



NATIONAL  
ESTUARINE  
RESEARCH  
RESERVE  
SYSTEM

SCIENCE & TOOLS FOR  
COASTAL COMMUNITIES NATIONWIDE

# RECOMMENDATIONS FOR A BENTHIC MAPPING STRATEGY

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for the National Estuarine Research Reserve System

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# A. EXECUTIVE SUMMARY

This report offers ten recommendations to advance the mapping of benthic habitats and their extent in the National Estuarine Research Reserve System (NERRS). Mapping these habitats (and others) was identified as a strategic concept in the NERRS Strategic Visioning and Planning process in 2021. In support of this, the National Oceanic and Atmospheric Administration (NOAA) convened a team composed of staff from NOAA's Office for Coastal Management, the NERRS, and the Centralized Data Management Office.

In spring 2023, the team conducted a System-wide survey to better understand management and research needs related to NERRS benthic habitats and inventory NERRS current and past benthic mapping activity. This survey informed the design of a fall 2023 workshop held at the Jacques Cousteau Reserve in New Jersey. The workshop engaged Reserve staff from six sites and experts in benthic ecology and mapping in the development of informal plans to use benthic mapping to help address research or management needs articulated by participating Reserves. The group also explored several ideas to advance NERRS benthic mapping at a national scale. These activities informed the recommendations below; additional context to support each recommendation is included later in this report.

1. Increase opportunities for Reserve engagement by embracing a broad range of benthic habitats and mapping approaches.
2. Adopt standardized (CMECS) benthic habitat definitions for the NERRS.
3. Clarify how benthic mapping goals relate to mapping other habitats and look for opportunities for benthic mapping activities to support characterization of other habitats and vice versa.
4. Leverage existing NERRS national programs to advance benthic mapping and enhance the usefulness of its data.
5. Inventory existing benthic mapping data in (or around) the NERRS and identify gaps.
6. Conduct a benthic mapping brainstorm at all Reserves as a first step toward developing a plan to use mapping to address local management and/or research needs related to benthic habitats.
7. Obtain high-resolution bathymetry for each Reserve.
8. Establish a central, accessible, online location for NERRS benthic data, standards, reports, etc.
9. Establish an advisory committee composed of professionals in- and outside the System with the expertise necessary to design and implement a nationally significant, locally relevant NERRS benthic mapping program.
10. Define benthic habitat specific metrics that are consistent with those identified in the SAV monitoring needs assessment and confirm relevant protocols for data collection, analysis, synthesis, storage, and reporting.



An early version of these recommendations was shared with the NERRS community during the 2023 NERRS/NERRA Annual Meeting. Ultimately, they will form the basis for a written plan for NERRS benthic mapping that will be submitted for review and further vetting across the System.

## B. RECOMMENDATIONS

### B.1 Broaden NERRS participation in benthic mapping and increase the value of benthic data

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#### Recommendation 1

Increase opportunity for Reserve participation by embracing a broad range of benthic habitats and mapping approaches.

#### Context

For the purpose of this effort, benthic habitat has been broadly defined as subtidal and intertidal areas, excluding emergent vegetation like marshes and mangroves. Essentially, if it is not visible under normal high water conditions (e.g., high tide), it is considered benthic. Using this definition, the NERRS national survey (Appendix C.1) revealed a diversity of benthic habitats in the 27 Reserves responding—from the vast eelgrass beds of Padilla Bay to the corals of Jobos Bay.

Management and research needs were likewise diverse, though they generally related to the management of shellfish beds, vegetative habitats, fish species, other estuarine biota, and shorelines, as well as restoration planning and monitoring. (See Appendix C.4, the 2022 NERRA SAV Monitoring Assessment, which identifies specific research and management questions for SAV.)

Given this diversity, allowing Reserves some flexibility in selecting benthic habitats for inclusion in mapping will help ensure the relevance of this work to local science and management needs. The broad definition of benthic habitats used for this project might be appropriate moving forward, though it may need to be updated to better support freshwater systems.

In preparing for the 2023 workshop (Appendix C.3), the team also determined that it was important to define benthic mapping itself more broadly so that it addressed the need for larger scale mapping and targeted ground truthing to assess map accuracy and population trends for selected species. Importantly, the latter could also help locate where a coarser scale resolution of data would suffice for management needs. This is particularly important for Reserves in the Southeast and those that have optically complex water habitats in general, as well as places where bathymetric and sediment composition are expected to be stable. The team also noted the benefits of mapping muddy expanses when seeking to understand the broader, hydrologic influences on habitats and infaunal communities that are often proxies for prevailing environmental conditions. Such work may, for example, uncover unanticipated challenges to habitat management, such as previously undocumented disturbances due to storm activity.



Principal benthic habitat types of interest within the NERRs: Coral reefs, seagrass meadows, shellfish beds, hard and rocky bottom areas, macroalgae, and unconsolidated sediments.

## Recommendation 2

Adopt standardized (CMECS) benthic habitat definitions for the NERRS.

### Context

Respondents to the national survey offered additional qualitative descriptions of the benthic habitats at their sites. These responses prompted the team to associate each type reported with the closest Coastal and Marine Ecological Classification Standard (CMECS) equivalent (Appendix C.2). The intent was to support standardization within the System, encourage use of NERRS benthic data by the broader science and management community, and increase the likelihood that data collected outside of the System could support NERRS science and management.

Workshop participants acknowledged the importance of this effort and encouraged the NERRS to formally adopt a version of CMECS standards for benthic habitats. This would be a natural addition to the recent national effort to use CMECS classifications for habitats surrounding System-Wide Monitoring Program (SWMP) stations, including the freshwater stations in the Great Lakes.

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## Recommendation 3

Clarify how benthic mapping goals and methods relate to the mapping of other habitats and look for opportunities to leverage benthic mapping activities to support characterization of other habitats and vice versa.

### Context

As indicated by the recent national survey (Appendix C.1) and the 2022 NERRS SAV Monitoring Assessment (Appendix C.4), there are several barriers to System-wide participation in a new national initiative. Chief among these are the relevance of benthic habitats to individual Reserves, the capacity of Reserve staff to implement a new program while others are in development, and concern about continuous, dedicated funding. To a lesser degree, there is also concern about Reserve capacity to address the technical challenges associated with benthic mapping.

There are opportunities to address these concerns, in part, by exploring ways to integrate Reserve approaches to mapping different habitats and considering how data collected for any habitat could support broader initiatives. For example, bathymetric maps are universally required datasets for any benthic mapping program. However, these maps can also benefit efforts to restore emergent vegetation like marshes and regional projects examining sediment transport. Similarly methods used to collect Coastal Change Analysis Program (C-CAP) data to map land-cover and terrestrial habitats could potentially be adjusted to map some shallow benthic habitats, including intertidal oyster reefs.

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## Recommendation 4

Leverage existing NERRS national programs to advance benthic mapping and enhance the usefulness of its data.

### Context

The 2022 NERRS SAV Monitoring Assessment indicated that the ability to integrate place-based monitoring with other national programs is a significant strength of the System and made it clear that new initiatives should learn from the development of other NERRS national programs. This was noted in the benthic mapping workshop. For example, in situ sampling as part of NERRS vegetation monitoring for seagrass could provide ground truth sites for larger scale benthic mapping efforts.

## B.2 Establish a baseline of benthic data

### Recommendation 5

Inventory existing benthic mapping data in (or around) the NERRS and identify gaps.

#### Context

The national survey confirmed there is a wealth of benthic mapping data in the System. Twenty-five of responding Reserves indicated there has been benthic mapping in or around their sites; two reported no such activity (Figure 1). In many instances, mapping within or adjacent to Reserves is conducted or supported by a state partner, nongovernmental organization, or university. Understanding the extent of existing benthic data, organizing this information in a consistent way, and identifying gaps is essential to advance future benthic mapping at a national scale in an efficient, cost-effective way.

As a result, the team recommends building on the survey results to compile a detailed inventory that catalogs extant NERRS benthic data, identifies relevant partners, and briefly describes plans to collect such data in the future. This would inform almost all aspects of a NERRS benthic mapping plan and help identify the professional network that supports (or could support) the NERRS in this regard. It would also help Reserves make better use of existing data. As part of this process, we also suggest exploring opportunities to enhance partnerships with mapping partners. This would result in improved project outputs and potentially reduce the burden on all participating organizations.

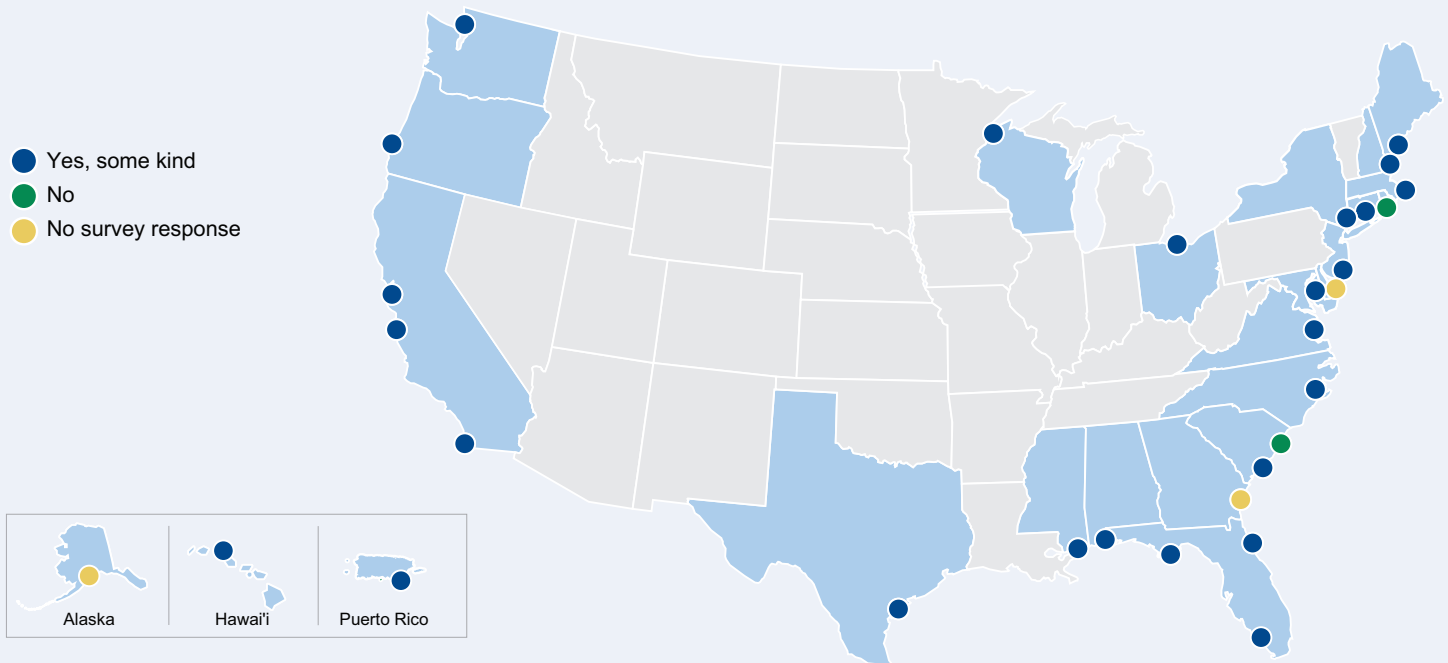


Figure 1. Benthic Mapping Activity in the NERRS

## Recommendation 6

Solicit input from all Reserves as a first step toward developing a plan to use mapping to address local management and/or research needs related to benthic habitats.

### Context

Twenty-six of the Reserves responding to the survey articulated a management or research need that could be supported by benthic mapping. Working with representatives of the six Reserves that participated in the workshop, the team refined a series of management/research questions that are relevant for their sites. These informed small group discussions at the New Jersey workshop, each focused on developing a “benthic mapping plan” to address a specific management or research need (Appendix C.6).

Through these discussions, the groups identified benthic metrics, methodologies to collect the data, and challenges and opportunities to implement these ideas. These conversations highlighted the wide diversity between Reserve contexts, goals, and mapping needs, but also areas of convergence. For example, the team exploring the use of benthic data to assess impacts of invasive mud snails was able to identify a general approach that every Reserve could benefit from, regardless of their habitats or the needs they were addressing.

Conducting a similar conversation—with support from NOAA and potentially Reserve Coastal Training Coordinators—at the remaining Reserves would advance several of these recommendations and inform the inventory suggested in recommendation five. This would require support from NOAA and the participation of individuals with appropriate expertise (specific to the Reserve’s habitats and needs) in each workshop.

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## Recommendation 7

Obtain high-resolution bathymetry for each Reserve.

### Context

Workshop participants agreed that many Reserves could benefit from this first, critical step in almost any benthic mapping effort. A national effort to collect existing bathymetric data and conduct surveys for Reserves that need them has the potential to support other Reserve priorities, including, e.g., those related to sediment transport. The team recommends NOAA explore supporting this at a national scale with private contractors, thereby reducing the effort needed by Reserves. This should be designed to help address key questions, including, for example, better understanding the “shelf life” of bathymetric data at each site given the dynamics of its local systems.

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## Recommendation 8

Establish a central, accessible, online location for data, standards, reports, etc.

### Context

While some of the benthic data reported in the national survey is accessible online, much of it is not, and in some cases, it is not collected by Reserves. Workshop participants underscored the inability to access this data—or even recognize it as benthic data—as a significant obstacle to advancing benthic mapping as a tool for science and management at the Reserve and System-wide scales.

To address this, the workgroup recommends the NERRS Centralized Data Management Office (CDMO) and NOAA explore how CDMO or resources like NOAA Geoportal could be a home for existing data (or create access to it in a centralized way) and lay the groundwork for uploading, storing, and accessing new data in the future. This work would lay the groundwork for standardization of protocols associated with data collection, analysis, synthesis, storage, and reporting.

## B.3 Incorporating expert knowledge

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### Recommendation 9

Establish an advisory committee composed of professionals in and outside the System with the expertise necessary to design and implement a nationally significant, locally relevant NERRS benthic mapping program.

#### Context

Accurate and effective benthic mapping requires the input of subject matter experts, including those with site specific knowledge, benthic ecologists, oceanographers, geologists, mathematical modelers, geodesists, and acoustic and optical remote sensing, and data management specialists. Yet in many cases, Reserves, like other organizations do not have access to those resources in house or among their existing partner networks.

Workshop participants recommended establishing a committee composed of professionals (within and outside the NERRS) who could represent the broad range of expertise necessary to design and implement a nationally significant NERRS benthic mapping program. Such a committee could help the NERRS define a set of standard metrics, refine protocols for collecting and reporting them, identify opportunities to work with partners across sectors, provide in person assistance to Reserves, and potentially represent NERRS priorities and products in national and international benthic communities of practice.

## B.3 Establish standards

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### Recommendation 10

Define benthic habitat specific metrics that are consistent with those identified in the NERRS SAV Monitoring Assessment (where relevant) and confirm relevant protocols for data collection, analysis, synthesis, storage, and reporting.

#### Context

The NERRS SAV Monitoring Assessment underscored the need to identify metrics that allow for as much flexibility as possible at the site scale and design associated protocols that are rigorous, efficient, and straightforward to apply. Workshop participants noted the importance of leveraging existing standards, including the [Global Ocean Observing System's Essential Ocean Variables](#), and the Seagrass Monitoring Approach for the Gulf of Mexico (Appendix C.6) to ensure that Reserve data is more broadly applicable and, conversely, data from outside the NERRS could be applied to Reserve science and management needs.

Also consistent with the NERRS SAV Monitoring Assessment, participants encouraged the identification of three tiers of monitoring, each with metrics that most Reserves could use, if those habitats existed at their sites. (See Neckles et al., Integrating Scales of Seagrass Monitoring to Meet Conservation Needs, *Estuaries and Coasts* 3, January 2012.)