Low-cost multibeam mapping to support habitat based groundfish assessment and deepwater coral research in the Gulf of Alaska

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Research Priority: Seafloor mapping

Justification: Many of the scientific activities conducted by the Alaska Fisheries Science Center Science Plan are directed towards 1) maintaining and improving assessments of fish and crab species, and 2) assessing the role of habitats in supporting healthy ecosystems. The seafloor mapping research we propose here supports both these Center goals, and addresses several of the NOAA Essential Fish Habitat (EFH) research themes in the Gulf of Alaska (GOA). Our proposed work to develop maps of GOA seafloor characteristics addresses the EFH Habitat Characterization research theme to "census and map habitat features including offshore habitats." Results of our proposed mapping work take the critical first step needed to address other EFH research themes such as EFH Utilization, EFH Productivity, and EFH Recovery Rates, which all require baseline information that describes fundamental habitat features of these critically important areas of interest. Thus, this proposed low-cost seafloor mapping project will supply critical baseline information, which is needed to design and conduct other important EFH process-related research work in the GOA in the future.

Assessments of rockfish and other groundfish species in Alaskan waters rely on standardized surveys (acoustic, bottom trawl and longline) to provide the data for fishery-independent estimates of relative abundance. The bottom trawl surveys in particular follow a stratified random sampling design. A problem for the accurate estimation of groundfish biomass using these surveys is the unknown (but presumed significant) amount of the continental shelf that is rocky habitat and consequently not fishable with the survey trawl (Cordue 2007). There is considerable evidence that untrawlable habitats can have different species assemblages and abundances than trawlable areas (Matthews and Richards, 1991; Jagielo et al. 2003, Rooper et al. 2007). Bottom trawl survey biomass is estimated by expanding catch per unit effort data across entire strata regardless of the proportion of untrawlable ground within strata (Wakabayashi et al. 1985). Non-uniform distributions in habitat and fish abundance can have a significant effect on the accuracy and precision of bottom trawl survey biomass estimates for some species of rockfish (Cordue 2007). Thus, there is a need for low-cost methods to map rocky habitats and untrawlable areas to enable habitat-based estimation of abundances, which will improve assessments for groundfish species (particularly rockfishes).

In addition, beginning in FY2012 the Alaska Region is expected to receive three years of funding for deep-sea coral research and assessment. These deepwater coral and sponge ecosystems (DCSEs) are important habitats for juvenile fishes and are potentially vulnerable to commercial fishing, oil exploration and other anthropogenic activities. One of the primary objectives of this coral and sponge program will be to determine the distribution of deepwater corals and sponges throughout Alaska and assess their role as habitat in supporting groundfish species. Past work has used biological and bathymetric characteristics to model where corals and sponges may

occur (Heifetz et al. 2007, Woodby et al. 2009). Accurate seafloor bathymetry and substrate classification is vital to determine the distribution of DCSEs, and multibeam mapping is needed to produce these bathymetry maps. Of course, substantial mapping support at low-cost will be required to accomplish the goal of assessing the role of DCSEs in support of healthy ecosystems.

Although the proposed research will ultimately support stock assessment activities, it has been submitted to the EFH program RFP call because of the wide application of seafloor maps in habitat research. The proposed project has specific goals of both improving fish assessments and determining the role of habitat in supporting healthy ecosystems and fish populations by generating maps of the seafloor to 1) estimate the amount of untrawlable habitat within the survey area (and ultimately, the associated biomass of fishes and invertebrates), and 2) identify regions likely to contain DCSEs (and subsequently their vulnerability to anthropogenic activities). Additionally, the development of a sampling protocol for low-cost mapping aboard the vessel of opportunity proposed here will be invaluable to subsequent habitat studies in the Gulf of Alaska.

Project Description: This large-scale field study will map the seafloor using the Simrad ME70 multibeam echosounder aboard the NOAA ship *Oscar Dyson* during the summer 2011 MACE acoustic-trawl survey of the GOA. The multibeam data will be analyzed to discriminate areas of different depth, slope, roughness and hardness in the GOA. The methods and analysis tools developed during the project will lay the groundwork for additional "opportunistic" ME70 data collections with the *Oscar Dyson* while the vessel is involved in various survey and research activities in the GOA in the future.

Mapping fieldwork: Simrad ME70 multibeam mapping data will be collected aboard the NOAA ship *Oscar Dyson* during the GOA-wide biennial acoustic-trawl survey planned for June – August, 2011 (Fig. 1). The system will be calibrated immediately before and after the survey. The *Oscar Dyson* will conduct the acoustic-trawl survey for walleye pollock and other dominant scatterers over the entire continental shelf from about the Islands of Four Mountains (170º W) to Yakutat (140º W) over a predetermined trackline. The uniformly-spaced parallel transects will be 20-nmi apart, except in several areas where transects will be more closely spaced (e.g., Shelikof Strait, the east side of Kodiak Island, Yakutat Trough). Researchers will collect

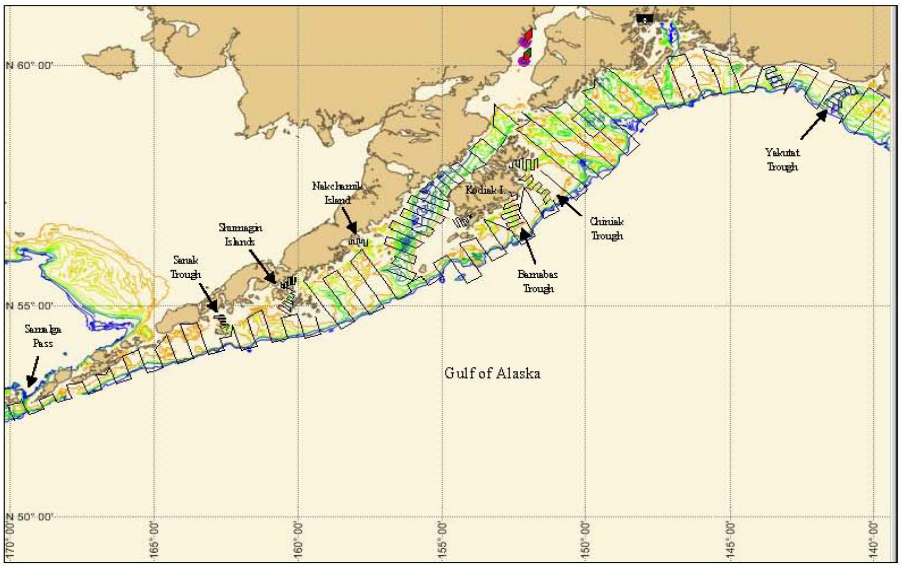

Figure 1.—Typical trackline for the summer Gulf of Alaska echo integration-trawl survey.

both water column and seafloor ME70 data along the predetermined trackline during the survey. In addition, and as time permits, ME70 fine-scale surveys (see below) will be conducted in two situations. First, these surveys will occur over localized areas where seafloor information has been previously collected with other devices (e.g., cameras, submersibles, bottom grab samples) to provide independent seafloor observations to ground truth ME70-based seafloor descriptions in these areas. Secondly, opportunistic, fine-scale ME70 surveys will also target localized areas having no ground truth sea floor data but which are suspected of being untrawlable (e.g., high relief, DCSEs) or characterized by some other unique habitat features (e.g., trough, canyon, bank) based on historical information from AFSC Groundfish surveys. Stereo camera deployments to characterize the sea floor for comparison with ME70 data will be conducted in these latter areas.

Ground truthing seafloor characteristics: Prior to the summer 2011 fieldwork, an assessment of available video and bottom trawl GOA survey data will be summarized to help ground truth the ME70 multibeam maps that will be generated from the summer 2011 acoustic-trawl survey data. The ground truth data summary is scheduled to be completed in spring 2011 by J. Heifetz, B. Stone and C. Rooper. This ground truth data summary will be completed as a part of the DCSE program, and will identify important areas of the GOA where multibeam data could be collected during the summer 2011 survey with matching ground truth data.

Fine-scale sampling at ground truth sites: In addition to the large-scale summer 2011 acoustic survey mapping effort along survey tracklines, fine-scale sampling with the ME70 will be conducted in 1) areas where ground truth data are available, and 2) where historical bottom trawl survey information identifies locations of unique and varied sea floor habitat types to "test" the capabilities of the ME70 to properly characterize the sea floor. In the latter areas where ground truth data are not available to compare with the ME70 data, a lowered stereo camera system (similar to that described in Williams et al. 2010) will be used to provide this information. (The camera data may also document the presence of animals associated with these habitats – see RACE companion project below). Fine-scale sampling will be conducted at ~15-20 sites in the GOA with camera drops planned for about half of the sites. About 1-2 hrs is allocated to complete each fine-scale ME70 mapping survey and 2-4 hrs for the 1-3 camera drops planned at each of the non-ground truth area sites.

Data analysis: Simrad ME70 multibeam acoustic data will be analyzed to determine seafloor characteristics including depth, slope, hardness and roughness of the seafloor. This analysis will be completed both for the large-scale GOA survey trackline and the fine-scale surveys.

The stereo drop camera will be used to groundtruth the substrate type. Substrate types will be estimated using the methodology of Stein et al. (1992) and Yoklavich et al. (2000).

The statistical approach will be to conduct a large-scale survey of the Gulf of Alaska with region-wide coverage. The relationships between multibeam derived seafloor characteristics and substrate type observed at both the existing ground truth sites and fine-scale sites that will be ground truthed during the 2011 survey (i.e., camera drops) will allow for a gulf-wide estimation of seafloor characteristics over the large-scale survey. The multiple ground truth sites will provide replication for the analyses.

As part of a closely-related companion project supported by RACE, fish and invertebrate counts and species identifications will be determined at each of the camera sites. Calibrated stereo image capabilities of the drop camera will also be used to measure fish length and determine the life history stage for each fish species (Williams et al. 2010). Simrad EK60 data collected during mini-surveys will also be used to estimate abundance of major scatterers in these areas, using standard acoustic survey methods (Simmonds and MacLennan 2005). With this information, species and densities of fish observed at the ground truth sites will be compared to those caught in the summer 2011 GOA bottom trawl survey and other available video studies (such as those conducted at boulder fields in the "Snakehead" area).

Required Resources: The expenses for this project will be heavily leveraged by AFSC and UNH supported activities planned for 2011. A post-doctoral researcher at UNH will conduct the majority of the seafloor characterization data analysis and will participate on the MACE summer 2011 GOA acoustic-trawl survey to assist with all aspects of the field data collections (e.g., acoustic, video). This post-doctoral researcher will be partially supported by UNH. The mapping data and samples will be collected at minimal cost from a survey of opportunity aboard the *Oscar Dyson* using existing acoustic equipment. Funding to construct the stereo video drop camera was provided by previous EFH and Advanced Sampling Technology Working Group proposals (in 2008 and 2009). Additional ground truth sampling can be conducted if needed from RACE 2011 Gulf of Alaska bottom trawl survey vessels. Thus, the resources required for the successful completion of the project will be minimal.

The resources required to complete the field portion of this project will limited to equipment and supplies to support maintenance of the stereo drop camera (including supplies and upgrades of image acquisition hardware and lighting = $2,000), software license for multibeam data analysis ($10,000), ME70 calibration downriggers ($3,500), travel ($5,000) and shipping of equipment to Dutch Harbor for the cruise ($1,900). Partial funding of the post-doctoral researcher and salary for T. Weber will also be needed ($45,000). The total necessary monetary resources will be $67,400.

Expected Products: In early FY13, we expect that a final project report and manuscript for peer-reviewed journal will be prepared describing the results of this study. A protocol for continuing collection of ME70 multibeam data aboard the *Oscar Dyson* will be developed and used by future survey and research activities in the GOA. Maps of the distribution of seafloor characteristics will also be produced and made available to managers and stock assessment scientists.

References:

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Status Report: NA

Budget
Low-cost Multibeam Mapping

Object Class	Description	Amount ($)
1100	Direct Labor:	
1150	Overtime and Hazard Pay	
1200	Benefits:	
2100	Travel	5000
2200	Transportation	1900
2300	Rents et al.	
2400	Printing	
2500	Contracts: University of New Hampshire	45000
2600	Supplies and Materials:	300
3100	Equipment: Drop camera upgrades	1700
	ME70 Downriggers	3500
	ME70 Software	10000
4100	Grants	
	Total	67400