Maine Outdoor Heritage Fund Final Report
151-01-07
Benthic habitat characterization of Maine's coastal waters

Project summary

Between May 2015 and March 2017, the Maine Coastal Program's Maine Coastal Mapping Initiative (MCMI) collected hydrographic and biological data that was used for habitat classification with the federally-approved Coastal and Marine Ecological Classification Standard (CMECS). These data included physical, biological, and geological characteristics of the seafloor and the overlying water column (e.g. bathymetry, sediment grain size, benthic infaunal community composition, marine mammal and bird sightings, water temperature, salinity, dissolved oxygen, and fluorescence). Data were collected in Midcoast Maine coastal waters to classify benthic marine habitat at 126 locations within the 137 mi^2 of coastal seafloor mapped by the MCMI in 2015 and 2016 (Photo 1). The 2015 data (72 samples) were statistically analyzed to investigate relationships between the physical environmental factors and biologic assemblages encountered across the seafloor in Midcoast Maine. The samples collected in 2016 are currently being analyzed following the methods tested for the 2015 samples. With further evaluation, MCMI will develop potential habitat maps that delineate the major habitat types determined through habitat classification efforts for the entire area of seafloor surveyed by the MCMI with multibeam sonar. The collection of data for the habitat classification would not have been possible without the support of MOHF, which enabled us to purchase a high-quality water quality data sonde. With this sonde, we were able to begin collecting all the data necessary to classify our sites within CMECS and to create habitat models and spatial models. The MOHF grant also enabled dedicated staff time for this project.

Project outcomes

1. Develop sampling plans to characterize the variety of coastal habitats in Maine.

The MCMI crew collected data on water column characteristics (temperature, salinity, dissolved oxygen, and chlorophyll concentrations) with the support of MOHF funding, as well as seafloor type and structure, infaunal organism community composition, and marine mammal and avian sightings using newly adopted sampling plans that detailed the procedures for each of these sampling methodologies. All sampling plans are available from MCP upon request. These include:

- Benthic Sampling Protocol, completed May 2015 and tested/adopted during field collections May 2015-November 2016,
- Infaunal Analysis Protocol, completed March 2016 and tested/adopted during lab analysis spring 2016,
- Video Processing Analysis Protocol for identifying and quantifying benthic epifauna, completed April 2016 and tested/adopted during lab analysis fall 2016 and winter 2017,
- Multibeam Survey Daily Operation Procedure, completed April 2016 and tested/adopted April-October 2016,
- Sediment Analysis Standard Operating Procedure, completed September 2016 and tested/adopted September-December 2016,
- Marine Mammal and Avian Observation Protocol, draft form completed July 2016, tested July-October 2016, currently in revisions.

2. Pilot the use of CMECS to characterize habitat in Maine's coastal waters.
A contracted benthic specialist, assisted by a student intern, incorporated biological, physical, and geological data collected and processed by the MCMI between 2013 and 2015 into CMECS, completing the task in November 2016. A final report is available from MCP upon request.

3. Test the utility of statistical software (e.g. PRIMER) to investigate relationships between benthic communities and their environments to enable habitat predictions statewide where limited data are available.
The benthic specialist determined that PRIMER statistical software would provide the needed statistical capacity to analyze marine and benthic habitat information in order to inform habitat classification models and spatial maps. This software was purchased in December 2016 using matching funds.

4. Generate biological and geological data layers and publish them via the Maine Coastal Atlas website.
Starting in 2015, MCMI was able to collect additional data using more advanced water quality monitoring equipment, purchased with the help of MOHF monies and other funding resources. This enabled the creation of vertical profiles for additional water quality parameters, including pH, dissolved oxygen and chlorophyll concentration for 41 of the 72 sites sampled in 2015 and all sites sampled in 2016. Infauna and epifaunal benthic communities were also described for the majority of sites.

A map compendium was created from hydrographic and benthic sampling surveys completed by the MCMI in 2015. Data products include digital maps of 80mi^2 of coverage for seafloor bathymetry (meters, MLLW), backscatter intensity (indicates nature of seafloor), seafloor textural classification (sediment type), and a point dataset of the 72 sampling site locations within the surveyed area. Maps showing collected bathymetry and backscatter with locations of benthic samples overlain (Figures 1 and 2) have been uploaded to the Maine Coastal Atlas Data Repository (http://www.mainecoastalatlas.org/layers/) where they may be downloaded. Similar products are now being completed for data collected in 2016.

5. Generate maps of known and predicted habitat and publish them via the Maine Coastal Atlas website.
The benthic specialist used the water column, benthic community, and bathymetric data collected in 2015 to develop a predictive model for habitat classifications. Because the majority of samples taken in 2015 were in deeper waters, the model may be skewed towards deeper biological communities. We are currently completing analysis of 2016 samples collected from shallower waters in the same ecoregion, and will incorporate these results into the model before creating predictive habitat maps. These layers will then be assimilated in ArcGIS to create a seamless mosaic of known and predicted habitat type statewide. These maps will be shared publically via the Maine Coastal Atlas.

Brief Summary of Project for use in MOHF newsletter and/or Facebook posts
With the support of MOHF and our other funding agencies, the Maine Coastal Program's Maine Coastal Mapping Initiative (MCMI) collected high-quality water quality data and benthic habitat information that allow us to better understand our marine environment and its biological

communities. The project also produced high resolution maps of bathymetry and substrate for 137 mi^2 of seafloor from hydrographic surveys conducted in coastal Midcoast Maine in 2015 and 2016. With this information, the MCMI has created maps of potential benthic marine habitat for the surveyed region. These bathymetric and habitat data have important applications for efficient offshore permitting, enhanced coastal resiliency, and informed regional ocean planning.

Detailed Accounting

The MOHF grant provided the funding to purchase our Exo 1, state of the art water quality monitoring sonde, and supported the part-time work of the MCMI's student benthic assistant, Samantha Garvey, who assisted with benthic sampling operations, infauna sample preservation and analysis.

| 1. **Funding Description:**	**MOHF** **Request**		**Cash Secured** **Source #1:**		**Cash Secured** **Source #2:**			**Total** **Budget**
			MCP Federal		NOAA POSM			
2. Personnel Expenses:								
Salary & Benefits	$0		$1,500		$0			**$1,500**
3. Other Expenses:								
Contractual Services	$1,413		$8,087		$25,000			**$34,500**
Supplies PRIMER Software	$0		$750		$0			**$750**
Total Other Expenses:	**$1,413**		**$8,837**		**$25,000**			$35,250
4. Capital/Land Acquisition								
(Equipment GT $5,000 or Land)								
Exo 1 Water Quality Sonde	$12,874.00							**$12,874**
5. **Subtotal**	**$14,287**		**$10,337**		**$25,000**			**$49,624**
6. Indirect Costs *(Rate: 18.53%)*	18.53%		18.53%		18.53%			
StaCap/DiCap or Other	**$262**		**$1,916**		**$4,633**			**$6,811**
7. Total Budget	**$14,549**		**$12,253**		**$29,633**			**$56,435**
MATCH SOURCES - MCP Annual Federal NOAA CZM Grant, NOAA Project of Special Merit **DESCRIPTION** – Source #1: Salary - MCP Assistand Director, Contractual Services - Marine mammal/avian Observer Internship and Benthic Intern; Source #2: Contractual Services - Benthic Ecologist								
MATCH PROVIDED:								
Cash In Hand:		74%	Match Met					
Total Cash:		74%	Match Met					
Cash & In Kind:		74%	Match Met					

Communications

Reports detailing the MCMI data collected in 2015 have been completed and 2016 reports are in progress. Several presentations were made for the program - presentation and report outputs are listed below. The Maine Coastal Program is also currently working to format existing data products for distribution through the Maine Coastal Atlas and the Northeast Ocean Data Portal.

List of reports and presentations:

Dobbs, K. 2017. High-resolution textural mapping of the inner/outer continental shelf: Cape Small to Cape Newagen, Maine. Maine Coastal Mapping Initiative, Maine Coastal Program, Augusta, ME. (technical report in progress)

Dobbs, K., 2017. 2016 Descriptive report for seafloor mapping: Mid-coast Maine. Maine Coastal Mapping Initiative, Maine Coastal Program, Augusta, ME. January 2017. 86p. (technical report)

Dobbs, K., 2017. 2016 Seafloor sediment analysis and mapping: Mid-coast Maine. Maine Coastal Mapping Initiative, Maine Coastal Program, Augusta, ME. 119 p. (technical report)

Dobbs, K., 2016. 2015 Seafloor sediment analysis and mapping: Mid-coast Maine. Maine Coastal Mapping Initiative, Maine Coastal Program, Augusta, ME. 22 p. (technical report)

Dobbs, K., 2016. 2015 Descriptive report for seafloor mapping: Mid-coast Maine. Maine Coastal Mapping Initiative, Maine Coastal Program, Augusta, ME. 45 p. (technical report)

Ozmon, I., 2016. Maine Coastal Mapping Initiative benthic infauna analyses and habitat classification in Mid-coast Maine. Maine Coastal Program, Augusta, ME. (technical report in progress)

Dobbs, K. Characterizing sand and gravel deposits using multibeam sonar in the Gulf of Maine. American Shore and Beach Preservation Association 90th Anniversary National Coastal Conference. October 28th, 2016. (oral presentation)

Dobbs, K., Ozmon, I., Norton, E., and M. Nixon. Maine Coastal Mapping Initiative progress update: Applications and utilization of high resolution multibeam echosounder data. Southern Maine Community College, Marine Technology course invitational lecture. South Portland. November 6, 2015. (oral presentation)

Dobbs, K.. Maine Coastal Mapping Initiative progress update: Applications and utilization of high resolution multibeam echosounder data. Maine Geological Survey Annual Meeting. Augusta, ME. November 11, 2015. (oral presentation)

Norton, E., Dobbs, K., Ozmon, I., and M. Nixon. Under the sea: Exploring submerged geologic features using multibeam sonar. Maine Geological Society Annual Meeting. Augusta, ME. November 11, 2015. (poster presentation)

Nixon, M., and E. Norton. Mapping Maine's seafloor: Maine Coastal Mapping Initiative. Port Safety Forum. Portland, ME. December 16, 2015. (oral presentation)

Figures and Photographs

Photographs
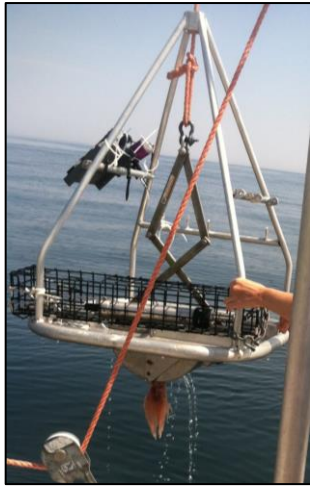
The MCMI grab sampling platform is retrieved from deployment to the seafloor. The sampler collects seafloor sediment and infauna samples, measures a variety of water quality parameters through the water column, and records underwater video with the use of a GoPro camera in waterproof housing, a dive light and two dive lasers, spaced 10cm apart for scale. These data are combined with information from our multibeam data products to generate habitat classifications for all sampling sites.

The 2016 Maine Coastal Mapping Initiative team includes Kerby Dobbs (project hydrographer), Ivy Ozmon (benthic ecologist), Ethan Barkalow (marine mammal and avian observer), Samantha Garvey (observer and benthic technician), Katelyn Doughty (marine mammal and avian observer), and Caleb Hodgdon (vessel owner and captain). The Kongsberg EM2040C multibeam sonar, GPS antennae, and inertial reference unit are pole-mounted on the bow of the boat.

The Maine Coastal Mapping Initiative benthic ecologist, Ivy Ozmon, readies the sediment sampling apparatus for seafloor sampling. A Ponar dredge takes a sediment sample that is processed in the lab.


Maine Coastal Mapping Initiative project hydrographer, Kerby Dobbs, presents information about bathymetric mapping, backscatter data collection and interpretation, and sand reserves in the submerged Kennebec paleodelta to participants in the New England Intercollegiate Geological Conference at Popham Beach, Phippsburg, ME.
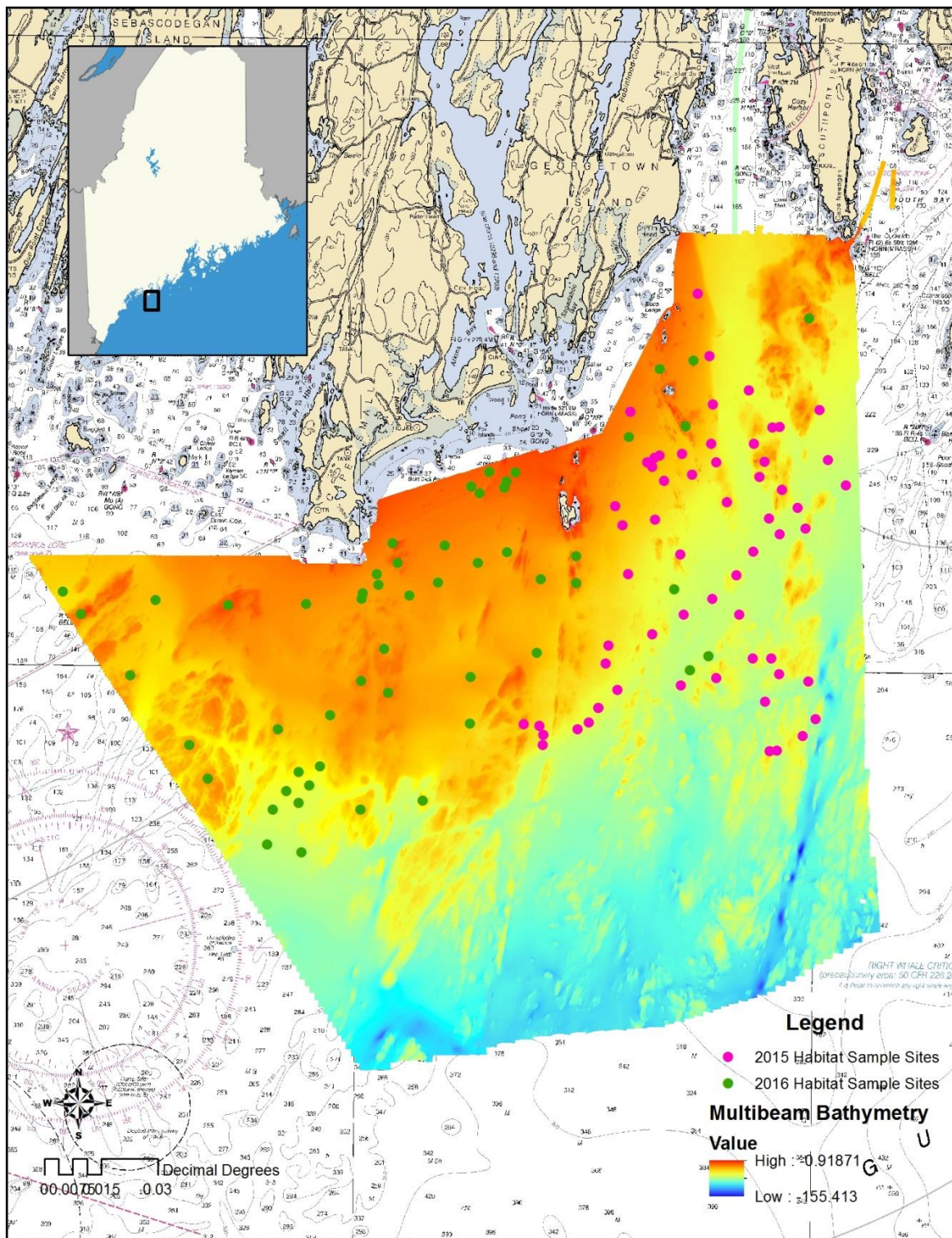
Figure 1. MCMI collected ~ 137 mi^2 of high resolution bathymetric data (meters; 4m grid resolution) off of Mid-coast Maine in 2015 and 2016 with water column and benthic habitat sampling locations.
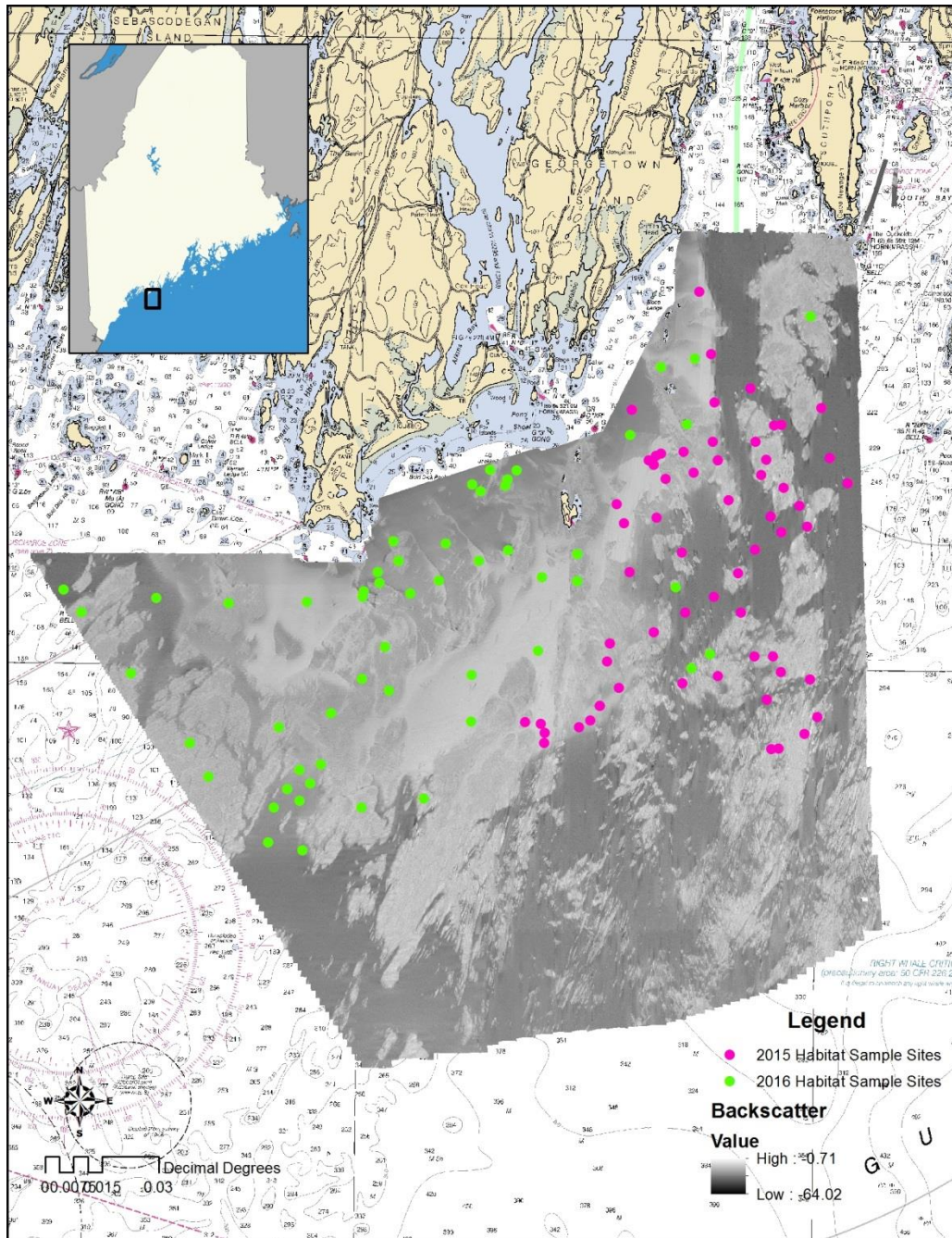
Figure 2. Water column and benthic sampling locations are plotted over the backscatter intensity map (decibels; 4m grid resolution) that indicates the relative hardness of the seafloor. High backscatter (lighter shading) is indicative of harder substrates like rock, cobble and gravel, and low backscatter (darker shading) indicates the presence of softer sediments, like mud.