Cruise Report for 2009 FISHPAC Project

Prepared by: RACE Division Habitat Research Team

Cruise ID:	**FISHPAC**	Vessel(s):	**NOAA Ship *Fairweather***
Cruise Dates:	**July 26 – August 7, 2009**	Hydrographic Survey:	**M-R908-FA-09, D00148**

Alaska Fisheries Science Center
7600 Sand Point Way NE
Seattle, WA 98115-6349

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Overview

The broad scope of the Essential Fish Habitat (EFH) mandate requires an efficient process for describing and mapping the habitat needs of federally managed species. Previous research indicates that the distribution and abundance of many groundfish species is related to surficial sediment properties. However, direct sampling of sediments with grabs and coring devices is impractical over areas as large as the EBS shelf. Acoustic tools, on the other hand, are suitable for large-scale surveying and show great promise as a substitute for the more conventional samplers, but they have not been proven for EFH purposes.

In 2009, an acoustic seafloor survey using two different sonar systems was conducted along strong gradients of groundfish abundance, as determined from many years of RACE bottom-trawl-survey catches at fixed stations. The value of acoustic backscatter as a habitat-defining characteristic will be judged based on the statistical association between normalized backscatter and fish density. Groundtruth samples of infauna and sediment along each trackline will provide additional biological and geological information for the analysis.

Additional sonar work was performed outside the scope of this survey. This is described in the Additional Activities section of this report.

Objectives

(1) Investigate the utility of acoustic backscatter for characterizing the EFH of eastern Bering Sea (EBS) species using a variety of sonar and groundtruthing systems.

(2) Evaluate the mechanism of association between groundfish and surficial sediments, involving coordinated sampling by the RACE bottom trawl survey.

(3) Provide hydrographic-quality bathymetry data to the NOAA Pacific Hydrographic Branch for updating nautical charts in areas with outdated or non-existent information.

Vessels and Gear

Operations were conducted aboard the NOAA Ship *Fairweather*, a multi-mission hydrographic survey vessel capable of continuous sonar operations.

Two hull-mounted multibeam echosounders (Reson models 8111-ER and 8160) were used to acquire acoustic backscatter in the study area (Table 1).

Manufacturer:	Reson	Reson
Model number:	8160	8111-ER
Configuration:	Hull-mounted	Hull-mounted
Frequency (kHz):	50	100
Bathymetry data:	Yes	Yes
Backscatter data:	Yes (snippets)	Yes (snippets)
Maximum speed with 100% coverage:	~7 kts	~7 kts

Table 1. Sonar systems used in 2009.

State-of-the-art groundtruthing instruments were used to sample the biological and geological characteristics of the seafloor (Figure 1). Sediment grabs and digital still photos were taken using the Seabed Observation and Sampling System (SEABOSS) grab sampler for the purposes of infauna and sediment characterization. SEABOSS was tracked using a hull-mounted Sonardyne USBL (ultra-short baseline) positioning system. Geophysical properties of the seafloor, as well as sound speed within the water column, were measured using a Brooke Ocean Technology Free-Fall Cone Penetrometer (FFCPT). Traditional CTD casts using the Seabird SBE 19plus profiler were conducted throughout the survey to complement and cross-check the sound-velocity profiles from the FFCPT.

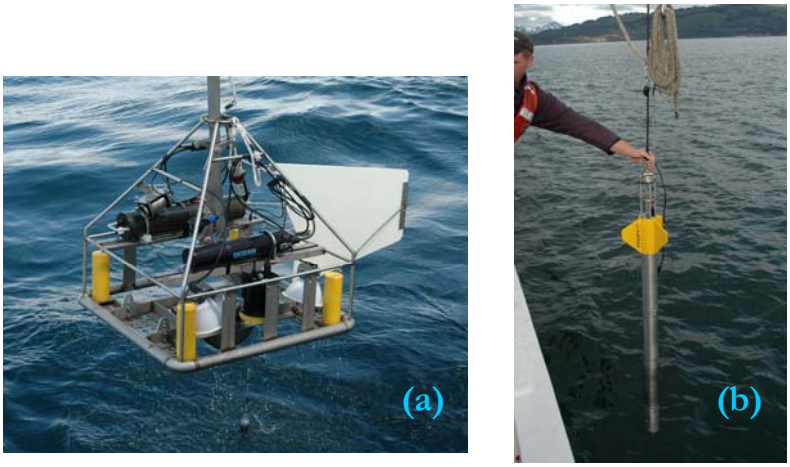

Figure 1. Groundtruthing devices used during FISHPAC 2009 cruise: (a) the SEABOSS sediment and infauna sampling system, and (b) the FFCPT sediment profiler with an integrated sound velocity and pressure sensor.

Itinerary

24 – 26 July	Mobilization of AFSC equipment & shakedown, Dutch Harbor, Alaska.
26 July – 7 August	Survey operations aboard NOAA Ship *Fairweather*, Bristol Bay region.
7 – 9 August	Demobilization and shipping of all field gear.

Survey Design and Methods

The 2009 survey area consisted of six 110-140 nautical mile tracklines across the EBS shelf at depths ranging from 20 to 160 meters (Figure 2). These tracklines were chosen to pass directly over 31 RACE bottom-trawl-survey stations at which a wide range of fish and invertebrate abundances has been observed. Nine additional stations were added at intermediate locations along lines 7 and 8, to provide additional infauna and sediment data. Each line was navigated once with continuous shipboard operations. On every pass, backscatter and bathymetry data were collected using the ship's two multibeam sonars with operator settings tuned for backscatter data.

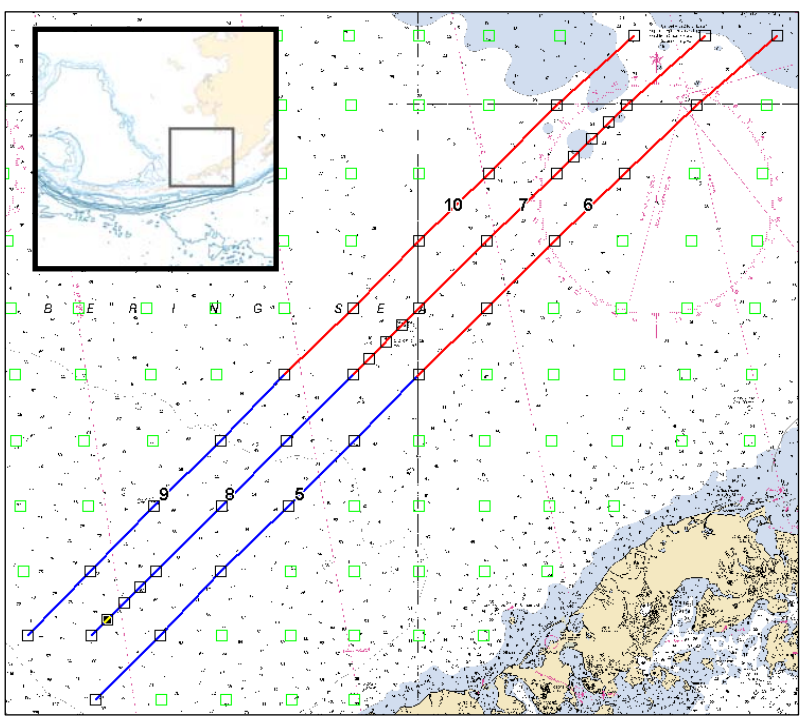

Figure 2. Completed survey tracklines, groundtruth sample locations (black boxes) and standard RACE bottom trawl survey stations for the Bering Sea shelf (green boxes).

The hydrographic survey required sound speed profiles at least every four hours. The FFCPT was initially used as the primary sound-speed instrument during FISHPAC operations, and could be deployed every few minutes for measurements while underway. A comparison to a standard hydrographic sound speed profiler (Seabird CTD) confirmed the acceptability of the FFCPT for this measurement. After numerous successful deployments, the FFCPT experienced a communications malfunction, leaving the CTD as the sole method of sound speed measurement for parts of the survey. Since the CTD is not deployable while underway, sound speed measurements were limited to four-hour intervals with this sensor.

SEABOSS was deployed at each groundtruth station along with the FFCPT (prior to FFCPT malfunction). Once ready, the FFCPT was allowed to free-fall with the aid of a line-pulling sheave. After penetration of the seafloor, the FFCPT was downloaded, retrieved and re-deployed. The SEABOSS required the power-up of the still and video camera systems, and the arming of the sediment grab prior to deployment. Camera systems were set to start shortly before bottom-contact. Using the ship's mechanical winch, the SEABOSS was lowered to the seafloor at 0.5 – 1 m/s. Two acceptable grabs were required for separate infauna and sediment samples. The infauna grab was first measured for volume and then sorted with fresh seawater on a 1 mm screen for conspicuous invertebrates. These were then fixed in 10% buffered formalin with rose bengal biological stain and subsequently transferred to 50% isopropanol. The sediment sample was qualitatively described in the grab upon retrieval. The topmost layer of the sample was collected and immediately frozen for characterizing carbon and nitrogen levels. The sediment grab was then cored and the sample stored for granulometric processing in the laboratory. Photographic records of the bottom were downloaded and stored in raw and compressed image formats (*.nef, *.jpg, *.avi).

Results

Scientific equipment was installed in Dutch Harbor before *Fairweather's* departure for the working grounds. Surveying began on 26 July and *Fairweather* returned to Dutch Harbor on the morning 7 August. Operationally, the cruise was successful. Six tracklines were completed during the course of the cruise (Figure 2) using two sonar systems (Table 1) and two groundtruthing systems (Figure 1). Some portions of survey lines were re-run due to weather effects on data quality. Multiple on-station deployments of sampling devices were safely performed by the scientists and crew. Large volumes of data and many groundtruth samples were obtained (Table 2). Data for each device were acquired and securely archived on redundant data drives. Collaborative processing and analysis of data for EFH research, nautical charting, and other technical purposes will be undertaken by research partners on *Fairweather*, in the RACE and REFM Divisions at the Alaska Fisheries Science Center, and at the NOAA

Pacific Hydrographic Branch, the University of New Hampshire, and the University of Alaska Fairbanks.

Instrument	Total sampling units
Reson 8160	798 nm
Reson 8111-ER	798 nm
SEABOSS grab	40 samples
SEABOSS grab	40 samples
SEABOSS still	958 MB
FFCPT drops	24 drops

Table 2. Data collected during the 2009 FISHPAC survey.

Additional Activities

Feature Investigation

During the cruise, a feature resembling a bowl or depression in the seafloor was detected between the standard survey lines. One of the *Fairweather* survey launches was deployed and investigated the area with a very-high-resolution multibeam system (Reson model 8125 operating at 455 kHz). A preliminary review of the data revealed a depression of unknown origin, measuring approximately 29 meters in diameter and 1.5 meters deep (Figure 3).

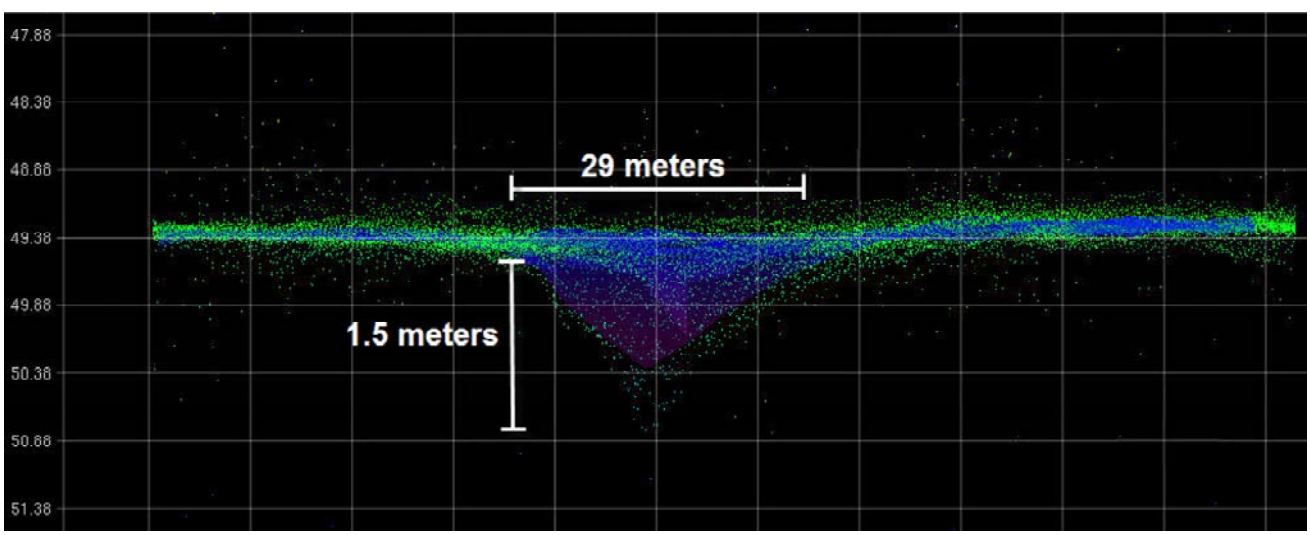

Figure 3. Two-dimensional representation of a bowl-shaped feature in Bristol Bay.

NOAA Ship Oscar Dyson – ME70 Water-Column Sonar

In addition to the planned survey lines, *Fairweather* and the FISHPAC team acquired bathymetry and backscatter data during two passes along a short transect near Dutch Harbor (Figure 4). These hydrographic-quality data will be compared with data collected a few weeks earlier by the NOAA ship *Oscar Dyson* using a multibeam sonar (Kongsberg ME70) configured to survey the water column rather than the seabed.

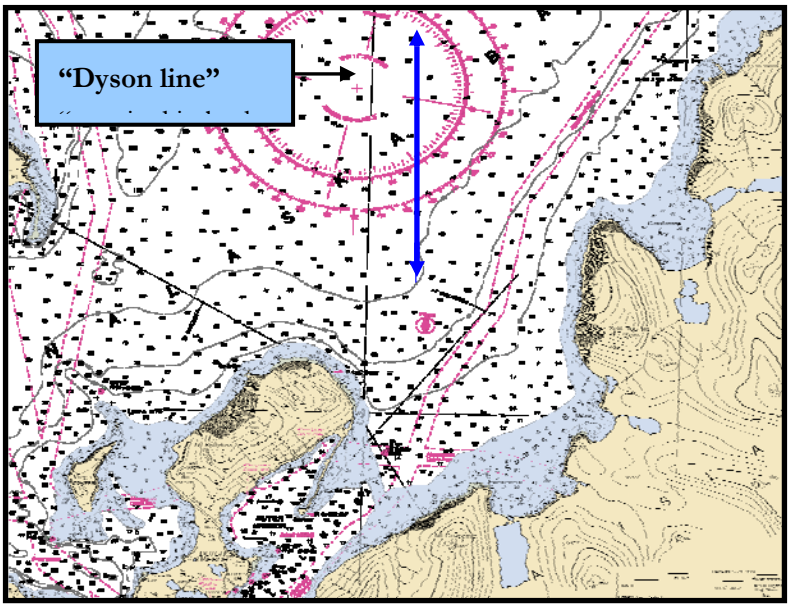

Figure 4. Location of the *Oscar Dyson* line surveyed by *Fairweather*.

Evaluation of skeg-mounted USBL transceiver

Performance characteristics of the USBL system were investigated during the return transit to Dutch Harbor. The USBL transceiver had previously been mounted on a pole that was temporarily attached to *Fairweather*. In response to a structural failure of the mounting pole during the 2008 FISHPAC cruise, the USBL transceiver on *Fairweather* was moved to the skeg of the vessel during the winter repair period. Some significant deficiencies were noted during the investigation and additional testing of the hull-mounted transceiver is needed. In general, system performance was inadequate at lower vessel speeds and shorter laybacks. The hull-mounted configuration did, however, provide acceptable positioning of the SEABOSS device while *Fairweather* was holding station during the regular cruise.

Scientific Personnel

AFSC RACE, Seattle, WA
Bob McConnaughey – Chief Scientist
Cynthia Yeung
Meghan McGovern
Steve Intelmann
Keith Smith
Steve Syrjala

Acknowledgements

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For further information, contact Russ Nelson, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA 98115-6349. Telephone (206) 526-4170.