Developing habitat classifications and models based on bathymetry, backscatter, and benthic sampling in Maine
Ivy M. Ozmon, Kerby Dobbs, Claire Enterline, and Matthew E. Nixon
Maine Coastal Program, 93 State House Station, Augusta, Maine 04333, Contact: Claire.Enterline@Maine.gov

Introduction

**Project Summary:** A comprehensive understanding of the benthic environment is necessary to effectively manage coastal resources. Historical sidescan and seismic profiles, sediment cores and grab samples have been used to model surficial sediment composition, but there are still large gaps in high resolution bathymetry, and very little is known about benthic biological habitat. The Maine Coastal Mapping Initiative (MCMII) collects bathymetry, backscatter intensity data, and benthic habitat information at distinct focus areas.

**Applications:**
- Characterize sand deposits for beach nourishment
- Improve nautical charts
- Improve accuracy of coastal inundation models
- Classify benthic habitat using the Coastal Marine Ecological Classification Standard (CMECS)

**Methods**
1. High resolution bathymetry and backscatter were collected with a multibeam echosounder (Kongsberg EM 2040c), corrected for boat motion and tidal height.
2. Substrate predictions based on backscatter were ground truthed using underwater video and sediment samples (Ponar grab). Sites were selected using a random stratified design based on depth and assumed substrate type.
3. Habitat classification with CMECS is informed by data on infauna and epifauna communities, grain size analysis, and water column profiles (Figure 1).
4. Seafloor sediment classifications are modeled for the entire mapped area based on grab sample data, backscatter intensity, bathymetry and its derivatives (slope, rugosity).
5. Potential benthic habitat maps will be developed after identifying environmental factors that best explain geographical distribution of biological communities (Bioenv procedure in Vegan package in R 3.2.2).

Our benthic sampling platform simultaneously collects sediment, infauna, video and water column data to ground-truth backscatter data and inform habitat classifications. Samples are sorted on board for later identification.

Results: Hydrographic mapping

**Hydrographic Mapping Key Results:**
- Hydrographic quality data collected for ~180mi²
- Documented canyon extending from the Damariscotta River
- Identification of previously un-mapped ledges and complex bathymetry

### Figure 1. Bathymetry (4m resolution) and grab samples collected offshore of Kennebunkport and Georgetown/ Phippsburg, ME.

### Biological Community Key Results for 2015:
- The majority unconsolidated substrates grab sampled supported diverse communities of soft-sediment infauna, and video footage revealed hydroid colonies and attached or mineral-boring species dominated hard bottom habitat in the surveyed region.
- Deeper offshore habitats were predominantly sampled in 2015.

### Table 1. Biotic and corresponding environmental data (mean ± st dev), N=59

<table>
<thead>
<tr>
<th>Burrowing Anemone</th>
<th>Sponges, Hydroid colonies</th>
<th>Sea Star</th>
<th>Sand Dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8 ± 0.9</td>
<td>12.9 ± 2.2</td>
<td>14.7 ± 1.5</td>
<td>25.1 ± 4.5</td>
</tr>
</tbody>
</table>

Videos are analyzed to identify epifauna and macrofauna to inform habitat classifications.

### Figure 2. Mean backscatter intensity at grab sample sites decreases with decreasing dominate grain size (from rock to mud).

**Habitat Classification Key Results:**
- Backscatter, bathymetric, grain size and other environmental parameter data may be used to develop models to predict benthic habitat using statistical correlations between biological communities and environmental parameters.

### Table 2. Folk identification codes are given with sediment descriptions.

<table>
<thead>
<tr>
<th>Folk Code</th>
<th>Description</th>
<th>% gravel</th>
<th>Sand</th>
<th>Mud</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 R</td>
<td>Rock or Boulders</td>
<td>-</td>
<td>0.0</td>
<td>100.0</td>
<td>8.6</td>
</tr>
<tr>
<td>1 R</td>
<td>Rock or Boulders</td>
<td>-</td>
<td>0.0</td>
<td>100.0</td>
<td>8.6</td>
</tr>
<tr>
<td>1 R</td>
<td>Rock or Boulders</td>
<td>-</td>
<td>0.0</td>
<td>100.0</td>
<td>8.6</td>
</tr>
<tr>
<td>1 R</td>
<td>Rock or Boulders</td>
<td>-</td>
<td>0.0</td>
<td>100.0</td>
<td>8.6</td>
</tr>
<tr>
<td>1 R</td>
<td>Rock or Boulders</td>
<td>-</td>
<td>0.0</td>
<td>100.0</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Acknowledgements
We would like to thank C. Hodgdon, A. Luzzio, S. Eckert, D. Bloch, R. Halinan and E. Shumchenia for assistance in sample and data collection and analysis.

References
Barry et al., 2004. Mapping the Gulf of Maine with Side-Scan Sonar: A New Benthic Type Classification for Complex Substrates. Journal of Coastal Research 11: 398-408.