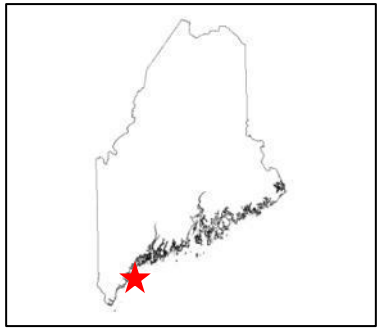
Geologic Site of the Month

April, 2015

Maine Coastal Mapping Initiative: An examination of gravelly and sandy benthic environments off the southern Maine coast



43° 18’ 25” N, 70° 20’ 00” W

by
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Introduction

Much of the data collected to produce marine depth maps in Maine coastal waters was collected at low resolution and much of the region has no high resolution data. Accurate depth mapping is a high priority for improving the effectiveness of the State's coastal management strategies. In 2012, the Maine Coastal Program (MCP) began the Maine Coastal Mapping Initiative (MCMI) to address this need. The data will improve regional ocean planning, coastal resource management, maritime navigation and offshore economic development (MCMI 2015).

Bathymetry is the depth at different locations. It is analogous to topography in a terrestrial environment and can be used to map the shape of the seafloor. Backscatter indicates the relative hardness of the substrate and it is used to approximate the composition of the seafloor (i.e. whether it is mud, sand, gravel, and/or bedrock). In addition to characterizing bathymetry and benthic surficial sediments, the MCMI aims to classify benthic habitat types using the Coastal and Marine Ecological Classification Standard (CMECS; FGDC, 2012), and to model and map the distribution of habitat in Maine's nearshore environment. Since benthic communities are determined predominantly by substrate type, it is possible to model benthic habitat using bathymetric and substrate classifications as model inputs (Brown and Collier, 2008).

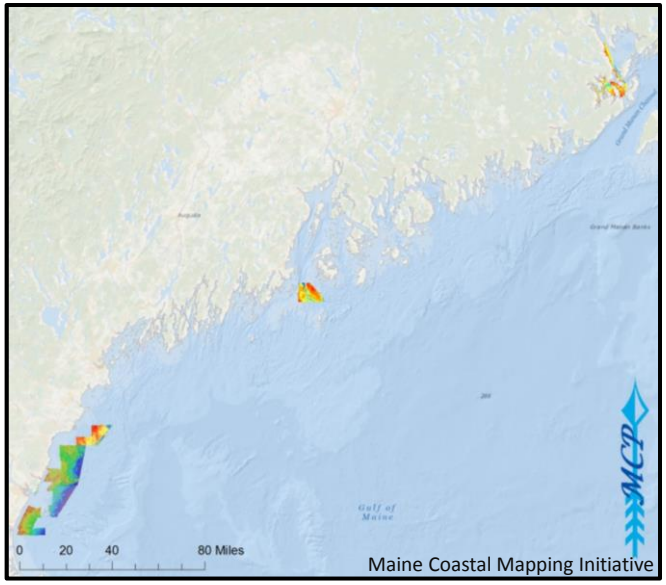

Figure 1. Map showing the few small areas along the Coast of Maine where there is high resolution bathymetric survey work.

Study Area

In 2014 approximately 40 mi^2 of bathymetry and backscatter data were collected off of Kennebunkport. 67 sites within the surveyed area had samples of the sea floor collected to verify the backscatter data and identify sediment types.

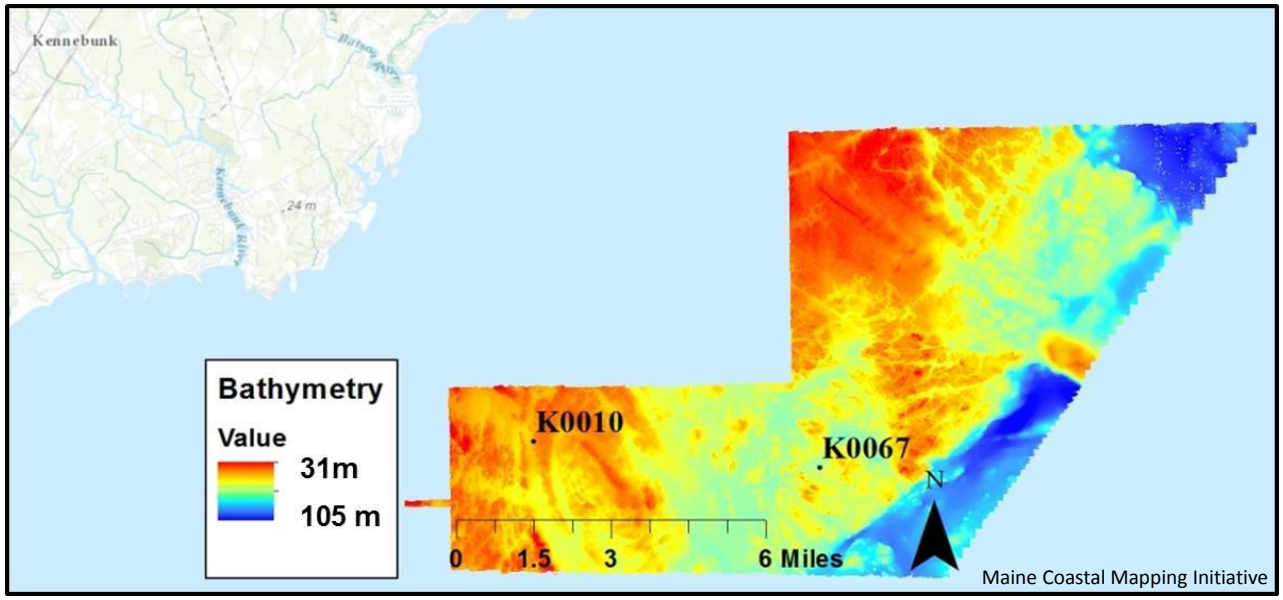

Figure 2. A bathymetric mosaic created by the Maine Coastal Mapping Initiative offshore of Kennebunkport, Maine. Two of the backscatter data ground-truth sample site locations are shown (K0010 and K0067).

Seafloor Data Collection

The multibeam sonar used for this study, a Kongsberg EM 2040C multibeam echosounder, was mounted on the bow of the R/V Amy Gale. The sonar system maps bathymetry using sound waves bounced off the sea floor. Benthic substrate was interpreted using backscatter data and sediment samples. High backscatter indicates the presence of softer sediments like sand, silt and clay. Low backscatter indicates the presence of harder substrates like bedrock, boulders and cobble. Sediment grain-size analyses of grab samples verify the substrate determinations made from interpretation of the multibeam surveys after processing the sonar backscatter data. Data processing involves incorporation of the hydrographic data with data measured in the water column (acoustic sound velocities) and location data derived from advanced GPS positioning (MCMI 2015).

Figure 3. MCMI Primary Survey Vessel, R/V Amy Gale, with bow-mounted sonar.

Study Site Ground Truthing

Underwater video was recorded with a GoPro camera to image the seafloor at multiple locations. Sediment grab samples were collected with a 0.05 m^2 Ponar grab sampler. Together, this information provided ground-truth data to compliment the sonar data.

Sediment analyses of the grab samples included the determination of gravel, sand and mud components (Folk, 1954), sand sorting and size distributions (Wentworth, 1922), in addition to descriptions of sediment color (Stanley, 1969). These data were necessary to make identifications of viable sand resources for beach nourishment projects and for predicting the types of biological communities likely supported by these environments (Brown and Collier, 2008).

To understand the biological community living in the sediment, grab samples were washed through a 1 mm sieve to isolate the infauna at each site. Organisms were identified and biomass measurements were taken to quantify biodiversity.

A review of results follows for the two ground truth sites shown in Figure 2:

- K0010 - a relatively gravelly site located 58.6 meters below the sea surface (43.3107°N, 70.3923°W)
- K0067 - a deeper site at 71.5 m below the surface dominated by sand (43.3053°N, 70.3122°W)

Site K0010: Sediment Results from a Gravelly Benthic Environment

By looking at the still image of the underwater video footage taken at the moment the camera impacts the seafloor, bottom substrate appears to be dominated by the mud size fraction. However, sediment analyses of the grab sample determined that gravel was the most abundant component of the sediment, followed by mud and sand. Sediments at this site were determined to be olive gray in color, containing moderately sorted medium sand.

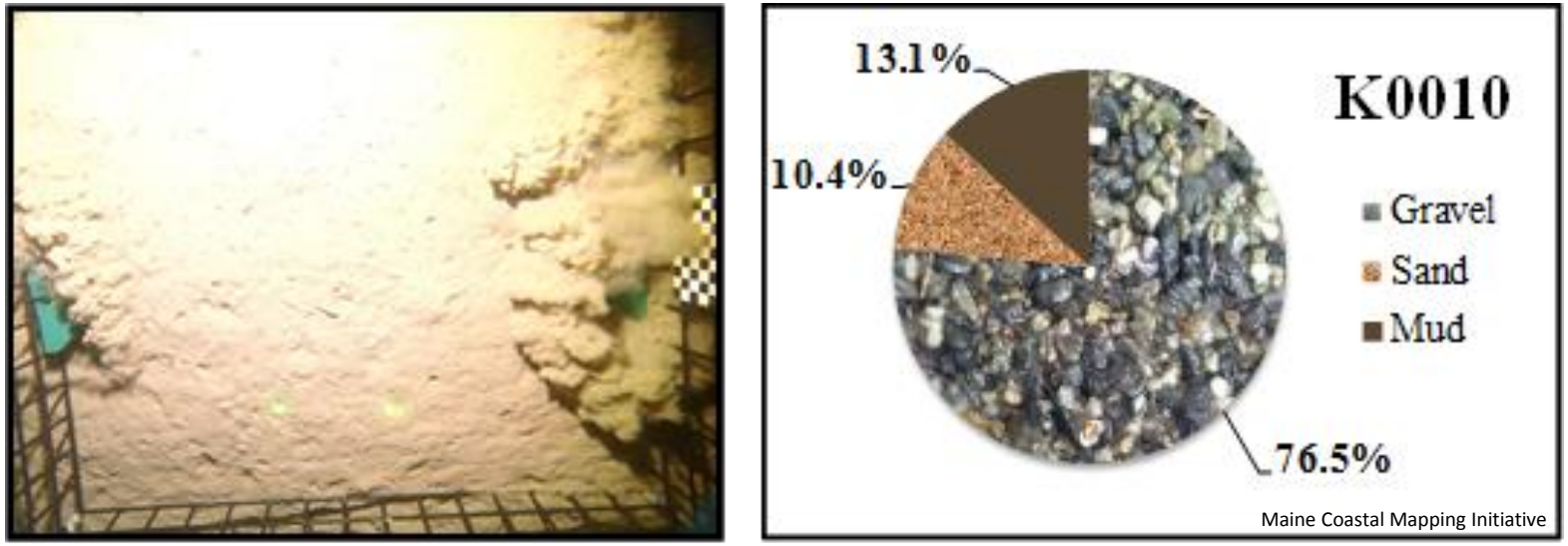

Figure 4. A still image (left) of the sea floor sediments. Sediment analysis results (right) of the grab sample.

Site K0010: Habitat Classification, Infauna and Epifauna Inhabitants

Using standardized classification language from CMECS, this muddy, sandy, gravel benthic site is classified as one that provides habitat for a soft sediment faunal bed dominated by *Arctica islandica* of the megafauna size class.

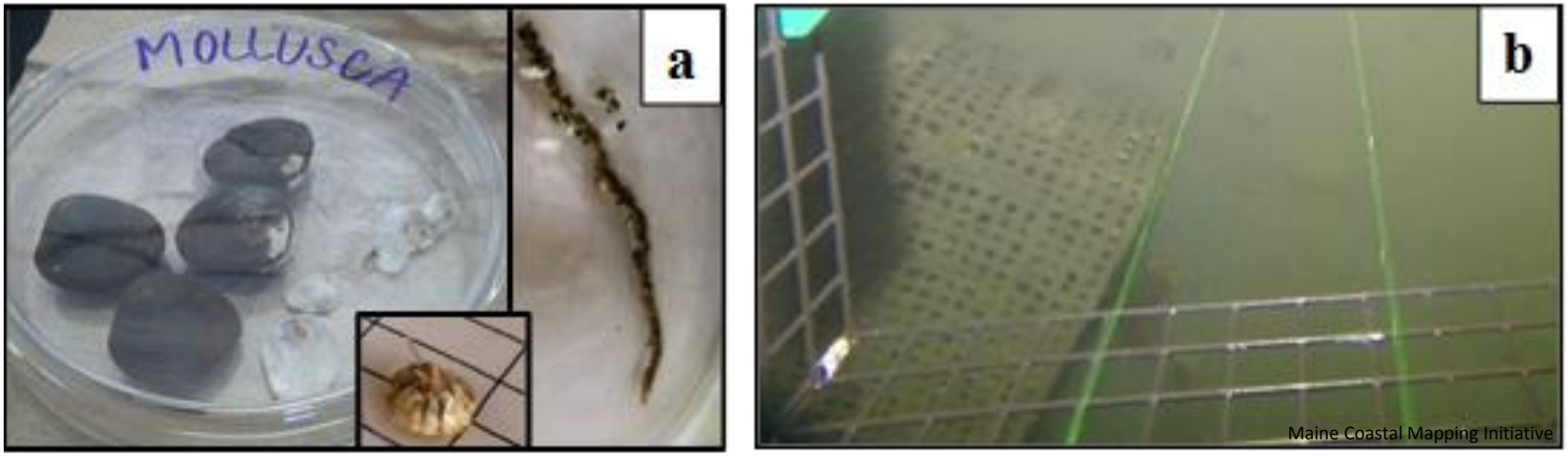

Figure 5. Infauna (a) and epifauna and debris (b) found at site K0010. Two types of bivalves, the ocean quahog, *Arctica islandica* (dark shells, (a), left), and Lea's spoon shells, *Periploma leanum* (white shells, (a), left), were recovered in the grab sample, along with a northern rock barnacle (*Balanus balanoides*, (a), center, inset) and one sedentary marine polychaete worm (inside of a sand and gravel encrusted tube, (a), right). A ghost lobster trap and lobster were observed on the underwater video (b), indicating that this site provides habitat for lobster as well.

Site K0067: Sediment Results from a Sandy Benthic Environment

Sand comprised the most abundant fraction of the sediment at this site, followed by mud and gravel. The sediment sample was olive in color, containing moderately sorted medium sand.

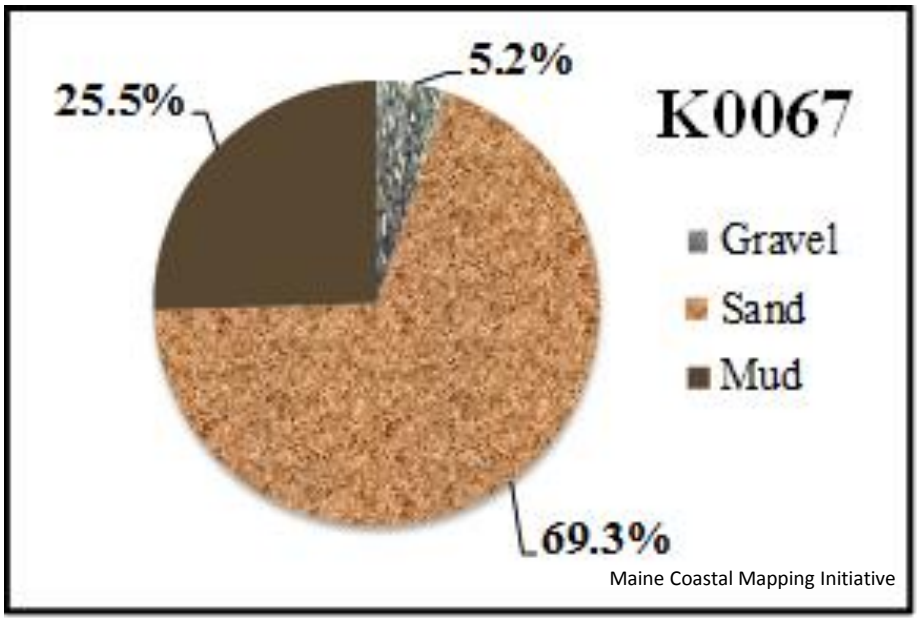

Figure 6. Sediment analysis results of the grab sample.

Site K0067: Habitat Classification and Infaunal Inhabitats

This site is classified within CMECS as a muddy sand benthic site providing habitat to a soft sediment faunal bed dominated by polychaete worms of the small macrofauna size class.

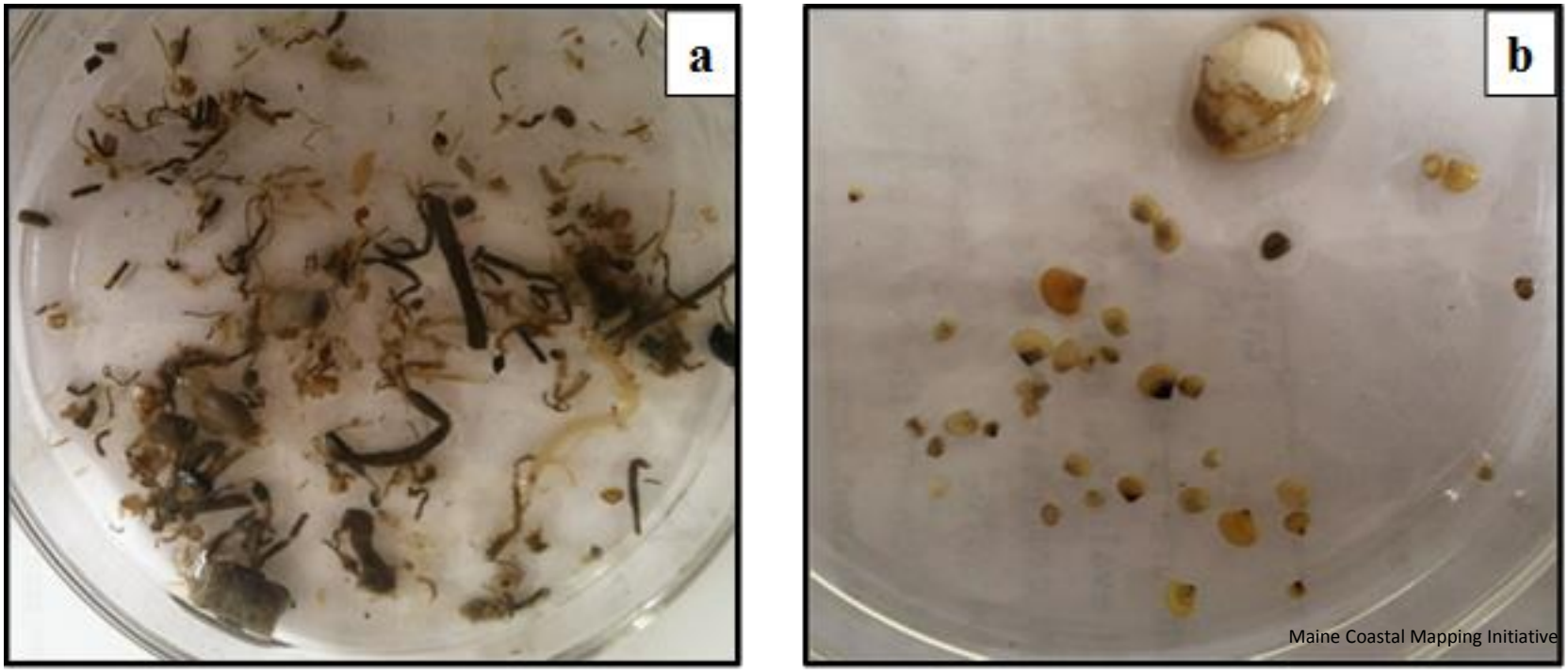

Figure 7. Infauna recovered at site K0067. Over five different polychaete species from the phylum Annelida dominated the infauna collected at this site (a). Co-occurring organisms in this location included many species of clam (b), smaller in size than those found at site K0010 and a few juvenile daisy brittle stars (*Ophiopholis aculeta*, not pictured).

Bathymetry and Backscatter Results: Comparison Between Sites

Bathymetry and backscatter observations are in agreement with ground-truthing data obtained from the two sites. The bathymetry data (a and c) reflect the relative difference in depth between the two sites; site K0010 is located in a shallower region than site K0067. Sediment analyses of grab samples from the sites indicated a gravel-dominated substrate for site K0010 and a sand-dominated substrate for K0067. The backscatter data (b and d) show K0010 is located on a relatively harder substrate (high backscatter) and K0067 is located on a relatively softer substrate (lower backscatter).

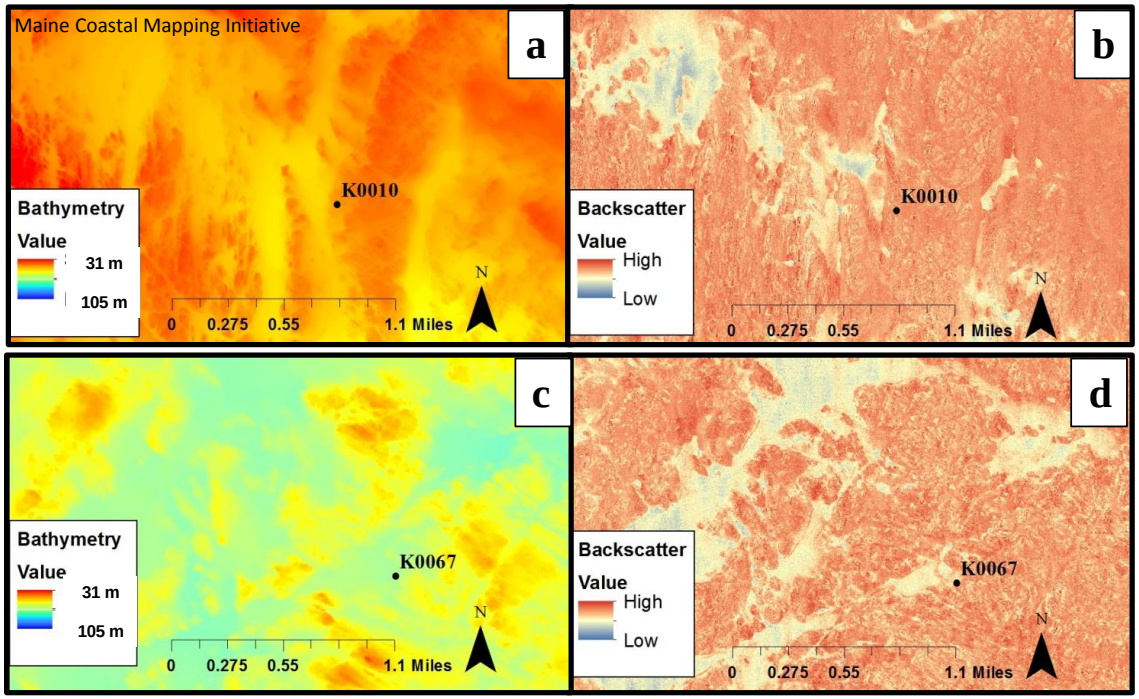

Figure 8. Bathymetric (a and c) and backscatter (b and d) maps produced from hydrographic surveys of the area surrounding the two sites of interest.

Next Steps

- Quantitative geophysical follow-up studies may be conducted by the Bureau of Ocean Energy Management (BOEM) at the locations where sandy surficial sediments were found to evaluate the volume of sand resources available for beach nourishment purposes. As a result, coastal resiliency in Maine will improve with regard to preparations for erosional storm events that impact our beaches.
- Storm surge and sea-level rise resiliency planning will also benefit from the improved bathymetric maps created by the MCMI. The Maine Geological Survey (MGS) and many academic partners will use these bathymetric data to improve geology maps of the sea floor.
- NOAA will incorporate the updated, more accurate, bathymetry collected under the MCMI into their nautical charts.
- MCP is actively involved in a regional planning effort through the Northeast Regional Ocean Council (NROC). MCMI data can be integrated into a mosaic of bathymetric data that will be used to conduct ocean planning on a regional scale. Government agencies, such as MCP or the Maine Department of Environmental Protection (MEDEP), will use these data to make better informed permitting and site selection decisions when evaluating the potential for offshore development, avoiding areas where development impacts would adversely affect the marine environment and its inhabitants.
- Bathymetry and backscatter data will be combined with data collected from other grab sampling efforts to classify and model habitat in Maine coastal waters. This habitat classification will help guide planning and management of offshore marine resources.

References and Additional Information

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