Mapping Submerged Resources in Ocean, Coastal and Great Lakes Parks

Thom Curdts, GIS & Remote Sensing Specialist
Jeffrey N. Cross, PhD., Chief, Ocean & Coastal Resources Branch

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
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Summary

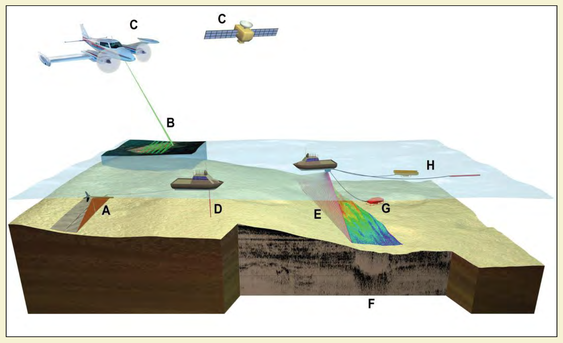
Managers of ocean, coastal and Great Lakes national parks face increasing impacts from coastal development, recreational use, terrestrial pollution, non-native species and climate change. However, park managers have only general knowledge of the nature, extent and condition of submerged resources within their park's boundaries. Unlike terrestrial units, managers of ocean and coastal parks cannot readily observe their resources. The most spectacular topography and geographic features are hidden from casual view and may only be detected by surveys that are technically complex, logistically difficult and expensive, which explains why submerged resources remain unmapped for the majority of these units.

The Ocean and Coastal Resources Branch has partnered with the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA) and several states and universities on benthic mapping projects in 13 parks from diverse areas, including Alaska, California, Great Lakes, Gulf of Mexico, and islands in the Caribbean and Pacific (see companion posters). Funding for most of these projects was provided by the NPS Inventory and Monitoring Division.

Benthic habitat mapping is a five-step process:

1. Collect data
2. Post-process data
3. Interpret data (classification)
4. Validate classification (ground truth)
5. Produce maps

1. Collect Data



A. Sidescan Sonar
B. LiDAR
C. Aerial or Satellite Imagery
D. Single-beam Sonar
E. Multibeam or Swath Sonar
F. Seismic
G. Bottom Visualization
H. Water-column Data

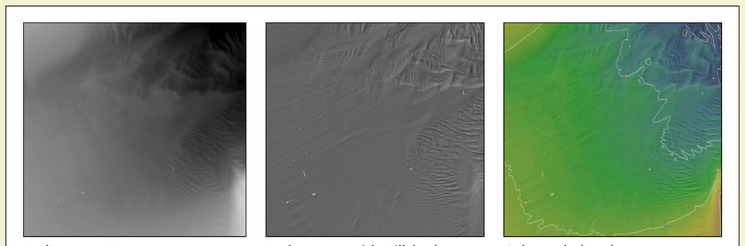
Remote sensing technologies with benthic mapping applications. Graphic from Moses, et al., 2010.

There are many technologies available for collecting benthic data. Benthic mapping technologies fall into three basic categories: visible imagery, acoustic data and bottom visualization.

- Visible imagery (B, C) is only effective in clear, shallow water (generally <30 m), but data can be gathered over large areas with relative ease.
- Acoustic systems (A, D, E, F) are generally effective in deeper, turbid waters and can produce bathymetric data, high-resolution three-dimensional images of the ocean floor and information about sea floor rugosity (roughness), from which bottom material (e.g. mud, sand, rock) can be inferred.
- There are a variety of bottom visualization techniques (G) including a diver with a camera, remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs). Still and video cameras can also be mounted directly to a vessel or towed at depth.

2. Post-process Data

Post-processing describes any steps that may be applied to remotely sensed data files to adjust, correct or otherwise transform the original data into a more usable format. This could include georectification, radiometric corrections, pan-sharpening and other forms of value-added processing of the original data. Post-processing of the data can be the most expensive and time-demanding step of the mapping process, depending on the acquisition technology.

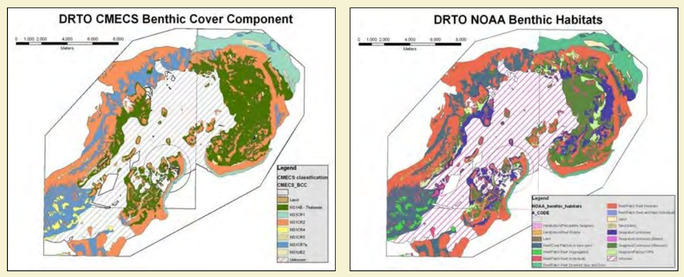


Example of post-processing. Graphics from Greene et al., 2009.

3. Interpret Data (classification)

Currently, there is no national standard for a benthic habitat classification scheme that can be used for mapping. A national habitat classification standard would ensure compatibility and widespread use of ocean and coastal habitat information. NOAA and NatureServe developed the Coastal and Marine Ecological Classification Standard (CMECS), which is currently under review for a national standard by the Federal Geographic Data Committee (FGDC). The NPS has participated in this review and is testing CMECS (v. III) in several benthic mapping projects.

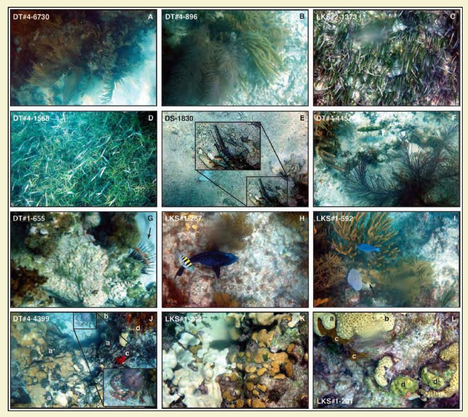
A standardized and robust classification scheme is necessary to describe the range of habitats found in NPS ocean, coastal and Great Lakes parks. It is also important for comparing parks to each other and for assessing change within a park. Below are examples of two classification schemes applied to Dry Tortugas National Park – CMECS with nine classes and a NOAA classification with sixteen.



Example of two different classification schemes for Dry Tortugas National Park, Florida. Graphics from Tim Battista, National Center for Coastal and Ocean Science, NOAA.

4. Validate Classification (ground truth)

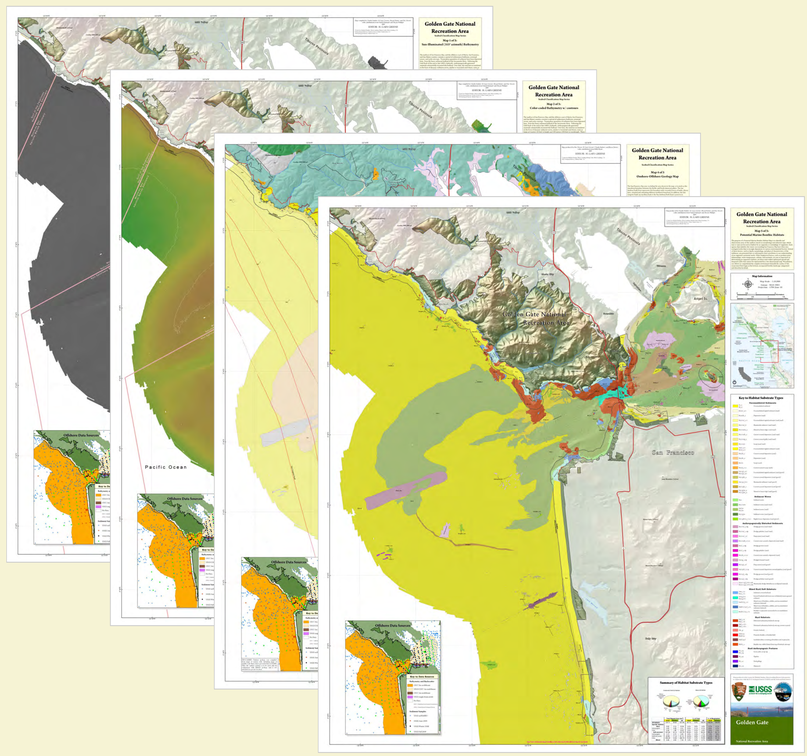
To validate habitat classifications based on remotely sensed data, it is necessary to directly sample the bottom. This can be done by physically sampling the substrate with grabs and cores, or by obtaining imagery of the bottom. Video and still images can be acquired by scuba divers or vessel-mounted, drop and towed camera systems. The USGS Along-Track Reef Imaging System (ATRIS) is an example of a camera system that can either be mounted to the vessel for shallow water operation (2-10 m) or towed at moderate depths (~ 1-27 m). The accuracy of the classified habitat map can be assessed by an independent team revisiting the study area and collecting samples at stratified random locations.



Images obtained by the Along-Track Reef Imaging System (ATRIS), developed by the USGS Coastal and Marine Geology Program, St. Petersburg, Florida (Lidz, et al., 2008).

5. Produce Maps

Validated benthic data are combined with ancillary data (e.g. terrestrial features, depth contours, labels, legends, etc.) to produce the final maps.



Example of final benthic habitat map series for Golden Gate National Recreation Area, California. Please see companion posters for additional examples.

References

Greene, H.G., et al., 2009, Marine Benthic Habitat Mapping in the Golden Gate National Recreational Area, San Francisco, CA.

Moses, C.S., Nayegandhi, Amar, Beavers, Rebecca, and Brock, John, 2010, A Servicewide Benthic Mapping Program for National Parks: U.S. Geological Survey Open-File Report 2010-1264.

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About the authors

Thom Curdts
GIS & Remote Sensing Specialist
ph 303-969-2342
thom_curdts@nps.gov

Jeffrey N. Cross, Ph.D.
Chief, Ocean & Coastal Resources Branch
ph 970-225-3547
Jeffrey_cross@nps.gov

Natural Resource Program Center
Water Resources Division
Ocean and Coastal Resources
1201 Oakridge Drive
Fort Collins, CO 80525