NOAA SHIP MILLER FREEMAN
Cruise No. 97-02
Preliminary Cruise Results
Echo Integration-Trawl Survey of the Southeastern Aleutian Basin near Bogoslof Island

Midwater Assessment and Conservation Engineering

Scientists from the Alaska Fisheries Science Center (AFSC) investigated the population distribution and characteristics of spawning walleye pollock (*Theragra chalcogramma*) in the southeastern Aleutian Basin near Bogoslof Island between February 28 and March 11, 1997, (12 sea days) using echo integration-trawl (EIT) survey techniques aboard the NOAA ship *Miller Freeman*. This research cruise was the ninth in a series that began in 1988 and has been continued annually with the exception of 1990 as part of long-term monitoring of Bering Sea walleye pollock. In 1997, the cruise began and ended in Dutch Harbor, Alaska, and was a cooperative effort involving scientists from the United States, China, Poland and South Korea.

The vessel's itinerary was as follows:

Feb 28	Embark scientists during touch and go in Dutch Harbor, standard sphere calibration in Captain's Bay, AK.
Mar 1-10	Echo integration-trawl survey of the Bogoslof Island region
Mar 11	Arrive Dutch Harbor; end of cruise

The primary cruise objectives were to collect echo integration data and midwater trawl data essential to determine the distribution, biomass, and biological composition of walleye pollock in the southeastern Aleutian Basin. The 38 kHz and 120 kHz scientific acoustic systems were calibrated using standard sphere techniques. Physical oceanographic data (temperature and salinity profiles) were collected at selected sites. Sea surface parameters (e.g., temperature, salinity, light level) were monitored continuously, and an acoustic Doppler current profiler was operated continuously in the water profiling mode.

Secondary objectives involved a number of separate projects and investigators from the AFSC, University of Alaska, and the Alaska Department of Fish and Game (ADF&G).

METHODS

Sampling Equipment

Acoustic data were collected with a Simrad EK500[1] quantitative echo-sounding system on board the NOAA ship *Miller Freeman*, a 66-m (216 ft) stern trawler equipped for fisheries and oceanographic research. The Simrad 38 kHz and 120 kHz split-beam transducers were mounted on the bottom of the vessel's centerboard. With the centerboard fully extended, the transducers were 9 m below the water surface. System electronics were housed inside the vessel in a new permanent laboratory space dedicated to acoustics that replaced the portable laboratory used on previous cruises. Data from the Simrad EK500 echo sounder/ receiver were processed using Simrad BI500 echo integration and target strength data analysis software on a SUN workstation. Results presented in this document are based on the 38 kHz data.

Midwater echo sign was sampled using an Aleutian Wing 30/26 trawl (AWT), a full mesh wing trawl constructed of nylon except for polyethylene towards the aft section of the body and the codend. Headrope and footrope lengths each measured 81.7 m (268 ft) and mesh sizes tapered from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend. The net was fitted with a 3.2 cm (1.25 in) codend liner. It was fished with 82.4 m (270 ft) of 1.9 cm (0.75 in) diameter 8x19 non-rotational dandylines, 454.5 kg (1,000-lb) tom weights on each side, and 5 m^2 “Fishbuster” doors [1,250 kg (2,750 lb)]. For one haul, 227.3 kg (500-lb) tom weights were used. Vertical net opening and depth were monitored with a WesMar third wire netsounder system attached to the headrope of the trawl.

Trawl hauls were made to identify selected echo sign and provide biological data and pollock samples. Haul duration was kept to the minimum necessary to ensure an adequate sample. Biological data collected from each haul included species composition, sex composition, length frequencies, whole fish and ovary weights, maturities, otoliths, pollock ovaries and whole stomachs from selected species.

Temperature/depth data were collected with a micro-bathythermograph (MBT) attached to the headrope of all trawls. Conductivity-temperature-depth (CTD) data were collected with a Seabird CTD system at calibration sites and selected locations.

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

While transecting, we collected temperature-depth profile data at other locations using expendable bathythermographs (XBT's). Sea surface oceanographic data and environmental data were collected using the *Miller Freeman*'s Scientific Collection System (SCS). Ocean current profile data were obtained using the vessel's acoustic Doppler current profiler system whose transducer is mounted in the centerboard.

Survey Methods

Four standard sphere calibrations of the acoustic systems were made in conjunction with the survey (Table 1). No significant differences were observed in the 38 kHz system parameters among the four calibrations. Results from calibration of the 120 kHz system are not presented here as that system was not used in the acoustic data analysis.

Between March 1 and 10, two EIT survey passes were run through the Bogoslof spawning area. Pass 1 (March 1-8) covered about 1400 nautical miles (nmi) of transects (Fig. 1). The trackline consisted of 27 north-south parallel transects beginning at about long. 165°44'W and ending near long. 170°20'W. Transect spacing at the eastern end was 10 nmi and decreased to 5 nmi between transects 7.0 and 17.0. Pass 2 (March 9-10) covered 525 nmi, and was run from west to east between longitudes 170°W and 167°30'W at 5 nmi spacing (Fig. 2). For both passes, southern transect endpoints were at approximately 100 m bottom depth on the Aleutian shelf but varied depending on bottom depth and fish echo sign. The northern extent of the 10 nmi-spaced transects was similar to that during previous winter surveys in the Bogoslof region, between latitudes 54°30' and 54°40'N east of long. 168°W and between latitudes 54°00' and 54°30'N west of long. 168°W.

Echo integration and trawl data were collected 24 hours a day. Vessel speeds averaged 11.5 kts during acoustic data collection and ranged between 7 and 12 kts, depending upon weather conditions. We collected echo integration data from 14 m below the surface to within 0.5 m of the bottom, or to 1000 m depending on bottom depth. These data were thoroughly scrutinized by one or more scientists and stored in an INGRES database. When properly scaled they were used to provide estimates of pollock density.

Midwater trawl hauls were made at selected locations to identify echo sign and provide biological samples. The average trawling speed was about 3 kts. The AWT’s vertical opening averaged about 32 m. Standard catch sorting and enumeration procedures

were used to process all catches. Each trawl catch was completely sorted unless it exceeded about 1000 kg; representative splits of large catches were sorted. Total weights and numbers of individuals, by species, were determined for each catch.

Individual pollock were further sampled to determine sex, fork length (FL), body weight, age, maturity, and ovary weight. An electronic scale was used to determine all weights taken from individual pollock specimens. Fish FLs were determined to the nearest cm with a Polycorder measuring device (a combination of a bar code reader and a hand held computer). Since winter 1996, maturities have been determined by visual inspection of gonads based on an internationally accepted 8-stage scale. Expressed in terms of the older 5-stage scale, the stages were categorized as: immature, developing 1 & 2, pre-spawning 1 & 2, spawning, and post-spawning 1 & 2.

Several special projects were completed in addition to species collections associated with the estimation of pollock biomass. They included collecting and preserving stomachs from lanternfish (Myctophidae), and smoothtongues (Bathylagidae) in 10% formalin for food habits studies. Mature walleye pollock were spawned and the fertilized eggs cultured for laboratory experiments on eggs and larvae. Samples of pollock ovary tissue were collected from pre-spawning females for a study of interannual variation in fecundity. Fin clip, muscle and otolith samples were taken from walleye pollock for FOCI/ADF&G genetic research. Samples of forage fishes (myctophids) were frozen for a University of Alaska (Fairbanks) study on seabird food habits. Whole pollock were collected and frozen for the Observer Program at AFSC.

PRELIMINARY RESULTS

Biological data were collected and samples preserved from 16 midwater trawls (Figs. 1&2, Tables 2-4). Pollock dominated the catches in both weights and numbers (Table 5). Oceanographic data were collected from 19 MBT casts (Table 2), 3 CTD casts, and 5 XBT casts (Table 6). Temperature profiles showed a well-mixed water column with an average temperature of 3.9° C between the surface and 500 m. Near-surface temperatures averaged 3.2° C on the eastern edge of the survey area, and 3.7° C on the western (Aleutian Basin) side (Fig. 3).

During both passes, pollock distribution was similar to that in 1996. Pollock were moderately concentrated between longitudes 165°30'-166°30'W and in the southern portion of the survey area along the Aleutian Island chain between 167°30'-168°30'W (Fig 4).

As in 1996, most pollock (60% of the biomass from pass 1) were concentrated in Samalga Pass, between Umnak Island and the Islands of Four Mountains (longitudes 169° -170° W, Figs. 4&5). They were distributed in several spawning aggregations 1-10 miles in horizontal extent and 200-400 m in vertical extent between 200-700 m in the water column. The average sizes of pollock increased from east to west. The eastern most haul (haul 1) caught pollock with lengths averaging 44.0 cm/41.9 cm for females/males, respectively (Fig. 6a). Between longitudes 166°W and 167° W, average lengths were 50.4 cm/46.8 cm for females/males (Fig. 6b). Lengths of pollock encountered west of long. 167°W averaged 55.4 cm/51.8 cm for females/males, respectively (Fig. 6c). Sampled lengths ranged from 33-66 cm for sexes combined. The sex ratio by haul spanned 0.29 to 0.96 female and averaged around 0.62 female. Maturities observed were mainly pre-spawning 1&2 (coded 4 and 5 in the current 8-point scale); 84% and 78% were pre-spawning among females/males, respectively (Fig. 7). The mean gonadosomatic index (gsi) for prespawning females was 0.20 (Fig. 8). Total pollock abundance in the Bogoslof area appeared to be lower than it was in 1996.

SCIENTIFIC PERSONNEL

Name	Sex/ Nationality	Position	Organization
Neal Williamson	M/USA	Chief Scientist	AFSC
Daniel Twohig	M/USA	Electronics Tech.	AFSC
Taina Honkalehto	F/USA	Fish. Biologist	AFSC
Steve de Blois	M/USA	Fish. Biologist	AFSC
Mike Guttormsen	M/USA	Fish. Biologist	AFSC
Kevin Landgraf	M/USA	Fish. Biologist	AFSC
Jerzy Janusz	M/Poland	Fish. Biologist	MIR
Seok-Gwan Choi	M/Korea	Fish. Acoustician	NFRDA
Xianyong Zhao	M/China	Fish. Acoustician	YSFRI

AFSC - Alaska Fisheries Science Center, Seattle, WA
MIR - Morski Intytut Rybacki, Gdynia, Poland
NFRDA - National Fisheries Research and Development Agency, Pusan, Korea
YSFRI - Yellow Sea Fisheries Research Institute, Qingdao, China

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For further information contact Dr. Gary Stauffer, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries

Service, 7600 Sand Point Way Northeast, Building 4, BIN C15700, Seattle, WA 98115-0070. Telephone (206) 526-4170.
