PRELIMINARY CRUISE RESULTS
NOAA SHIP MILLER FREEMAN
CRUISE NO. 96-05

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 15-27, 1996 for a total of 13 sea days. The cruise began and ended in Kodiak, Alaska.

The itinerary for the *Miller Freeman* was as follows:

VESSEL ITINERARY

Mar 14	Embark scientists in Kodiak
Mar 15	Transit to survey start location near Chirikof Island.
Mar 15-26	EIT survey of Shelikof Strait area
Mar 26-27	Conduct sphere calibration; transit to Kodiak.
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, light level, and productivity) and water current profiles;

3) collect stomachs from walleye pollock, arrowtooth flounder (*Atheresthes stomias*), Pacific cod (*Gadus macrocephalus*), and all species of shark except spiny dogfish (*Squalus acanthius*);

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 interannual variation in fecundity; and

6) collect micronekton samples with fine-mesh nets attached to trawl gear.

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[1] EK500 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. System electronics were housed in a portable laboratory mounted on the vessel's weather deck. 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.

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

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

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]). Additionally, one or two small-mesh nets, each 6.1 m (20 ft) long with a 10.8 m^2 opening and 0.5 cm mesh, were attached to several locations along the AWT to sample micronekton and macrozooplankton in the path 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 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.

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.

Vertical profile measurements of water temperature and salinity were collected at most trawl stations 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 was slaved to the EK500 and operated continuously throughout the cruise in the water profiling mode.

SURVEY METHODS

An echo integration-trawl survey was 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 about 14 km (7.5 nmi) apart except along the western side of the Strait, where 7 km (3.75 nmi) spacing was used (Fig. 1). Greater sampling effort was allocated to the western side of the strait since it has historically contained most of the pollock

spawning biomass. Transects generally did not extend into waters less than about 75 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 9 m and a vertical resolution of 1-2 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 31 m (range 27-34 m). The PNE trawl's vertical mouth opening was about 9 m (range 8-10 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 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, Pacific cod, and arrowtooth flounder and were preserved in 10% formalin. 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, Washington, and Newport, Oregon, 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 4 in Puget Sound, Washington, on February 16 in Belkofski Bay, Alaska, and on March 8 in Nateekin Bay, Unalaska Is., Alaska. Upon completion of the cruise a calibration was conducted on March 27 in Malina Bay, Kodiak Is., Alaska. No significant differences in the 38 kHz system parameters were observed between the four calibrations.

Acoustic data were collected between March 15-26 in the Shelikof Strait area along about 2,175 km (1,350 nmi) of tracklines
(Fig. 1). A distributional plot of acoustic backscattering attributed primarily to adult pollock (>31 cm) is presented in Fig. 2. The densest adult pollock aggregations were broadly distributed near Capes Kekurnoi and Kuliak along the west side of the strait, where historically the greatest densities of pollock have been observed during surveys conducted in March. Most fish were detected within 50-100 m of the bottom. Acoustic backscattering attributed primarily to age-2 pollock (17-30 cm) was often detectable in a well-defined, mid-water layer
about 150-200 m below the surface from Uyak Bay to the southern limits of the surveyed area near Chirikof Island (Fig. 3).

Biological data were collected at the 30 AWT midwater and 8 PNE bottom trawl locations (Tables 2-3, Fig. 1). In 19 of the 30 AWT midwater tows, the numbers of age-2 pollock exceeded the catch of older pollock. Tows made between Cape Kekurnoi and Kuikpalik Island on the Alaska Peninsula side of the strait (Hauls 24-35) caught mostly adult pollock, while tows conducted elsewhere caught mostly age-2 pollock, with varying amounts of age-1 (9-16 cm) and adult pollock (Fig. 4).

Pollock was the dominant fish species captured in midwater trawl hauls, comprising 92.5% by weight and 77.1% by numbers of the total catch (Table 4). Eulachon (*Thaleichthys pacificus*) was the next most common species caught and were primarily associated with tows occurring within 25 m of the bottom on the Kodiak Island side of the strait or south of Middle Cape. Pollock ranked first in weight and numbers among fishes captured in bottom trawl hauls, comprising 97.8% and 95.3%, respectively (Table 5). Arrowtooth flounder (1.1% by weight) and eulachon (2.8% by numbers) were the next most common species caught.

A total of 4,181 pollock were sampled for maturity from the trawl catches during the survey. No females less than 43 cm FL or males less than 41 cm FL were determined to be mature (Fig. 5). The mean gonadosomatic index, defined as the ratio of gonad weight to total body weight for mature females, was 0.18
(Fig. 6).

A total of 26 CTD casts and 34 successful MBT casts were made during the acoustics group's operations (Tables 6-7, Fig. 7).

SCIENTIFIC PERSONNEL

(15 - 27 March 1996)

Name	Nationality	Position	Organization
Chris Wilson	USA	Chief Scientist	AFSC
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