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PRELIMINARY CRUISE RESULTS

NOAA SHIP MILLER FREEMAN, CRUISE NO. 95-01
COMBINED ECHO INTEGRATION-TRAWL SURVEY OF WALLEYE POLLOCK IN THE GULF OF ALASKA, AND PMEL/FOCI MOORING DEPLOYMENTS IN THE BERING SEA AND GULF OF ALASKA

CRUISE PERIOD, AREA, AND SCHEDULE

Scientists from the Alaska Fisheries Science Center (AFSC) and the Pacific Marine Environmental Laboratory (PMEL) conducted a research survey aboard the NOAA vessel Miller Freeman from February 12-24, 1995, for a total of 13 sea days. The cruise began in Kodiak, Alaska, and ended in Dutch Harbor, Alaska. Scientists from AFSC conducted an echo integration-trawl (EIT) survey of walleye pollock (Theragra chalcogramma) in the Shumagin Islands, Gulf of Alaska (GOA). Scientists from PMEL conducted mooring deployments/recovery in the GOA, and mooring deployments on the eastern Bering Sea (EBS) shelf.

The itinerary for the NOAA ship Miller Freeman follows:

Feb 12	Embark scientists in Kodiak
Feb 12-13	Conduct sphere calibration in Ugak Bay; transit to Shumagin Islands area
Feb 14-20	Conduct EIT survey of Shumagin Islands area, and recover/deploy Pavlof Island mooring
Feb 20-23	Deploy 3 Unimak Pass and 2 EBS moorings, and occupy Unimak CTD stations
Feb 23-24	Conduct Atka mackerel groundfish experiment; transit to Dutch Harbor; disembark scientists; end of cruise

OBJECTIVES

The principal objectives of the cruise are divided into those of the Acoustics Group and those of other groups.

The objectives of the Acoustics Group were to:

1. collect echo integrator data and midwater and demersal trawl data necessary to determine the distribution, biomass, and biological composition of walleye pollock in the Shumagin Islands area;

2. collect pollock target strength data for use in scaling the echo integration data to estimates of absolute abundance;

3. calibrate the 38 kHz and 120 kHz scientific acoustic systems using standard sphere techniques;

4. collect various meteorological and physical oceanographic data including vertical profiles of temperature and salinity at selected sites, and continuous monitoring of near-surface currents, temperature, salinity, light levels, etc.;

5. collect stomach samples from arrowtooth flounder (Atheresthes stomias), Pacific cod (Gadus macrocephalus), and non-spawning walleye pollock (Theragra chalcogramma); and

6. collect age-0 walleye pollock (Theragra chalcogramma) for stomach contents analysis.

The objective of the FOCI Group was to recover/deploy surface moorings at various locations in the study area.

The objective of the RACE Groundfish Group was to ascertain the feasibility of using acoustic methods to characterize Atka mackerel (Pleurogrammus monopterygius) aggregations.

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship Miller Freeman, a 65.5 m (216-foot) stern trawler equipped for fisheries and oceanographic research. Acoustic data were collected with a quantitative echo sounding system (Simrad EK500[1]). The Simrad 38 kHz and 120 kHz split-beam transducers were mounted on the bottom of the vessel's centerboard. The 38 kHz transducer was used for the primary data collection. 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. Data from the Simrad EK500 echo sounder/receiver were stored and processed using the Simrad BI500 echo-integration and target strength data collection and analysis software on a SUN workstation.

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

Midwater echosign was sampled using a modified Northern Gold midwater rope trawl (NET Systems, Inc., Bainbridge Island, Washington). 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 was fitted with a 3.2-cm (1.25-in) mesh codend liner. Length of the headrope was 94.5 m (310 ft) when measured between the attachment points at the breastline. Length of the footrope was 50 m (164 ft) when measured between the tom weight attachment points. The breastlines measured 79.4 m (260.5 ft). The net was fished with 1.8-m X 2.7-m (6-ft X 9-ft) steel V-doors [1000-kg (2200-lb)], and 227-kg (500-lb) tom weights on each side. Vertical net opening, depth, and temperature at depth were monitored with a Furuno wireless netsounder system attached to the headrope of the trawl.

Fish on and near bottom were sampled with a polyethylene Nor'eastern 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. It was fitted with a nylon codend liner with a mesh size of 3.2 cm (1.25 in). The 27.2-m (89.1-ft) headrope held 21 floats [30-cm (12-in) diameter]. A 24.7-m (81-ft) chain fishing line was attached to the 24.9-m (81.6-ft) footrope which was constructed of 1-cm (0.4-in) 6-ft x 9-ft wire rope wrapped with polypropylene rope. The 24.2-m (79.5-ft) roller gear was constructed with 36-cm (14-in) rubber bobbins spaced 1.5-2.1 m (5-7 ft) apart. A solid string of 10-cm (4-in) rubber disks separated some of the bobbins in the center section of the roller gear. Two 5.9-m (19.5-ft) wire rope extensions with 10-cm (4-in) and 20-cm (8-in) 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 (6.5 lbs) each] which were comprised of 5 links and 1 ring. The trawl was rigged with triple 54.9-m (180-ft) galvanized wire rope dandylines. Again, the net was fished with 1.8-m X 2.7-m (6-ft X 9-ft) steel V-doors [1000-kg (2200-lb)], and vertical net opening, depth, and temperature at depth were monitored with a Furuno wireless netsounder system attached to the headrope of the trawl.

Vertical profile measurements of water temperature and salinity were collected at 12 trawl stations and the calibration site using a Sea-Bird CTD (conductivity/temperature/depth) Seacat system. Temperature profile data were collected at two sites using expendable bathythermographs (XBT). Additional temperature and depth data were collected using a microbathythermograph (MBT) attached to the headrope of four selected trawls. The acoustic Doppler current profiler was slaved to the EK500 and operated continuously throughout the cruise in the water profiling mode.

SURVEY METHODS

An EIT survey was conducted in the Shumagin Islands area to assess the pollock's distribution, abundance, and biological characteristics. The parallel survey transect spacing was 9.3 km (5 nmi) within the Shumagin Gully, 3.7 km (2 nmi) north of the Shumagin Islands, and 7.4 km (4 nmi) elsewhere (Fig. 1). Bottom depths rarely exceeded 250 m along any transect.

Survey operations were conducted 24 hours a day. Vessel speed averaged approximately 11 kts while running transects, although it varied between 6 and 13 kts depending upon weather conditions. The acoustic system was used to collect echo-integration and ***in situ*** target strength data during survey operations. Estimates of absolute pollock abundance will be derived from the former data after they are appropriately scaled.

Midwater and bottom trawl hauls were made at selected locations to identify echosign and provide biological samples during the survey. The average trawling speed was approximately 3 kts. The vertical net opening for the midwater rope trawl averaged about 23 m (range 13-28 m). The Poly Nor'eastern trawl vertical mouth opening was about 10 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), age, maturity, and body and ovary weights. An electronic scale was used to determine all weights taken from individual pollock specimens. Fish lengths were taken with a Polycorder measuring device (combination hand-held computer and bar code reader). Age-0 pollock were frozen for stomach contents analysis.

PRELIMINARY RESULTS

Standard Sphere Calibrations

Standard sphere calibrations were conducted on four separate occasions before, during, and after the cruise (Table 1). The 38 kHz and 120 kHz acoustic systems were both 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 (60 mm for the 38 kHz; 23 mm for the 120 kHz) were measured. The 60 mm sphere has a known target strength of -33.6 dB; the target strength of the 23 mm sphere is -40.3 dB. Both spheres were suspended below the transducer with the smaller sphere suspended 5 m above the large one. 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 MF95-01 were derived from the second calibration.

EIT Survey

Approximately 1,602 km (865 nmi) of acoustic tracklines and 14 hauls were completed during February 14-20. A distributional plot of the acoustic backscattering attributed primarily to pollock for this survey is presented in Fig. 2. Pollock echosign was observed throughout the study area, although most fish were concentrated immediately to the northeast of the Shumagin Islands near Renshaw Point and Stepovak Bay. Significant quantities of fish were also detected within the Shumagin Gully. Other localized areas with moderate pollock echosign were the deeper areas in West Nagai Strait, and off Swedania Point. Most echosign was generally within 75 m of the bottom, although tight, spatially-discrete aggregations of pollock were also observed in mid-water in some areas (e.g. Shumagin Gully). Pollock echosign was rarely detected over bottom depths less than 100 m (Fig. 3).

Biological data were collected at 14 trawl locations. Trawl station and catch data are summarized for all hauls in Table 2. Biological data collected for pollock are tallied in Table 3. A total of 14 successful CTD casts (Table 4), 1 successful XBT cast (Table 5), and 3 successful MBT casts (Table 6) were made. Additional CTD casts were made by the PMEL/FOCI group at the mooring deployment locations as well as at other locations (see FOCI Results).

Biological data were collected at 13 midwater trawl locations (Table 7), and 1 bottom trawl location (Table 8) during the survey. Pollock accounted for more than 98% of the catch. Age-1 pollock were observed along with adult pollock in the Shumagin Gully region in hauls 1, 2, 3, and 5. The size distributions for age-1 pollock ranged between 8-13 cm FL with a modal length of 11 cm. Outside the Shumagin Gully region, pollock size distributions were strongly unimodal. These adult pollock ranged between 37-69 cm FL with a modal length centered near 48 cm (Fig. 4).

A total of 1,515 pollock, 794 males and 721 females, were sampled for maturity from the 14 trawl hauls. The percentage of mature, prespawning fish for each sex was 81%. Only 8% of the males and 2% of the females were actively spawning (Fig. 5). The gonado-

somatic index (GSI: gonad weight/total body weight) for mature, pre-spawning females was 0.12 (Fig. 6).

PMEL/FOCI Operations

During the cruise three bongo casts were conducted. The purpose of these casts was to determine if there were any pollock eggs in the water column (Shumagins only) and to collect calanoid copepods for DNA analyses. The 60 cm bongo frame with 333 ?m mesh was used. A Sea-Bird Seacat was attached to the winch wire above the bongo frame. Bongo casts were taken to within approximately 10 m of the bottom. When the SCS system supported the Seacat, the Seacat transmitted pressure, temperature and conductivity in real-time and recorded data internally. The bongo sites were near the Shumagin Islands, mooring F-95BSS1, and mooring F-95BSS2. One sample from each cast was preserved in formalin; the other sample in pure, non-denatured (200 proof) alcohol.

A total of eighteen CTDs were conducted using the PMEL Sea-Bird CTD (real-time) and the Acoustic Group's Sea-Bird CTD (internally recording). At nine of the CTD stations, data from an analog CHLAM (chlorophyll absorption meter) were also recorded. A CTD cast was conducted before the recovery and after the deployment of each mooring (an exception is the Pavlof Bay mooring--the AFSC Kodiak Lab requested XBTs instead of CTDs). CTD casts were taken to within approximately 7 m of the bottom. Due to a problem with the port winch, and to expedite operations, the Acoustics Group's internally recording Sea-Bird CTD was used at the Unimak Pass mooring sites. Salinity samples were collected at eighteen stations and reversing thermometers at seven stations to obtain calibration data for the PMEL CTD.

A total of six moorings were deployed. Three were located in a line across Unimak Pass (F-95UP-1, F-95UP-2, F-95UP-3), one northeast of Unimak Pass (F-95BSS-1), one on the southwest Bering Sea slope (F-95BSS-3), and one in Pavlof Bay (for the NMFS Kodiak Crab Lab). The Unimak Pass moorings all have Seagauges mounted on the anchor; in addition, the center Unimak Pass mooring has an Aanderaa current meter located 10 m above the bottom. The center Unimak Pass mooring was deployed in 79 m; the outer Unimak Pass moorings were deployed in 64 to 66 m. The F-95BSS-1 and F-95BSS-3 moorings are 600 KHz and 150 KHz Acoustic Doppler Current Profilers respectively, in a bottom mounted trawl resistant cage. Each of these two moorings has a Seacat with tubing which collects water 5 m above the cage and then pumps the water down to the Seacat sensors. These particular Seacats measure conductivity and temperature, but not pressure. F-95BSS-1 was deployed in 68 m, while F-95BSS-3 was deployed in 124 m. The Pavlof Bay mooring consists of three TempMentor Sensors (18, 58, 96 m). An XBT was done after the deployment of

the Pavlof Bay mooring. All deployments occurred without incident.

A mooring located at Pavlof Bay was recovered. The mooring had been deployed on JD 050, 1994 by PMEL/MILLER FREEMAN for the AFSC Kodiak Lab. It has three TempMentor sensors (21, 66, and 99 m). The sensors were given to CST Bill Floering for return to P. Anderson/AFSC Kodiak Lab. An XBT was done prior to the mooring recovery.

RACE Groundfish Operations

The RACE Groundfish task conducted an investigatory set of transects and tows to test the feasibility of using the EK-500 to detect Atka mackerel.

Twenty-one zig-zag transects, totaling 129.6 km (70 nmi), were run across a ridge of the continental shelf from 9.3 km-18.5 km (5 nmi-10 nmi) north of Akun Island, perpendicular to bathymetric contours at depths from 80 m-150 m. This area and depth range were typical of historic Atka mackerel fishery activity in the area. The transect period was timed to overlap the end of a high current period associated with a strong ebb tide, its subsequent slack tide period and the beginning of the following weaker flood tide. Three major echosign types were observed: non-contiguous aggregations within 3 m-5 m of the bottom, weak and sporadic near-bottom echosign, and diffuse, relatively uniformly distributed low density sign within 25 m-75 m of the bottom. After completing 15 transects, some transects were replicated. During the replication set, one tow was conducted on each sign type.

The standard Poly Nor'eastern bottom trawl was used for the first tow, on scattered high density sign. An estimated 19,000 kg of Atka mackerel was caught during this ten minute tow. The net was severely damaged during the tow and total catch could have been considerably larger, but was inestimable due to large holes in the intermediate of the net. Approximately 550 kg of northern and dusky rockfish, 170 kg of Pacific cod and 30 kg of other groundfish were also present in the catch. The acoustical sign observed at this site did not appear to account for this very high density of Atka mackerel, but further observations will be necessary to clarify the relation of echosign to Atka mackerel abundance.

A second Poly Nor'eastern bottom trawl was used for the subsequent tow over bottom with little or no acoustical sign. The duration was reduced to two minutes due to damage to the other bottom net. Less than 15 kg of fish were caught in this tow, including two Atka mackerel.

The mid-water rope trawl was used for the final tow through profuse low density sign, which was assumed to be primarily smaller pelagic organisms. A twenty-one minute tow produced less than 280 kg of fish, of which 99% were Pacific cod and walleye pollock. No Atka mackerel were caught in this mid-water tow.

SCIENTIFIC PERSONNEL

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