APPENDIX D

Echo Integration-Trawl Survey Results for Walleye Pollock
in the Gulf of Alaska during 2001

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INTRODUCTION

Scientists from the Midwater Assessment and Conservation Engineering (MACE) Program at the Alaska Fisheries Science Center (AFSC) have conducted annual winter/spring echo integration-trawl (EIT) surveys in the Gulf of Alaska (GOA) since 1980 (except 1982, 1999) to assess the distribution and abundance of pre-spawning walleye pollock (*Theragra chalcogramma*). Most of these efforts have focused within the Shelikof Strait area although some work has been conducted elsewhere within the GOA (Williamson 1989, Karp 1990, Wilson et al. 1995, and references therein). Winter surveys were conducted in the Shumagin Islands in 1994-1996, for example, where substantial pre-spawning aggregations of pollock were detected (Wilson 1994, Wilson et al. 1995, Wilson et al. 1996). Surveys in areas outside Shelikof Strait and the Shumagin Islands areas, however, have not generally indicated large amounts of pollock, although these efforts have been quite restricted temporally and spatially. This report presents results from two winter/spring 2001 surveys in the GOA: 1) the Shumagin Islands area (AFSC cruise number MF01-02), and 2) the Shelikof Strait and east Kodiak Island areas (AFSC cruise number MF01-04). The primary objectives of these surveys were to determine walleye pollock distributional patterns and estimate abundance and biological characteristics of the fish. Results from the east side of Kodiak will be used with those from the summer 2000 EIT survey (Hollowed et al. 2001) of the same area to evaluate seasonal trends in pollock abundance and distribution patterns within this region of the GOA.

MATERIALS AND METHODS

Sampling Equipment

The surveys were conducted using the NOAA ship *Miller Freeman*, a 66-m (215-ft) stern trawler equipped for fisheries and oceanographic research. Acoustic data were collected with a Simrad[1] EK500 quantitative echo-sounding system (Bodholt et al. 1989). Simrad 38 and 120 kHz split-beam transducers were mounted on the bottom of the vessel's retractable centerboard, which was fully extended during all scientific operations. This positioned the transducers 9 m (30 ft) below the ocean surface. All results presented here are based on data collected with the 38 kHz transducer. Acoustic backscatter data from the Simrad EK500 echo sounder/receiver were processed using the Simrad BI500 echo integration and target strength data analysis software (Foote et al. 1991) on a SUN workstation.

Mid-water echosign was sampled using an Aleutian Wing 30/26 trawl (AWT), which is a full mesh wing trawl constructed of nylon except for polyethylene towards the aft section of the body and the codend. The headrope and footrope lengths were 81.7 m (268 ft). Mesh sizes tapered from 325 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend. The codend was fitted with a 3.2-cm (1.25-in) mesh liner. The AWT was fished with 82.4 m (270 ft) of 1.9-cm (0.75-in) diameter 8 by 19 non-rotational dandylines,

[1]Reference to trade names or commercial firms does not constitute U.S. government endorsement.

340-kg (750-lb) tom weights on each side, and 5 m^2 (49 ft^2) "Fishbuster" doors (1,250 kg {2,756 lb}; NET Systems, Inc., Bainbridge Island, Washington).

Fish on and near bottom were sampled with a polyethylene Nor'eastern (PNE) high-opening bottom trawl equipped with roller gear. The trawl was constructed with stretch mesh sizes that ranged from 13 cm (5 in) in the forward portion of the net to 8.9 cm (3.5 in) in the codend. The codend was fitted with a 3.2-cm (1.25-in) mesh liner. The 27.2-m (89 ft) headrope held 21 floats (30-cm {1 ft} diameter). A 24.7-m (81-ft) chain fishing line was attached to a 24.9-m (82-ft) footrope constructed of 1-cm (0.4-in) diameter 6 by 19 wire rope wrapped with polypropylene rope. The 24.2-m (79-ft) roller gear was constructed with 36-cm (14-in) diameter rubber bobbins spaced 1.5-2.1 m (5-7 ft) apart. A solid string of 10-cm (4-in) diameter rubber disks separated some of the bobbins in the center section of the roller gear. Two 5.9-m (19-ft) wire rope extensions with 10- and 20-cm (4- and 8-in) diameter rubber disks were used to span the two lower flying wing sections and were attached to the roller gear. The roller gear was attached to the fishing line using chain toggles (2.9 kg {6 lb} each) which were comprised of five links and one ring. The trawl was rigged with triple 54.9-m (180-ft) galvanized wire rope dandylines. The net was fished with the "Fishbuster" doors.

Temperature profile data were collected by attaching a Seabird SBE39 micro bathythermograph to the trawl headrope. Vertical profile measurements of water temperature and salinity were collected at the calibration sites using a Seabird conductivity/temperature/depth system. Data to describe ocean currents were collected using a vessel-mounted acoustic Doppler current profiler (ADCP), which was slaved to the EK500 to avoid interference. The ADCP operated continuously throughout the cruise in the water-profiling mode.

Survey Methods

Echo integration-trawl surveys were conducted in the Shumagin Islands, the Shelikof Strait area, and the east Kodiak area to assess the distribution, abundance, and biological characteristics of pollock. Survey tracklines consisted of uniformly spaced, parallel transects. For the Shumagin Islands survey, transect spacing was 9.3 km (5 nmi) within Shumagin Trough and 5.9 km (3 nmi) elsewhere (Fig. 1). Transects generally did not extend into waters less than about 35 m (19 fm) deep. For the Shelikof Strait area, which includes Shelikof Strait proper and the area between Middle Cape and Chirikof Island, transect spacing was 13.9 km (7.5 nmi) for the first pass and 27.8 km (15 nmi) for the second pass (Figs. 2-3). The Shelikof transects generally did not extend into waters less than about 75 m (41 fm) deep. For the survey of the east Kodiak area, transect spacing in Chiniak Trough was 11.1 km (6 nmi) and in Barnabas Trough was 5.6 km (3 nmi) except for the southernmost 3 transects, which were 11.1 km (6 nmi) apart (Fig. 4). The east Kodiak transects generally did not extend into waters less than about 50 m (27 fm) deep.

Attempts were made to conduct a second pass through the Shelikof Strait area because relatively few mature, pre-spawning pollock were detected in the sea valley between Katmai Bay and Cape Nukshak on the west side of Shelikof Strait (see Results). This is the area of the Strait where the greatest densities of pollock have been observed in March (Williamson 1989, Karp 1990, Guttormsen and Wilson 2000). The intent of this effort was to provide data which could be used to determine whether additional pre-spawning pollock moved into the Strait, and to document any progression in the maturity composition of the fish since the first pass.

Plans for the second pass were to re-run alternate transects from the first pass beginning near Chirikof Island and progressing north through the Strait proper. Inclement weather, however, prevented completion of the second pass (Fig. 3). Thus, pass 2 results were not used to calculate an abundance estimate.

Survey operations were conducted 24 hours a day. The acoustic system was used to collect echo integration and *in situ* target-strength data. Typical vessel speed was between 5.7-6.2 m/s (11-12 kts) while conducting transects. Trawl hauls were made at selected locations to identify echosign and provide biological samples.

Average trawling speed was about 1.5 m/s (3 kts). The vertical net opening for the mid-water AWT trawl averaged about 23 m (75 ft) (range 20-26 m {66-85 ft}). The PNE trawl vertical mouth opening averaged 6 m (20 ft) (range 4-8 m {13-26 ft}).

Standard catch sorting and biological sampling procedures were used to provide weight and number by species for each haul. Pollock were further sampled to determine sex, fork length (FL), age, maturity stage, and body and ovary weights. A Marel M60 motion-dampening electronic scale was used to determine weights of individual pollock to the nearest 2 g. Fish lengths were taken with a polycorder measuring device (a combination of a bar code reader and a hand-held computer; Sigler 1994). Fecundity samples were removed from selected mature females and preserved in 10% formalin. Tissue and otolith samples were collected from individual pollock for a Fisheries Oceanography Coordinated Investigations Program (FOCI) genetic research project. Adult pollock were successfully spawned, and the fertilized eggs were transported to Seattle, Washington, and Newport, Oregon, where various studies were conducted utilizing pollock eggs and larvae.

Four standard sphere calibrations were carried out in conjunction with the surveys (Table 1). The vessel was anchored fore and aft during these calibrations. The acoustic system was calibrated by suspending copper spheres with known backscattering characteristics below the transducer and measuring the acoustic returns following the procedure outlined by Foote et al. (1987). Sphere diameters were 60 and 23 mm for the 38 and 120 kHz transducers, respectively. Split-beam target strength and echo-integration data from the copper spheres were collected to describe acoustic gain parameters and transducer beam pattern characteristics. No significant differences in the 38 kHz system parameters were observed among the four calibrations.

Data Analysis

Estimates of pollock abundance were derived from the echo-integration and trawl data in the following manner. Pollock length data were aggregated into analytical strata based on echosign type, geographic proximity of hauls, and similarity in size composition data. Estimates of pollock backscattering strength in the area represented by each stratum were calculated. These echo integration values were then scaled to age- and length-specific fish numbers and biomass using a previously derived relationship between target strength and fish length (TS = 20 log FL – 66, Traynor 1996), length composition data, and length-weight relationships and age-length keys derived from trawl catches. For the Shumagin Islands, age-specific estimates of biomass and numbers will be generated after the otolith samples are aged.

Large numbers of eulachon (*Thaleichthys pacificus*) contaminated the acoustic returns from pollock in some of the surveyed areas (see Results). Thus it was necessary to apportion the acoustic sign between these two species. This was accomplished by using the catch weight of the two species from hauls within the area in a manner similar to that done for the 1992-1998 and 2000 Shelikof Strait surveys (Hollowed et al. 1992, Guttormsen and Wilson 2000).

Although annual EIT abundance estimates have been generated for the Shelikof Strait area since 1981, comparisons of these estimates are confounded because of a change in echo sounders that occurred in 1992. The newer sounder is considered more accurate than the earlier sounder primarily due to improved detectability (lower noise, higher signal-to-noise ratio), and ability to analyze acoustic data closer to the bottom. Thus, the ability to compare earlier estimates from the older sounder to recent estimates with the newer system is limited because pollock distributional patterns likely vary from year to year. Nevertheless, comparison of acoustic data collected with both sounders in 1991 showed that similar biomass estimates were obtained when the volume backscattering (S_V) threshold of the newer system was adjusted to -58.5 dB (Hollowed et al. 1992). Because of the lower noise level, an S_V threshold of -69 dB has been used to generate abundance estimates since 1992. Based on data collected with the new sounder in 1992 and 1993, biomass estimates based on an S_V threshold of -58.5 dB are about 21% less than those based on a threshold of -69 dB (Hollowed et al. 1994).

RESULTS AND DISCUSSION

Shumagin Islands Area

Distribution

Acoustic data were collected along 852 km (460 nmi) of transect tracklines in the Shumagin Islands between February 12-19 (Fig. 1). Age-2[2] pollock often formed a well-defined layer at 150-180 meters depth, and adult pollock were generally within 50 m (27 fm) of the sea floor. By mapping the geographical distribution of this backscattering, it is apparent that the densest aggregations were located in Unga Strait and across the mouth of Stepovak Bay between Renshaw and Kupreanof Points (Fig. 5). Pollock generally exhibited similar distribution patterns to those described during the winter EIT surveys in 1994-96, although the temporal and spatial coverages among surveys differed (Wilson 1994, Wilson et al. 1995, Wilson et al. 1996). Relatively few pollock were detected inside of Stepovak Bay in 1996 and 2001 whereas fish were found throughout the bay in 1994-95. Pollock were often concentrated in the vicinity of Swedania and/or Renshaw Points in previous years, except in 1994 when these areas were not surveyed. Quantities of pollock were detected near the head of the Shumagin Trough near Korovin Island in 1995, 1996, and 2001. Pollock were also observed farther seaward in the Trough in 1994 and 2001 compared to 1995 (this area was not surveyed in 1996).

Biological data were collected at 10 midwater trawl locations and at 7 bottom trawl locations (Tables 2-3, Fig. 1). The numbers of age-1 and age-2 pollock greatly exceeded the catch of older pollock in tows conducted in West Nagai Strait and Shumagin Trough (Fig. 6). Tows made north of Unga Island and up into Stepovak Bay caught mostly adult pollock (modal FL 49).

Pollock was the dominant fish species captured in midwater trawl hauls, comprising 93% by weight and 66% by numbers of the total catch (Table 4). Eulachon was the next most common species caught (4% by weight and 34% by number) and were caught primarily in tows conducted in Shumagin Trough. Pollock ranked first in weight (85%) and in numbers (76%) among fishes captured in bottom trawl hauls (Table 5). Arrowtooth flounder (*Atheresthes stomias*) was the next most common species caught (6% by weight and 7% by number).

Maturity Composition

A total of 1,199 pollock was sampled for maturity. All females less than 42 cm FL and males less than 36 cm FL were classified as either immature or developing (Fig. 7). The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 3% developing, 65% mature pre-spawning, 17% spawning, and 15% spent. The maturity composition for females longer than 40 cm FL was 0% immature, 3% developing, 52% pre-spawning, 15% spawning, and 30% spent. Comparison of these female maturity results with earlier Shumagin surveys which were also conducted in mid-February, suggest that the timing of peak spawning has varied slightly among years. For example, the percent of the female pollock that were classified as either "spawning" or "spent" in 1995 was only 6%, whereas in 1996 it was about 37% which was similar to the value reported in 2001 (45%).

[2]Because age data are not yet available for the Shumagin Islands survey, length ranges were used as a proxy for age based on length at age from previous surveys. Pollock between 9-16 cm FL are considered age 1, between 17-26 cm FL are considered age 2, most of the pollock from 27-34 cm FL are considered age 3, and most pollock exceeding 34 cm FL are considered adults.

The mean GSI (gonad weight/total body weight) for mature pre-spawning females was 0.16 (Fig. 8), which was higher than the mean GSI of 0.12 obtained during the 1995 survey but lower than the mean GSI of 0.19 obtained during the 1996 survey (Wilson et al. 1996). Female maturity-at-length data were fitted to a logistic model, which predicted that 50% of the females were mature at a length of 42 cm FL (Fig. 9). This estimate is similar to the 1995-96 survey estimates of 45 and 42 cm FL, respectively.

Abundance

The abundance of pollock in the Shumagin Islands area is estimated to be 3.54 x 10^8 pollock weighing 108,296 metric tons (t). The estimates include adjustments for backscattering attributed to eulachon, which reduced the total pollock biomass estimate by about 9%. Earlier surveys were not adjusted for the presence of eulachon because catches of this species were minimal (percent of total species caught by weight: 1994 (0%); 1995 (0.7%); 1996 (<0.1%)).

The relative increase in juvenile fish for the pollock size composition for 2001 was markedly different from the previous surveys (Fig. 10). In particular, the abundance of age-1 and age-2 pollock was low for the 1994-96 surveys, but increased to 78% by number and 22% by weight of pollock for 2001.

Inference about pollock abundance trends is difficult to make for the Shumagin Islands area because a suitable time series does not exist. The abundance of pre-spawning pollock in 1995 is the only estimate that is comparable to 2001 because the exploratory survey effort in 1994 occurred in March, well after spawning, and areas surveyed in 1994 and 1996 were much smaller than in 1995 and 2001 (Wilson et. al. 1996). The abundance estimate for adult pre-spawning fish in 1995 was about three times larger than the 2001 estimate. Whether this difference was because the timing of peak spawning was relatively earlier in 2001, or because the abundance of fish actually declined in 2001 compared to 1995 is unknown.

Shelikof Strait Area

Distribution

Acoustic data were collected along 1,448 km (782 nmi) of tracklines for pass 1 in the Shelikof Strait area (Fig. 2). Acoustic backscattering was assigned to 2 categories of echosign: well-defined midwater layers of primarily age-2 pollock at about 150-200 m (492-656 ft) below the surface or near-bottom layers of primarily adult and subadult (9-68 cm) pollock. A distributional plot of the acoustic backscattering attributed primarily to subadult and adult pollock during pass 1 indicated that the densest aggregations of pollock occurred from about 80 nmi (148 km) northwest of Chirikof Island to about Cape Kekurnoi (Fig. 11). Virtually no echosign was detected along the western portion of the Strait between Katmai Bay and Cape Nukshak, where mature pre-spawning pollock are typically observed. A small amount of pollock was detected on the east side of Strait between Uyak Bay and Kupreanof Strait, similar to that observed during the 1988 survey (Nunnallee and Williamson 1988). Acoustic backscattering attributed to midwater layers of primarily age-2 pollock was distributed similarly to the near-bottom layers (Fig. 12). The highest density of acoustic backscattering attributed primarily to age-1 pollock was observed on the second transect, near Chirikof Island.

Acoustic data were collected along 400 km (216 nmi) of tracklines during pass 2 (Fig. 3). Because of insufficient trackline coverage (see Methods), it is difficult to draw firm conclusions from these data. However, virtually no mature, pre-spawning fish occurred along the west side of the Strait between Katmai Bay and Cape Nukshak during pass 2. Pollock backscattering within the Strait decreased when compared with pass 1 based on data for the six transects that were completely run across the Strait (Figs. 11-14).

Whether this decline suggests movement of fish out of the survey area or a redistribution of fish within the Strait and southern Strait area is unknown.

Fifteen midwater hauls and 4 bottom trawls were conducted during pass 1 (Tables 6-7, Fig. 2). The size composition of pollock varied over the survey area (Fig. 15). Hauls conducted south of about Middle Cape caught mostly age-2 pollock (modal FL 20 cm) in both the midwater and near-bottom layers, with slightly larger amounts of age-3 and adult pollock present in the near-bottom layer. On the Kodiak side of the Strait, where only 4% of the biomass occurred, the mid-water layer contained larger amounts of age-1 and age-3 pollock than elsewhere in the Strait, and the single tow conducted in the near-bottom layer caught mostly adult pollock. Pollock exhibited similar size compositions in the 2 midwater hauls and 5 bottom trawls conducted during pass 2.

Pollock was the dominant fish species captured in midwater trawl hauls, comprising 86% by weight and 74% by numbers of the total catch (Table 8). Eulachon was the next most common species caught (12% by weight and 26% by number) and was associated primarily with tows conducted near the bottom. Pollock ranked first in weight (27%) and second in numbers (41%) among fishes captured in bottom trawl hauls (Table 9). In bottom trawl catches, eulachon ranked first in numbers (44%) and third in weight (21%), and arrowtooth flounder ranked second by weight (27%).

Maturity Composition

A total of 1,917 pollock was sampled for maturity during pass 1. All females less than 29 cm FL and males less than 26 cm FL were classified as immature or developing (Fig. 16). The unweighted maturity composition for males longer than 40 cm FL was 4% immature, 16% developing, 72% mature pre-spawning, 5% spawning, and 3% spent. The female maturity composition of fish longer than 40 cm FL was 1% immature, 24% developing, 71% mature pre-spawning, 0% spawning, and 3% spent.

A total of 748 pollock was sampled for maturity during pass 2. All females less than 33 cm FL and males less than 27 cm FL were classified as immature or developing (Fig. 17). The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 8% developing, 68% mature pre-spawning, 23% spawning, and 1% spent. The female maturity composition of fish longer than 40 cm FL was 0% immature, 15% developing, 82% mature pre-spawning, 2% spawning, and 1% spent. The percent of females in the spawning and spent stage of maturity from other recent Shelikof surveys generally exceeded the values reported this year (3%). For example, the estimates reported for the previous 4 surveys were 3% (2000), 17% (1998), 15% (1997), and 23% (1996; Wilson et al. 1996, Guttormsen and Wilson 1997, Guttormsen and Wilson 1998).

The mean GSI of 0.12 and 0.15 obtained from pre-spawning females during pass 1 and pass 2, respectively (Figs. 18-19), was slightly lower than the mean GSIs (0.14-0.19) reported for recent (1992-2000) Shelikof surveys (Guttormsen and Wilson 1998). The GSI estimates for the present survey, and trends observed in the maturity composition data, suggest that the fish may have spawned relatively later in Shelikof this year.

Female maturity-at-length data were fitted to a logistic model, which predicted that 50% of the females were mature at lengths of 46 and 44 cm FL for Pass 1 and 2, respectively (Figs. 20-21). These estimates are similar to recent survey estimates but were markedly larger than estimates from the early 1980s (Guttormsen and Wilson 2000).

Abundance

The abundance of pollock in the Shelikof Strait area is estimated to be 1.20 x 10^9 pollock weighing 369,600 t. Estimates are based on pass 1 results only. The estimates include adjustments for backscattering attributed by eulachon, which reduced the total pollock biomass estimate by about 15%. Results from surveys prior to 1992 did not account for the eulachon contribution in the acoustic returns.

Based on results from the EIT surveys, the abundance of pollock within Shelikof Strait has shown a dramatic decline between 1981 and 1988 (Fig. 22). Since 1988, estimates have remained relatively low and stable compared to earlier years. Results from the present survey, although lower than the 1990-2000 estimates, continue this trend.

The unusual areal distribution and relatively low numbers of adult pollock reported this year in Shelikof Strait were unexpected. However, similar findings were reported for the 1988 survey. During that survey, most pollock scattering within the Strait also occurred along the east side, near Kupreanof Strait (Nunnallee and Williamson 1988). Young fish from both surveys also dominated the age composition. For example, the size/age composition consisted primarily of young fish from the 1984 and 1985 year classes in 1988 whereas young fish from the 1999 year class dominated the size/age composition from the present survey.

The pollock size composition for 2001 is consistent with results from earlier surveys (Fig. 23). The temporal progression of the relatively strong 1988 year class through the population can be clearly seen since it appeared at a modal length of about 12 cm FL in 1989. This cohort is represented by fish in the 55-60 cm FL range, although in small numbers. The abundance of the 1994 year class, which represented the largest estimates of 1-, 2-, 3-, and 4-year-old fish in the history of the Shelikof Strait area EIT surveys, is represented by fish in the 45-55 cm FL range. The 1999 year class, which represented the second largest estimate of 1-year-old fish observed during the survey history, dominated the abundance in 2001, both in numbers and biomass.

Variance estimation

Error bounds for the 1992-2001 Shelikof Strait surveys were derived using the one-dimensional geostatistical approach described in Petitgas (1993) and Williamson and Traynor (1996). For each survey, transects were assigned to strata based on similar transect spacing. Next, s_A values were summed over the water column and averaged for each transect, then multiplied by the transect length to provide a transect total. Transect totals were summed for each stratum, then multiplied by the transect spacing to provide an estimate of the total relative abundance, Q*. Data were modeled using Estimation VAriance (EVA) software provided by Petitgas and

Data were modeled using Estimation VAriance (EVA) software provided by Petitgas and Prampart (1993) to provide variance estimates. The relative estimation error for each survey was obtained using the equation

$$relative estimation error = \frac{\sqrt{\Sigma variance_i}}{\Sigma Q*_i}$$

where

variance$_i$ = the variance estimate for strata i

Q*$_i$ = the estimate of total relative abundance for strata i.

Biomass error bounds were then calculated using the equation *biomass estimate* ± 2 * *relative estimation error*.

Table 10 summarizes the relative estimation errors and biomass error bounds based on variability in acoustic sampling for the 1992-2001 surveys. The relative estimation errors were consistently low and the biomass was relatively stable for the 1992-2000 surveys. These trends suggest that the spatial structure within the Shelikof Strait area was consistent among years. Furthermore, the increased effort along the west side of the strait where transect spacing was reduced from 13.9 km (7.5 nmi) to 6.95 km (3.75 nmi) for surveys beginning in 1994 did not reduce the precision of the biomass estimates. Thus the survey design for 2001 was modified to use the larger 13.9 km (7.5 nmi) transect spacing throughout the survey area.

Geostatistically derived error bounds quantify acoustic data sampling variability and provide error bounds on the biomass point estimates but do not account for error sources such as target strength-to-length relationships, trawl selectivity, or differences in diel distribution. Although not statistically rigorous, this treatment of error provides a general idea of the acoustic sampling variability.

Although EIT surveys may underestimate age-1 pollock abundance relative to older fish due to factors such as availability and net selectivity, survey results are an indicator of future abundance. McKelvey (1996), for example, explained 61% of the variability in the year-class strength when regressing Gulf-wide population estimates of 3-year-old pollock (Hollowed et al. 1994) against the Shelikof Strait EIT estimates of age-1 pollock for the 1980-1990 year classes. Based on Table 2 in her paper, the 2001 EIT estimate of 2.72×10^8 age-1 fish suggests that the strength of the 2000 year class is medium.

East Kodiak area

Distribution

Acoustic data were collected along 843 km (455 nmi) of transect tracklines in Chiniak and Barnabas Troughs on the east side of Kodiak Island (Fig. 4). Very little echosign, which was attributed to pollock, was observed in either trough. Subadult pollock often formed a well-defined layer at 25-75 m (14-40 fm) depth, and adult pollock were generally within 50 m (27 fm) of the sea floor. The fish were distributed in Sitkalidak Strait and Ugak Bay within Barnabas Trough and near Cape Chiniak in Chiniak Trough, as indicated in Fig. 24. In contrast, acoustic backscattering indicated the densest aggregations of subadult pollock seen during the August 2000 survey were throughout Chiniak Trough, while the densest aggregations of adult pollock were in the northern portion of Barnabas Trough.

Three midwater hauls were conducted in Chiniak Trough, and 3 midwater hauls and 1 bottom haul were conducted in Barnabas Trough (Tables 6-7, Fig. 4). Juvenile pollock dominated the catches in both Troughs (Fig. 25). By numbers, age-1 and age-2 comprised 48% and 49%, respectively, in Chiniak Trough, while in Barnabas Trough, age-1 pollock comprised 98% of the pollock catch. During the August 2000 survey, sub-adult juveniles accounted for 95% of pollock caught in Chiniak Trough. However, in Barnabas Trough, juvenile pollock only accounted for 4% of the pollock by number.

Pollock was the dominant fish species captured in the midwater hauls, comprising 90% by weight and 97% by numbers of the total catch (Table 11). The next most common species caught were eulachon by number (2%) and arrowtooth flounder by weight (6%). In the single bottom trawl, pollock was the dominant fish species captured, comprising 29% by weight and 93% by numbers (Table 12). Arrowtooth flounder was the second most abundant species caught, both by weight (28%) and by numbers (4%) in the bottom trawl.

Maturity Composition

A total of 488 pollock was sampled for maturity. All females less than 47 cm FL and males less than 42 cm FL were classified as immature or developing (Fig. 26). The unweighted maturity composition for males longer than 40 cm FL was 11% immature, 37% developing, 45% mature pre-spawning, 5% spawning, and 3% spent. The female maturity composition of fish longer than 40 cm FL was 0% immature, 42% developing, 49% pre-spawning, 0% spawning, and 8% spent.

The mean GSI for mature, pre-spawning females was 0.12 (Fig. 27), which was similar to those reported for Shelikof Strait pre-spawning females this year. Female maturity-at-length data were fitted to a logistic model, which predicted that 50% of the females were mature at a length of 51 cm FL (Fig. 28).

Abundance

The abundance of pollock in the east Kodiak area is estimated to be 1.13 x 10^8 pollock weighing about 4,500 metric tons. The estimates include adjustments for backscattering attributed by eulachon, which reduced the total pollock biomass estimate by about 6%. More pollock were present in either trough during the summer, 2000, when about 25,400 mt of fish were reported (Hollowed et al 2001).

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