PRELIMINARY CRUISE RESULTS
NOAA SHIP *Miller Freeman*
CRUISE NO. 97-03

ECHO INTEGRATION-TRAWL SURVEY OF WALLEYE POLLOCK IN SHELIKOF STRAIT

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*) in the Shelikof Strait area in the Gulf of Alaska aboard the NOAA ship *Miller Freeman* from March 13-26, 1997, for a total of 14 sea days. The cruise began in Dutch Harbor and ended in Homer, Alaska. The itinerary for the *Miller Freeman* was as follows:

VESSEL ITINERARY

Mar 13	Embark scientists in Dutch Harbor and transit to Nateekin Bay, for sphere calibration.
Mar 13-14	Transit to Shelikof Strait.
Mar 14-25	EIT survey of Shelikof Strait area.
Mar 22	Transit to Kodiak to disembark scientist, embark personnel, resume EIT survey.
Mar 25-26	Conduct sphere calibration; transit to Homer.
Mar 27	Disembark scientists; end of cruise.

OBJECTIVES

The primary objectives of the cruise were to:

1) collect echo integration data and midwater and bottom trawl data necessary to determine the distribution, abundance, and biological composition of walleye pollock in the area

of operations; and,

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

The secondary objectives of the cruise were to:

1) calibrate the 38 kHz and 120 kHz scientific acoustic systems using standard sphere techniques;

2) collect physical oceanographic data including temperature and salinity profiles at selected sites, and conduct continuous monitoring of sea surface parameters (e.g., temperature, salinity, and light level);

3) collect stomachs from walleye pollock, and arrowtooth flounder (*Atheresthes stomias*) for food habits analysis;

4) spawn mature pollock and culture the fertilized eggs for laboratory experiments on eggs and larvae;

5) collect samples of pollock ovary tissue for studying the interannual variation in fecundity;

6) collect genetic samples of pollock and pacific cod (*Gadus macrocephalus*) for stock identification studies; and,

7) collect eulachon for a seabird foraging study.

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship *Miller Freeman*, a 66 m stern trawler equipped for fisheries and oceanographic research. Acoustic data were collected with a Simrad EK500[1] quantitative echo-sounding system. Simrad 38 kHz and 120 kHz split-beam transducers were mounted on the bottom of the vessel's retractable centerboard. The centerboard was fully extended during all scientific operations. This positioned the transducers 9 m below the surface. All results presented here are based on data collected with the 38 kHz transducer. 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.

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

Midwater echo sign was sampled with 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 both measured 81.7 m (268 ft). Mesh sizes tapered from 3.25 m (128 in) in the forward section of the net to 89 mm (3.5 in) in the codend. The codend was fitted with a 32 mm (1.25 in) liner. The AWT was fished with 82.3 m (270 ft) of 1.9 cm (0.75 in) diameter 8x19 non-rotational dandylines, 455 kg (1,000 lb.) tom weights on each side, and 5 m^2 (53.8 ft^2) "Fishbuster" doors (1,250 kg [2,750 lb.]).

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 89 mm (3.5 in) in the codend. It was fitted with a nylon codend liner with a mesh size of 32 mm (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 x 19 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 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.

Most trawl hauls were monitored with a WesMar third wire trawl sonar attached to the headrope of the trawl. Vertical and horizontal net openings, depth, and temperature at depth were measured. A Furuno wireless net sounder system was used on four trawl hauls.

Vertical profile measurements of water temperature and salinity were collected at calibration sites using a Seabird CTD (conductivity/temperature/depth) system. Temperature profile data were also collected by attaching micro bathythermographs (MBT) to most trawls. The acoustic Doppler current profiler transducer cable was damaged immediately prior to the cruise and prevented successful operation of the acoustic Doppler profiler during the survey.

SURVEY METHODS

Two EIT survey passes were conducted in the Shelikof Strait area to assess the distribution, abundance, and biological characteristics of pollock. The "Shelikof Strait area" refers to Shelikof Strait and the area surveyed between Middle Cape and Chirikof Island. Survey transects were oriented parallel to one another. Transects were spaced 14 km (7.5 nmi) apart except on the western side of the Strait, where 7 km (3.75 nmi) spacing was used (Figs. 1- 2). Greater sampling effort was allocated to the western side of the Strait because it has historically contained most of the pollock spawning biomass. Transects generally did not extend into waters less than about 30 m in depth.

Survey operations were conducted 24 hours a day. Typical vessel speed was about 11-12 knots when running transects. Echo integration data were collected with a horizontal resolution of about 9 m and a vertical resolution of 0.5-1 m. 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. Average trawling speed was about 3 knots. The vertical net opening for the midwater AWT trawl averaged about 29 m (range 25-34 m). The PNE trawl vertical mouth opening was about 9 m (range 6-10 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 (8 point scale), and body and ovary weights. An electronic scale was used to determine weights of individual pollock specimens. Fish lengths were usually taken with a Polycorder measuring device (a combination of a bar code reader and a hand held computer). Stomachs were collected from pollock and arrowtooth flounder and were preserved in 10% formalin. Tissue and otolith samples were collected from individual walleye pollock for Fisheries-Oceanography Coordinated Investigations (FOCI) and Alaska Department of Fish and Game genetic research. Fecundity samples were removed from mature females and preserved in 10% formalin. Adult pollock were successfully spawned, and the fertilized eggs were transported to Seattle, WA, and Newport, OR, where various studies utilizing

pollock eggs and larvae are conducted.

PRELIMINARY RESULTS

Four standard sphere calibrations were carried out in conjunction with the survey (Table 1). Three calibrations were completed prior to the cruise: on February 11 in Puget Sound, WA; on February 28 in Captain's Bay, Unalaska Is., AK; and, on March 14 in Nateekin Bay, Unalaska Is., AK. Upon completion of the cruise a calibration was conducted on March 26 in Malina Bay, Kodiak Is., AK. No significant differences in the 38 kHz system parameters were observed among the four calibrations.

Acoustic data were collected between March 14-25 in the Shelikof Strait area along about 2,040 km (1,100 nmi) of transect tracklines on two passes (Figs. 1-2). Pollock acoustic backscattering was assigned to 2 categories of echosign: 1) that attributed primarily to pollock from the 1994 year class which formed a well-defined midwater layer; and, 2) echosign attributed primarily to adult pollock. A distributional plot of the acoustic backscattering attributed primarily to adult pollock during pass 1 indicated that the densest adult pollock aggregations were broadly distributed around Cape Kekurnoi and Cape Kuliak along the west side of the Strait (Fig. 3). The greatest densities of pollock have historically been observed in these areas during surveys conducted in March. Backscattering attributed primarily to adult pollock during pass 2 was similarly distributed, although relatively greater scattering was detected off Katmai Bay (Fig. 4). Most echosign from adult pollock was detected within 50-100 m of the bottom. Acoustic backscattering attributed primarily to pollock from the 1994 year class (year class tentatively identified on the basis of fork length, otolith age data not yet available) during passes 1 and 2 was often detectable as a well-defined, mid-water layer about 150-200 m below the surface. This layer existed from Sitkinak Strait to about Uyak Bay, although during pass 2 some fish were also found near Cape Kuliak (Figs. 5-6). Some 2-year-old fish likely occurred in the mid-water layer, based on the

size distribution data from the layer, although this will need to be confirmed with the otolith age data when they become available.

Biological data were collected at 16 AWT midwater and 14 PNE (5 conducted in midwater) bottom trawl locations (Tables 2-3, Fig. 1). The size composition of pollock varied in different regions of the survey area (Fig. 7). The numbers of age-3

pollock (modal FL range 26-28 cm) exceeded the catch of older pollock in all tows that targeted the mid-water layer in the survey area. The near-bottom tows conducted in the southern Strait area caught mostly age-3 pollock, with varying amounts of age-1 (modal FL range 12-13 cm) and adult pollock (modal FL range 37-53 cm). Tows made between Cape Kekurnoi and Kuikpalik Island on the western side of the Strait caught mostly adult pollock (modal FL range 50-55 cm).

Pollock was the dominant fish species captured in midwater trawl hauls, comprising 93.8% by weight and 79.2% by numbers of the total catch (Table 4). Eulachon (*Thaleichthys pacificus*) was the next most common species caught (20.5% by number) and were primarily associated with tows occurring within 50 m of the bottom south of Cape Kekurnoi. Pollock ranked first in weight and numbers among fishes captured in bottom trawl hauls (includes midwater and on-bottom hauls), comprising 93.4% and 89.4% respectively (Table 5). Arrowtooth flounder (3.3% by weight) and eulachon (5.7% by numbers) were the next most common species caught. Table 6 summarizes the special studies carried out during the survey.

A total of 2,836 pollock were sampled for maturity from the trawl catches during the survey. No females less than 33 cm FL or males less than 25 cm FL were classified as mature (Fig. 8). Eighty-eight percent of the females greater than 34 cm FL were either in prespawning or spawning condition and only 6% were in spent condition. The mean gonadosomatic index, defined as the ratio of gonad weight to total body weight for mature females, was 0.19 (Fig. 9).

A total of 31 successful MBT casts were made during the survey (Table 2).

SCIENTIFIC PERSONNEL

Name	Nationality	Position	Organization	Dates Aboard
Chris Wilson	USA	Chief Scientist	AFSC	Mar. 13-26
Dan Twohig	USA	Electronics Tech.	AFSC	Mar. 13-26
Michael Guttormsen	USA	Fish. Biologist	AFSC	Mar. 13-22

Taina Honkalehto	USA	Fish. Biologist	AFSC	Mar. 13-26
Steve de Blois	USA	Fish. Biologist	AFSC	Mar. 13-26
Kevin Landgraf	USA	Fish. Biologist	AFSC	Mar. 13-26
Tom Wilderbuer	USA	Fish. Biologist	AFSC	Mar. 13-26
Harold Zenger	USA	Fish. Biologist	AFSC	Mar. 13-26
Lisa Britt	USA	Fish. Biologist	FOCI	Mar. 13-26

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