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PRELIMINARY CRUISE RESULTS

NOAA SHIP MILLER FREEMAN, CRUISE NO. 95-05
ECHO INTEGRATION-TRAWL SURVEY OF WALLEYE POLLOCK ON THE EASTERN BERING SEA SHELF AND SLOPE

CRUISE PERIOD, AREA, AND SCHEDULE

Scientists from the Alaska Fisheries Science Center (AFSC) conducted an echo integration-trawl (EIT) survey of walleye pollock (Theragra chalcogramma) aboard the NOAA ship Miller Freeman from April 1-14, 1995. The cruise began at sea after fishing operations for cruise MF95-04 were completed, and ended in Dutch Harbor, Alaska. The survey area covered the eastern Bering Sea (EBS) shelf and slope from the Alaska Peninsula in the southeast to west of the Pribilof Islands.

The itinerary for the NOAA ship Miller Freeman follows (dates are local):

Apr 1	Transit to survey start near Amak Island (Scientists embarked March 29 in Kodiak, Alaska, during cruise MF95-04.)
Apr 2-9	Pass 1 EIT survey of EBS shelf and slope
Apr 9-10	Transit back to Unimak Pass area
Apr 10-13	Pass 2 EIT survey of EBS shelf at Unimak Pass and north of Unimak Island
Apr 13	Transit to Unalaska Island; sphere calibration in Anderson Bay
Apr 14	Disembark scientific personnel in Dutch Harbor; end of cruise

OBJECTIVES

The principal objective of the cruise was to collect echo-integration data and midwater and demersal trawl data necessary to determine the distribution, biomass, and biological

composition of walleye pollock in the survey area.

Secondary objectives were to:

1. collect walleye pollock target strength data for use in scaling echo-integration data to estimates of absolute abundance;

2. calibrate two centerboard-mounted acoustic systems using standard sphere techniques;

3. collect and preserve stomachs from pollock and Pacific cod (Gadus macrocephalus) for food habits studies (contact: Patricia Livingston, AFSC);

4. collect mature pollock ovaries to assess interannual variations in fecundity (contact: Bern Megrey, AFSC);

5. spawn mature pollock from the southeastern Bering Sea shelf and then culture fertilized eggs for laboratory experiments on larval growth rates and metabolism (contact: Gail Theilacker, AFSC);

6. collect adult pollock for observer training program (contact: Sheryl Corey, AFSC); and

7. collect physical oceanographic data including temperature and salinity profiles at selected sites, plus continuous monitoring of sea surface parameters (e.g., temperature, salinity, light level, and productivity) and water current profiles.

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The NOAA ship Miller Freeman is a 65.5-m (216-foot) stern trawler equipped for fisheries and oceanographic research. Two Simrad[1] split-beam transducers, one operating at 38 kHz and the other at 120 kHz, 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 in a portable laboratory mounted on the vessel's weather deck. Acoustic data were collected at both frequencies with a quantitative echo-sounding system (Simrad EK500). Data from the Simrad EK500 echo sounder/receiver were stored and processed using Simrad BI500 echo-integration and target-strength data analysis software on

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

a SUN workstation.

Midwater echosign was sampled using a modified Northern Gold 1200 midwater rope trawl (NET Systems, Inc.). The trawl was constructed with ropes in the forward section and stretch mesh sizes ranging from 163 cm (64 in) immediately behind the rope section to 8.9 cm (3.5 in) in the codend. It was fished in a bridleless configuration and fitted with a 3.2-cm (1.25-in) mesh codend liner. Headrope and footrope lengths were 94.5 m (310 ft) and 50 m (164 ft), respectively, and breastlines measured 79.4 m (260.5 ft). The headrope length was measured between the points of attachment at the breastline. The footrope length was measured between the points where tom weights were attached. The net was fished with 1.8-m X 2.7-m (6-ft X 9-ft) steel V-doors [1,000 kg (2,200 lb)], and 227-kg (500-lb) tom weights on each side. Vertical net opening, depth, and temperature were monitored with a Furuno wireless netsounder system attached to the headrope.

Fish on and near bottom were sampled with an 83/112 bottom trawl without roller gear. Net mesh sizes ranged from 10.2 cm (4 in) forward and 8.9 cm (3.5 in) in the codend, to 3.2 cm (1.25 in) in the codend liner. Headrope and footrope lengths were 25.6 and 34.1 m (83.9 and 111.9 ft), respectively, and the breastlines measured 3.4 and 3.2 m (11.3 and 10.5 ft). The 83/112 demersal trawl was fished with the same steel V-doors that were used with the rope trawl. The Furuno netsounder system monitored trawl mouth opening, depth, and temperature.

Age-1 fish and euphausiids in midwater were targeted with a Marinovich trawl. Meshes in the Marinovich trawl measured 7.6 cm (3.0 in) forward, 3.2 cm (1.3 in) in the codend, and 0.32 cm (1/8 in) in the codend liner. Headrope and footrope lengths were each 9.1 m (30 ft). The Marinovich trawl was also fished with the same steel V-doors used with the rope trawl. Again, the Furuno netsounder system monitored the trawl mouth opening, depth, and temperature.

Tow depth profiles for all trawls were obtained by attaching a microBT (small, retrievable temperature profiler) to the net. Water temperature and salinity profile data were collected at trawl and calibration sites with a Seabird CTD system. Additional temperature profile data were obtained by launching expendable bathythermographs (XBTs). Sea surface oceanographic data and environmental data were collected using the NOAA ship Miller Freeman's Scientific Collection System (SCS). Ocean current profile data were provided by the vessel's acoustic doppler current profiler system whose transducer is mounted in the centerboard.

SURVEY METHODS

The EIT survey of the EBS shelf and slope consisted of parallel, north-south transects that were spaced either 25 nmi or 12.5 nmi apart. A first pass (Fig. 1) started northeast of Unimak Island and proceeded west along the shelf to an area west of the Pribilof Islands. A second pass (Fig. 2) was conducted at Unimak Pass and north of Unimak Island. The southern extent of transects extending off the shelf was near the 1,000-m bottom depth contour. Northern extents were limited by the winter ice pack. A large portion of the area planned to be surveyed during the

cruise had to be omitted because the ice edge was unusually far south. Trackline mileage (including transit and mileage for haul operations) totaled approximately 2,800 nmi.

Standard survey operations occurred 24 hours per day. Favorable weather conditions permitted an average vessel speed of between 12 and 13 knots while running transects. Both acoustic systems (38 kHz and 120 kHz) collected echo-integration data and split-beam target strength data concurrently. Collection of target strength data required suitable conditions (e.g., low fish density, monospecific aggregation, and calm seas) and involved passing repeatedly (at speeds of less than 4 kts) over an aggregation of pollock, then collecting biological data from hauls conducted just prior to and just after collection of acoustic data. Target strength data will be interpreted together with historical target strength information, then used to scale echo-integration values from the 38 kHz transducer to provide estimates of pollock density (numbers/m^2). Echo-integration data from the 120 kHz acoustic system will be used to assess abundance and distribution of euphausiids and other prey items of pollock.

Midwater and demersal trawl hauls were made at selected locations (Fig. 3) to identify echosign and to provide biological samples. The average trawling speed for all gear types (except Marinovich trawls) was about 3 knots; trawling speed for Marinovich trawls was about 2 knots. The vertical net opening for the midwater rope trawl averaged about 20 m and ranged from 16-24 m. The net opening for the Marinovich midwater trawl was 2-4 m. The 83/112 mouth opening was 2 m. 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), body weight, age, maturity, and mature or spent ovary weight. An electronic scale was used to determine all weights taken from individual pollock specimens. Fork lengths of adult and juvenile pollock were measured to the nearest cm and recorded with a Polycorder measuring device (a combination of bar code reader and hand-held computer), then downloaded into a personal computer. When collected, pollock and Pacific cod stomachs were preserved in a 10% formalin solution. Mature pollock ovaries for the fecundity study were preserved in Gilson's solution.

PRELIMINARY RESULTS

Standard sphere calibrations

Standard sphere calibrations were conducted on four separate occasions before and during the cruise (Table 1). Both the 38 kHz and 120 kHz acoustic systems were calibrated each time. For calibration, the NOAA Ship Miller Freeman was anchored fore

and aft in 74-110 m of water. Acoustic properties of two copper spheres suspended below the transducer were measured. Split-beam target strength and echo-integration data collected with the Simrad EK500 system described acoustic system gain parameters and transducer beam pattern characteristics. No significant differences in gain parameters or transducer beam pattern characteristics for the 38 kHz system were observed among any of the four calibrations. For the 120 kHz system, SV gain dropped 1 db and TS gain dropped 0.8 db between the first and third calibrations, then remained unchanged between the third and fourth calibrations. Collection parameters for MF95-05 were derived from the third and fourth calibrations.

EIT survey

The greatest densities of pollock were observed in Unimak Pass and north of Unimak Island during pass 1 and pass 2 (Figs. 1 and 2). Most aggregations were within 50 m of bottom. Relatively little echosign was observed west of 167° W. It is of interest to note that pollock were observed right up to the ice edge along most transects.

Biological data were collected and specimen and tissue samples were preserved from 21 midwater (18 rope and 3 Marinovich) and 4 bottom trawl hauls. Trawl station and catch data from all hauls are summarized in Table 2. Oceanographic data were collected from 14 CTD casts (Fig. 4, Table 3), 11 XBT casts (Fig. 4, Table 4), and 23 microBT casts (Table 5).

Walleye pollock was the most abundant fish species captured by all three gear types (Tables 6, 7, and 8), and together with jellyfish accounted for greater than 99% of midwater rope trawl catch composition. Two successful Marinovich trawls were made. One caught only euphausiids while the other caught essentially just pollock. Bottom trawl catch composition was more diverse than off-bottom catch compositions. Pacific cod accounted for nearly a third of the catch by weight, but pollock (at 50%) still comprised the largest single portion of the catch by both weight and numbers. Types of biological data and numbers of samples and measurements collected from pollock and Pacific cod by all trawl types are listed in Table 9.

Walleye pollock captured in trawls ranged in length from 26 cm to 79 cm. Raw length measurements were summed into unweighted length frequency distributions (Fig. 5). Male pollock caught in midwater rope trawl hauls averaged 43.1 cm long; females averaged 46.3 cm. Pollock caught in bottom trawl hauls were larger than pollock caught in midwater rope trawls. Males averaged 46.8 cm and females averaged 53.2 cm. Sex ratios differed markedly from 0.5 for some hauls (range = 0.2-0.8), but an examination of sex ratio versus gear depth, bottom depth, and depth of gear off

bottom revealed no apparent trend.

Maturity-length compositions for both sexes of pollock are shown in Fig. 6. East of 168° W, more female pollock were in a spent condition than a mature condition (Fig. 7). West of 168° W the opposite was true. This would suggest that the population near Unimak Pass (i.e., east of 168° W) spawned sooner in the year than did the population located near the Pribilof Islands. Gonado-somatic indices (gonad weight/total body weight) for mature, prespawning pollock females east and west of 168° W (Fig. 8) suggested a weak, positive association with length. Mean GSI values for the two areas were not significantly different.

Target strength data collection

Target strength data were collected and hauls were made north of Unimak Pass on the early morning (local time) of April 12 (hauls 21, 22, and 23) and the night (local time) of April 12-13 (hauls 24 and 25). Catch compositions were very monospecific. Hauls 21 and 22 were at least 99% pollock, and hauls 24 and 25 were just under 95% pollock. One Marinovich trawl (haul 23), conducted to sample smaller organisms in the water column, captured a small quantity of euphausiids. Pollock caught in hauls 21 and 22 were from a unimodal size distribution, averaging about 47 cm and ranging from 38 to 62 cm long. Pollock from hauls 24 and 25 were smaller, averaging 41 cm and ranging from 32 cm to 61 cm. Their size distribution was also unimodal.

SCIENTIFIC PERSONNEL

Name	Sex/ Nationality	Position	Organization
Neal Williamson	M/USA	Chief Scientist	AFSC
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