March 10, 1998 F/AKC2:MG

PRELIMINARY CRUISE RESULTS
NOAA Ship Miller Freeman CRUISE NO. 97-10

MEASUREMENT OF WALLEYE POLLOCK RESPONSE TO VESSEL AND TRAWL NOISE USING AN ACOUSTIC BUOY

CRUISE PERIOD, AREA, AND SCHEDULE

Scientists from the Midwater Assessment and Conservation Engineering (MACE) Program of the Resource Assessment and Conservation Engineering (RACE) Division at the Alaska Fisheries Science Center (AFSC) conducted a study to assess the behavioral response of walleye pollock (Theragra chalcogramma) to vessel and trawl noise aboard the NOAA ship Miller Freeman. The response of the acoustic backscattering was quantified using a freely drifting buoy which was capable of acoustic data collection. The study occurred in the eastern Bering Sea from September 29 to October 6, 1997, for a total of eight sea days. The cruise began and ended in Dutch Harbor, Alaska.

The itinerary for the Miller Freeman was as follows:

Sep 29-30 Embarked scientists in Dutch Harbor, AK. Sphere calibration of the acoustic buoy system in Akutan Harbor, Akutan Island, AK.

Sep 30-Oct 5 Transited to first experimental site and began acoustic buoy work.

Oct 5-6 Transited to Dutch Harbor, AK. Debarked scientific party. End of cruise.

The objectives of the cruise were to:

1) collect acoustic data from the buoy and shipboard scientific acoustic systems to determine the distribution and behavioral response of walleye pollock to ship and trawl noise;

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

3) calibrate the buoy scientific acoustic system using standard sphere techniques;

4) collect physical oceanographic data including vertical profiles of temperature and salinity at selected sites, and continuous monitoring of sea surface temperature, salinity, and near-surface current velocities, and

5) conduct bottom trawling operations using tension meters to determine the amount of vessel motion that is transmitted to the trawl under different sea states.

VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The acoustic buoy consisted of a 1.30 m long aluminum cylinder (inner dia. 50 cm, wall thickness 0.635 cm) with a "donut" floatation collar (outer dia. 107 cm, 53 cm ht.) at one end. A bulkhead inside the cylinder separated the cylinder into an upper (i.e., instrument) and lower (i.e., battery) watertight compartment which could be accessed by removing the appropriate aluminum end cap (lid thickness 1.91 cm). An 86 cm diameter ring (guard rail) at the upper end of the cylinder was used to lift the buoy during deployment/recovery.

The buoy electronic components included an instrument package within the buoy well, and components suspended below the buoy. The onboard instrument package consisted of a 38 kHz Simrad(1) EY echosounder, Toshiba laptop computer, GPS/Argos transceiver, and 902-928 MHz wireless data transceiver. A split-beam transducer and heading sensor were suspended in an aluminum cage 6.5 m below the buoy using 10.7 m of line. Twenty-three floats were equally spaced along the line so that the cage assembly was only slightly negatively buoyant. The resulting catenary in the line reduced the transfer of buoy motion to the transducer. The 183 cm long buoy mast included a radar reflector, marker light, and several antennas. Four 100 ampere-hour batteries powered the buoy. The total weight of the buoy was about 300 kg. The echosounder was remotely controlled from the Miller Freeman, and acoustic data were stored onboard the buoy and transmitted to the vessel in real time.

Midwater echosign 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 m2 (53.8 ft2) "Fishbuster" doors (1,250 kg [2,750 lb]).
Fish on 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 m and 34.1 m (83.9 ft and 111.9 ft), respectively, and the breastlines measured 3.4 m and 3.2 m (11.3 ft and 10.5 ft).

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. During bottom trawl hauls, a wire tension meter was attached between the lower tail wire and tail chain of the port door, and another meter/snatch block assembly was attached to the warp midway between the port trawl winch and stanchion block to determine if differences in trawl warp tension were detectable as differences in vertical tension in the trawl warp.

Vertical profile measurements of water temperature and salinity were collected at the calibration site using a Seabird conductivity/temperature/depth system. Temperature profile data were also collected by attaching micro bathythermographs to most trawls.

SURVEY METHODS

Scientific operations occurred 24 hours per day. The Miller Freeman followed a trackline based on results from the summer echo integration-trawl survey, MF9708, and catch locations from the commercial fishery during September, 1997. The major activity during the cruise consisted of deployments and recoveries of a freely drifting acoustic buoy and repeated passes by the Miller Freeman past the buoy, both free-running and towing a trawl. The duration of the deployments ranged from 2-4 hours. After the buoy was released, the vessel traveled at least 2 km from the buoy, then steamed toward the buoy, passing as closely as possible, and continued on until the buoy was at least 2 km away.

+Midwater or bottom trawl hauls were conducted at selected study sites 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 25 m (range 21-29 m). The 83/112 trawl vertical mouth opening was about 2 m.

Standard catch sorting and biological sampling procedures were used to provide weight and number by species for hauls conducted with the codend closed. Pollock were further sampled to determine sex, fork length (FL), age, maturity (8-point scale), and body weights. An electronic scale was used to determine weights of individual pollock specimens. Fish lengths were taken with a Polycorder measuring device (a combination of a bar code reader and a hand held computer).

PRELIMINARY RESULTS

Biological data were collected at 3 midwater and 1 bottom trawl locations. Pollock (99.3% by numbers; 45.1% by weight) and jellyfish (Scyphozoa sp.; 54.8% by weight) were the dominant species captured in the midwater trawl hauls. Pollock ranked first in weight and numbers among fishes captured in the bottom trawl haul, comprising 63.2% and 51.4% respectively. Arrowtooth flounder (Atheresthes stomias; 18.6% by weight and 12.7% by numbers) and flathead sole (Hippoglossoides elassodon; 6.0% by weight and 18.0% by numbers) were the next most common species caught.

The acoustic buoy was deployed 6 times during the cruise . The communication performance between the buoy and the vessel, and the stability of the buoy after redistributing the buoy ballast were successfully evaluated during a test deployment (Deployment 0) made near Akutan Harbor. Deployments 1-3 were conducted in a free-running mode and deployments 4 and 5 were conducted while towing the bottom trawl. The deployments were conducted on either light pollock echosign or unidentified backscattering (most likely a combination of age-0 pollock and jellyfish). No dense aggregations of pollock were located during the survey. The buoy was deployed under a variety of conditions (seas 8 ft; winds 26 kts). Performance of the buoy during all deployments was excellent. Analysis of data collected with the buoy is in progress.

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1. 0 Reference to trade names or commercial firms does not constitute U.S. government endorsement.