 | 6.3420E+08 | 4.9360E+04 |
| " 47.0 - 52.0" | 1.4560E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.5370E-05 | 30 | 1.1550E-10 | 2.4910E-04 | 3.6277E+04 | 1.2180E+08 | 2.1630E+04 |
| " 52.0 - 57.0" | 1.4470E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.7370E-05 | 29 | 2.5860E-11 | 1.2240E-04 | 1.7701E+04 | 2.6940E+07 | 1.0170E+04 |
| " 57.0 - 62.0" | 1.4390E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.3100E-05 | 29 | 1.3430E-11 | 9.2290E-05 | 1.3285E+04 | 1.3850E+07 | 7.2950E+03 |
| " 62.0 - 67.0" | 1.4290E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.5670E-05 | 29 | 1.4530E-11 | 1.1040E-04 | 1.5778E+04 | 1.4800E+07 | 7.5390E+03 |
| " 67.0 - 72.0" | 1.4210E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 9.4980E-06 | 29 | 4.9600E-12 | 6.6910E-05 | 9.5043E+03 | 4.9910E+06 | 4.3790E+03 |
| " 72.0 - 77.0" | 1.4090E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.0140E-05 | 29 | 7.7750E-12 | 7.1420E-05 | 1.0065E+04 | 7.6900E+06 | 5.4350E+03 |
| " 77.0 - 82.0" | 1.4010E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.1690E-06 | 29 | 2.3620E-12 | 2.9370E-05 | 4.1132E+03 | 2.3030E+06 | 2.9750E+03 |
| " 82.0 - 87.0" | 1.3410E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.1680E-06 | 28 | 1.4410E-13 | 8.2270E-06 | 1.1035E+03 | 1.2900E+05 | 7.0400E+02 |
| " 87.0 - 92.0" | 1.3100E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.9490E-07 | 27 | 1.1680E-13 | 4.8950E-06 | 6.4109E+02 | 9.9510E+04 | 6.1830E+02 |
| " 92.0 - 97.0" | 1.2650E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.2110E-07 | 26 | 2.5160E-14 | 2.9670E-06 | 3.7522E+02 | 2.0010E+04 | 2.7720E+02 |
| " 97.0 -102.0" | 1.2310E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 7.8040E-07 | 25 | 3.0980E-13 | 5.4970E-06 | 6.7646E+02 | 2.3300E+05 | 9.4600E+02 |
| "TOTAL" | 2.9720E+09 | | | | | | | | | 5.0389E+06 | "+ or -" | 6.4450E+05 |



ACE 6208407

Appendix A.30. Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.6720E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 4.2640E-04 | 45 | 1.6460E-08 | 7.5610E-04 | 1.2640E+05 | 1.4490E+09 | 7.4600E+04 |
| " 7.0 - 12.0" | 1.6660E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 7.1620E-04 | 45 | 5.3680E-08 | 2.0860E-03 | 3.4748E+05 | 1.2950E+10 | 2.2300E+05 |
| " 12.0 - 17.0" | 1.6510E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 1.4760E-03 | 45 | 1.8670E-07 | 4.8720E-03 | 8.0433E+05 | 6.0470E+10 | 4.8200E+05 |
| " 17.0 - 22.0" | 1.5820E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 1.9560E-03 | 45 | 1.1920E-07 | 9.1320E-03 | 1.4443E+06 | 6.5570E+10 | 5.0190E+05 |
| " 22.0 - 27.0" | 1.4500E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 1.8310E-03 | 41 | 9.1560E-08 | 9.9760E-03 | 1.4470E+06 | 5.7650E+10 | 4.7060E+05 |
| " 27.0 - 32.0" | 1.3550E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 1.5410E-03 | 39 | 5.8700E-08 | 9.5070E-03 | 1.2886E+06 | 4.1490E+10 | 3.9920E+05 |
| " 32.0 - 37.0" | 1.3190E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 7.9770E-04 | 38 | 3.3630E-08 | 4.8720E-03 | 6.4265E+05 | 2.2370E+10 | 2.9320E+05 |
| " 37.0 - 42.0" | 1.2910E+08 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 3.6630E-04 | 37 | 2.9800E-08 | 2.7080E-03 | 3.4968E+05 | 2.7840E+10 | 3.2700E+05 |
| " 42.0 - 47.0" | 1.2790E+08 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 8.8750E-05 | 35 | 2.3970E-10 | 7.7720E-04 | 9.9364E+04 | 3.0600E+08 | 3.4290E+04 |
| " 47.0 - 52.0" | 1.2460E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.5020E-05 | 35 | 3.1900E-11 | 1.7620E-04 | 2.1956E+04 | 2.4700E+07 | 9.7400E+03 |
| " 52.0 - 57.0" | 1.1880E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.2090E-05 | 35 | 5.9490E-11 | 1.5560E-04 | 1.8481E+04 | 4.1730E+07 | 1.2660E+04 |
| " 57.0 - 62.0" | 1.1280E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.5030E-05 | 32 | 2.7990E-11 | 1.0590E-04 | 1.1947E+04 | 1.7720E+07 | 8.2520E+03 |
| " 62.0 - 67.0" | 1.1040E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.5080E-05 | 31 | 4.9810E-11 | 2.4710E-04 | 2.7276E+04 | 3.0320E+07 | 1.0790E+04 |
| " 67.0 - 72.0" | 1.0690E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.8250E-05 | 30 | 6.8210E-11 | 1.2850E-04 | 1.3737E+04 | 3.8710E+07 | 1.2190E+04 |
| " 72.0 - 77.0" | 1.0110E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.0720E-05 | 30 | 1.0780E-11 | 7.5510E-05 | 7.6345E+03 | 5.4840E+06 | 4.5900E+03 |
| " 77.0 - 82.0" | 9.5340E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 9.4910E-06 | 29 | 9.7410E-12 | 6.6860E-05 | 6.3740E+03 | 4.4040E+06 | 4.1130E+03 |
| " 82.0 - 87.0" | 9.3090E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.4540E-06 | 27 | 1.0480E-12 | 1.0240E-05 | 9.5350E+02 | 4.5070E+05 | 1.3160E+03 |
| " 87.0 - 92.0" | 9.1970E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.6870E-07 | 25 | 1.0390E-13 | 4.7110E-06 | 4.3324E+02 | 4.3650E+04 | 4.0950E+02 |
| " 92.0 - 97.0" | 9.0490E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.1570E-07 | 25 | 1.0450E-14 | 1.5200E-06 | 1.3751E+02 | 4.2520E+03 | 1.2780E+02 |
| " 97.0 -102.0" | 8.9720E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.7920E-07 | 25 | 1.3250E-14 | 1.9670E-06 | 1.7645E+02 | 5.3000E+03 | 1.4270E+02 |
| "TOTAL" | 2.4620E+09 | | | | | | | | | 6.6589E+06 | "+ or -" | 1.0560E+06 |



ACE 6208408

Appendix A.31. Hydroacoustic estimate of fish inhabiting Area 2, Skilak Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume ($m^3$) | Mean Sigma | Number of Echoes | 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 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 7.0610E-04 | 43 | 6.3350E-08 | 1.2520E-03 | 2.0922E+05 | 5.5690E+09 | 1.4630E+05 |
| " 7.0 - 12.0" | 1.6090E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 7.4110E-04 | 43 | 3.2960E-08 | 2.1580E-03 | 3.4724E+05 | 7.5440E+09 | 1.7020E+05 |
| " 12.0 - 17.0" | 1.5540E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 1.1320E-03 | 40 | 4.1230E-08 | 3.7360E-03 | 5.8052E+05 | 1.3470E+10 | 2.2740E+05 |
| " 17.0 - 22.0" | 1.5470E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 1.8280E-03 | 40 | 8.2560E-08 | 8.5340E-03 | 1.3203E+06 | 4.3560E+10 | 4.0910E+05 |
| " 22.0 - 27.0" | 1.5320E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 1.5300E-03 | 40 | 6.5250E-08 | 8.3370E-03 | 1.2769E+06 | 4.5800E+10 | 4.1950E+05 |
| " 27.0 - 32.0" | 1.4840E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 8.6750E-04 | 40 | 1.4150E-08 | 5.3510E-03 | 7.9408E+05 | 1.2030E+10 | 2.1500E+05 |
| " 32.0 - 37.0" | 1.4200E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 4.6140E-04 | 39 | 4.0960E-09 | 2.8180E-03 | 4.0026E+05 | 3.2950E+09 | 1.1250E+05 |
| " 37.0 - 42.0" | 1.3740E+08 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 1.6630E-04 | 37 | 7.8580E-10 | 1.2290E-03 | 1.6895E+05 | 9.6860E+08 | 6.1000E+04 |
| " 42.0 - 47.0" | 1.2730E+08 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 6.5860E-05 | 37 | 2.1920E-10 | 5.7670E-04 | 7.3414E+04 | 2.7540E+08 | 3.2530E+04 |
| " 47.0 - 52.0" | 1.1290E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.7250E-05 | 31 | 3.0860E-11 | 1.2150E-04 | 1.3724E+04 | 1.9580E+07 | 8.6730E+03 |
| " 52.0 - 57.0" | 1.1010E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.0870E-05 | 29 | 1.5410E-11 | 7.6590E-05 | 8.4360E+03 | 9.2940E+06 | 5.9750E+03 |
| " 57.0 - 62.0" | 1.0590E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 8.5550E-06 | 29 | 6.2310E-12 | 6.0260E-05 | 6.3806E+03 | 3.4770E+06 | 3.6550E+03 |
| " 62.0 - 67.0" | 1.0190E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.4920E-05 | 27 | 3.6660E-11 | 1.0510E-04 | 1.0709E+04 | 1.8920E+07 | 8.5250E+03 |
| " 67.0 - 72.0" | 9.7370E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 7.8550E-06 | 26 | 5.1440E-12 | 5.5330E-05 | 5.3878E+03 | 2.4280E+06 | 3.0540E+03 |
| " 72.0 - 77.0" | 9.2500E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 9.5590E-06 | 25 | 1.4100E-11 | 6.7340E-05 | 6.2289E+03 | 5.9960E+06 | 4.7990E+03 |
| " 77.0 - 82.0" | 8.7270E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.9910E-06 | 24 | 5.8010E-13 | 1.4030E-05 | 1.2242E+03 | 2.1960E+05 | 9.1850E+02 |
| " 82.0 - 87.0" | 8.1220E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.0160E-06 | 23 | 1.1040E-12 | 1.4200E-05 | 1.1534E+03 | 3.6160E+05 | 1.1790E+03 |
| " 87.0 - 92.0" | 7.4160E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.9360E-07 | 21 | 2.2710E-13 | 4.8860E-06 | 3.6233E+02 | 6.2010E+04 | 4.8810E+02 |
| " 92.0 - 97.0" | 6.6120E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.8960E-07 | 19 | 1.6640E-13 | 4.8580E-06 | 3.2121E+02 | 3.6130E+04 | 3.7250E+02 |
| " 97.0 -102.0" | 5.7920E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.5450E-07 | 17 | 1.1550E-14 | 1.7930E-06 | 1.0385E+02 | 1.9260E+03 | 8.6010E+01 |
| "TOTAL" | 2.3340E+09 | | | | | | | | | 5.2249E+06 | "+ or -" | 7.1360E+05 |



ACE 6208409

Appendix A.32. Hydroacoustic estimate of fish inhabiting Area 3, Skilak Lake, Alaska in 1989 based on transect 1 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.1250E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 1.4970E-03 | 21 | 6.0290E-07 | 2.6550E-03 | 2.9870E+05 | 2.4010E+10 | 3.0370E+05 |
| " 7.0 - 12.0" | 1.1250E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 7.1080E-04 | 21 | 7.1280E-08 | 2.0700E-03 | 2.3286E+05 | 7.7900E+09 | 1.7300E+05 |
| " 12.0 - 17.0" | 1.1250E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 9.9730E-04 | 21 | 6.0070E-08 | 3.2920E-03 | 3.7040E+05 | 9.3510E+09 | 1.8950E+05 |
| " 17.0 - 22.0" | 1.0860E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 8.4040E-04 | 21 | 2.6220E-08 | 3.9240E-03 | 4.2613E+05 | 6.7910E+09 | 1.6150E+05 |
| " 22.0 - 27.0" | 1.1110E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 1.3620E-03 | 21 | 1.1940E-07 | 7.4210E-03 | 8.2427E+05 | 4.3860E+10 | 4.1050E+05 |
| " 27.0 - 32.0" | 1.1090E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 2.7310E-03 | 21 | 2.0930E-06 | 1.6840E-02 | 1.8681E+06 | 9.8040E+11 | 1.9410E+06 |
| " 32.0 - 37.0" | 1.1070E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 1.3160E-03 | 21 | 1.4200E-07 | 8.0390E-03 | 8.8959E+05 | 6.5930E+10 | 5.0330E+05 |
| " 37.0 - 42.0" | 1.1040E+08 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 6.2480E-04 | 21 | 2.8190E-08 | 4.6190E-03 | 5.1016E+05 | 2.0220E+10 | 2.7870E+05 |
| " 42.0 - 47.0" | 1.0970E+08 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 2.1380E-04 | 21 | 1.6780E-09 | 1.8720E-03 | 2.0538E+05 | 1.5720E+09 | 7.7710E+04 |
| " 47.0 - 52.0" | 1.0940E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.4010E-04 | 21 | 7.6490E-10 | 9.8690E-04 | 1.0797E+05 | 4.5740E+08 | 4.1920E+04 |
| " 52.0 - 57.0" | 1.0890E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 9.0030E-05 | 21 | 6.7380E-10 | 6.3420E-04 | 6.9079E+04 | 3.9800E+08 | 3.9100E+04 |
| " 57.0 - 62.0" | 1.0830E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.1000E-04 | 21 | 1.5140E-09 | 7.7460E-04 | 8.3869E+04 | 8.8270E+08 | 5.8230E+04 |
| " 62.0 - 67.0" | 1.0630E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 8.8630E-05 | 21 | 1.3130E-09 | 6.2430E-04 | 6.6359E+04 | 7.3740E+08 | 5.3220E+04 |
| " 67.0 - 72.0" | 1.0320E+08 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.7850E-05 | 21 | 5.2540E-10 | 4.7790E-04 | 4.9298E+04 | 2.7810E+08 | 3.2680E+04 |
| " 72.0 - 77.0" | 9.9540E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.4390E-05 | 20 | 1.5420E-10 | 3.1270E-04 | 3.1123E+04 | 7.6080E+07 | 1.7100E+04 |
| " 77.0 - 82.0" | 9.5680E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.2690E-05 | 20 | 1.5210E-10 | 3.0070E-04 | 2.8770E+04 | 6.9300E+07 | 1.6320E+04 |
| " 82.0 - 87.0" | 9.1910E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.0820E-05 | 20 | 2.3610E-11 | 7.6220E-05 | 7.0054E+03 | 9.9090E+06 | 6.1700E+03 |
| " 87.0 - 92.0" | 8.7590E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 5.4960E-06 | 20 | 7.2000E-12 | 3.8710E-05 | 3.3906E+03 | 2.7440E+06 | 3.2470E+03 |
| " 92.0 - 97.0" | 8.2590E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.8170E-06 | 18 | 2.2860E-12 | 1.9840E-05 | 1.6389E+03 | 7.7440E+05 | 1.7250E+03 |
| " 97.0 -102.0" | 7.7200E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.0140E-06 | 17 | 1.1860E-12 | 1.4190E-05 | 1.0951E+03 | 3.5090E+05 | 1.1610E+03 |
| "TOTAL" | 2.0690E+09 | | | | | | | | | 6.0751E+06 | "+ or -" | 2.1140E+06 |



ACE 6208410

Appendix A.33. Hydroacoustic estimate of fish inhabiting Area 3, Skilak Lake, Alaska in 1989 based on transect 2 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.1240E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 4.9910E-04 | 14 | 8.4280E-08 | 8.8490E-04 | 9.9425E+04 | 3.3470E+09 | 1.1340E+05 |
| " 7.0 - 12.0" | 1.1100E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 1.2110E-04 | 14 | 3.0190E-09 | 3.5270E-04 | 3.9153E+04 | 3.1940E+08 | 3.5030E+04 |
| " 12.0 - 17.0" | 1.1020E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 8.1610E-04 | 14 | 1.1510E-07 | 2.6940E-03 | 2.9702E+05 | 1.5930E+10 | 2.4740E+05 |
| " 17.0 - 22.0" | 1.0950E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 1.4390E-03 | 14 | 4.2550E-07 | 6.7180E-03 | 7.3579E+05 | 1.1140E+11 | 6.5430E+05 |
| " 22.0 - 27.0" | 1.0890E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 1.4390E-03 | 14 | 3.6690E-07 | 7.8410E-03 | 8.5411E+05 | 1.2940E+11 | 7.0490E+05 |
| " 27.0 - 32.0" | 1.0810E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 8.1200E-04 | 14 | 3.0430E-08 | 5.0080E-03 | 5.4131E+05 | 1.3610E+10 | 2.2860E+05 |
| " 32.0 - 37.0" | 1.0570E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 1.6110E-03 | 14 | 4.0870E-07 | 9.8370E-03 | 1.0398E+06 | 1.7180E+11 | 8.1230E+05 |
| " 37.0 - 42.0" | 1.0110E+08 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 4.0120E-04 | 13 | 2.2400E-08 | 2.9660E-03 | 2.9987E+05 | 1.3010E+10 | 2.2360E+05 |
| " 42.0 - 47.0" | 9.9240E+07 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 1.4160E-04 | 13 | 2.7480E-09 | 1.2400E-03 | 1.2302E+05 | 2.0840E+09 | 8.9470E+04 |
| " 47.0 - 52.0" | 9.7590E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 5.1710E-05 | 13 | 5.2290E-10 | 3.6430E-04 | 3.5551E+04 | 2.4750E+08 | 3.0830E+04 |
| " 52.0 - 57.0" | 9.5920E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.6970E-05 | 12 | 8.6050E-11 | 1.9000E-04 | 1.8222E+04 | 3.9370E+07 | 1.2300E+04 |
| " 57.0 - 62.0" | 9.5030E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 5.6040E-05 | 12 | 3.0680E-10 | 3.9480E-04 | 3.7514E+04 | 1.3790E+08 | 2.3010E+04 |
| " 62.0 - 67.0" | 9.3470E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.7450E-05 | 12 | 1.2990E-10 | 4.7510E-04 | 4.4410E+04 | 5.6840E+07 | 1.4780E+04 |
| " 67.0 - 72.0" | 9.2240E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.8680E-05 | 12 | 9.5120E-11 | 2.0200E-04 | 1.8636E+04 | 4.0250E+07 | 1.2430E+04 |
| " 72.0 - 77.0" | 9.1410E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 8.8230E-06 | 12 | 1.0830E-11 | 6.2150E-05 | 5.6813E+03 | 4.4980E+06 | 4.1570E+03 |
| " 77.0 - 82.0" | 8.9460E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.8640E-06 | 12 | 9.7510E-12 | 4.8350E-05 | 4.3251E+03 | 3.8770E+06 | 3.8590E+03 |
| " 82.0 - 87.0" | 8.7540E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.8560E-06 | 12 | 8.2680E-12 | 2.7160E-05 | 2.3779E+03 | 3.1450E+06 | 3.4760E+03 |
| " 87.0 - 92.0" | 8.5110E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.0090E-06 | 12 | 1.7000E-12 | 1.4150E-05 | 1.2046E+03 | 6.1140E+05 | 1.5330E+03 |
| " 92.0 - 97.0" | 8.0850E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.8860E-07 | 11 | 6.3310E-14 | 2.0330E-06 | 1.6438E+02 | 2.0540E+04 | 2.8090E+02 |
| " 97.0 -102.0" | 7.9610E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.4660E-07 | 11 | 1.8720E-14 | 1.0330E-06 | 8.2209E+01 | 5.8890E+03 | 1.5040E+02 |
| "TOTAL" | 1.9540E+09 | | | | | | | | | 4.1977E+06 | "+ or -" | 1.3310E+06 |



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Appendix A.34. Hydroacoustic estimate of fish inhabiting Area 3, Skilak Lake, Alaska in 1989 based on transect 3 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.1120E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 7.5660E-04 | 18 | 2.5660E-07 | 1.3410E-03 | 1.4922E+05 | 9.9870E+09 | 1.9590E+05 |
| " 7.0 - 12.0" | 1.0820E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 5.7890E-04 | 18 | 8.3610E-08 | 1.6860E-03 | 1.8237E+05 | 8.3830E+09 | 1.7950E+05 |
| " 12.0 - 17.0" | 1.0410E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 5.0920E-04 | 18 | 2.1160E-08 | 1.6810E-03 | 1.7494E+05 | 2.7350E+09 | 1.0250E+05 |
| " 17.0 - 22.0" | 1.0280E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 6.5400E-04 | 17 | 1.2590E-08 | 3.0530E-03 | 3.1384E+05 | 2.9270E+09 | 1.0600E+05 |
| " 22.0 - 27.0" | 1.0170E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 7.8470E-04 | 17 | 1.8300E-08 | 4.2740E-03 | 4.3486E+05 | 5.6640E+09 | 1.4750E+05 |
| " 27.0 - 32.0" | 1.0140E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 1.0340E-03 | 17 | 2.8380E-07 | 6.3760E-03 | 6.4658E+05 | 1.1110E+11 | 6.5340E+05 |
| " 32.0 - 37.0" | 1.0020E+08 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 5.7680E-04 | 17 | 2.2420E-08 | 3.5230E-03 | 3.5300E+05 | 8.5630E+09 | 1.8140E+05 |
| " 37.0 - 42.0" | 9.9200E+07 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 3.3110E-04 | 16 | 7.0090E-09 | 2.4480E-03 | 2.4285E+05 | 4.0950E+09 | 1.2540E+05 |
| " 42.0 - 47.0" | 9.8150E+07 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 1.3550E-04 | 16 | 1.4950E-09 | 1.1860E-03 | 1.1645E+05 | 1.1120E+09 | 6.5360E+04 |
| " 47.0 - 52.0" | 9.7040E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.5490E-05 | 16 | 3.2820E-10 | 4.6130E-04 | 4.4767E+04 | 1.5390E+08 | 2.4320E+04 |
| " 52.0 - 57.0" | 9.6180E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.1240E-05 | 16 | 2.5810E-10 | 2.9050E-04 | 2.7936E+04 | 1.1870E+08 | 2.1350E+04 |
| " 57.0 - 62.0" | 9.5360E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.9500E-05 | 16 | 1.1540E-10 | 2.0780E-04 | 1.9812E+04 | 5.2180E+07 | 1.4160E+04 |
| " 62.0 - 67.0" | 9.4630E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.7110E-05 | 16 | 1.4950E-10 | 3.3190E-04 | 3.1402E+04 | 6.6710E+07 | 1.6010E+04 |
| " 67.0 - 72.0" | 9.3880E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.6990E-05 | 16 | 3.2800E-10 | 3.3100E-04 | 3.1076E+04 | 1.4370E+08 | 2.3490E+04 |
| " 72.0 - 77.0" | 9.3090E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.1980E-05 | 16 | 4.1630E-11 | 1.5480E-04 | 1.4410E+04 | 1.7960E+07 | 8.3050E+03 |
| " 77.0 - 82.0" | 9.1420E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.2840E-05 | 16 | 1.9990E-11 | 9.0450E-05 | 8.2682E+03 | 8.3070E+06 | 5.6490E+03 |
| " 82.0 - 87.0" | 8.9550E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 9.5290E-06 | 15 | 1.2640E-11 | 6.7130E-05 | 6.0109E+03 | 5.0380E+06 | 4.3990E+03 |
| " 87.0 - 92.0" | 8.7880E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.0200E-06 | 14 | 4.7710E-12 | 2.1270E-05 | 1.8691E+03 | 1.8290E+06 | 2.6510E+03 |
| " 92.0 - 97.0" | 8.6350E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.8720E-06 | 14 | 1.0330E-12 | 1.3190E-05 | 1.1387E+03 | 3.8250E+05 | 1.2120E+03 |
| " 97.0 -102.0" | 8.2550E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.6550E-07 | 14 | 3.8730E-14 | 3.2790E-06 | 2.7066E+02 | 1.3120E+04 | 2.2450E+02 |
| "TOTAL" | 1.9350E+09 | | | | | | | | | 2.8011E+06 | "+ or -" | 7.7210E+05 |



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Appendix A.35. Hydroacoustic estimate of fish inhabiting Area 3, Skliak Lake, Alaska in 1989 based on transect 4 integrator output.

| Depth Stratum (m) | Stratum Volume (m^) | Mean Sigma | Number of Echoes | Standard Deviation Sigma | A Constant | Integrator Output | Number of Sequences | Mean Integrator Variance | Fish Density (no./m^) | Estimated Number of Fish | Variance | Confidence Limits (95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " 2.0 - 7.0" | 1.1240E+08 | 1.0520E-05 | 138 | 1.6410E-06 | 1.7730E+00 | 2.3640E-04 | 18 | 3.6920E-08 | 4.1920E-04 | 4.7117E+04 | 1.4670E+09 | 7.5060E+04 |
| " 7.0 - 12.0" | 1.1090E+08 | 6.4050E-06 | 525 | 7.4280E-06 | 2.9120E+00 | 6.8470E-04 | 18 | 1.7030E-07 | 1.9940E-03 | 2.2111E+05 | 1.7890E+10 | 2.6220E+05 |
| " 12.0 - 17.0" | 1.0820E+08 | 5.6500E-06 | 1662 | 2.0290E-05 | 3.3010E+00 | 4.1530E-04 | 18 | 7.9930E-09 | 1.3710E-03 | 1.4828E+05 | 1.1900E+09 | 6.7600E+04 |
| " 17.0 - 22.0" | 1.0440E+08 | 3.9950E-06 | 3322 | 3.8050E-06 | 4.6690E+00 | 6.7040E-04 | 17 | 1.4910E-08 | 3.1300E-03 | 3.2692E+05 | 3.5740E+09 | 1.1720E+05 |
| " 22.0 - 27.0" | 1.0280E+08 | 3.4240E-06 | 4082 | 3.3240E-06 | 5.4480E+00 | 8.2310E-04 | 17 | 3.0180E-08 | 4.4840E-03 | 4.6096E+05 | 9.5140E+09 | 1.9120E+05 |
| " 27.0 - 32.0" | 1.0090E+08 | 3.0240E-06 | 4009 | 3.1850E-06 | 6.1680E+00 | 6.5150E-04 | 17 | 1.6620E-08 | 4.0190E-03 | 4.0535E+05 | 6.4790E+09 | 1.5780E+05 |
| " 32.0 - 37.0" | 9.9000E+07 | 3.0540E-06 | 3312 | 6.4030E-06 | 6.1080E+00 | 2.7880E-04 | 17 | 2.2070E-09 | 1.7030E-03 | 1.6859E+05 | 8.4450E+08 | 5.6960E+04 |
| " 37.0 - 42.0" | 9.7670E+07 | 2.5230E-06 | 1982 | 8.3360E-06 | 7.3930E+00 | 2.2780E-04 | 17 | 2.9610E-09 | 1.6840E-03 | 1.6448E+05 | 1.6930E+09 | 8.0650E+04 |
| " 42.0 - 47.0" | 9.6720E+07 | 2.1300E-06 | 1290 | 1.8200E-06 | 8.7570E+00 | 9.4030E-05 | 16 | 7.9870E-10 | 8.2340E-04 | 7.9640E+04 | 5.7650E+08 | 4.7060E+04 |
| " 47.0 - 52.0" | 9.5960E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 5.4470E-05 | 16 | 6.9430E-10 | 3.8370E-04 | 3.6819E+04 | 3.1760E+08 | 3.4930E+04 |
| " 52.0 - 57.0" | 9.5330E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.9840E-05 | 16 | 3.4910E-10 | 3.5110E-04 | 3.3468E+04 | 1.5770E+08 | 2.4610E+04 |
| " 57.0 - 62.0" | 9.4820E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.8470E-05 | 15 | 1.7210E-10 | 3.4140E-04 | 3.2373E+04 | 7.7040E+07 | 1.7200E+04 |
| " 62.0 - 67.0" | 9.4360E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 6.1760E-05 | 15 | 3.9560E-10 | 4.3500E-04 | 4.1050E+04 | 1.7520E+08 | 2.5940E+04 |
| " 67.0 - 72.0" | 9.3470E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 3.9400E-05 | 15 | 3.6250E-10 | 2.7750E-04 | 2.5943E+04 | 1.5730E+08 | 2.4580E+04 |
| " 72.0 - 77.0" | 9.2810E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.6230E-05 | 15 | 8.6700E-11 | 1.8480E-04 | 1.7149E+04 | 3.7140E+07 | 1.1940E+04 |
| " 77.0 - 82.0" | 9.2150E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.4970E-05 | 15 | 2.6790E-11 | 1.0540E-04 | 9.7176E+03 | 1.1320E+07 | 6.5940E+03 |
| " 82.0 - 87.0" | 9.1330E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 7.6760E-06 | 15 | 6.5370E-12 | 5.4070E-05 | 4.9380E+03 | 2.7120E+06 | 3.2280E+03 |
| " 87.0 - 92.0" | 9.0420E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 2.5420E-06 | 15 | 1.8600E-12 | 1.7910E-05 | 1.6192E+03 | 7.5520E+05 | 1.7030E+03 |
| " 92.0 - 97.0" | 8.8620E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 4.5020E-07 | 15 | 4.3210E-14 | 3.1710E-06 | 2.8105E+02 | 1.6860E+04 | 2.5450E+02 |
| " 97.0 -102.0" | 8.6250E+07 | 2.6480E-06 | 3482 | 2.5860E-06 | 7.0440E+00 | 1.7720E-06 | 15 | 8.8180E-13 | 1.2480E-05 | 1.0764E+03 | 3.2580E+05 | 1.1190E+03 |
| "TOTAL" | 1.9480E+09 | | | | | | | | | 2.2269E+06 | "+ or -" | 4.1190E+05 |



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Appendix A.36. Species composition of net samples collected from Skilak and Kenai Lakes, Alaska, 1989.

| | | | | Species Composition (number of fish) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lake | Date | Sample No. | Duration (min) | Sockeye Salmon | Coho Salmon | Stickleback | Round Whitefish | Lake Trout | Sculpin | Total |
| Skilak | 9/26 | 1[a] | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 2 | 60 | 4 | 0 | 0 | 3 | 0 | 0 | 7 |
| | | 3 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 4 | 30 | 12 | 0 | 0 | 0 | 0 | 0 | 12 |
| | | 5 | 25 | 248 | 0 | 2 | 8 | 0 | 8 | 266 |
| | 10/12 | 1[b] | 110 | 561 | 0 | 0 | 6 | 2 | 1 | 570 |
| | | Total | 310 | 825 | 0 | 2 | 17 | 2 | 9 | 855 |
| | | Percent | | 96.5 | 0 | 0.2 | 2.0 | 0.2 | 1.1 | 100.0 |

- Continued -



ACE 6208414

Appendix A36. (p. 2 of 2)

| Lake | Date | Sample No. | Duration (min) | Species Composition (number of fish) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sockeye Salmon | Coho Salmon | Stickleback | Round Whitefish | Lake Trout | Sculpin | Total |
| Kenai | 10/13 | 1 | 60 | 36 | 0 | 0 | 0 | 0 | 0 | 36 |
| | 10/17 | 1 | 60 | 10 | 1 | 0 | 0 | 0 | 3 | 14 |
| | | 2[a] | 75 | 65 | 1 | 0 | 0 | 1 | 1 | 68 |
| | | Total | 195 | 111 | 2 | 0 | 0 | 1 | 4 | 118 |
| | | Percent | | 94.1 | 1.7 | 0.0 | 0.0 | 0.8 | 3.4 | 100.0 |

[a] Surface tow; all other tows on this date were made at approximately 27 meters.
[b] Tow made between 10-20 meters.



ACE 6208415-1/4/CB