Preliminary results of a interaction study, NOAA Ship Miller Freeman 02-09, between commercial fishing and walleye pollock (*Theragra chalcogramma*) off East Kodiak, August-September 2002

by Sarah Stienessen, Anne Hollowed, and Chris Wilson

INTRODUCTION

Scientists from the Alaska Fisheries Science Center (AFSC) conducted an echo integration-trawl (EIT) survey of walleye pollock (*Theragra chalcogramma*) off the east side of Kodiak Island over Chiniak and Barnabas Troughs during August and September, 2002. Preliminary results presented here are from work conducted aboard the NOAA ship *Miller Freeman* from August 13 to September 5, 2002 (22 sea days). The cruise began and ended in Kodiak, Alaska. The principal cruise objective was to collect echo integration data and midwater and bottom trawl data to determine the distribution, biomass, and biological composition of walleye pollock in Chiniak and Barnabas Troughs. Commercial trawling operations were not allowed in Chiniak and Barnabas Troughs when the *Miller Freeman* conducted the first and second survey passes through the troughs. Commercial trawling operations had commenced in Barnabas Trough when the *Miller Freeman* conducted its third and fourth passes of Chiniak and Barnabas troughs. This report presents preliminary information on the pollock geographical distribution and size composition, and an inventory of the biological and physical data samples. Biomass estimates, acoustic system calibration results, and other survey results will be reported in a subsequent document.

METHODS

Itinerary

Aug 12	Embark scientists in Kodiak, Alaska
Aug 13-18	Conduct first pass of EIT survey in Chiniak and Barnabas Troughs
Aug 18-24	Conduct second pass of EIT survey in Chiniak and Barnabas Troughs
Aug 25-26	Inport Kodiak, Alaska.
Aug 27-Sept 2	Conduct third pass of EIT survey in Chiniak and Barnabas Troughs
Sept 2-3	Conduct fourth pass of EIT survey in Barnabas Trough, and conduct fish avoidance research with acoustic buoy

Sept 4 Acoustic sphere calibration in Ugak Bay

Sept 5 Disembark scientists; end of cruise

Acoustic equipment

Acoustic data were collected with Simrad EK500[1] and Simrad EK60 quantitative echo-sounding systems on board the NOAA ship *Miller Freeman*, a 66-m stern trawler equipped for fisheries and oceanographic research. The Simrad 38-kHz, 120-kHz and 200 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 permanent laboratory space dedicated to acoustics. Acoustic data were collected using the EK500 echo sounder operating at 38 kHz and 120 kHz. The 38 kHz data were post-processed using Simrad BI500 echo integration and target strength data analysis software on a SUN workstation. Acoustic data collected using the Simrad EK60 echo sounder were collected at 200 kHz and processed with SonarData Echolog Software. Acoustic system settings used during the collection were based on results from acoustic system calibrations and on experience from prior surveys. Results presented in this document are based on the 38-kHz data.

Trawl Gear and Oceanographic Equipment

Midwater echosign was sampled with an Aleutian Wing 30/26 trawl (AWT). Fish on and near bottom were sampled with a polyethylene Nor'eastern (PNE) high-opening bottom trawl equipped with roller gear. Vertical net opening and depth were monitored with either a WESMAR third wire netsounder system or a Furuno acoustic link netsounder system. Both nets were fished with 5 m^2 Fishbuster trawl doors. A Methot trawl was used to target macrozooplankton.

Physical oceanographic data collected during the cruise included temperature/depth profiles obtained with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope and conductivity-temperature-depth (CTD) profiles collected with a Sea-Bird CTD system at calibration sites and other locations. Expendable bathythermograph (XBT) probes were used to collect water temperature profile data at selected locations. Satellite-tracked drifters, which were drogued at 40 m (131.2 ft), were released to document near-surface current flow. Sea surface temperature, salinity, other environmental data, and input for the vessel's Marine Operations Abstract (MOA) were collected and stored on the *Miller Freeman*'s Scientific Computing System (SCS). Ocean current profile data were obtained using the vessel-mounted acoustic Doppler current profiler system operating continuously in water-profiling mode. Vessel pitch, roll, and heave data were collected with a TSS Position and Orientation System for Marine Vessels (POS/MV Model 320) to monitor transducer motion. This instrument was not calibrated.

Buoy deployment

A drifting buoy containing an echosounder and associated equipment was deployed and

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

recovered during the survey on an opportunistic basis. After the buoy was released in an area over fish echosign, the vessel steamed about 1.8 km from the buoy and maintained that distance until the scientist in charge notified the bridge to begin free-running at normal survey speed along a course that took the vessel as close as possible past the buoy. The vessel continued steaming until about 1.8 km past the buoy. Multiple passes were run past the buoy.

Survey Design

Two series of parallel transects, with the transects spaced 3 nmi apart, were used to survey Chiniak and Barnabas Troughs repeatedly (Figs. 1 - 4). Transect endpoints were usually located in the shallower waters along trough edges where backscattering attributed to walleye pollock had declined to undetectable levels. Three survey passes, each consisting of 15 transects and 161 nmi, were conducted over Chiniak Trough. Three survey passes, each consisting of 15 transects and 265 nmi, were conducted over Barnabas Trough. A fourth, partial pass consisting of the last 13 transects (215 nmi) was also completed over Barnabas Trough.

Primary EIT survey operations, which included the collection of acoustic and trawl data, took place during the 14-15 daylight hours per day. Nighttime activities during the remaining 9-10 hours included re-running portions of the survey track line to evaluate the diel distribution patterns of the dominant scatterers, conducting additional trawl hauls to supplement daytime sampling and to verify nighttime scattering layers, CTD sampling to describe water column properties, and conducting other ancillary scientific projects.

Pollock, and Pacific cod (*Gadus macrocephalus*) for two trawl hauls (55 &56), were sampled to determine sex, fork length, body weight, age, and maturity. Maturity was determined by visual inspection and categorized as immature, developing, pre-spawning, spawning, or post-spawning on an 8-point scale for pollock and a 5-point scale for Pacific cod.

Data Analysis

Acoustic data were collected between 14 m from the surface (5 m below the centerboard-mounted transducer) and 0.5 m off the bottom. Data from echosign identified as pollock were stored in a relational database.

PRELIMINARY RESULTS

Two standard sphere calibrations of the 38-kHz and 120-kHz scientific acoustic systems were made before and during the survey (Table 1). No substantial differences in system parameters between these and historical calibrations for the 38-kHz system were observed.

Biological data were collected and samples preserved from 52 midwater trawls, 21 bottom trawls, and 2 Methot trawls (Figs. 1-4, Tables 2-8). Pollock, followed by capelin, *Mallotus villosus*, and unidentified jellyfish, were the dominant species caught in midwater trawls. Large numbers of eulachon, *Thaleichthys pacificus*, and unidentified shrimp were also caught (Table 4). The 17 midwater trawls that targeted capelin occurred between transects 5-10 in Chiniak and in the southern potion of Barnabas Trough (i.e., along transects 1-10). Arrowtooth flounder (*Atheresthes stomias*), pollock, Pacific cod, Pacific halibut (*Hippoglossus stenolepis*) and

flathead sole (*Hippoglossoides elassodon*) were the most common species caught in bottom trawls (Table 5). Most of the cod and halibut were captured in hauls 55 and 56 (Chiniak Trough, 3210.1 kg and 791.4 kg, respectively). Several bottom trawls (hauls 11, 35, 38, 43) were made in areas where no on-bottom pollock echo-sign was present to investigate whether pollock were present on bottom but undetectable in the acoustic data. No pollock were captured in any of these tows.

Two Methot trawl hauls were conducted in Chiniak Trough to identify the species composition of a nearly continuous scattering layer that occurred in the deeper portions of the survey area (Tables 3,6). The first trawl haul sampled the water directly above this scattering layer and caught mostly gelatinous zooplankton (e.g. salps). The second haul was conducted within this scattering layer and caught mostly euphasiids.

Acoustic backscattering was classified into primarily three groups: adult pollock, juvenile pollock, and capelin (Figs. 5-16). Adult pollock were located in the northern portion of Barnabas Trough and throughout Chiniak Trough, where they generally formed loose, on-bottom aggregations during the day. Juvenile pollock were located throughout the two troughs, but usually were shallower in the water column at depths of about 75-150 m during the day. They dispersed broadly at night. Capelin were often broadly distributed over the shallower edges of Chiniak Trough, whereas in Barnabas, they were found over a wide range of bottom depths and mostly in the southen portion of the Trough.

Pollock size distributions, based on data from trawl hauls that targeted this species, were mostly uni-modal (Fig. 17). Bimodal distributions did occur in some cases when juvenile pollock, which formed a relatively shallow scattering layer, were inadvertently captured during hauls that targeted the deeper scattering layers attributed to the larger adult pollock. Adults, which represented the near-bottom echosign, tended to have a prominent length mode around 47 cm in Chiniak Trough and around 53 cm in Barnabas Trough. Juvenile pollock, which typically occurred higher in the water column than the adults, were characterized by a length mode of around 31 cm in Chiniak Trough and around 32 to 34 cm in Barnabas Trough. The length-weight regression curve for pollock is shown in Figure 18.

Capelin exhibited a slightly bimodal size distribution of relatively larger fish in Barnabas than those captured in Chiniak Trough (Fig. 19). A linear regression was fitted to the capelin length data to describe the relationship among total, fork, and standard fish lengths (Fig 20).

Pollock maturities observed during the survey were dominated by developing males and females (Fig. 21). No spawning pollock were observed, and only 17 pollock were classified as pre-spawning.

Physical oceanographic data were collected from 73 SBE39 casts associated with trawl hauls (Tables 2 and 3), 52 CTD casts (Table 9; Figs. 22-25), 74 XBT casts (Table 10; Figs. 22-25), 7 moorings (Table 11, Fig. 22) and 3 satellite-tracked drifters (Table 12). Mean sea surface temperatures at 1 m depth, based on XBT data, were cooler in Chiniak Trough (10.9°C) than Barnabas Trough (11.7°C) and exhibited little variation among passes. Temperatures for the upper 5 m of the water column ranged between about 10°C to15°C and at depths greater than

120 m ranged between 5°C to 7°C (Fig. 26).

The acoustic buoy was deployed once over adult walleye pollock. During this nighttime deployment, the *Miller Freeman* made ten passes within 2-20 m of the buoy. Analysis of the data is in progress.

SCIENTIFIC PERSONNEL

Name	Sex/ Nationality	Position	Organization
Leg 1:			
Chris Wilson	M/USA	Chief Scientist	AFSC
Steve de Blois	M/USA	Fish. Biologist	NWFSC
Mike Guttormsen	M/USA	Fish. Biologist	AFSC
Peter Giesen	M/USA	Student Intern	UW
Libby Logerwell	F/USA	Fish. Biologist	AFSC
Dennis Benjamin	M/USA	Fish. Biologist	AFSC
Bill Floering	M/USA	Fish. Biologist	AFSC
Sung Il Lee	M/Korea	Fish. Biologist	AFSC
Guy Fleischer	M/USA	Fish. Biologist	NWFSC
Emily Shepherd	F/USA	Teacher at Sea	OLA
J. Preston Larimer	M/USA	Teacher at Sea	OLA
Leg 2:			
Chris Wilson	M/USA	Chief Scientist	AFSC
Anne Hollowed	F/USA	Fish. Biologist	AFSC
Libby Logerwell	F/USA	Fish. Biologist	AFSC
Sarah Stienessen	F/USA	Fish. Biologist	AFSC
Dennis Benjamin	M/USA	Fish. Biologist	AFSC
Bill Floering	M/USA	Fish. Biologist	AFSC
Brian Battaile	M/USA	Fish. Biologist	UA
Larry Hufnagle	M/USA	Fish. Biologist	NWFSC
Amy Moreland	F/USA	Teacher at Sea	OLA

AFSC - Alaska Fisheries Science Center, Seattle, Washington
OLA - NOAA Office of Legislative Affairs, Teachers at Sea Program, Washington, D.C.
UW - University of Washington, Seattle, Washington
NWFSC -Northwest Fisheries Science Center, Seattle, Washington
UA -University of Alaska, Juneau, Alaska