RESTORE CMAP Report Series: Task 2

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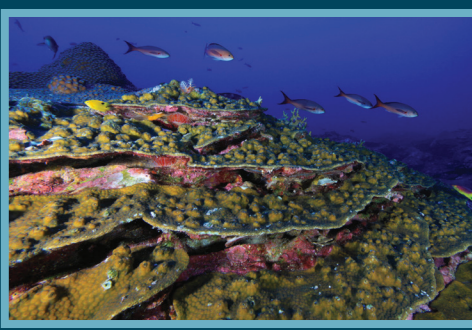

COUNCIL MONITORING AND ASSESSMENT PROGRAM (CMAP)

Inventory of Existing Habitat and Water Quality Monitoring, and Mapping Metadata for Gulf of Mexico Programs

A joint collaboration between
National Oceanic and Atmospheric Administration and the U.S. Geological Survey

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NOAA National Ocean Service, National Centers for Coastal Ocean Science, Marine Spatial Ecology Division
NOAA National Marine Fisheries Service, Southeast Regional Office

and

USGS Southeast Region
USGS Wetland and Aquatic Research Center
USGS Texas Water Science Center
USGS Lower Mississippi Gulf Water Science Center

RESTORE Council Background

The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) was signed into law on July 6, 2012. The RESTORE Act calls for a regional approach to restoring the long-term health of the valuable natural ecosystem and economy of the Gulf Coast region. The RESTORE Act dedicates 80 percent of civil and administrative penalties paid under the Clean Water Act, after the date of enactment, by the responsible parties in connection with the Deepwater Horizon oil spill to the Gulf Coast Restoration Trust Fund (Trust Fund) for ecosystem restoration, economic recovery, and tourism promotion in the Gulf Coast region.

In addition to creating the Trust Fund, the RESTORE Act established the Gulf Coast Ecosystem Restoration Council (Council). The Council includes the Governors of the States of Alabama, Florida, Louisiana, Mississippi and Texas, the Secretaries of the U.S. Departments of Agriculture, the Army, Commerce, Homeland Security, and the Interior, and the Administrator of the U.S. Environmental Protection Agency.

The Council plays a key role in developing strategies and implementing projects that help ensure the Gulf's natural resources are sustainable and available for future generations. This has included the development of a Comprehensive Plan to restore the ecosystem and the economy of the Gulf Coast region. Approved in 2013 and updated in 2016, the Comprehensive Plan provides a framework to implement a coordinated, Gulf Coast region-wide restoration effort in a way that restores, protects and revitalizes the Gulf Coast. The Comprehensive Plan identifies five goals for Gulf Coast restoration: Restore and Conserve Habitat, Restore Water Quality, Replenish and Protect Living Coastal and Marine Resources, Enhance Community Resilience, and Restore and Revitalize the Gulf Economy.

Under the Council-Selected Restoration Component of the RESTORE Act, the Council develops Funded Priority Lists (FPLs) that describe the projects and programs it will fund. Projects and programs funded through this component must be in furtherance of the goals and objectives of the Council's Comprehensive Plan and address at least one of the restoration criteria identified in the RESTORE Act. The Initial FPL, finalized in December of 2015, had a strong focus on watershed and estuary restoration and foundational cross-Gulf projects.

Approved as a Gulf-wide investment in the 2015 Initial FPL, The Council Monitoring and Assessment Program (CMAP) is administered jointly by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS). Funded activities include the development of basic, foundational components for Gulf-wide monitoring to measure beneficial impacts of investments in Gulf restoration by the Council. The program, in coordination with the Gulf of Mexico Alliance (GOMA) and through collaboration with the Gulf States, Federal and local partners, academia, non-governmental organizations, and business and industry, has leveraged existing resources, capacities, and expertise and build on existing monitoring data and programs.

Project Team

We would like to thank the project team for their participation and expertise.

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1 Program Overview

American white water lily, Florida Everglades. Credit: USGS Florida Cooperative Fish and Wildlife Research Unit

Under the Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act), the Gulf Coast Ecosystem Restoration Council (RESTORE Council or Council) is required to report on the progress of funded projects and programs. Systematic monitoring of restoration at the project-specific and programmatic-levels (watershed and Gulf of Mexico [GoM]) enables consistent reporting and gives the public confidence that the restoration investments selected by the RESTORE Council will be evaluated and adaptively managed accordingly. Monitoring information that has been collected at different spatial and temporal scales can be used as the foundation to illustrate progress toward comprehensive ecosystem restoration goals and objectives that promote holistic GoM recovery (see 'RESTORE Council Background' at the beginning of this report for additional Council information).

The best available science is required to make informed decisions to effectively manage ecosystem resources at multiple geographic scales across the GoM. However, knowing what data are being collected where is a daunting challenge. Thus, a spatially and temporally comprehensive environmental monitoring network for habitat monitoring, water quality monitoring, and habitat mapping is a foundational element that can support making scientifically sound decisions regarding the health and viability of the GoM ecosystem. In the context of Gulf protection and restoration, a coordinated compilation of existing environmental monitoring programs will provide essential information to support the development, selection, and application of effective management and restoration alternatives, and inform adaptive management decisions at the local, state, and regional levels.

Currently, Federal, State and local agencies, universities, private industry, and non-governmental organizations (NGOs) are conducting extensive monitoring activities around the Gulf. In addition, each RESTORE Council-funded project will, at a minimum, perform project-specific monitoring. This collection of monitoring activities is being inventoried and coordinated into a network of existing programs by the Council funded RESTORE Council Monitoring and Assessment Program (CMAP), which will suggest opportunities for efficiencies and collaborative cross-program review of performance with other Gulf ecosystem recovery efforts. CMAP is designed and funded to inventory and begin to integrate existing monitoring efforts, improve discovery and accessibility of existing monitoring data, and ensure collected information supports management decision making.

The fundamental approach to building the CMAP Gulf habitat mapping, water quality and habitat monitoring network is to:

1. Adopt, or construct as needed, a comprehensive inventory of existing habitat and water quality observation, monitoring, and mapping programs in the Gulf;
2. Evaluate the suitability/applicability of each program and its existing and prospective data for use in restoration activities;
3. Coordinate and integrate appropriate existing observations and monitoring systems to form a regional

monitoring network with an integrated data management structure;

4. Identify information gaps;
5. Provide recommendations to strategically supplement and refine observations and monitoring systems to fill the acknowledged gaps with available capabilities and capacities of all the regional partners; and
6. Develop a searchable monitoring information portal/ database to enable access to collected information and products.

This report is a deliverable to the RESTORE Council for *Task 2: Create an inventory of existing habitat and water quality monitoring, and mapping programs, data, and protocols* and is intended to describe the process used to create an inventory of existing water quality monitoring, habitat monitoring, and mapping program metadata in the GoM and the results of the inventory. Additional reports detailing the process and results of the other tasks will be developed throughout the project. A list of the CMAP tasks is included below.

1. Program Management;
2. Inventory the existing habitat and water quality monitoring programs, data, protocols and standards;
3. Determine the minimum monitoring program elements needed to measure and evaluate the performance of restoration projects;
4. Evaluate the suitability of the inventoried programs and determine what data are missing (i.e., information gaps);
5. Provide recommendations to the Council to supplement and refine the existing monitoring programs to fill-in information gaps where possible;
6. Monitoring Community of Practice Coordination and Workshops;
7. Document existing baseline assessments of habitat and water quality conditions; and
8. Combine appropriate data from the existing programs into searchable databases for Council use

This chapter (Chapter 1) provides background information about CMAP as well as goals and objectives for the monitoring program inventory. Chapter 2 examines the variety of sources that were mined for program information, describes the process for program inclusion into the database, and outlines other information gathering activities. Chapter 3 provides a detailed description of the development and final version of the database framework. Chapter 4 describes the internal and external review process for maintaining information accuracy in the database. Chapter 5 details additional information that was gathered in the process. Chapter 6 provides summary information about the monitoring programs identified for the database. Lastly, Chapter 7, 8 and 9 describe the immediate and long-term future of the database including how it will be used for the remaining elements/tasks of the CMAP project, the benefits and uses beyond RESTORE Council projects, and lessons learned.

Monitoring Program Inventory Goals and Objectives

GOAL Create an inventory of existing habitat and water quality monitoring, and mapping programs, data, and protocols.

OBJECTIVE Assemble a standardized summary, including program attributes, of national, regional, state, and local water quality monitoring, habitat monitoring, and mapping programs in the GoM to provide decision making information to the Council.

CMAP integrated and expanded upon Ocean Conservancy, Global Change Monitoring Portal (GCMP), and Gulf of Mexico Alliance (GOMA) databases to develop a more comprehensive directory of active and inactive monitoring and mapping programs in the GoM. CMAP conducted further exploration (beyond the previous inventories) of suitable programs through internet queries and by obtaining information from experts across Federal/State government agencies, academia, NGOs, and industry. Metadata collected include programmatic information, such as program names, points of contact, website addresses, types, timing, and frequency of monitoring. More detailed information was also collected, including but not limited to public accessibility of data, protocols and methods, and geographic metadata.

Synthesized information was reviewed both internally and, whenever possible, with each inventoried monitoring program's point of contact. Once all information was reviewed for accuracy, the database was considered final and ready for a webtool that is planned for development in the last year of the CMAP project.

Ultimately the information collected is planned to be made web accessible via a geo-referenced, quality assured and controlled inventory of key water quality and habitat monitoring metadata for GoM programs. This framework web directory design could accommodate multiple search features across numerous database attributes. This feature is planned for completion in 2020.

2 Information Synthesis and Framework


Florida Everglades. Credit: NASA-Landsat

Existing Monitoring Information

The intent of the monitoring inventory was to discover, assess and provide access to existing monitoring information and products, where available. As such, CMAP synthesized an inventory of extant monitoring inventories (Appendix 1) to capture existing information to build upon, coordinate, and obtain feedback from Gulf monitoring experts. Several components of these inventories and their organizational frameworks were used in the development of the CMAP inventory (Table 1).

Understanding that these existing inventories, a few of which are described in more detail below, were developed to meet different objectives, but in general collected similar information, CMAP incorporated the relevant program information and added more information, if available, to meet project objectives. For example, CMAP was interested in identifying and providing access to monitoring protocols and methodologies. Where available, the database indicates that a program has documentation of monitoring data that were collected or analyzed and where data may be found. Not all monitoring programs discovered by the existing inventories were included in the CMAP inventory due to the varying objectives and criteria for inclusion in CMAP (Chapter 3).

Table 1 Existing primary inventories and their general database frameworks. X indicates a topical category that is included within a particular inventory.

	Ocean Conservancy	GCMP	DWH Project Tracker	DIVER	GOMA Water Quality	Florida Water-CAT
Program Objectives	X	X	X	X	X	X
Program Duration	X	X	X	X		X
Monitoring Frequency	X	X		X		X
Monitoring Targets (endpoints)	X	X	X	X		X
Geographic Extent	X	X		X		X
Funding Source	X		X	X		
Funding Amount			X	X		
Observational Accuracy and Precision				X		
Standard Operating Procedures				X		
Data Access	X	X		X		X
Program Contacts	X	X	X	X		X

GCMP= Global Change Monitoring Program; DWH= Deepwater Horizon; DIVER= Data Integration, Visualization, Exploration, and Reporting; GOMA= Gulf of Mexico Alliance; Water-CAT= Water Resource Monitoring Catalog

Ocean Conservancy

In 2015, the Ocean Conservancy released a report (Love et al., 2015) describing their extensive inventory of active and inactive monitoring programs in the GoM (https://oceanconservancy.org/wp-content/uploads/2017/05/Charting-the-Gulf.pdf). With this information, they conducted an expert-based assessment of long-term monitoring needs and identified gaps in monitoring for species and habitats impacted by the Deepwater Horizon (DWH) oil spill. The Ocean Conservancy database used the 12 Natural Resource Damage Assessment (NRDA) injury categories as the framework for their inventory and identified nearly 1,000 programs. The categories are:

Deep-water communities

Nearshore sediments and associated resources

Water column and invertebrates

Oysters

Birds

Submerged aquatic vegetation

Marine mammals

Shallow and mid-water corals

Marine fish

Shorelines

Sea turtles

Terrestrial species

Not all monitoring programs discovered by the Ocean Conservancy were included in the CMAP inventory. The Ocean Conservancy targeted programs that met two requirements: 1) contained a minimum data record of five years of continuous sampling or a minimum of two sample years that span a 5-year range; and 2) included program outputs as a principal source of information for resource assessment or management. Some relevant programs were included that didn't meet these criteria. Exceptions for inclusion are: 1) Geographic scope, 2) Primary data source, 3) NRDA Resource Category, 4) Foundational Data Source, or 5) Limited Data Availability.

Global Change Monitoring Portal (GCMP)

The Global Change Monitoring Portal (GCMP) was developed through a project of the Department of the Interior (DOI) Southeast Climate Science Center and aims to support the efforts of multiple Federal, State, and other organizations by providing a centralized, comprehensive catalog of observational networks associated with aquatic and terrestrial ecosystems in the southeastern United States (U.S.; https://my.usgs.gov/gcmp/). The Southeast GCMP region of interest encompasses all or part of several Landscape Conservation Cooperatives (LCCs) in the southeastern U.S. and the Caribbean.

Information about existing and historical observational networks and monitoring sites was compiled into a relational database. Programs and sites are classified according to:

- the type of media being monitored— air, land, water
- the general type of measurements that are made— biological, chemical, physical, and
- the general type of parameters that are measured (e.g., fauna) within a particular measurement type (e.g., biological)

Monitoring locations are included when made available by a monitoring network. Sites are classified according to several geographic criteria: State, LCC, Level III Ecoregion, and 8-digit hydrologic unit. Monitoring network and site information can be displayed and searched using geographic and/or measurement categories. Observational data are not stored in the GCMP database, but links for accessing data from a monitoring program are provided when available.

Deepwater Horizon (DWH) Project Tracker

The DWH Project Tracker is a comprehensive website (https://dwhprojecttracker.org/) that allows the public to access maps and key information about restoration and recovery projects funded as a result of the April 2010 DWH oil spill. The tool summarizes dozens of attributes, such as the total funding dollars per area or project type, so users can quickly assess where and how DWH funds are being used by all funders and implementing organizations. Users can overlay various geospatial layers with project areas for in-depth research and analysis.

Natural Resource Damage Assessment (NRDA) Data Integration Visualization Exploration and Reporting (DIVER)

The Data Integration, Visualization, Exploration, and Reporting (DIVER) tool serves as the public National Oceanic and Atmospheric Administration (NOAA) repository for data related to the DWH Trustees' NRDA efforts. To provide additional context for the NRDA data, the site also includes historical (pre-2010) contaminant chemistry data

for the onshore area of the GoM, as well as contaminant chemistry data collected during the response efforts and by the responsible party, British Petroleum (BP). These contaminant data are available to the general public and are accessed through a query and mapping interface called DIVER Explorer (https://www.diver.orr.noaa.gov/deepwater-horizon-nrda-data).

Gulf of Mexico Alliance (GOMA)

GOMA is a Regional Ocean Partnership led by the five Gulf States. GOMA collaborates regionally with Federal agencies, academics, businesses, and other non-profit organizations to enhance the environmental and economic health of the GoM. In 2013, GOMA released a white paper that recommended the implementation and funding of a Gulf-wide water quality monitoring network that would address questions that cannot be answered by then-existing monitoring programs (GOMA, 2013). This document described monitoring goals and objectives similar to those identified by CMAP and provides a broad categorical framework. Goals included:

1. Integrate monitoring and related research and technology development efforts to aid in answering local, regional, and Gulf-wide questions;
2. Promote inter-agency data sharing and the expansion of international partnerships;
3. Provide real-time or near real-time observations; and
4. Provide synthesized information and products.

Additionally, the report included a list of key water quality monitoring programs in the Gulf and online monitoring catalogs and data portals, which were useful for discovery of monitoring programs by CMAP staff. The report can be found on GOMA's website: https://gulfofmexicoalliance.org/files/projects/files/goma_gulf_monitoring_white_paper.pdf.

Florida Water-CAT

The Florida Water Resource Monitoring Catalog (Water-CAT; website: https://water-cat.usf.edu/) is an online searchable database of programmatic metadata to find information about water resources in Florida. The webtool represents a more regionalized (Florida) effort similar to CMAP and provides programmatic information for 1,459 programs. Water-CAT staff provided programmatic information for evaluation and subsequent inclusion into CMAP database.

Forty-one other databases or web portals were reviewed for monitoring programs. These are listed in Appendix 1.

Engagement with Existing Gulf of Mexico Monitoring Experts and Practitioners

In addition to using existing products such as the Ocean Conservancy and GOMA synthesis frameworks as a template, CMAP captured additional programmatic information and more detailed monitoring parameters for water quality, habitat monitoring, and mapping programs beyond the compiled information by reaching out to various practitioners, workgroups and others. Those groups and meetings held are described below.

Council Monitoring and Assessment Work Group (CMAWG)

The overarching purpose of the Council Monitoring and Assessment Work Group (CMAWG) is to serve as the leadership body responsible for coordinating Council monitoring activities, including the recommendation of monitoring and assessment standards that will be used on Council projects and programs. The CMAWG consists of the primary and secondary representatives from the 11 RESTORE Council members (States of Florida, Alabama, Mississippi, Louisiana, and Texas; U.S. Departments of Agriculture, Interior, Commerce and Homeland Security; U.S. Army Corps of Engineers; and the U.S. Environmental Protection Agency [US EPA]). The CMAWG conducts conference calls every six weeks and a total of five face to face meetings during the CMAP project period (2018–2020). The CMAWG leads Council monitoring activities, reviews draft products and deliverables, and develops necessary recommendations to the Council. The CMAWG was engaged and provided feedback throughout the development of the inventory.

Monitoring Community of Practice (MCoP)

The Gulf of Mexico Monitoring Community of Practice (GoM MCoP) provides a forum for sharing and coordinating monitoring knowledge with the larger monitoring and restoration community. The GoM MCoP provides a broad network of monitoring experts across the GoM, specifically through collaboration with GOMA's Priority Issue Teams (PITs). The primary goals associated with the development of the GoM MCoP were to promote regional collaboration, as well as to improve coordination, accessibility, and comparability of monitoring information and to develop and share tools and practices aimed to support GoM ecosystem health. This coordination and information exchange was designed to occur during five workshops and periodic webinars during the three-year CMAP project.

The GoM MCoP was first introduced to the CMAP project and objectives through an informational webinar held on February 23, 2018. Approximately 70 individuals participated in the webinar. The first in-person workshop was held on June 11, 2018, where MCoP members provided feedback on the development of the monitoring inventory framework. Approximately 90 individuals representing Federal, State, and local governments, as well as non-profit, academic, and industry sectors attended the day-long workshop. Workshop attendees were asked to query the database, provide additional monitoring programs that were missing at the time, and to begin population of the baseline assessment catalog. This process added 35 programs to the inventory database. Additionally, a questionnaire was circulated to MCoP members, and two webinars were held in March and April of 2019. Questionnaire responses and webinar content were intended to prepare for the discussions outlined for the in-person workshop on June 10, 2019. The primary focus of the June 2019 workshop was the review and feedback of inventory-discovered common methodologies, discussion of member program monitoring attributes and guidelines, as well as discussions pertaining to the development of a gap analysis framework and prioritization scheme.

User Needs Workshops

Early in 2018, two workshops, one focusing on water quality monitoring information users (Appendix 2) and the other targeting habitat monitoring and mapping information users (Appendix 3), were held to obtain additional detail regarding Gulf monitoring programs. Information gathered from these workshops was useful in designing the final database framework and providing details to CMAP staff on how the information would best be served to the greater restoration or natural resource management community.

Oyster reef, Fantasy Island. Credit: Peter Plague, US Fish and Wildlife Service

Objectives for the User Needs Workshops

Share CMAP structure, desired outcomes, and timeline with workshop participants

Identify how CMAP can address user needs for GoM habitat and water quality monitoring and habitat mapping information and tools

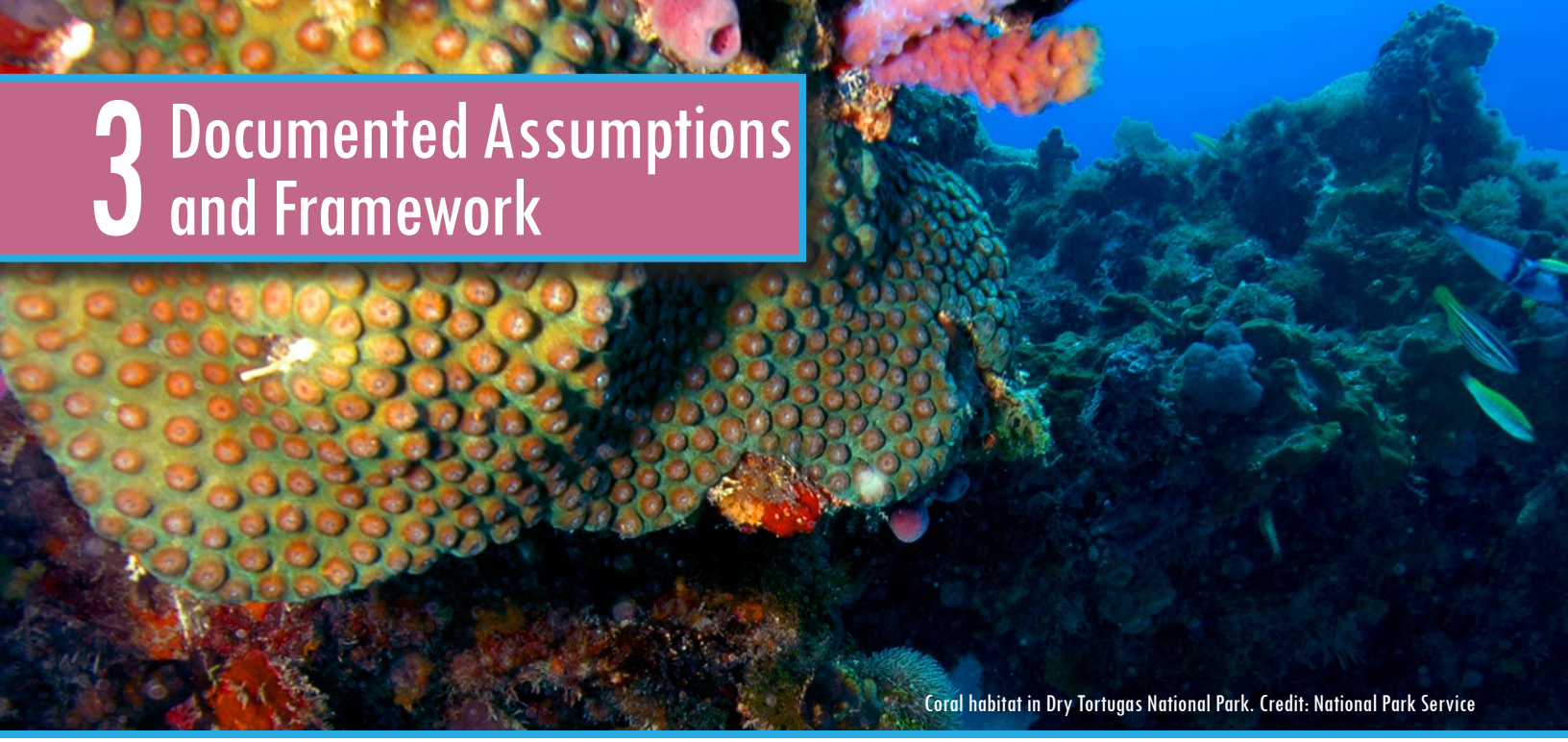
Get feedback from users on the products of CMAP, including identifying processes or products that could enhance the utility of the project

Coordinate with regional stakeholders to continue gathering Gulf-wide information on existing baseline assessments, monitoring and mapping efforts, and monitoring and mapping standards

Identify and discuss how to prioritize gaps in mapping and monitoring that CMAP might be able to help fill, considering the monitoring program attributes needed to achieve desired outcomes for the region

Identify strategies for how CMAP can help with implementing the GOMA's Master Mapping Plan

3 Documented Assumptions and Framework



Coral habitat in Dry Tortugas National Park. Credit: National Park Service

Documented Assumptions

The Documented Assumptions were developed as a guidance document that provides criteria for program inclusion into the CMAP monitoring inventory database (Appendix 4). The assumptions specifically provide criteria for inclusion of a monitoring or mapping program and provide information for general and specific parameters, habitat types, aquatic settings, and spatial/temporal criteria for inclusion in the database.

Temporal Criteria

In general, CMAP's objective was to identify and include long-standing monitoring programs. However, not all programs have long lifespans. This may be indicative of changing agency objectives or reduced/limited funding. Additionally, programs may have started as a result of DWH and thus have a short duration but have planned long-term activities.

Temporal criteria were developed to focus on programs with more recent activity. CMAP included active or inactive programs with monitoring information collected between 1980 to the present. Similar to the Ocean Conservancy's duration requirements (Love et al., 2015), CMAP included programs with a minimum data record of five years of recurrent sampling. For programs that do not collect data annually, a minimum of two sample years spanning the five-year range was required. To ensure that important data sets were not excluded, exceptions to the criteria were considered on a case-by-case basis and those programs, active or inactive, that provide a principal source of information or data for a certain geography, related to a NRDA resource category, or limited data availability were included. For example, the Bureau of Ocean Energy Management (BOEM) conducted mapping and characterization studies in deep water coral communities in the northwestern GoM (CSA International, Inc., 2007). Due to the difficulty in sampling deep benthic communities these types of data are limited, even though they do not meet the temporal criteria and were only collected one time, these are the only principal sources of this data and are excepted from the temporal criteria.

Spatial Criteria

CMAP's spatial criteria reflect the spatial domain established by the RESTORE Act. The Act defines the domain to include the coastal zone of the Gulf States, including Federal lands, the adjacent land, water/watershed within 25 miles of the coastal zone, and all Federal waters within the U.S. Exclusive Economic Zone (EEZ; Figure 1). Within the coastal zone, this boundary intersects with the U.S. Geological Survey (USGS) hydrologic unit code polygons (HUC-10, described in detail in Chapter 4). For spatial consistency, CMAP aligned the spatial domain to be concurrent with the HUC-10 polygon where the RESTORE Act spatial domain intersects.

CMAP monitoring programs must have footprints within this spatial domain; however, the program does not have to be completely contained within this domain. For those programs that extend beyond the GoM, CMAP only considered the monitoring that occurs within the Gulf domain. Programs that have minimal footprints in the Gulf, intersect with the U.S./Mexico border, or intersect the boundary between the Gulf and Atlantic, were evaluated on a case-by-case basis.

Documented Assumptions
(criteria for inclusion in the inventory)

Temporal Criteria

Spatial Criteria

Program Criteria

Monitoring Inventory Program Types

Water Quality Monitoring

Habitat Monitoring

Mapping

Figure 1 CMAP spatial domain. Blue-green line indicates the integration of the RESTORE Council boundary extent of the coastal zone plus 25 miles, and the underlying HUC-10 boundaries.

Water Quality Monitoring Programs

Water quality monitoring programs are those that implement recurrent monitoring of water quality parameters alone or as a complementary data stream to a biological monitoring program or other monitoring activity. These programs can be active or inactive. Where possible, water quality measurements associated with natural resources monitoring (e.g., birds, marine mammals, fish, sea turtles) were included. For example, the Southeast Area Monitoring and Assessment Program (SEAMAP) Groundfish Surveys (Rester, 2017) collect water quality information along with other biological collections.

Information collected by water quality programs were categorized into nine general parameters and 38 detailed parameters (Table 2). Water quality programs were required to collect information on at least one of these detailed parameters and must have met the additional spatial and temporal criteria described earlier in this chapter.

Table 2 Water quality general and detailed parameters.

General Parameters	Detailed Parameters	
Nutrients	Total nitrogen Nitrite Nitrate Nitrite + nitrate Ammonia Ammonia + organic nitrogen	Total phosphorus Soluble phosphorus Phosphate Orthophosphate Silicate
Pathogens	*Escherichia coli* *Enterococcus* Fecal coliforms Total coliforms	*Giardia* *Cryptosporidium* *Vibrio*
Aquatic primary producers	Phytoplankton Chlorophyll	
Harmful algal bloom indicators	Cyanobacteria Algal toxins	
Sediment	Suspended sediment concentration Total suspended solids	
Mercury	Total mercury Methylmercury	
Freshwater inflow	Discharge Stage	
Field parameters	Water temperature Conductance Dissolved oxygen Turbidity	pH Light attenuation Currents Water level
Carbon	Organic carbon Polycyclic aromatic hydrocarbons (PAHs)	

Habitat Monitoring Programs

Habitat monitoring programs are those that gauge the occurrence, distribution, condition, or state of habitat through *in situ* measurements. Habitat data associated with natural resource monitoring (e.g., birds, marine mammals, fish, sea turtles) were included where appropriate.

Information collected by habitat monitoring programs are categorized into three general parameters, eight parameter groups, and 36 parameter subgroups (Table 3). The group—subgroup organization allowed CMAP staff to distinguish between parameter subgroups that are shared between the general parameters (e.g., density of corals vs. density of macroalgae). For inclusion in this inventory, habitat monitoring programs were required to collect information on at least one of the parameter subgroups and meet additional spatial and temporal criteria described earlier in this chapter.

Divers collecting a core sample from a Florida coral reef. Credit: USGS

Table 3 Habitat general and detailed parameters.

General Parameters	Parameter Group	Parameter Subgroup	
Submerged habitat-building animals	Ecological metrics	Composition Abundance Cover	Density Distribution Biomass
	Physiology/Health	Disease Size	Bleaching Growth
	Population dynamics	Settlement/Recruitment Survivorship Larval transport	Spawning Mortality
Plants/Macroalgae	Ecological metrics	Composition Abundance Distribution	Biomass Cover Density
	Physiology	Canopy extent/Structure Size	Growth Litterfall
	Population dynamics	Recruitment Survivorship Mortality	Reproductive effort Primary production
Abiotic	Substrate metrics	Substrate geochemistry Substrate composition Topographic complexity	Sediment classification Substrate depth
	Coastal processes	Vertical accretion Subsidence	

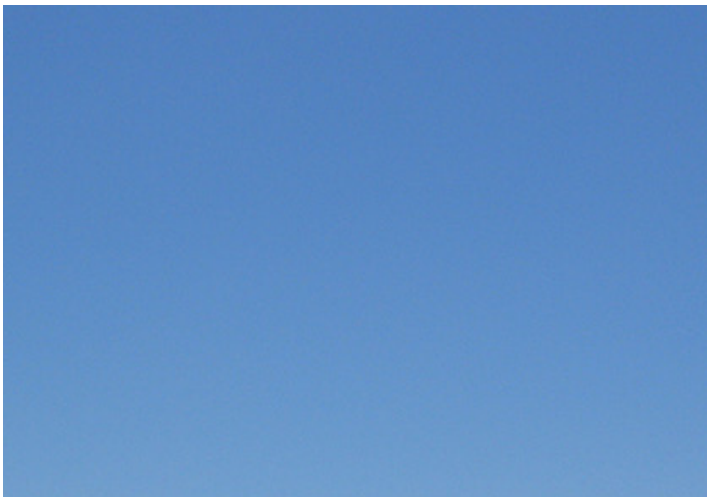
Mapping Programs

Three classes of mapping activity were used to delineate a mapping program. First, we considered those programs (or platforms/satellites/data sets) that gauge the condition or state of water quality or habitat through remotely sensed measurements (e.g., lidar, sonar, satellite, aerial). Second, mapping programs may collect primary data that can be used to develop derived products, such as a habitat map. Third, some programs may develop recurrent or foundational map products for one of a variety of targeted habitat types.

Information collected for mapping programs were classified by the tool or technology used to collect data. The CMAP inventory includes 14 tools/technological techniques (Table 4) with an additional 20 mapping parameters (Table 5). In order to be included in the inventory, mapping programs were required to collect information on at least one mapping parameter and meet the additional spatial and temporal criteria described earlier in this chapter.

Table 4 Mapping program technology and tool types.

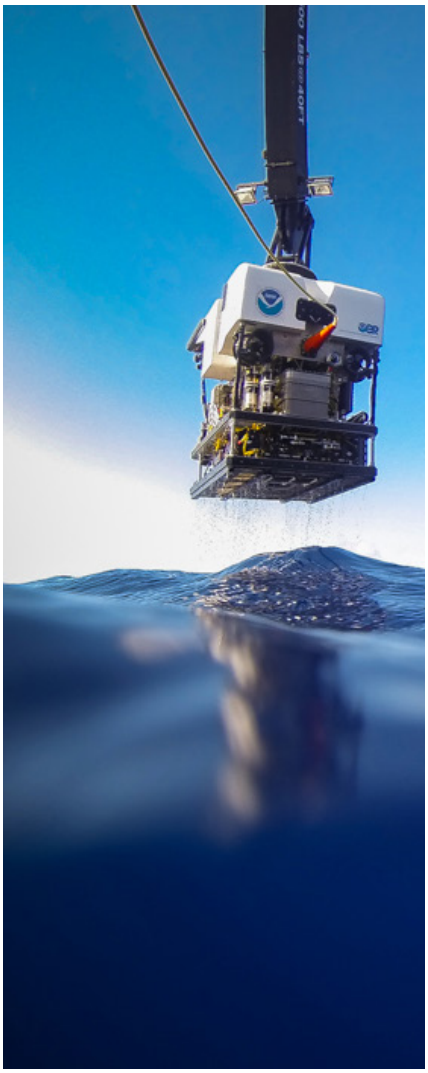
Technology/Tool Types
Multibeam echosounder (MBES)
Single beam echosounder (SBES)
Split beam echosounder
Side-scan sonar
Seismic
Subbottom
Acoustic doppler current profile (ADCP)
Light detection and ranging (Lidar)
Camera-based and/or satellite-based imagery
Radar
Synthetic aperture radar (SAR)
Interferometric synthetic aperture radar (IFSAR)
Real-time kinematic global positioning system (RTK GPS)
Total station

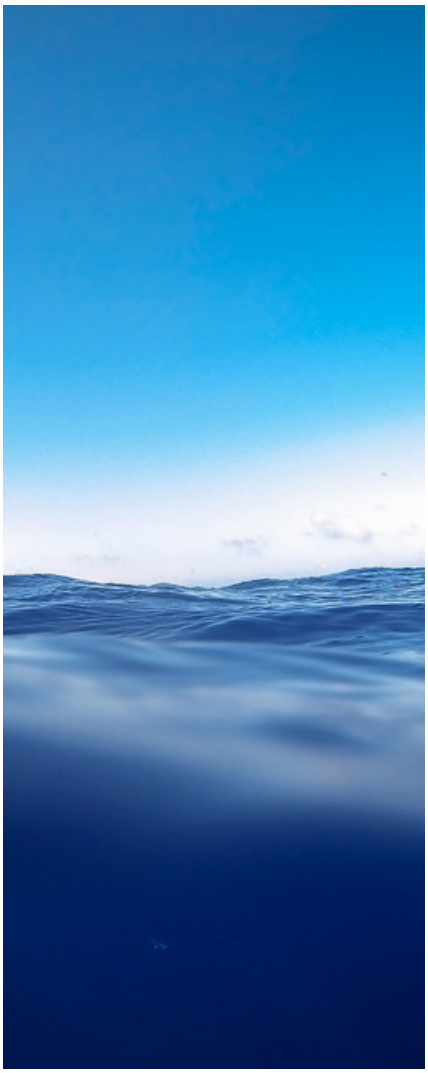


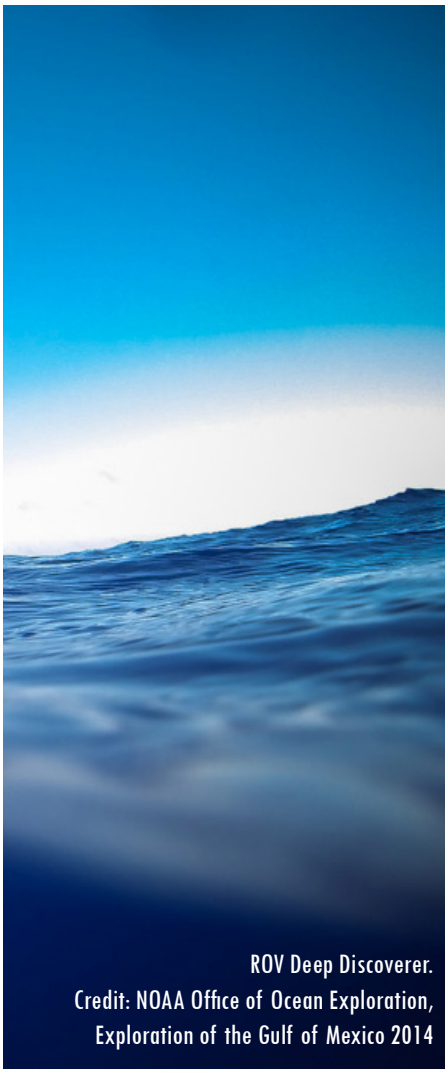
Unmanned Aircraft System (UAS) flying over Florida beach. Credit: Jennifer Brown, USGS

Table 5 Mapping program parameters.

Parameters			
Area of habitat types	Land use/Land cover	Sediment depth	Turbidity
Backscatter intensity	Multispectral imagery	Sediment grain size	Vertical accretion
Chlorophyll	Reflectivity	Soil type	Water column profiling
Currents	Salinity	Subsidence	Water temperature
Digital photography	Sea surface height	Surficial elevation	
Hyperspectral imagery	Sea surface temperature	Tides	







ROV Deep Discoverer.
Credit: NOAA Office of Ocean Exploration, Exploration of the Gulf of Mexico 2014

4 Database Framework

Bon Secour National Wildlife Refuge, Alabama.
Credit: US Fish and Wildlife Service

The database is organized into four sections: General Program Information, Water Quality Monitoring, Habitat Monitoring, and Mapping. Within each section are subsections containing information fields specific to that section. Table 6 displays the General Program Information section, subsections, field names, field definitions, and data type, which are common to all monitoring programs in the database. All field names and parameters have controlled vocabularies that are listed in the Glossary (Appendix 5) and more specific information may also be found in the CMAP Manual and Protocols for Data Entry and Review (Appendix 6).

General Program Information

Program Information

This subsection (Table 6) contains nine fields and provides basic programmatic information, such as the monitoring program name, the agency executing the program, and the agency funding the program (if applicable). The definitions are self-explanatory and more information may be found in the Glossary (Appendix 5).

Program Type

Program type provides four fields that have descriptive terminology about the monitoring program.

ProgramType refers to the type of monitoring being conducted. It could be water quality, habitat, mapping, or any combination of the three.

NRDAKeyword loosely aligns with the NRDA Programmatic Damage Assessment and Restoration Plan (PDARP) injury categories: water column, benthic, estuarine coastal wetlands, subtidal oysters, beaches, shallow unvegetated habitats, gulf sturgeon, submerged aquatic vegetation, birds, sea turtles, marine mammals, and recreational use. It is important to note that the CMAP inventory did not strictly follow the NRDA definitions tied to these terms, but used them in a more general sense so that connections can be made between CMAP, NRDA and other restoration programs at this topical level.

AquaticSetting is a hydrologic setting or stratum that is observed within a program's extent. The aquatic setting may be one or a combination of nine possible settings.

HabitatType refers to specific habitat types where monitoring occurs within a program's extent. A program may have one or a combination of 18 possible habitat types.

When combined (Table 7), ***AquaticSetting*** and ***HabitatType*** provide a general description of location or where a monitoring program's activities take place.

CollectionType is an attribute that serves to identify citizen science groups within the GoM.

POC Info

This subsection contains five fields to identify a program's point of contact (POC) and their contact information, such as phone number and email address.

Timeline

This subsection provides information about the current status (active or not) and longevity of the program.

Spatial Extent and Info

This subsection contains 11 fields that identify where the program is generally located in the GoM region. Most of the attributes are political boundaries, such as state and county.

SpatialData is a field that provides information about the spatial extent of a monitoring program. Some programs may have a polygon that provides a bounding box that represents their monitoring domain, while others may have site locations with precise latitude and longitude coordinates. Bounding box coordinates (***WestBnd***, ***EastBnd***, ***NorthBnd***, ***SouthBnd***) were derived from the spatial footprint for each program.

Coverage is a general geographic descriptor of the program. Choices included International, Nationwide, Atlantic, Gulfwide, Multistate, Statewide, or Local. Local refers to a program that operates at a scale smaller than Statewide.

Ecoregion is a field that represents an ecological framework developed by the US EPA (Omernik, 1987, 1995). Ecoregions are identified by analyzing the patterns and composition of biotic and abiotic phenomena that affect or reflect differences in ecosystem quality and integrity. A Roman numeral classification scheme has been adopted by the US EPA for different hierarchical levels of ecoregions, ranging from general regions to more detailed regions. CMAP is using the Level IV classification.

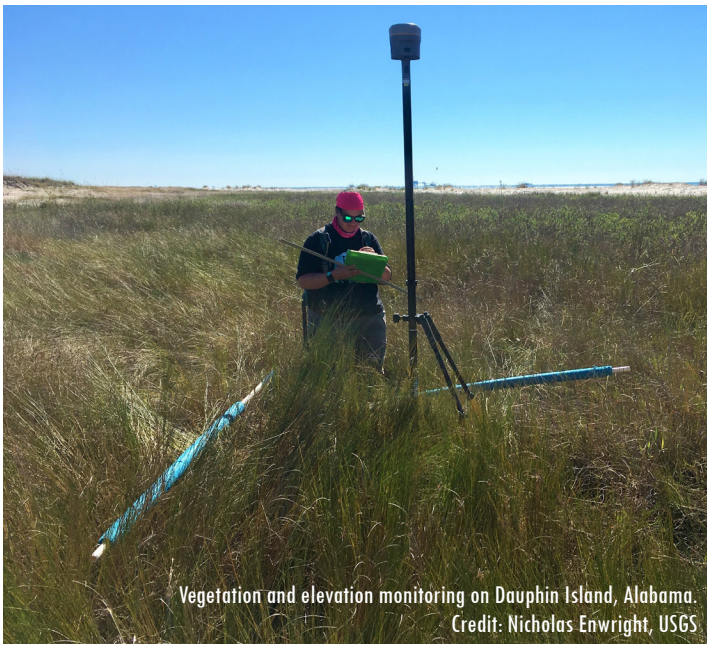
Hierarchical Levels of Ecoregions

Level I
12 ecoregions in the continental U.S.

Level II
25 ecoregions in the continental U.S.

Level III
105 ecoregions in the continental U.S.

Level IV
967 ecoregions in the conterminous U.S.



Vegetation and elevation monitoring on Dauphin Island, Alabama. Credit: Nicholas Enwright, USGS

HUC10, Hydrologic Unit Code (HUC), is a hydrologic classification system developed by the USGS (Seaber et al., 1986). Every hydrologic unit is identified by a unique HUC consisting of two to 12 digits based on the levels of classification in the hydrologic unit system. The United States is divided and subdivided into successively smaller hydrologic units, which are classified into four levels: regions, sub-regions, accounting units, and cataloging units. The hydrologic units are arranged or nested within each other from the largest geographic area (regions) to the smallest geographic area (cataloging units). The HUC-10 level reflects smaller watershed areas within the Gulf.

Waterbody uses the Coastal Assessment Framework as the organizational unit (NWFSC, 2019), which is a standardized naming convention and geographic index for the Nation's coasts and estuaries.

Accessibility

This subsection contains seven fields which provide access information for the monitoring programs data, metadata, data format, and metadata format. There is also a field to identify relevant publications.

Procedures and Quality Assurance

This subsection provides information about the availability and location of data collection, analytical, and quality assurance (QA) procedures as documented by the collecting program.

Table 6 General Program Information subsections, field names, definition and data type.

	Field Name	Definition	Data Type
Program Information	Name	Name of monitoring program	Text
	Description	Abstract or brief description of the program	Text
	DescriptionSrc	Source of the program description (Project website, metadata, POC entered, Synthesized by CMAP staff)	Text (Dropdown)
	Website	URL of program's website	Text/Hyperlink
	ExecutingAgency	Agency or organization leading the program	Text (Dropdown)
	AgencyType	Type of agency leading the program (i.e., Federal, State, Academic, NGO, etc.)	Text (Dropdown)
	FundAgency	Agency or organization funding the program	Text (Dropdown)
	FundSrc	Dropdown list of funding source for the program	Text
	FundAmt	Funds allotted to the program	Text
Program Type	ProgramType	Water Quality; Habitat Monitoring; Habitat Mapping	Text (Dropdown)
	NRDAKeyword	General program type (Water Quality, Habitat Monitoring, and/or Habitat Mapping) that loosely align with NRDA injury restoration categories to describe targets of the program	Multiple selection
	AquaticSetting	Hydrologic setting/stratum falling within program extent	Text (Dropdown)
	HabitatType	Habitat types monitored/mapped (linked to specific aquatic settings)	Text (Dropdown)
	CollectionType	Does this program incorporate volunteer or citizen science?	Yes/No
POC Information	POCName	Name of the primary point of contact (POC) for the agency/organization	Text
	POCTitle	Title of the point of contact for the agency/organization implementing the program/project	Text
	POCOffice	Office name	Text
	POCPhone	Primary POC phone number	Text (xxx-xxx-xxxx Ext. xxx)
	POCEmail	Primary POC email address	Text
Timeline	Status	Is the program active or inactive?	Text (Dropdown)
	StartDate	Start of program (MM/DD/YYYY)	Date (MM/DD/YYYY)
	EndDate	End of program (MM/DD/YYYY); Current if still ongoing	Date (MM/DD/YYYY); Current if still ongoing
Spatial Extent and Information	SpatialData	Do we have the program spatial extent data (i.e., site locations, program extent, no spatial data, etc)?	Text (Dropdown)
	WestBnd	Spatial extent of program - West bounding coordinates (decimal degrees)	Text
	EastBnd	Spatial extent of program - East bounding coordinates (decimal degrees)	Text
	NorthBnd	Spatial extent of program - North bounding coordinates (decimal degrees)	Text
	SouthBnd	Spatial extent of program - South bounding coordinates (decimal degrees)	Text
	Coverage	Gulfwide; Nationwide; International; etc	Text
	States	State(s) where project occurs	Text (Dropdown)
	Counties	County(ies) where project occurs	Text (Dropdown)
	Ecoregion	Omernik Ecoregions Level IV	Text
	HUC10	Watershed hydrological unit code (HUC-10) ID	Text
	Waterbody	Sea areas, water bodies, etc. (Coastal Assessment Framework [CAF])	Text

Table 6 cont. General Program Information subsections, field names, definition and data type. Y/N = Yes or No selection.

	Field Name	Definition	Data Type
Accessibility Information	Access	Are any of the raw data accessible?	Text (Dropdown)
	Information	URL or contact info for data source	Text/Hyperlink
	DataFormat	Are data available in a machine readable format?	Yes/No
	Metadata	Are metadata files available for the program?	Yes/No
	MetadataStd	What metadata standard was used?	Text (Dropdown)
	MetadataSrc	URL or how to obtain program's metadata	Text/Hyperlink
	Publications	List of a program's publications	Text
Procedures and Quality Assurance	Collection Procedures	Does the program/project have documented collection procedures for the majority of parameters?	Yes/No
	Collection Procedures URL	URL for documented collection procedures	Text/Hyperlink
	Analytical Procedures	Does the program/project have documented analytical procedures for the majority of parameters?	Yes/No
	Analytical Procedures URL	URL for documented analytical procedures	Text/Hyperlink
	QA Documentation	Does the program have quality assurance (QA) protocols?	Yes/No
	QA Protocol URL	URL for quality assurance protocols	Text/Hyperlink

Mangroves, Florida Bay. Credit: USGS

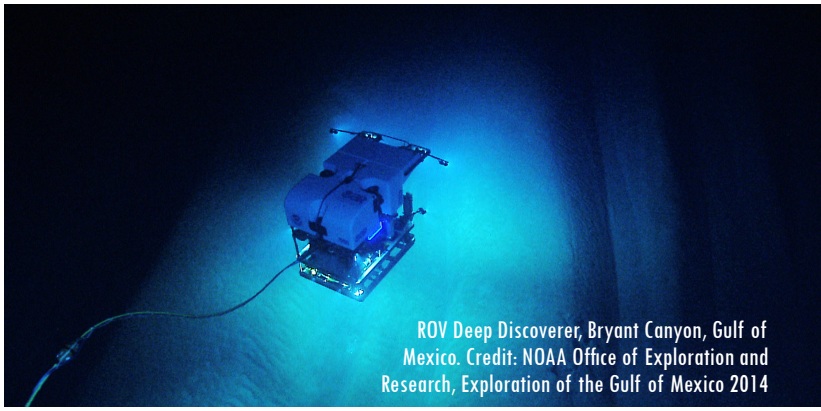
Table 7 CMAP Program Aquatic Settings (columns) and Habitat Types (rows). A monitoring program may have multiple selections within this matrix. Below is an example from Pinellas County Ambient Surface Water Quality Monitoring Program. Refer to Appendix 6 for Aquatic Setting and Habitat Type definitions.

Habitat Type	Upland	Riverine	Palustrine	Lacustrine	Estuarine	Marine Nearshore	Marine Offshore	Marine Oceanic
Agriculture	X							
Artificial reef					X	X		
Barrier island					X	X		
Beach/dune					X	X		
Coral reef								
Deep sea benthic communities								
Emergent marsh				X	X			
Forest		X	X					
Hard bottom		X			X	X		
Karst/Barren								
Mangrove		X			X	X		
Oyster/Bivalve bed					X	X		
Sargassum/Floating macroalgae								
Submerged aquatic vegetation (SAV)		X		X	X	X		
Shrub/Grassland		X						
Soft bottom		X	X	X	X	X		
Tidal flat					X	X		
Urban	X							
Water column		X	X	X	X	X		

Marine Nearshore: 0–30 m depth; Marine Offshore: 30 m to approximately 100/200 m; Marine Oceanic: 100/200–11000 m

St. Landry Parish, Louisiana, Wetlands Reserve Program. Credit: Kristen Lemoine, USDA National Resource Conservation Service.

Water quality monitoring on Lake Houston in 2017. Credit: USGS, SachinShah



ROV Deep Discoverer, Bryant Canyon, Gulf of Mexico. Credit: NOAA Office of Exploration and Research, Exploration of the Gulf of Mexico 2014

Program Type Parameters

The database sections below capture the specific parameters within water quality, habitat, or mapping program types. Some programs only conduct one type of monitoring, such as water quality, while some may conduct all three.

Water Quality Monitoring Information

This section includes six fields (Table 8) that identify all monitoring parameters collected by a program, the schedule/frequency of collection, where in the water column collection is located, and parameter units. For more information on general and detailed parameters see the documented assumptions in Table 2.

This categorization was carefully selected from previous water quality assessments or inventories (GOMA 2013; Love et al., 2015). CMAP hosted two workshops (Users Needs workshop held in March 2018 and a Monitoring Community of Practice workshop in June 2018) where participants provided feedback and recommendations on a draft set of parameters. The final list of detailed parameters was vetted and approved by the Council Monitoring and Assessment Workgroup during an in person workshop held on October 24–25, 2018, in New Orleans, LA.

Table 8 Program level water quality information.

Field Name	Definition	Data Type
ParametersGenWQ	List of general parameters	Text (Dropdown)
ParametersDetWQ	List of detailed parameters	Text (Dropdown)
Units	Unit of measure for each corresponding parameter	Text (Dropdown)
Medium	Are monitoring parameters collected in the water column, porewater, or tissue?	Text (Dropdown)
MeasSchedWQ	Does the program collect continuous or discrete water quality data?	Text (Dropdown)
MeasFreqWQ	What is the general monitoring frequency? (more frequent than hourly, hourly, daily, weekly, monthly, annually, less frequent than annually, no set frequency, etc.)	Text (Dropdown)

Habitat Monitoring Information

This section includes six attributes identifying monitoring parameters, the schedule and frequency of collecting, and monitoring activity (Table 9). The attribute ***MonitoringActivity***, is a controlled list of activities: bathymetry, topography, habitat classification, beach renourishment, marine debris, shoreline, inundation modeling, human use, seafloor characterization, environmental modeling, hydrocarbon detection, maritime heritage, and water column hydrodynamics.

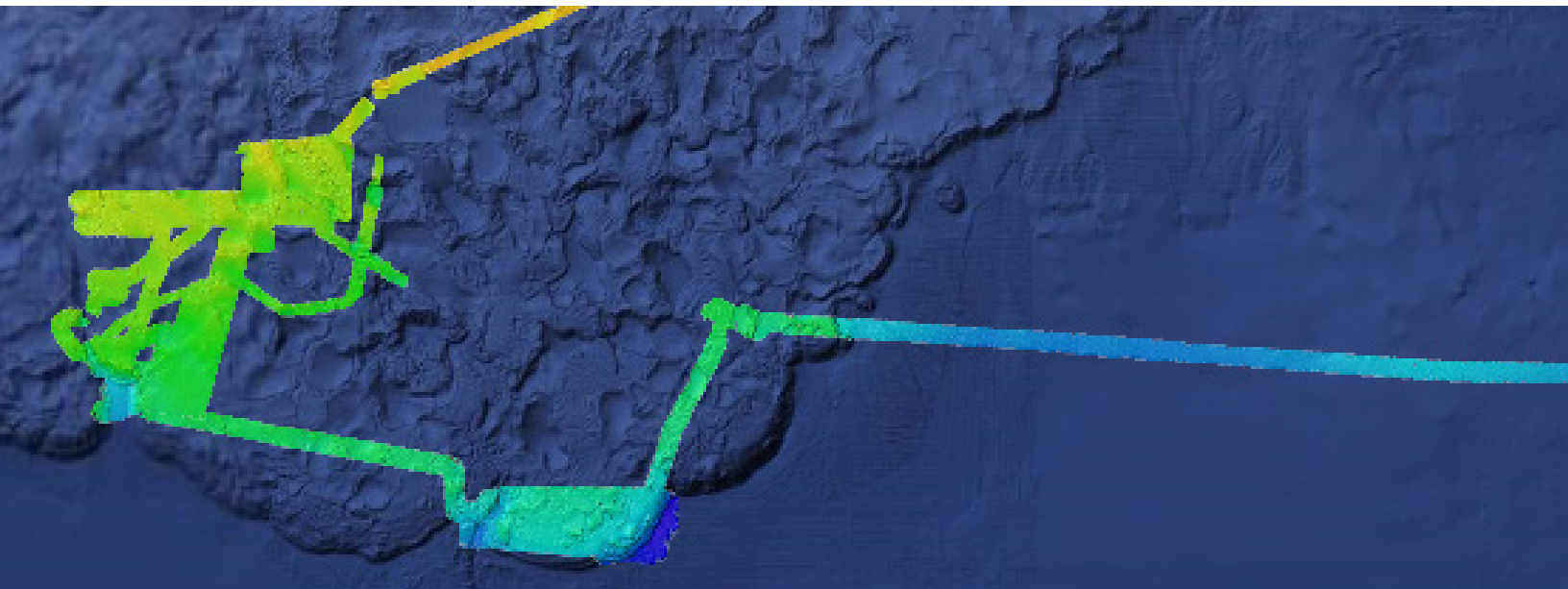
Habitat monitoring parameters, first introduced in the documented assumptions (Table 3), were grouped by three levels to provide functional organization. ***ParametersGenHM*** include three broad 'General' levels based on living or abiotic habitats. These levels include: 1) Submerged habitat building animals, which focuses on oysters and corals but also includes sponges, tube worms and bivalves; 2) Plants and Macroalgae, which includes terrestrial plants, seagrasses, and floating and/or benthic algal communities; and 3) Abiotic which includes the non-living chemical and physical aspect of a habitat.

The next tier of habitat monitoring information, groups, are similar groupings for plants and animals. Physiology/Health are parameters that portray growth, size, or any effects from disease. Population dynamics are parameters that depict reproductive or spawning capacity, mortality, survivorship, etc. Ecological metrics are community parameters including percent cover, abundance, and species composition.

Abiotic groups include substrate metrics, which describe or classify substrate, and coastal processes, which are influencing factors in coastal zone habitats.

Table 9 Program level habitat monitoring information.

Field Name	Definition	Data Type
ParametersGenHM	List of general parameters	Text (Dropdown)
ParametersGrpHM	List of detailed parameters identified within level 2 groupings	Text (Dropdown)
ParametersSubGrpHM	List of detailed parameters identified within level 3 groupings	Text (Dropdown)
MonitoringActivity	Types of monitoring activities done within program/project	Text (Dropdown)
MeasSchedHM	Does the program collect continuous or discrete water quality data?	Text (Dropdown)
MeasFreqHM	What is the general monitoring frequency? (more frequent than hourly, hourly, daily, weekly, monthly, annually, less frequent than annually, no set frequency, etc.)	Text (Dropdown)



Mapping Information

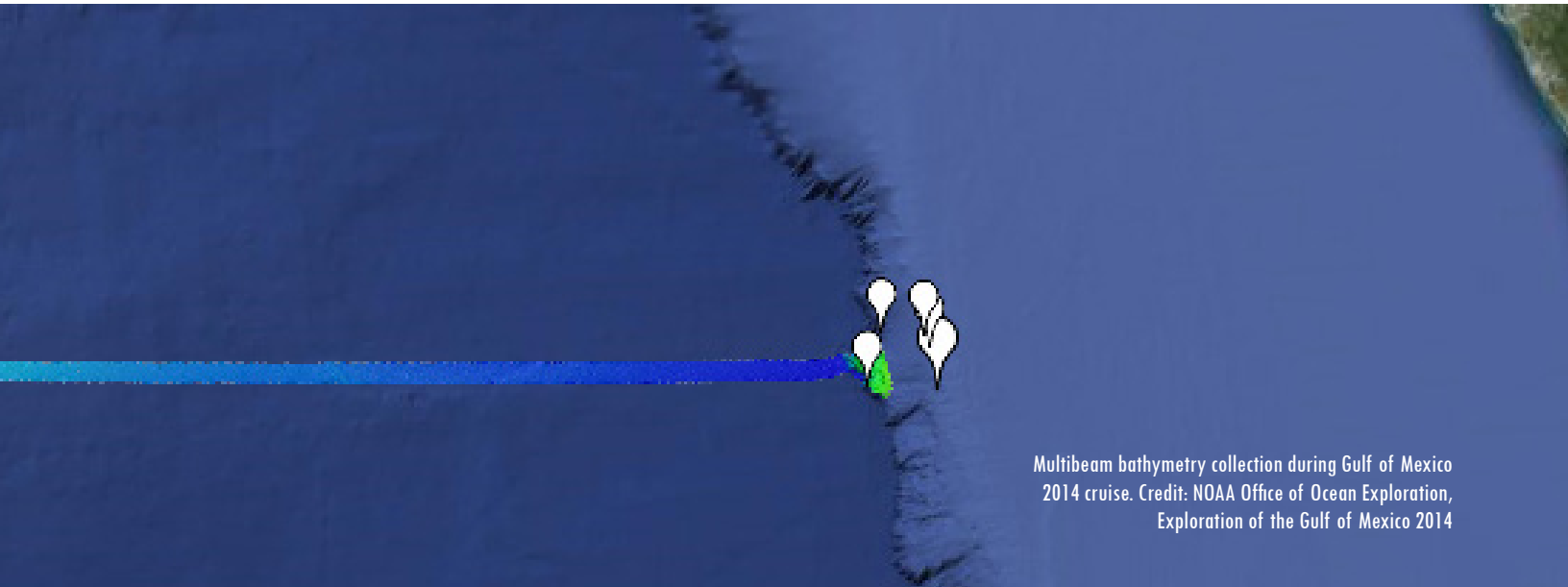
Mapping program attributes (Table 10) were drafted and compiled through a collaborative process among CMAP staff and in consultation with habitat and seafloor mapping experts. Source materials surrounding the topic of habitat mapping and classification standards and guidelines, such as those developed by the USGS (Heidemann, 2018; NOAA, 2011), International Hydrographic Organization (IHO, 2008), American Society for Photogrammetry and Remote Sensing (ASPRS, 2014) and others (Story and Congalton, 1986; Diaz et al., 2004), were referenced to develop selections for the various elements involved in the collection and development of mapping source data and products.

This subsection includes eight fields that provide information about mapping platforms, tools, activities, classification, if any, and spatial and temporal components.

Detailed mapping information, previously described with documented assumptions (Tables 4 and 5), is classified by 14 technologies or tools that are used to collect information. Mapping parameters include 20 raw measurements or products that are derived from mapping data. More information can be found in the Glossary (Appendix 5) and CMAP Manual (Appendix 6).

Table 10 Program level mapping information.

Field Name	Definition	Data Type
PlatformType	Type of platform technology or tool(s) deployed	Text
MappingTechnology	Technology or tool(s) used to collect data	Text (Dropdown)
ParametersMap	Quantifiable measured collected	Text (Dropdown)
MappingActivity	Bathymetry, Elevation, Habitat classification, Seafloor characterization, Beach renourishment, Marine debris, Shoreline, Inundation modeling, Human use, Marine mammals, etc	Text (Dropdown)
ClassificationScheme	What is classification scheme used?	Text (Dropdown)
SpatialResolution	Spatial resolution of map products; If produced from scanned analog photography what was scale and dpi (if available)?	Text
TemporalResolution	What is the temporal resolution of the data? Was it a single mapping event? Have there been any other year(s) mapped?	Text
MapDate	Year(s) mapped	YYYYMMDD (Multiple selection)



Multibeam bathymetry collection during Gulf of Mexico 2014 cruise. Credit: NOAA Office of Ocean Exploration, Exploration of the Gulf of Mexico 2014

5 Database Development

Big Cypress National Preserve. Credit: NPS

Manual and Protocols for Data Entry and Review

The inventory was expected to be a substantial task with many hours of effort expended by both NOAA and USGS staff, many of which are located across the GoM. As such, a manual was developed to coordinate the discovery, evaluation, and capture of monitoring information to reduce duplication and increase efficiency. NOAA and USGS staff developed the manual, and all staff conducting discovery, evaluation, and information capture were advised to use the manual throughout the process. The document outlines the process of assessing, entering, and reviewing monitoring program information for the inventory. It is presented in five sections (and a Glossary) not to be confused with database sections previously described. Each section details a specific component of the inventorying process. Each section contains both internal bookmarks/links, as well as links to external reference documents. Below is a brief summary of the manual; for more details, refer to Appendix 6.

Section 1 provides two filters for the inclusion of potential monitoring programs into the database. The first is an internal check to see if the program has already been entered into the database. If not, the program is checked against the Documented Assumptions/Criteria for Inclusion (Appendix 6, Section 2) and its requirements (Appendix 4). If the program satisfies the requirements, then data entry can proceed (Appendix 6, Section 3). A website was developed for CMAP staff to populate program information into the database. Section 3 is a detailed guide that references how to enter information for each field and identifies potential trouble spots and offers potential remedies. Section 4 focuses on programs that do not meet the requirements of the Documented Assumptions. These programs were not included in the database, but placed in a separate database and labeled as Questionable or Deferred Programs. There are six factors that may cause a program to be included on the Questionable or Deferred list:

Questionable/Deferred Factor List

1. ***Faunal species monitoring***
   A program/project that only monitors faunal species (no habitat or water quality data collection)
2. ***Atmospheric monitoring***
   A program/project that collects atmospheric data (i.e., precipitation, winds, air temperature, etc.)
3. ***Other monitoring targets***
   A monitoring program/project that does not monitor habitat or water quality condition
4. ***Geographic coverage***
   A potential program/project in which the collection area does not overlap with the CMAP spatial extent
5. ***Temporal coverage***
   A program/project that does not meet the temporal Documented Assumption
6. ***Lack of information***
   A program/project that cannot be assessed comprehensively due to a lack of available information

Programs that did not meet the Documented Assumptions/ Criteria for inclusion for focal reasons (i.e., not water quality, habitat, or mapping programs) may be investigated in the future in the event the CMAP effort is extended to other focal areas (i.e., birds, fish, other faunal species). If a program did not meet the requirements based on spatial or temporal requirements, the program was cross checked with the five exceptions (Appendix 4) to evaluate if the program meets any of those criteria. If no criteria were met, the program was added to the Questionable/Deferred List.

For those programs that lacked information, a review of the program was conducted by an additional staff member to see if other clarifying information could be identified. If no additional information was discovered, the program was moved to the Questionable/Deferred List.

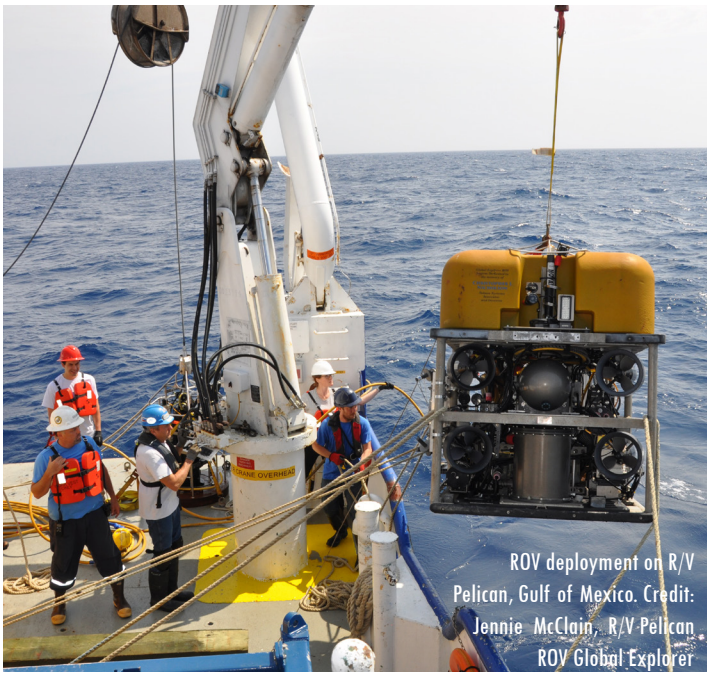
Website development

Once the database framework was established, a PostgreSQL relational database was created to store program information for the inventory. A website was developed for CMAP staff to manage the contents of the database; this website was internal only for development of the inventory. The site included a series of web forms that allow staff to enter new program/project records; search, view, and amend existing records; and usher a record through the review process. The web forms covered all information collected about a program/project in the inventory except spatial data, which were imported into the database in a separate process (Chapter 7, Spatial data).

In support of the data entry and review process (Chapter 6), the website provided buttons and internal comment fields that helped CMAP staff communicate and track the status of each record. Individual user accounts were issued to each CMAP staff member, limiting access to the database to only CMAP staff while the inventory was under development. The website also used these accounts to facilitate the review process within the bounds set forth by the manual (Appendix 6, Section 5a), ensuring that a record could not be edited during review except by the reviewer and preventing a user from acting as both data entrant and reviewer on the same record.

Website users could also export information from the database, either for a single record in a Portable Document Format (PDF) file (for POC review) or for all records in a comma-separated values (CSV) file (for external analysis).

Turtle grass, St. Martins Marsh Aquatic Preserve, Florida. Credit: Jon Brucker, Florida Department of Environmental Protection



ROV deployment on R/V Pelican, Gulf of Mexico. Credit: Jennie McClain, R/V Pelican ROV Global Explorer

6 Database Entry and Review Process

Feeding birds at study site in coastal salt marsh, Louisiana. Credit: USGS

The manual for data entry and review listed in Chapter 5 provides details for the program review process. The inventory record review process involves four stages:

1

1st Round of Internal Record Review

2

Point of Contact Review

3

2nd Round of Internal Record Review

4

Record Completion

All programs that were entered into the database and those listed as questionable were reviewed internally. Each record was reviewed by a staff member who did not conduct the original entry. This review process included verifying that the Documented Assumptions or exceptions criteria were met and validating each field of the record. Field validation involved searching for information to populate fields that were not originally completed. In cases where the reviewer identified potential errors or recommended information removal, the reviewer collaborated and agreed upon the needed action for the record with the data entrant before making the appropriate changes in the database.

Following the internal review, the POCs were contacted and feedback was requested regarding the information compiled to ensure accuracy. POCs were contacted via email, which included: 1) A letter outlining our efforts and our request for feedback (Figure 2); 2) an editable PDF containing program information for review (Figure 3, Appendix 7); and 3) a CMAP glossary defining all terms used in the PDF (Appendix 5). The POC was asked to review programmatic content and to provide data collection methods and procedural documentation (i.e., collection procedures, analytical procedures, and quality assurance protocols) if none were identified in the program review. These procedural documents will be used for other CMAP components (Minimum Monitoring Elements — Task 3 and Gap Analysis — Task 5). The POC was also asked for spatially referenced data (i.e., project footprint boundary, sampling station/site locations, and/or sampling station/site locations, along with information specifying what parameters are collected where and at what frequency) if existing.

POCs were given 14 days to review their program information (additional time was allowed for POCs in which multiple program reviews were requested). Edits received were reviewed and, if necessary, followed up for clarification and/or additional files (i.e., procedure documentation and/or spatial data). If the POC did not respond to our request for edits or additional files within the allotted time, we reached out to the POC a second time. All received files connected to Tasks 3, 5, and 8 were vetted and stored in the appropriate libraries.

TEXT IN BODY OF EMAIL:

Subject Line: PROGRAM INFORMATION REQUEST, PLEASE RESPOND

Dear **X**,

The **[project/program name]** has been identified for inclusion in the RESTORE Council Monitoring & Assessment Program (CMAP) inventory of habitat and water quality monitoring and mapping activities in the Gulf of Mexico. CMAP is a collaborative effort between NOAA and USGS funded by the Gulf Coast Ecosystem Restoration Council (https://www.restorethegulf.gov/), whose objective is to build foundational components for a Gulf-wide monitoring network that can provide data to track the progress of restoration investments. The **[Project/program name]** will be a valuable component of this network, and by fulfilling this request you will ensure the inclusion of accurate information about this activity in the inventory.

You have been identified as a point of contact for this project/program. We respectfully ask for your support in reviewing programmatic content, and if possible, provide any missing information. In the event you are the point of contact for additional programs or not the point of contact for this program, please let us know via email.

Attached you will find:

1. Editable Portable Document Format (PDF) containing your program/project information and instructions for review
2. Glossary of terms for reference

We would appreciate your feedback within **two weeks** of this email. If we have not heard back from you we will follow up to see if you have any questions or need assistance with this request. In the event that we do not receive a response from you after a follow up, then we will consider the current entry for the project/program as final.

CMAP, in coordination with the Gulf of Mexico Alliance (https://gulfofmexicoalliance.gov/) and multiple agencies and organizations, will leverage existing resources, capacities, and expertise and build on existing monitoring activities to acquire and use the best available science to support restoration and resource managemen
more information on CMAP.

If you have any questions regarding this requ
address or by phone with CMAP staff listed be

We are grateful for your time and consideratio

This editable Portable Document Format (PDF) form has been populated with information describing **[Project/program name]**. We have included some general instructions as well as a glossary of terms to help complete the review and/or revision of this information. Once completed, the CMAP team will incorporate your edits for the project/program(s) records into the RESTORE CMAP database.

We would appreciate your feedback within **two weeks** of this email. Please let us know if you have any questions regarding the process or technical issues with the PDF. We greatly appreciate your participation in the CMAP effort.

INSTRUCTIONS FOR REVIEW:

- PDF form may be opened and edited in Adobe Acrobat Reader (free download here)
- Review program information and make revisions as necessary
- Provide missing information
- Save your edits (if any)
- If no additions or changes are needed please confirm your review and let us know that no revisions are necessary
- Return modified PDF to RESTORECouncil_Monitoring@restorethegulf.gov along with any additional comments

REVIEWER FEEDBACK:

Please specify one of the following options in the return email:

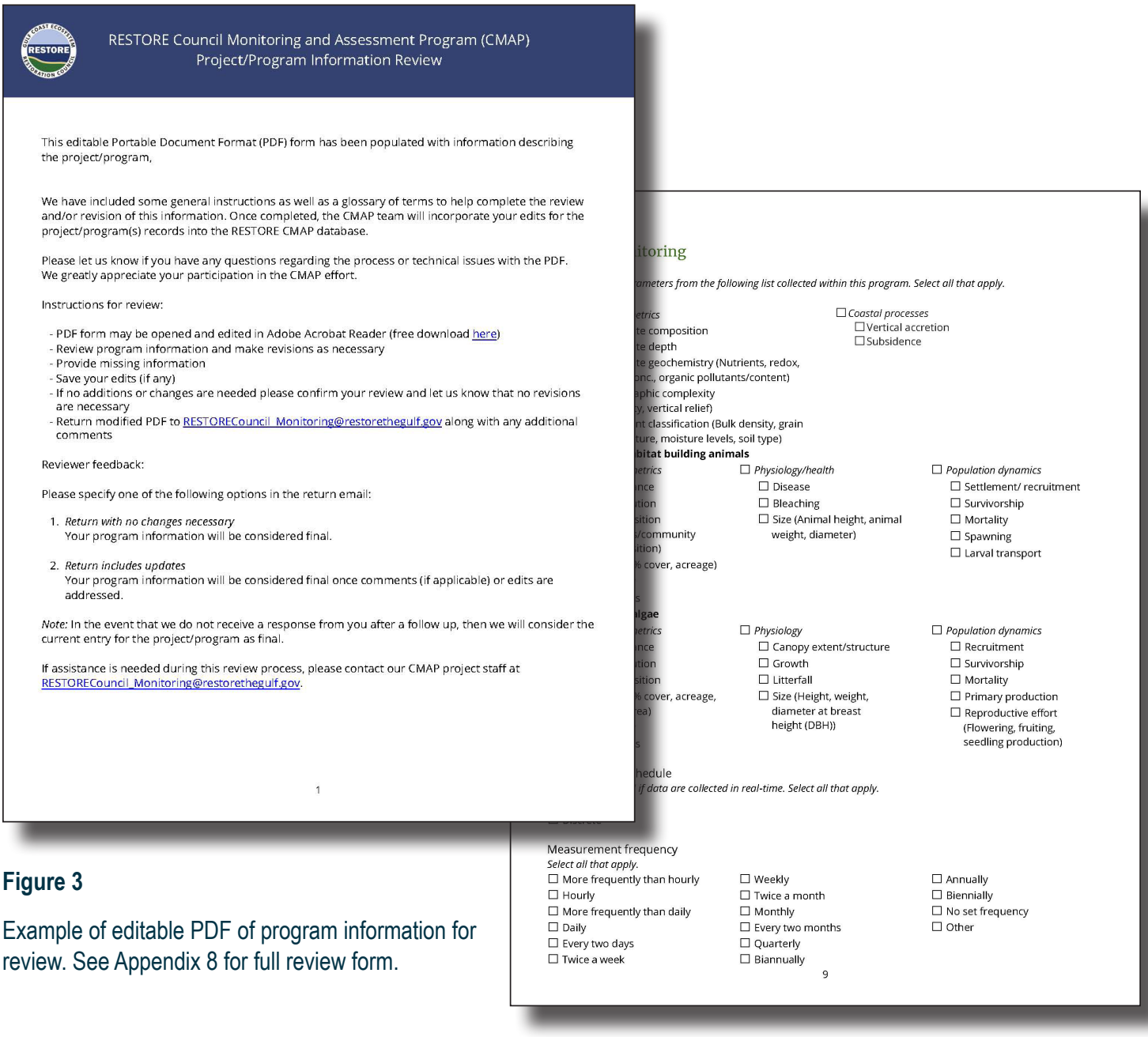
1. *Return with no changes necessary*
   Your program information will be considered final.

2. *Return includes updates*
   Your program information will be considered final once comments (if applicable) or edits are addressed.

Note-
In the event that we do not receive a response from you after a follow up, then we will consider the current entry for the project/program as final.

If assistance is needed during this review process, please contact our CMAP project staff at RESTORECouncil_Monitoring@restorethegulf.gov

Figure 2 Feedback request email template sent to Points of Contact (POC).



RESTORE Council Monitoring and Assessment Program (CMAP)
Project/Program Information Review

This editable Portable Document Format (PDF) form has been populated with information describing the project/program,

We have included some general instructions as well as a glossary of terms to help complete the review and/or revision of this information. Once completed, the CMAP team will incorporate your edits for the project/program(s) records into the RESTORE CMAP database.

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If assistance is needed during this review process, please contact our CMAP project staff at RESTORECouncil_Monitoring@restorethegulf.gov.

1

itoring

ameters from the following list collected within this program. Select all that apply.

☐ *Coastal processes*
☐ Vertical accretion
☐ Subsidence

bitat building animals

☐ *Physiology/health*
☐ Disease
☐ Bleaching
☐ Size (Animal height, animal weight, diameter)

☐ *Population dynamics*
☐ Settlement/ recruitment
☐ Survivorship
☐ Mortality
☐ Spawning
☐ Larval transport

lgae

☐ *Physiology*
☐ Canopy extent/structure
☐ Growth
☐ Litterfall
☐ Size (Height, weight, diameter at breast height (DBH))

☐ *Population dynamics*
☐ Recruitment
☐ Survivorship
☐ Mortality
☐ Primary production
☐ Reproductive effort (Flowering, fruiting, seedling production)

hedule

if data are collected in real-time. Select all that apply.

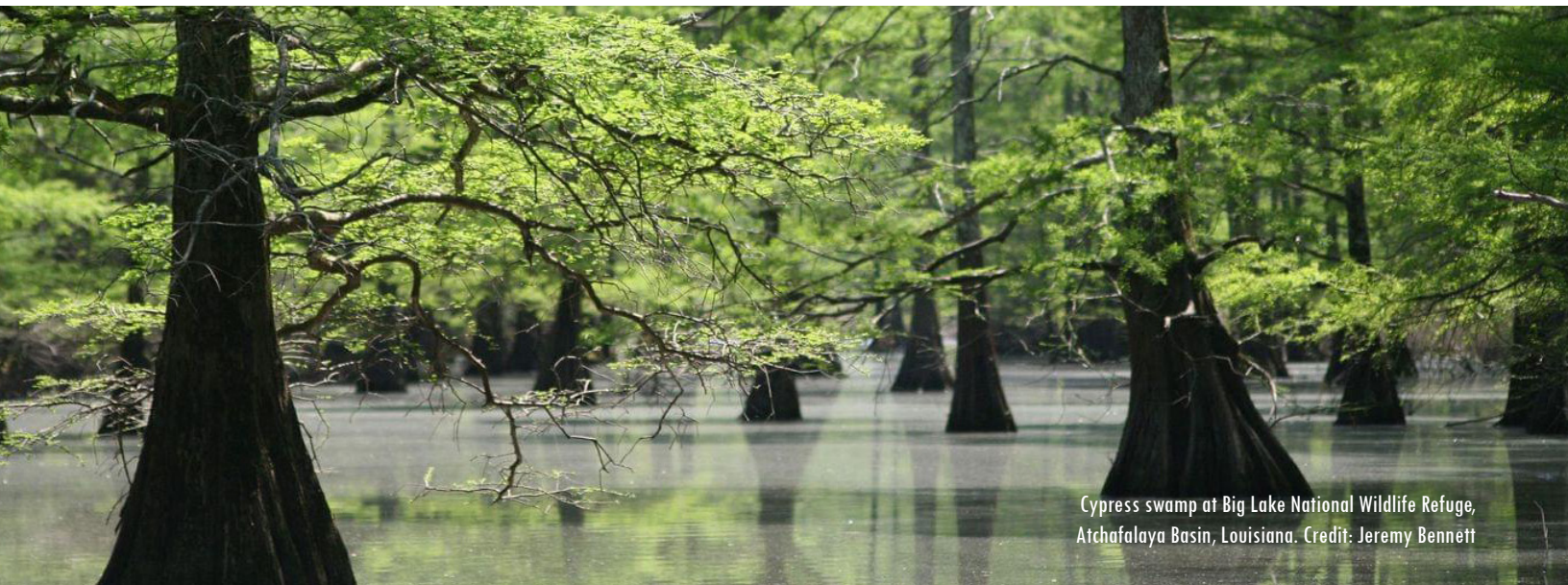
Measurement frequency
Select all that apply.

☐ More frequently than hourly
☐ Hourly
☐ More frequently than daily
☐ Daily
☐ Every two days
☐ Twice a week
☐ Weekly
☐ Twice a month
☐ Monthly
☐ Every two months
☐ Quarterly
☐ Biannually
☐ Annually
☐ Biennially
☐ No set frequency
☐ Other

9

Figure 3

Example of editable PDF of program information for review. See Appendix 8 for full review form.



Cypress swamp at Big Lake National Wildlife Refuge, Atchafalaya Basin, Louisiana. Credit: Jeremy Bennett

When POCs returned their reviews, CMAP staff followed up with further questions as needed or thanked them for their participation within an appropriate time frame. However, the length of CMAP response time was greater during the holiday season and government furlough. All correspondence was carefully tracked in a spreadsheet shared with the review team.

Between November 2018 and April 2019, CMAP staff engaged POCs for 599 programs. Edits were received from POCs with a singular program review request within three to 23 days and within nine to 29 days for POCs with multiple programs to review.

After completion of the POC engagement process, a total of 544 programs were retained in the database, the other 55 programs were either marked Deferred/Questionable or were identified as a duplicate of another record during the POC and final review process. Nearly one-half of the programs linked to a POC assigned to multiple programs; program review requests ranged between two and 50 for these POCs.

Of the 544 programs retained in the database, CMAP staff received responses from POCs for 61% (332) programs and 39% (212) received no POC response (Figure 4). Nearly all of the POC responses (98%; 323 programs) included suggested edits to their program record, while 2% (9) had no suggested edits to the original information catalogued (Figure 4). For two records, no POC response was received, but record information was verified via the Florida Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR) database.

The response rate to requests for additional files (i.e., protocol documentation and/or spatial data) and/or follow up questions was just under 60%.

Feedback from POCs was carefully reviewed before changes were incorporated in the inventory. Records for which we received no feedback were internally reviewed for a third time. All records underwent a final quality assurance procedure ensuring consistent formatting.

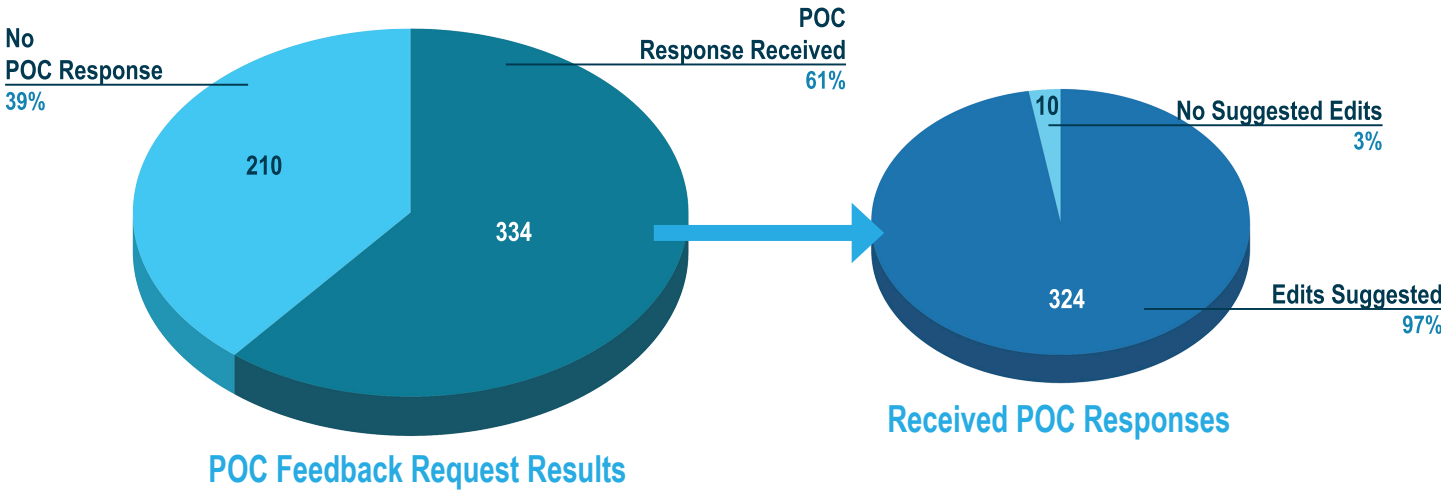


Figure 4 Point of Contact (POC) engagement results out of a total of 544 programs.

7 Summary for Inventory Results

Coral and lobster from the West Florida Shelf. Credit: NOAA Office of Ocean Exploration and Research, Gulf of Mexico 2014

General Results

Several targeted inventories of Gulf monitoring programs were initially developed by the Gulf Coast Ecosystem Restoration Task Force, USGS, Ocean Conservancy, GOMA, and others following the BP oil spill (Appendix 1). The RESTORE Council Monitoring and Assessment Program compiled, integrated and expanded upon these catalogues to provide a comprehensive directory of water quality, habitat monitoring, and mapping programs searchable by geography, monitoring parameter, habitat, status, and restoration type.

CMAP, in consultation with the CMAWG and the MCoP, determined the type(s) and detail of information (attributes) to be collected from the monitoring programs identified. These metadata attributes include elements such as:

1. Program objectives;
2. Program duration and monitoring frequency;
3. Observational accuracy and precision;
4. Geographic extent;
5. Methodology protocols for collection, analysis, data management, Quality Assurance/Quality Control (QA/QC) etc.;
6. Funding source and amount;
7. Data access/outlets (e.g., web portals, FTP sites, etc.); and
8. Program contacts

The joint USGS-NOAA team made direct contact with monitoring program staff (i.e., points of contact) through email correspondence and or phone calls to convey the CMAP objectives, and to gather the specified program metadata. Team members entered the data into a structured relational database, and then presented the information back to the program POC to verify accuracy of the documentation. The POC review process was successful and yielded a 65% response rate.

Summary Program Information

During the course of data entry, over 12,500 program or project records were evaluated for inclusion in the inventory from across 43 other existing databases and inventories. This total number of records, however, overestimates the number of unique programs and projects due to duplication across multiple existing databases and inventories. All records were not included in the inventory either due to not meeting the CMAP Documented Assumptions/Criteria for Inclusion or due to a lack of information that prevented CMAP staff from accurately assessing whether the assumptions/criteria were met.

A total of 544 monitoring and mapping programs or projects out of the 12,500 records evaluated met the CMAP Documented Assumptions and are catalogued in the inventory. The majority (362; 66%) of programs or projects monitor water quality; 242 (44%) monitor habitats and 219 (40%) collect or create mapping data and map products

(Figure 5); percentages total over 100% because of programs or projects which fall into more than one Program Type. Many programs or projects participate in multiple monitoring or mapping efforts (202; 37%); the majority of those include 77 (14% of total) programs that monitor both water quality and habitat and are producing some sort of mapping data or product. Appendix 8 is an example of an actual program from the inventory.

While the inventory identified 544 specific programs, many contained multiple entities that were considered the executing agency (these entities included Federal, State, local agencies, academia, industry and NGO partners). Appendix 9 lists all of the 434 entities identified as lead agencies for the programs included in the inventory.

The majority of water quality, habitat, and mapping programs occur at the local scale (Figure 6). Note that the number of programs for this comparison is greater than the total number of programs (N=544) displayed in Figure 5. Many of the programs may include more than one program type.

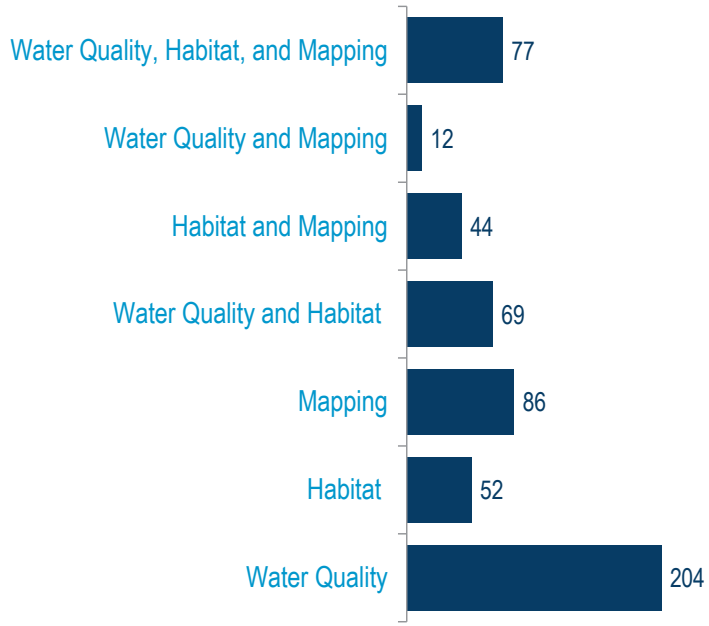


Figure 5 Total records by monitoring/mapping type (N=544).

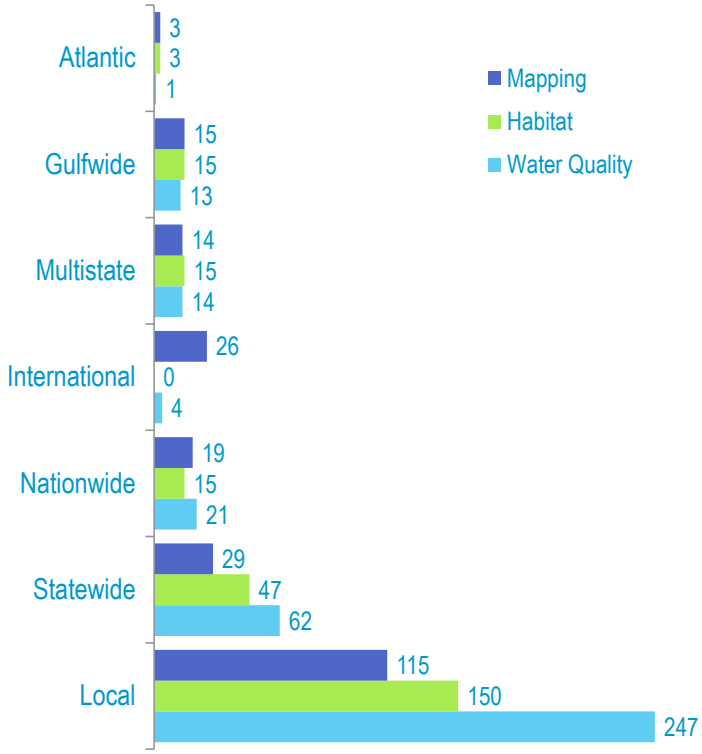


Figure 6 Number of programs per regional coverage.

Atchafalaya River Basin water quality monitoring. Credit: Jennifer LaVista, USGS

The State of Florida is well-represented in the inventory with 361 (66%) of the programs or projects monitoring or mapping within the State's jurisdictional boundary (Figure 7). Louisiana, Texas, Alabama, and Mississippi have similar percentages in the inventory ranging from 110 to 129 (20–24%) programs or projects working within each State. Monitoring or mapping activity in Georgia account for 76 (14%) programs. Only 80 (15%) programs or projects are monitoring or mapping within Federal marine nearshore, offshore, and oceanic waters; the majority of those (64) are collecting or producing mapping data and products (Figure 8). Florida's large percentage can be primarily explained due to the inclusion of the entire state within the CMAP study area, but it is also important to note that monitoring efforts within Florida are well documented and accessible due to similar database inventory efforts such as Water-CAT and Terra-CAT (https://terra-cat.usf.edu/).

Water quality, habitat monitoring, and mapping program types, compared by state, identifies that Florida has 242 water quality programs occurring in the state, nearly the sum of all the other Gulf states combined (Figure 8). Similarly, Florida has more habitat monitoring and mapping programs than the other Gulf states. Program type numbers are similar among Alabama, Mississippi, Louisiana, Texas, and the Federal-Marine jurisdiction. Georgia has slightly fewer program types than the Gulf states.

A matrix of the number of programs and projects within the aquatic setting and habitat type are provided in Table 11. The top five habitat types and aquatic settings within which programs or projects are monitoring (total value in parentheses) include:

53%
Water column - Estuarine (291)

45%
Water column - Marine Nearshore (246)

32%
Water column - Riverine (176)

28%
Emergent marsh - Estuarine (151)

18%
Water column-Lacustrine (99)

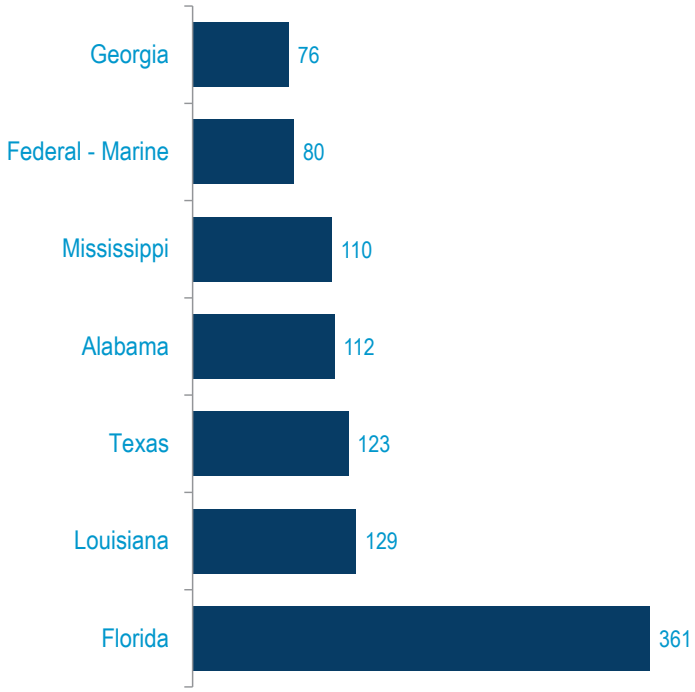


Figure 7 Number of monitoring programs by state or federal jurisdiction.

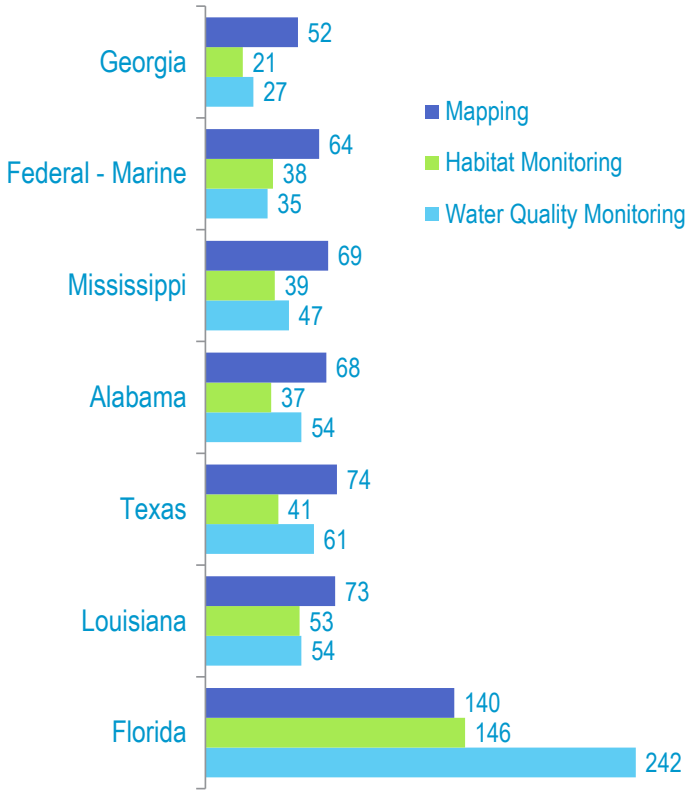


Figure 8 Number of water quality, habitat monitoring, and mapping program types by state or federal jurisdiction.

Table 11 Number of programs and projects within the aquatic setting and habitat type matrix.

Habitat Type	Upland	Riverine	Palustrine	Lacustrine	Estuarine	Marine Nearshore	Marine Offshore	Marine Oceanic
Agriculture	44							
Artificial reef					4	21	5	16
Barrier island	59		23	20	50	55		
Beach/Dune	63				17	69		
Coral reef						42	23	4
Deep sea benthic communities							10	20
Emergent marsh		45	76	36	151	32		
Forest	55	49	67	7	25			
Hard bottom		5	5	7	24	35	22	20
Karst/Barren	18					1	1	
Mangrove		13			90	71		
Oyster/Bivalve bed		1		1	71	38		
Sargassum/Floating macroalgae					6	8	3	1
Submerged aquatic vegetation (SAV)		13	8	10	78	69	1	
Shrub/Grassland	53	19	37	16	40	1		
Soft bottom		10	10	11	55	59	22	16
Tidal flat	1		2	1	90	70	1	1
Urban	42							
Water column	21	176	78	99	291	246	65	49

Marine Nearshore: 0–30 m depth; Marine Offshore: 30 m to approximately 100/200 m; Marine Oceanic: 100/200–11000 m

CRMS site, Mermentau Basin, Louisiana. Credit: USGS

Summary Parameter Information

Water quality parameter frequency of occurrence is displayed in Figure 9. Field parameters, such as water temperature (86%), conductance/salinity (84%), turbidity (81%), and dissolved oxygen (68%), were the most commonly collected parameters among the programs in the inventory. Chlorophyll (43%) was the most frequently collected aquatic primary producer parameter. The most commonly collected nutrients were total nitrogen (38%), total phosphorus (38%), ammonia (36%), and nitrite + nitrate (32%). Total suspended solids were noted for 30% of the programs and the most frequently collected in the sediment general parameter. The most frequently collected pathogens were fecal coliforms (17%) and *Enterococcus* (16%) and the remaining pathogens were observed at frequencies less than 10%. Mercury parameters were collected by less than 10% of programs. Harmful algal bloom parameters, cyanobacteria and algal toxins, were collectively represented in 5% of water quality programs.

Ecological metrics for both the submerged habitat building animals and plant/macroalgae general habitat monitoring parameters were the most commonly collected parameters in the inventory. (Figure 10). Composition (67%), percent cover (62%) and abundance (55%) were the most frequently measured parameters within the ecological metrics (Figure 10). Each abiotic parameter was observed in fewer than 35% of programs, with substrate composition (33%) and sediment classification (32%) having the highest frequencies of occurrence. Physiological and population parameters yielded low frequency of occurrence, generally less than 15% for each parameter.

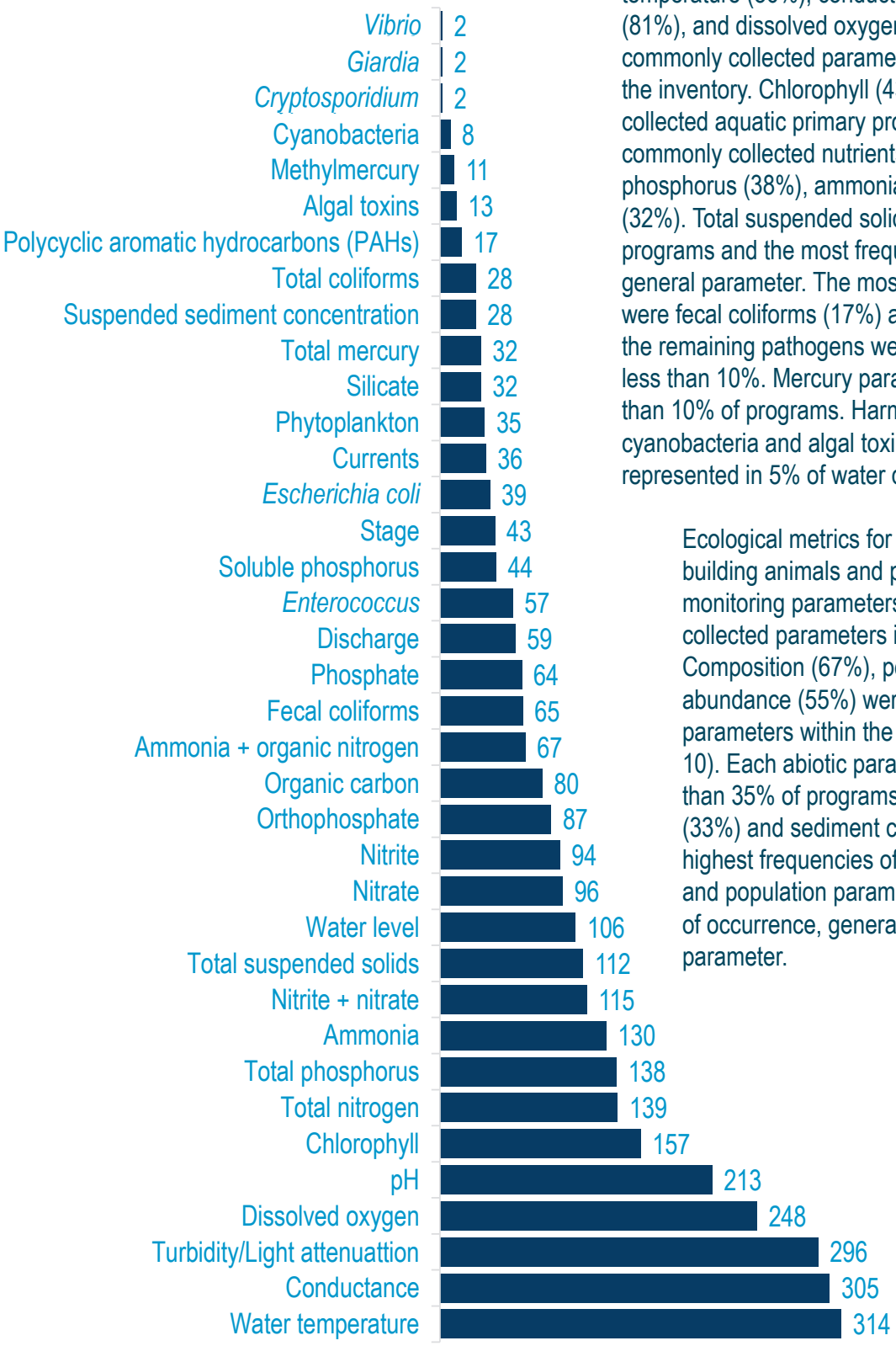
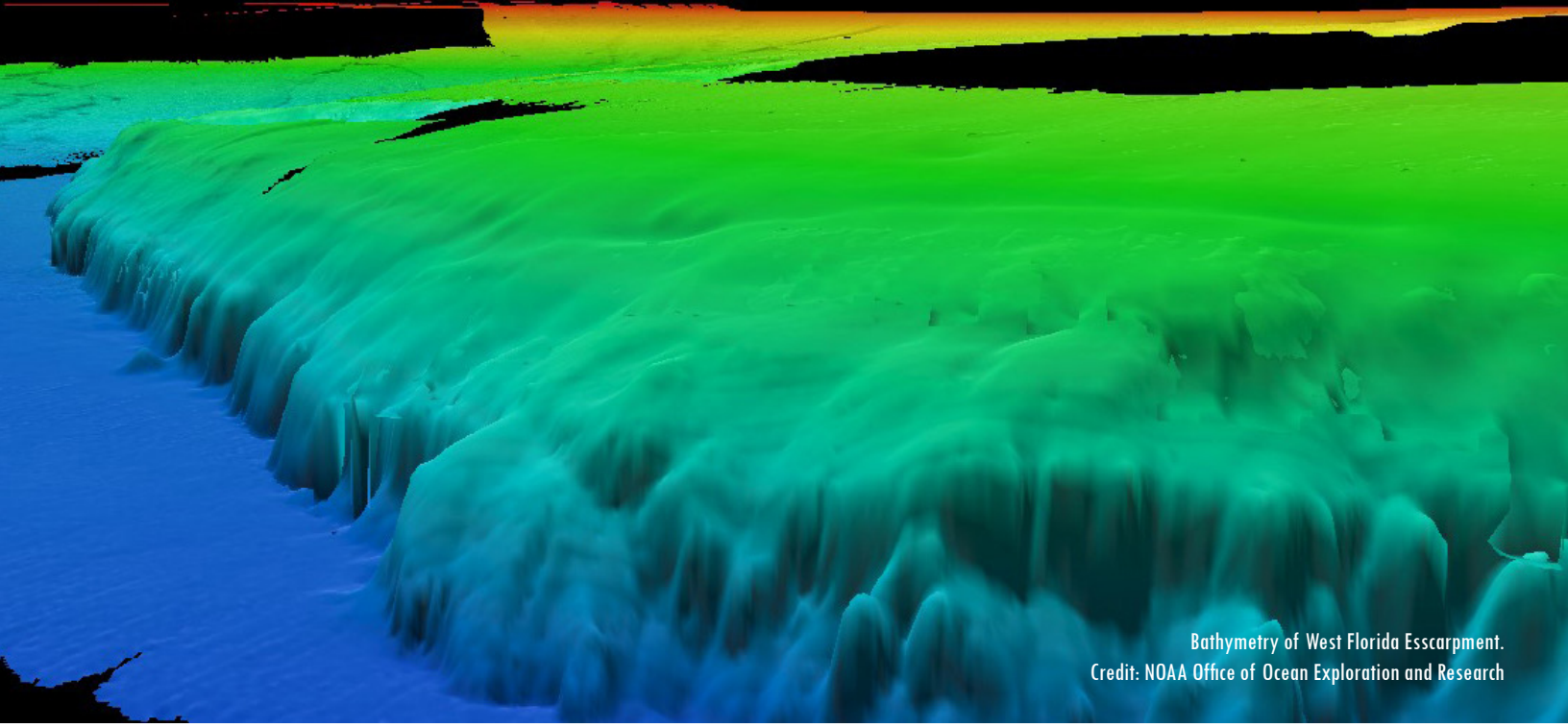


Figure 9 Occurrence for parameters collected by water quality programs (N=362).



Bathymetry of West Florida Esscarpment.
Credit: NOAA Office of Ocean Exploration and Research

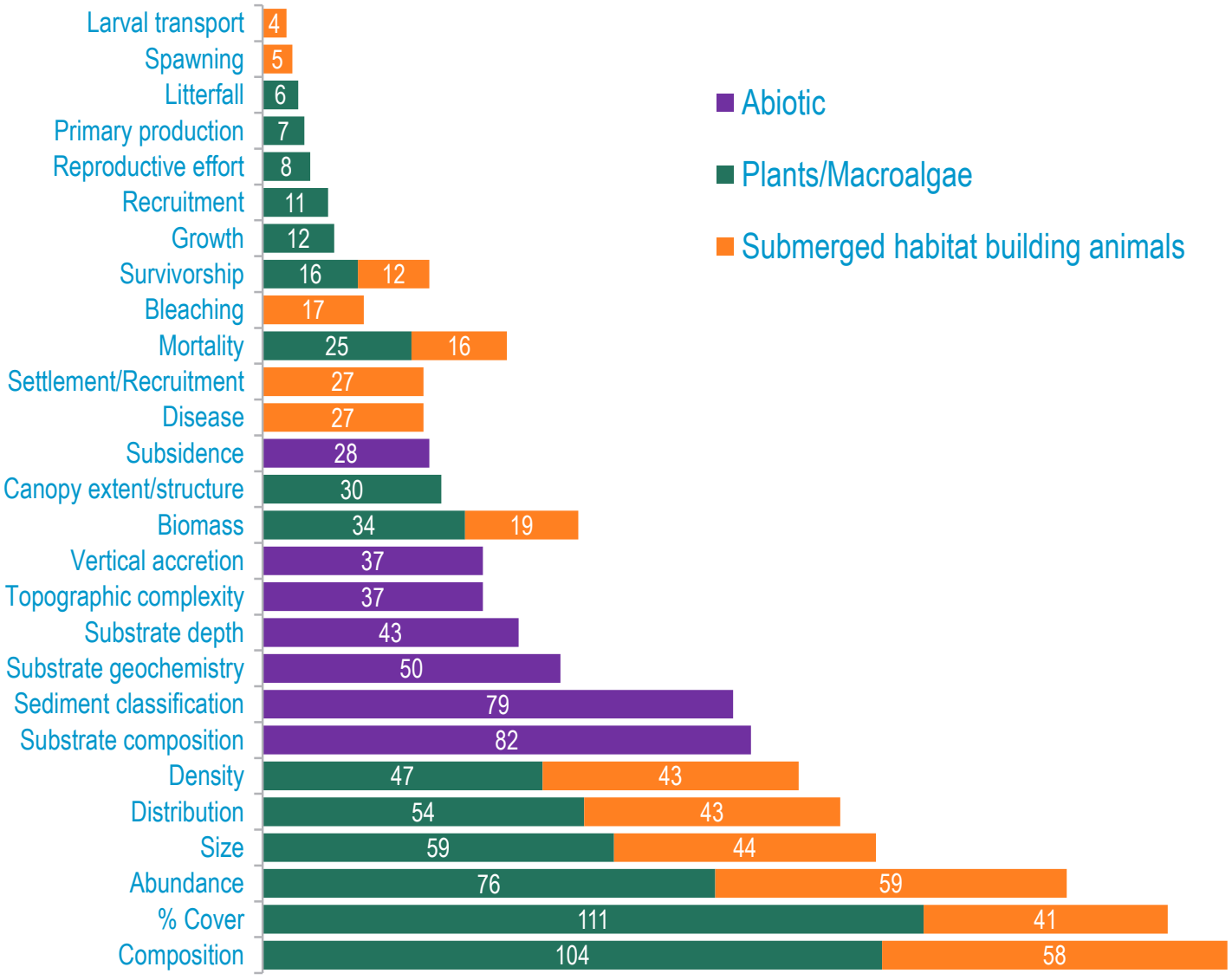


Figure 10 Occurrence for habitat monitoring parameters by general parameters (N=243).

Camera-based or satellite-based imagery was the most widely used mapping technology (67%) for mapping programs in the inventory (Figure 11). The remaining tools/technologies occurred in no greater than 20% of programs. Lidar (20%), RTK GPS (20%), side-scan sonar (17%), and multibeam sonar (15%) were the most frequently observed technologies following camera/satellite-based imagery.

Most mapping programs (50%) used map products to determine or evaluate area of habitat types (Figure 12). Surficial elevation (42%) and land use/land cover (20%) were the only other parameters with frequencies greater than 20%. The remaining parameters were inclusive of a variety of ecological or environmental parameters, most occurring at a Gulf-wide scale.

Program Documentation and Data Access

The majority of water quality (62%), habitat (76%) and mapping (67%) programs had documented protocols and quality assurance documents that CMAP was able to collect or point to online access (Figure 13). The quality of these documents will be assessed in the Task 3 report that will examine programs similarity of protocol and methods across the Gulf.

Eighty-six percent of programs in the inventory had accessible monitoring data online (65%) or was available upon request (21%; Figure 14).

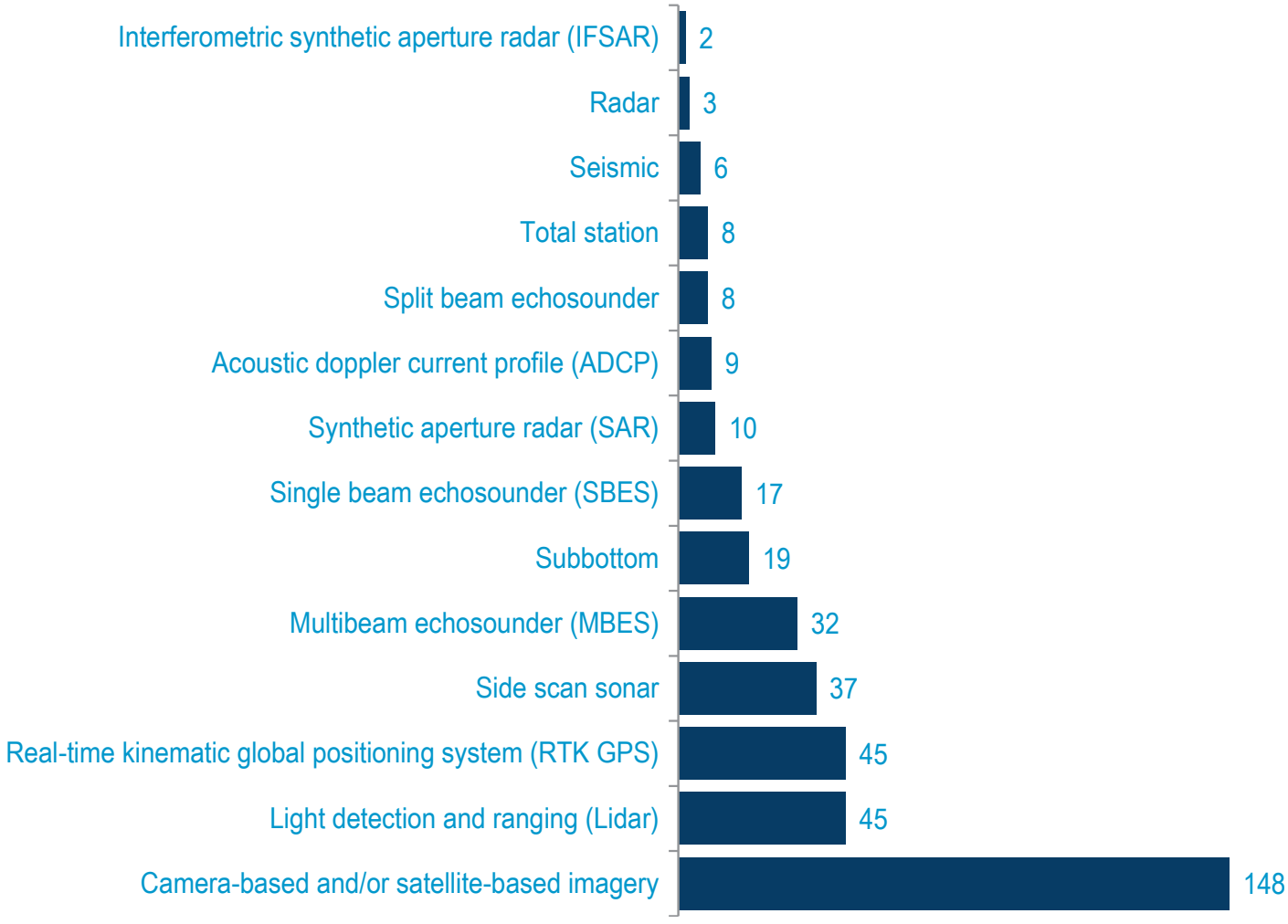


Figure 11 Occurrence for mapping tools/technologies used by mapping programs.

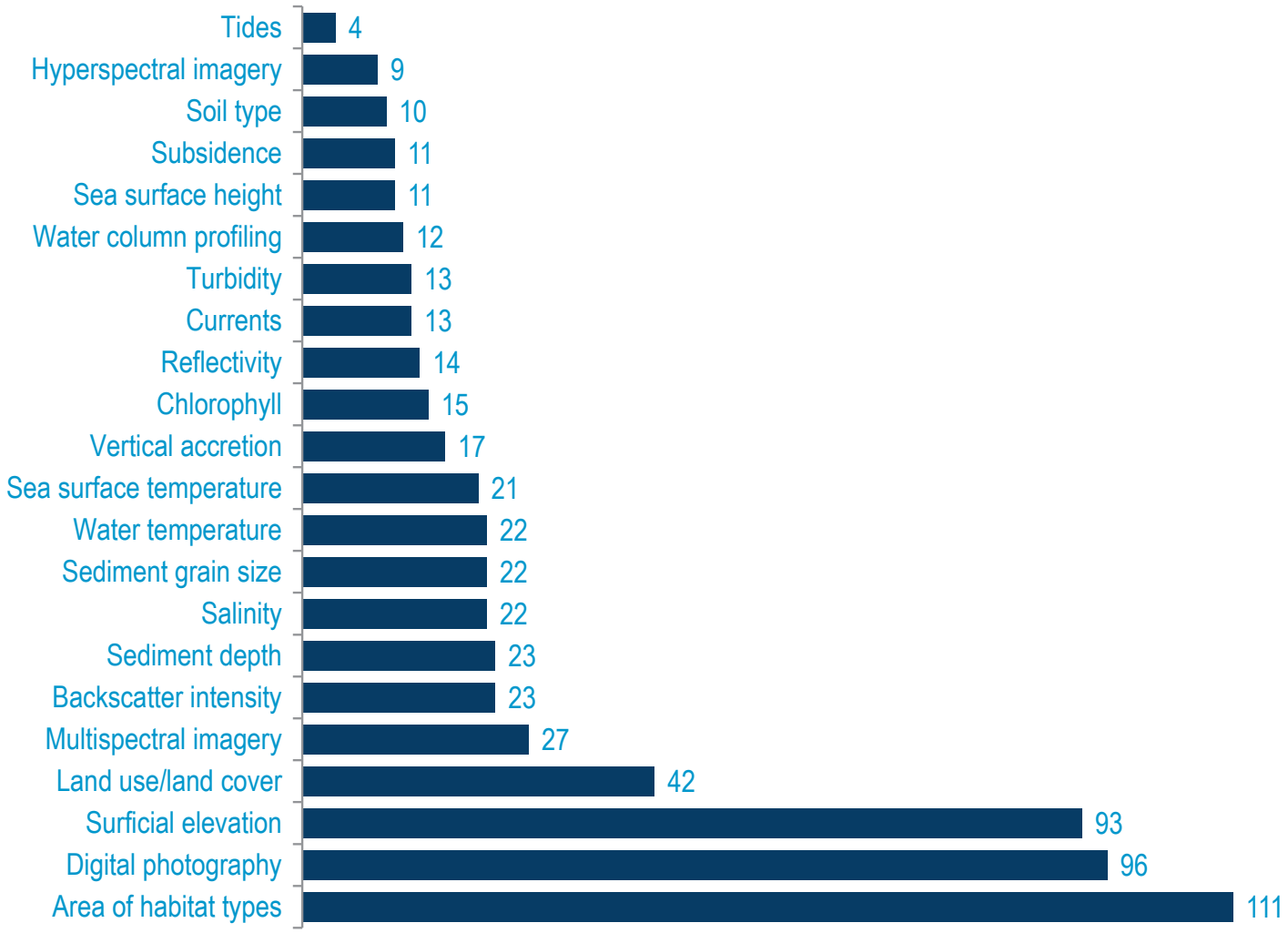


Figure 12 Occurrence for mapping parameters (N=219).

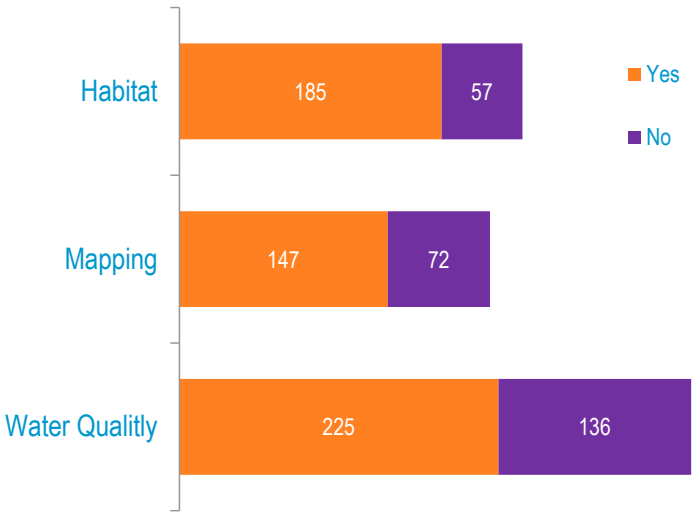


Figure 13 Numbers of programs, by program type, that had accessible protocols and quality assurance documents.

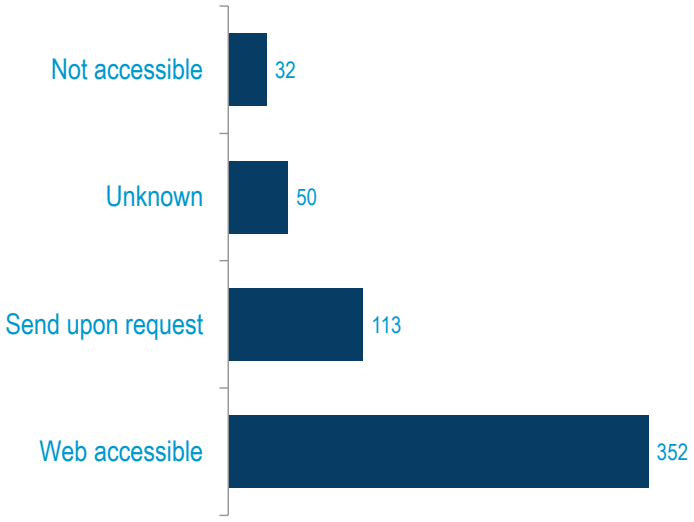


Figure 14 Accessibility of program data.

8 Uses and Benefits of the Inventory

Technical diver collecting benthic habitat data in the Flower Garden Banks National Marine Sanctuary, Gulf of Mexico. Credit: Greg McFall, NOAA

Supporting Other CMAP Tasks

The monitoring inventory was the first activity completed under CMAP. The inventory metadata will be used as the information basis to build on and develop the other CMAP deliverables as described below.

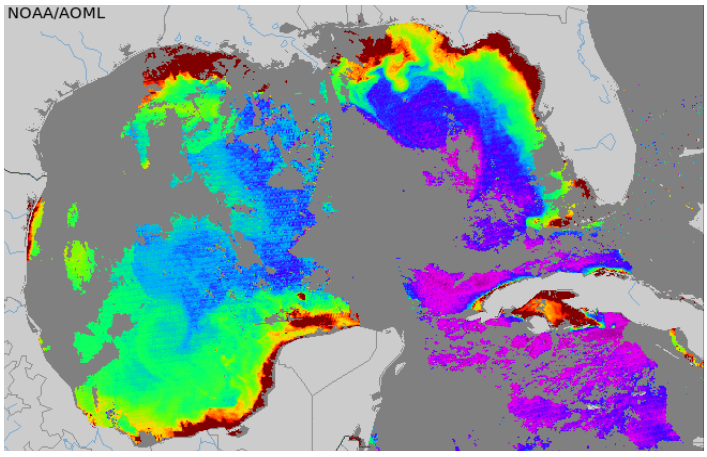
Monitoring Program Methods Documentation

During inventory development, each monitoring program's data collection, analytical, and QA/QC protocols were gathered and stored in an organized library. The compiled information in the library will be used to review program methods in more detail to look for spatial and temporal commonalities and discrepancies to support the remaining CMAP Tasks related to guidelines on monitoring parameters and methodologies (Task 3) and a gap analysis (Task 5). Information obtained from methods documents includes sampling locations, sampling frequency, sampling design, sampling methods, parameters collected, quality assurance and control techniques, and units of information collected. This information will also be used to identify and evaluate spatial and temporal gaps for water quality, habitat, and mapping within the GoM (using the metadata collected in the inventory).

If program methods were not identified during development of the inventory, the program POC was asked if documentation could be provided during the POC review process. It should be noted that programs were not removed from the inventory due to undocumented methodology, but the program will not be evaluated for monitoring standards and methods (Task 3).

Spatial data

Each program within the inventory database is stored in a separate spatially referenced geodatabase. The geodatabase includes polygon footprints representing where a program is generally conducting monitoring activities. Sample locations were available for some of the programs in the inventory. When these data were available, sample locations were stored in the geodatabase as either points for monitoring stations or lines (for transect-style sampling) to more accurately represent where work is occurring. To ensure consistency in the processing of spatial data layers, a tool was developed in ArcGIS 10.5 which enables the user to input the source data layer (e.g., point, line, or polygon features), document properties about the record (e.g., unique identification number, program name, etc.), and append the spatial representation of the record into the geodatabase feature layers.



Daily AQUA MODIS concentration of chlorophyll in sea water, Gulf of Mexico, May 1, 2019. Credit: NOAA AOML

Spatially referenced data were acquired from a variety of sources including other existing inventory databases (as referenced in Chapter 2. Information Synthesis and Framework), program websites or data portals, or shared directly via program POCs (Appendix 7). Whenever possible, the spatial representation for a program was represented by program-generated footprints that were either provided by the POC or readily available online. If program-generated footprints were not available, but sample locations were obtained from either the POC or an existing monitoring program inventory, then the tool used these data to select intersecting areas from a custom grid developed by CMAP staff. This grid includes HUC 12 boundaries, which have a higher resolution than HUC 10 boundaries, for estuarine and upland areas and the hexagonal grid developed by the Ocean Conservancy (Love et al., 2015) for marine areas. If data were not available, then the best available information (i.e., graphic on website, program description, etc.) was used to develop a general footprint with either the CMAP grid or other data (e.g., state boundaries).

Assessments

The inventory supports the development of baseline assessments or condition reports in the GoM. CMAP Task 7 includes compilation of existing assessments of habitat, water quality and mapping into a comprehensive searchable web-based directory to be used primarily by the RESTORE Council for restoration planning, development, and performance monitoring. Programs and reports that assess the condition of a particular habitat or water quality and meet spatial and temporal criteria will be cataloged as part of Task 7 at a descriptive metadata level.

The MCoP was also asked to help identify assessments at the 2018 MCoP workshop. Participants were asked to note relevant assessments on individual state maps located at different stations within a room. Overall, this process generated over 230 assessment documents for potential inclusion into the catalog. Where appropriate, the monitoring programs in the database will be linked to assessments.

Webtool

Ultimately the monitoring program database is planned for integration into a searchable database and online mapping tool designed for RESTORE Council use. The webtool, which is in its preliminary phases of development, is planned to be designed to present and query the attributes for the inventoried habitat and water quality monitoring and mapping programs.

Storm-Tide Sensor, Packery Channel, Corpus Christi, 2017.
Credit: Brian Petri (USGS)

How Can the Inventory Be Used to Support RESTORE Council

The monitoring inventory provides a tool for the Council members to explore data that can inform restoration actions based on the best available science. The inventory may help members to identify relevant data sets that can be used to look at baseline condition and status and trends in support of restoration needs and priorities in a given geography. Projects can use this inventory during planning and design to provide a stronger scientific foundation because they will utilize the most recent and robust data sources to identify available suitable habitat for restoration and help to identify the potentially most appropriate techniques in that setting. This will help the RESTORE Council select and prioritize projects for funding. Furthermore, RESTORE Council-funded projects that have been completed in areas where long-term monitoring program metadata have been inventoried and made available will have a sound foundation for performance evaluation and adaptive management. The existing data and ongoing monitoring may serve to support a data trend analyses at multiple scales (project, cross-project, watershed, etc.), which could inform the Council's programmatic restoration planning.

For example, the RESTORE Council may want to see how a geographically targeted restoration effort (e.g., emphasis on a particular watershed) can impact water quality. Data from long-term water quality monitoring programs identified in the inventory as having sites in that watershed may be mined to establish reference conditions and an assessment of potential need for restoration actions in that area. These data may also be used and/or coupled with other tools such as US EPA's Recovery Potential Screening tool (https://www.epa.gov/rps) to help assess recovery potential of certain watersheds and determine specifically what types of restoration approaches may have the greatest potential to address the identified problems and the optimal locations for the implementation of specific projects. Finally, in concert with project-specific monitoring, long-term monitoring data can help to identify trends to be factored into adaptive management decisions at the project-specific and programmatic scales.

The final webtool is envisioned to provide the RESTORE Council with a singular and definitive point of access to information required to help inform ecosystem monitoring decisions.

Sediment survey, Breton Island, Louisiana.
Credit: Jim Flocks (USGS SPCMSC)

Benefits/Uses of Inventory Beyond RESTORE Council

The CMAP inventory provides access to existing programs and data to help determine the current state of the available data for water quality, habitat, and mapping in the GoM, and the utility of the CMAP inventory will transcend restoration program boundaries. The inventory tool developed is expected to be able to assist with restoration planning, design, siting, implementation, evaluation and adaptive management for all restoration activities.

All monitoring program information will be more readily accessible to the public. Partners working in the Gulf will then be able to discover and work with the identified programs to conduct queries based on their interest with regard to location, time, and parameters. When all programs working in a given geography, or on a particular resource or resources have access to reliable information to describe environmental conditions, these entities can more effectively and efficiently coordinate their efforts to achieve measurable goals and objectives based on an accurate understanding of the need in a given area. Programs can then better coordinate and allocate scarce resources (funding, capabilities, and capacity) to match the identified restoration needs and approaches.

Considerable input from the greater monitoring and restoration community was gathered and it is anticipated that the inventory will be useful beyond the Council's need. Specific examples of usages that have been mentioned to us by the restoration community are included below.

Swamp tree growth measurements, northern Gulf Coast, July 2016. Credit: Evelyn Anamaet and Beth Middleton (USGS)

The information can be used to gain access to ongoing monitoring data that could be used to bolster project-specific monitoring, and critically may provide information that could be used to understand the effects and progress of restoration actions on larger scale programmatic and/or regional ecosystem restoration goals.

Provide easier path to discover data sets
Compile existing condition data sets for restoration planning

Establish reference conditions

Build upon existing programs and data when developing a monitoring plan

Compile data for status and trends assessments

Gather data sets for project evaluation assessments

Data to help design and site a project during restoration planning including habitat suitability for a given resource

Determine the consistent way to collect data across a geographic area

9 Lessons Learned/ Future Considerations

Rookery Bay. Credit: NOAA NCCOS

Inventory development

The development of the monitoring inventory incorporated an initial exploratory phase which was necessary to gather information regarding work similar to the CMAP effort and other available resources. This phase also enabled the internal CMAP team to discuss and reach consensus on the various elements to be catalogued in the inventory. It also allowed for engagement and participation from the CMAWG, MCoP, and greater GoM monitoring and mapping community through workshops, meetings, and various presentations. This collaborative process aided in the creation of a final product that serves and benefits not only the Council, but also the monitoring and mapping community as a whole.

These opportunities for engagement, however, could have been more beneficial to the exploratory and developmental phases of the task had they occurred earlier within the project timeline. This could have provided more time for the record review process and POC engagement.

Protocol Benefits

POC Engagement

The POC engagement process was more successful than expected with a response rate of 61%. However, the number of times and methods of POC contact could have been better defined prior to initial POC engagement. Requests to POCs should be clear and concise yet comprehensive enough to gather the needed information and materials to minimize the need for follow up contact. For example, definitions of data and file requests could have been more explicitly defined prior to engaging POCs. CMAP staff were successful in assessing and adapting to various issues as they arose.

In isolated cases during the later stages of the POC engagement, we were able to identify a missing POC through responsive POCs within the same agency or through the assistance rendered by the CMAWG or MCoP. We may have achieved an even better success rate by implementing these strategies earlier in the process.

Next Steps

An approach will need to be developed for long-term database maintenance. The database is static and will require routine updating to ensure accurate program information. New programs may also be added over time.

References

American Society for Photogrammetry and Remote Sensing (ASPRS). 2014. ASPRS positional accuracy standards for digital geospatial data. Photogrammetric Engineering and Remote Sensing 81(3):A1–A26.

CSA International, Inc. 2007. Characterization of northern Gulf of Mexico deepwater hard bottom communities with emphasis on *Lophelia* coral. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007–044. 169 pp.

Diaz, R.J., M. Solan, and R.M. Valente. 2004. A review of approaches for classifying benthic habitats and evaluating habitat quality. Journal of Environmental Management 73:165–181.

Gulf of Mexico Alliance (GOMA). 2013. White paper on Gulf of Mexico Water Quality Monitoring: Providing water quality information to support informed resource management and public knowledge. Gulf of Mexico Alliance Water Quality Team - Monitoring Workgroup. 124 pp.

Heidemann, K.H. 2018. Lidar base specification (ver. 1.3, February 2018): U.S. Geological Survey Techniques and Methods, Book 11, Chapter B4.101 pp. doi: https://doi.org/10.3133/tm11b4.

International Hydrographic Organization (IHO). 2008. IHO Standards for Hydrographic Surveys, Special Publication No. 44, 4th Edition. 23 pp.

Love, M., A. Baldera, C. Robbins, R.B. Spies, and J.R. Allen. 2015. Charting the Gulf: Analyzing the gaps in long-term monitoring of the Gulf of Mexico. The Ocean Conservancy, New Orleans, LA. 94 pp.

National Oceanic and Atmospheric Administration (NOAA). 2011. NOAA integrated ocean and coastal mapping seafloor mapping standards. National Oceanic and Atmospheric Administration. Online: https://iocm.noaa.gov/reports/NOAA_IOCM_seafloor_mapping_standards2.0.pdf (Accessed 20 June 2019)

Northwest Fisheries Science Center (NWFSC). 2019. Coastal Assessment Framework - National Assessment of Estuary and Coastal Habitats. InPort Medata Library. NOAA National Marine Fisheries Service, Northwest Fisheries Science Center. Online: https://inport.nmfs.noaa.gov/inport/item/30858 (Accessed 20 June 2019)

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Map (scale 1:7,500,000). Annals of the Association of American Geographers 77(1):118–125.

Omernik, J.M. 1995. Ecoregions: A spatial framework for environmental management. p.49–62. In: W.S. Davis and T.P. Simon (eds.), Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. CRC Press, Lewis Publishers, Boca Raton, FL. 432 pp.

Rester, J.K. 2017. SEAMAP environmental and biological atlas of the Gulf of Mexico, 2016. Gulf States Marine Fisheries Commission. No. 268. 64 pp.

Seaber, P.R., F.P. Kapinos, and G.L. Knapp. 1986. Hydrologic Unit Maps. United States Geological Survey Water-Supply Paper 2294. 63 pp.

Story, M., and R.G. Congalton. 1986. Accuracy assessment: A user's perspective. Photogrammetric Engineering and Remote Sensing. 52(3):397–399.

Discharge measurement collection, Colorado River (Texas) downstream from Yancey Creek. Credit: Christopher Braun, USGS

Appendices

Appendix 1: Inventory of Inventories

List of databases or inventories that were used to populate Council Monitoring and Assessment (CMAP) inventory. Total records indicates the total number of possible programs or projects that were contained in each.

U.S. Geological Survey (USGS) Science Data Catalog	2,500
Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC)	2,200
E-Enterprise Community Inventory Platform	1,904
Water-CAT- The Florida Water Resource Monitoring Catalog	1,432
Ocean Conservancy	796
Deepwater Horizon (DWH) Project Tracker	779
Marine Cadastre Environmental Studies Program Information System (ESPIS)	584
Gulf Base Database	518
Bathymetric Data Viewer	335
Global Change Monitoring Portal(GCMP)/Southeast Climate Science Center (SECSC)	296
Data Integration Visualization Exploration and Reporting (DIVER) Explorer	246
National Oceanographic Partnerships Program (NOPP)	207
Gulf of Mexico Alliance (GOMA)/Monitoring Community of Practice (MCoP) Workshop Feedback	157
Marine Cadastre	149
Gulf Environmental Benefit Fund	122
National seabed characteristics database (usSEABED)	112
Louisiana System Wide Assessment and Monitoring Program (SWAMP)	92
Terra-CAT- Florida Species and Habitat Monitoring Programs Catalog	61
Gulf of Mexico Alliance (GOMA) Water Quality/GoMonitor Catalog of Monitoring Programs	51
National Benthic Inventory (NBI)	32
National Oceanic and Atmospheric Administration (NOAA) RESTORE Science Program	22
National Data Buoy Center (NDBC)/Gulf of Mexico Coastal Ocean Observing System (GCOOS)/Integrated Ocean Observing System (IOOS)	18
Coastal Information & Management System (CIMS)	17
United States Interagency Elevation Inventory	15
Applied Coastal Research and Engineering	1
Florida Deepwater Horizon Projects	1
Bureau of Ocean Energy Management (BOEM) Deepwater Gulf of Mexico Bathymetry Map	1
Environmental Response Management Application (ERMA)	1
Marine Resources Information System (MRIS)	1
National Water Information System (NWIS)	1
National Oceanic and Atmospheric Administration (NOAA) Physical Oceanographic Real-Time System (PORTS)	1
National Oceanic and Atmospheric Administration (NOAA) Northern Gulf Operational Forecast System	1
National Oceanic and Atmospheric Administration (NOAA) Shoreline	1
National Oceanic and Atmospheric Administration (NOAA) St John's River Operational Forecast System	1
National Oceanic and Atmospheric Administration (NOAA) Storm QuickLook	1
National Oceanic and Atmospheric Administration (NOAA) Tampa Bay Operational Forecast System	1
National Oceanic and Atmospheric Administration (NOAA) Tides and Currents	1
Northern Gulf of Mexico Sentinel Site Cooperative	1
STOrage and RETrieval and Water Quality eXchange (STORET and WQX)	1
Texas Natural Resources Information System	1
Water Data for Texas	1
Water Quality Portal	1

Appendix 2: Council Monitoring and Assessment Program Water Quality Monitoring User Needs Workshop Summary

Gulf of Mexico Water quality Information User Workshop

NOAA National Water Center, Tuscaloosa, AL
March 6-7, 2018
Hosted by the Gulf Coast Ecosystem Restoration
Council Monitoring and Assessment Program (CMAP)

Summary of Workshop Minutes

Gulf of Mexico Water quality Information User Workshop

Workshop Objectives

- Share the structure, desired outcomes, and timeline of the RESTORE Council's Monitoring and Assessment Project (CMAP)
- Identify how CMAP can address user needs for Gulf of Mexico water quality information and tools
- Get feedback from users on the products of CMAP, including identifying processes or products that could enhance the utility of the project
- Coordinate with regional stakeholders to continue gathering Gulf-wide information on existing baseline assessments, monitoring efforts, and monitoring standards
- Identify and prioritize gaps in water quality mapping and monitoring that CMAP might be able to help fill, considering the minimum monitoring elements needed to achieve CMAP's desired outcomes

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Appendix 2: CMAP WQ Monitoring User Needs Workshop Summary

Tuesday, March 6th

1. Welcome and Review of Agenda

1.1 Objective:

Welcome attendees, set the context: why we're here, what we hope to accomplish

1.2 Activities:

- Mark Monaco, Steve Giordano, and Randy Clark from the National Oceanic and Atmospheric Administration (NOAA) and Jessica Henkel (RESTORE Council) welcomed attendees, reviewed overall purpose of the meeting, touched on how attendees were selected and what CMAP group hoped to accomplish by the end of the meeting.
- Chris Ellis (NOAA workshop facilitator) reviewed the agenda, ground rules, and logistics.

2. Introduction to the Gulf Coast Ecosystem Restoration Council Monitoring and Assessment Program (CMAP)

2.1 Objective:

Provide an overview of program components, goals, etc., with a focus on water quality constituents, and allow some time for questions

2.2 Activities:

- Steve and Randy presented on CMAP - overview, goals, and objectives of CMAP, and components to be used to reach those goals and objectives
- Mike Lee and Richard Rebich from the United States Geological Survey (USGS) presented on water quality parameters and constituents included in the CMAP review of programs, documented assumptions, and the products intended to be provided as a result of CMAP

- Chris facilitated questions from the audience on the overall CMAP program. Attendees were asked to give name and affiliation the first time they spoke.

3. Large Group Discussion: Feedback on Documented Assumptions and Constituents Important for CMAP to Capture

3.1 Objective:

Get input from users and contributors to Gulf of Mexico water quality monitoring programs on water quality constituents that should be monitored and included in the CMAP inventory.

3.2 Activities:

- Chris asked group for "Reactions to the documented assumptions?"
- Chris asked "Which water quality parameters and constituents are considered important for the CMAP program to capture?"

3.2.1 Reactions to the documented assumptions?

- Overall no significant questions with relation to documented assumptions. Two questions were clarified about new programs that have been in existence for less than 5 years. CMAP intends to keep those programs that are newly developed that anticipate long term implementation.

- Program POC's will have the opportunity to review CMAP program entries. Programs are not being evaluated, rather CMAP is looking for long term, comprehensive monitoring. Program information is being collected and assessed at various scales to determine commonalities.

3.2.2 Which water quality parameters and constituents are considered important for the CMAP program to capture?

- Approximately 20 parameters were suggested for addition to the list of water quality parameters. This list was revisited in the large group setting on day 2.

4. Breakout Groups: How Can CMAP Address User Needs for Gulf of Mexico Water quality Information and Tools

4.1 Objective

Get input from attendees on applications and users of water quality information and tools

4.2 Questions

1. Are you using water quality information and tools and, if so, how?
2. Are there new applications of water quality information and tools you would like to pursue?
3. Is there anything that you would like, or need, to do that cannot currently be supported by available water quality information available to you?
4. Who is missing from this conversation? Who else uses water quality information and tools? Are there applications being done that we haven't listed yet?

4.2.1 Question 1 SUMMARY: How are you using water quality information and tools now?

Top 5 Responses

1. Regulatory
2. Parameters for models
3. Restoration planning/prioritization
4. Assessments/management plans
5. Baseline performance monitoring

Key Points

1. Not many analytical tools, most are for discovery
2. Primary data sources: State agencies, United States Geological Survey (USGS) gauge stations, Academics, Gulf of Mexico Coastal Ocean Observing System (GCOOS), NOAA National Center for Environmental Information (NCEI), Louisiana Coastal Reference Monitoring System (CRMS), Florida Water Resource Monitoring Catalog (Water-CAT).
3. Needs: researchers need quality quantitative data. Boaters/beachgoers need interpreted data.
4. Need more baseline information for restoration.
5. Limitations: proprietary data

4.2.2 Question 2 SUMMARY: Are there new applications of water quality information and tools you would like to pursue?

Top 5 Responses

1. Comprehensive searchable database (one-stop shop) with metadata
2. Modeling/forecasting
3. Analytical capabilities
4. Linking with other resources (fish, sediment, etc)
5. Reporting tools

Key Points

1. Non-governmental organizations not using tools all that much
2. Would like to see models/tools vetted by more levels of users so that irrelevant tools are weeded out and more common tools are used
3. Ability to discern users (research/management/public)
4. Most would like to see site level information

4.2.3. Question 3 SUMMARY: Is there anything that you would like, or need, to do that cannot currently be supported by available water quality information available to you?

Top 5 Responses

1. Ability to download/store/analyze raw data
2. Scalable data
3. More nutrient data
4. Data quality/citizen science information
5. More continuous spatial and temporal data

Key Points

1. CMAP tool should share metadata
2. CMAP tool should share data services
3. CMAP tool should have clear outputs/results

4. CMAP tool should be user friendly
5. CMPA data should be scalable
6. Long term monitoring covering more than 10 years of time is lacking
7. CMAP will need to be dynamic, not static

4.2.4. Question 4 Summary: Who is missing from this conversation? Who else uses water quality information and tools? Are there applications being done that we haven't listed yet?

Top 5 Responses

1. Academics
2. Natural Resource Monitors
3. Oil and Gas
4. Tribes
5. Local Jurisdictions

Key Points

1. End user very important (research/applied research/public)
2. Other key groups not present: United States Army Corps of Engineers, restoration practitioners
3. System monitoring vs project monitoring
4. Make better use of citizen science

5. Ongoing Water quality/Observations Program Inventory Efforts, Minimum Monitoring Elements for CMAP

5.1 Objective

Build awareness on CMAP inventory and approach.

5.2 Activities

- Randy and Richard presented the CMAP inventory and approach; what has been accomplished to date; the evaluation approach and criteria – including identification of Minimum Monitoring Elements for CMAP Network Components; an explanation of the minimum monitoring elements considered in the evaluation.
- Chris facilitated questions

6. Large Group Discussion: Continuing to Build the Inventory

6.1 Objective

Get input from attendees on additional databases and monitoring efforts to build out the inventory

6.2 Activities:

For Discussion

- Are there other databases beyond The Ocean Conservancy that we haven't included yet?
- What constituents/parameters are you monitoring?
- Feedback on minimum monitoring elements
- Are your data sets publically available and how are they available?

6.2.1 What databases are missing?

- Water quality portal associated with National Water quality Monitoring Council
- Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) database on academic water data
- Data one ecological database
- Environmental Response Management Application (ERMA)

6.2.2 What constituents are you monitoring?

- Decided to walk through the list and add recommendations on the following day.

6.2.3 Minimum monitoring elements:

- Call it something else & define clearly! Lots of discussion about what this is.
- Participants liked **monitoring program attributes** (more details in full notes document)

- Monitoring program attributes are program criteria that may identify how robust your data is. These criteria may become recommendations for future restoration projects.

6.2.4. Are your data sets publicly available; if so, how are they available?

- Florida, Louisiana: yes
- Louisiana Department of Environmental Quality available on a website, but currently being re-done
- Alabama, everything but biological data is available,
- Integrated Coastal Ocean Observation System (ICOOS): available and query-able only some via a web service
- United States Environmental Protection Agency (EPA) coastal survey is up to 2006 is available through the Water Quality Exchange (WQX)
- Texas Commission on Environmental Quality (TCEQ) is available through map viewer, and via data management group

6.3.5. Additional Discussion: Programs and site level information

- Most data that is needed is kept in multiple databases
- Which key databases with site level information should be included?

- Seems that there are probably only a few within each state that are really important; but we need to figure out where the line falls between important and not important
- There are only a handful of folks who are accessing and collecting a lot of water quality
- Florida has over 100 groups but most go to STORET or Water-CAT
- Engage the Community of Practice (CoP) with this down the road
- Who, on a local level, should be invited to joining the CoP? Need this information from the different states for water quality and habitat. This list should include who the state needs to help them look after their own interests.

Wednesday, March 7th

7. Review of Day 2 Agenda, Reflections from Day 1

7.1 Objective

Welcome back, set expectations for day

7.2 Activities

Review agenda for day 2, including substituting large group discussions for break out group sessions

8. Large Group Discussion: Review of and Feedback on Planned Products

8.1 Objective

Get input from Gulf of Mexico users of water quality data on CMAP products

8.2 Activities:

Discussion Points

- Are we covering what is useful? What is needed? What is missing?
- Feedback on functionality/utility of the products
- Feedback on functionality/utility of the geospatial database

8.2.1 General Discussion

- Talked about CMAP structure and participating groups (Council Monitoring and Assessment Work Group [CMAWG], Monitoring Coordination Committee, CoP).
  - CMAWG: Need a representative from Texas
  - Monitoring Coordination Committee
  - Missing: no one identified
- CMAP milestones & deliverables w/dates shown

8.2.2 Spatial

- Consider using or linking National Coastal Survey for EPA: data cut off is salinity concentration.
- Programs will extend well beyond the yellow boundary line. Sturgeon, birds, etc.
- Will examine the entire water column
- Will eventually look at living marine resources (future Phases)
- Water quality, especially pathogens, will this include sediments?

8.2.3 Parameter Table Additions (from Day 1)

Suggestions to add or condense

- Biological oxygen demand & carbonaceous biochemical oxygen demand (Under Carbon)
- Delete ammonium
- Color (field parameters)
- Don't we want % saturation to be under field parameters?
- Fecal coliform under pathogens
- Total alkalinity (field parameter)
- Dissolved inorganic carbon & aragonite potential (Omega) (under field parameters) Ocean & coastal suite
- Need a wet chemistry section
- Grain size (habitat parameters?)
- Chlorophyll a
- Groundwater (habitat we account for in water column). Need to know groundwater inputs when modeling—possibly put in separate matrix with groundwater DO, etc.
- Demoic acid as a toxin (or just algal toxins?)
- Suspended sediment concentration: inorganic (mineral) and organic (organic fraction) need them indicated separately. Also consider volatile suspended sediments.

ACTION: CMAP team will review these recommendations

9. Large Group Discussion: Obvious Spatial/Temporal Water quality Gaps, Priorities

9.1 Objective

Get input from attendees on gaps/needs and prioritize

9.2 Activities

Discussion Topics
Participants identify from workshop what are the remaining gaps or inconsistencies? What is CMAP not doing with regards to products and services?

9.2.1 Prioritization Exercise

Group first took a tangent discussion about CMAP and CoP.

CMAP goal is to develop a web-accessible tool to access the information and develop a CoP. Are there things missing?

- Need a **glossary** of terms (define discrete, continuous, contiguous, habitat, etc.)
- Need **sales pitch** to convince data providers why they should put their data in CMAP
- Develop **marketing tools** for future/resource development

CoP: key function is to develop a mechanism for coordination

- Response: Can we divide CoP into broad functionality and CMAP-specific functionality? For example, CoP will offer specific things for CMAP, but not operate entirely under CMAP
- Need a **CoP charter w/ objectives and subgroups**
- CMAP/CoP bleeding together… clarity on CMAP objectives? Provide clarity in June at Gulf of Mexico Alliance all hands
- Subgroups in CoP- some CMAP oriented, others may be broader. Let's let the process self-organize

Inventory suggestions

Cross reference inventory with other lists/designations

- Impaired waters
- Landscape Conservation Cooperative
- Other marine protected areas

How will the users and practitioners be able to access/interface with products?

- CMAP will develop a web-enabled georeferenced queryable tool.
- Products are targeted for practitioners/users/professionals not necessarily the public.
- Tool/products should be service enabled, so others' tools can pick it up

Gap analysis: What is the overall objective?

- CMAP needs to fully define what the gap analysis is.
- The inventory provides a Gulf wide network of existing programs. Look for:
    - Spatial gaps
    - Temporal gaps
    - Monitoring program elements/gaps
        - Examples:
        - If you're restoration practitioners/restore council, a number of projects being implemented, want to make sure we have the ability to comment on their performance
        - E.g. don't have satisfactory distribution of sites for monitoring

- Master mapping plan wants every inch of the gap characterized… can easily identify these gaps
- Difference in scale and utility

ACTION: Participants suggested that a summary document for CMAP be developed to help clarify objectives, tasks and products.

What happens after the gap analysis? Do you expect states to participate?

- how we rank them in priority
- availability of resources to go out and get them
- If offshore, NOAA; if coastal zone, USGS/NOAA/State will potentially collaborate

9.2.2 Explain and justify gap analysis (with CMAP overview document)

- Address questions in succinct way
- Alter some of the pre-existing language (e.g. minimum monitoring standards)
- CMAP needs to hold to some language with Federal standard- can't change language too dramatically

Project specific information

- Council is starting to put together project pages. Can be a source of information.
- Happening on project by project basis

Is it worthwhile knowing where projects have contributed to models? If someone is interested in similar modeling? (e.g. nutrients/sediment flux)

- Useful- but how could we discover that?
- User responsibility vs. ours
- Inventory of models in Southeast through EPA? Could be a start
- A place to share code for modelers? Briefly discussed in breakout group, github for example? Formulation of a Modeling CoP?
  - Could be included under marketing materials… cool thing but is it a gap? Is it within scope?

Tribes, academics not present at workshop, potential gap

- How do we engage them?
- Where can they leave comments/suggestions?
  - CoP is a start and most direct
  - Market to CoP, what's in it for them? Purpose driven community; how does it make their jobs easier

Other Discussion

Some participants struggled with complexity of CoP

- probably needs to be self organizing

- Two way communication
- Some more involved than others
- Using information from CoP vs. influencing/providing information for CoP?

Participants suggested seven additional products/information that might help CoP. Group voted to prioritize

Top 4 ranked priorities:

1. CMAP Overview Document (simple, clear document)
2. Glossary of terms
3. CoP Charter (objectives/subgroups) To be developed during GOMA all hands
4. Sales pitch to data providers
    a. Several ideas were brought up but the scope may have been breached. Reminder CMAP is not providing or serving data, but focusing on program metadata. CMAP team is providing man power to develop inventory, need buy in from program points of contact to vet program information.
5. Other items
    - Integrate CMAP inventory with Impaired waterways list/key management boundaries
    - Marketing tools for future development
    - Broader stakeholder engagement

10. Next Steps and Meeting Wrap-Up

10.1 Objective

Thank attendees, share next steps, pass out voluntarily workshop evaluations

10.2 Activities

- Describe how the input received at the workshop will be used
- Listed next steps for CMAP
- Provided information for upcoming monitoring CoP kick-off meeting in June 2018
- Workshop adjourned

Appendix 3: Council Monitoring and Assessment Program Habitat Monitoring and Mapping User Needs Workshop Summary

Gulf of Mexico Habitat Monitoring and Mapping User Workshop and Mapping Summit
NOAA Disaster Response Center
April 3-5, 2018

Hosted by the Gulf Coast Ecosystem Restoration Council Monitoring and Assessment Program (RESTORE CMAP) and the Gulf of Mexico Alliance (GOMA) Data and Monitoring Priority Issues Team (PIT)

Minutes of Workshop

~ Objectives ~

- Share the structure, desired outcomes, and timeline of the RESTORE Council's Monitoring and Assessment Project (CMAP)
- Identify how CMAP can address user needs for Gulf of Mexico habitat monitoring and habitat mapping information and tools
- Get feedback from users on the products of CMAP, including identifying processes or products that could enhance the utility of the project
- Coordinate with regional stakeholders to continue gathering Gulf-wide information on existing baseline assessments, monitoring and mapping efforts, and monitoring and mapping standards
- Identify and discuss how to prioritize gaps in mapping and monitoring that CMAP might be able to help fill, considering the monitoring program attributes needed to achieve desired outcomes for the region
- Identify strategies for implementing the Gulf of Mexico Alliance's Master Mapping Plan

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Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Tuesday, April 3rd
Welcome and Review of Agenda

Objective: Welcome attendees, set expectations for the three days, outline what hope to accomplish.

Summary Notes:
This workshop is designed to begin sharing and coordinating information to support the RESTORE Council Monitoring and Assessment Program (CMAP) and Gulf of Mexico Master Mapping Plan (MMP). By highlighting our common objectives we will discuss the best ways to move forward.
This community of users should look at CMAP as a stakeholder and framing in context of what the community needs or wants. This workshop could be a kick-off at forming a mapping community of practice. We also want your opinions and thoughts on direction CMAP is moving. The National Oceanic and Atmospheric Administration (NOAA) and United States Geologic Survey (USGS) staff will present the development and status of the monitoring program inventory and would value participant's feedback. We will also discuss MMP and frame where the user fits within that activity and how MMP integrates with CMAP.

Master Mapping Plan (MMP): History and Future Directions

Objective: Provide a summary of MMP history. Presented by Dave Reed.
Summary Notes:
Identifying and classifying habitats was start of Data & Monitoring Priority Issue Team in Action Plan I. Seagrass came out as one of first habitat priorities. Action Plan II – developed Priority Issue Teams and birth of MMP through Ecosystem Integration and Assessment PIT – identifying mapping needs and requirements and develop collaborative strategy to acquire data.

Master Mapping Plan to Date:

- lack of funding resulted in slow progress
- want to establish baselines in the Gulf
- gaps
- MMP contributions
    - Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) has developed a Federal mapping coordination tool using SeaSketch: https://www.seasketch.org/#projecthomepage/5272840f6ec5f42d210016e4 / forum/5580b2f2ac2dddd42976b4e6/topic/5761cfb2e50086fb190544e9
    - USGS Storm Change
    - Mississippi Coastal Improvements Program (MsCIP)
    - Mississippi/Alabama SeaGrant
    - Florida Coastal Mapping Program
    - Louisiana Coastal Protection and Restoration Authority
    - Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA)

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Priorities now:

- Need a full inventory of what exists in the Gulf
- Long term vision: to identify gaps and secure funding to fill
- Work with a community of practice to facilitate coordination of regional mapping
    - GOMA is a coordination body not directing hard science/filling gaps. Focus of this workshop is to review work that has been done and to build on that.

Introduction to the RESTORE Council Monitoring & Assessment Program

Objective: Share the structure, desired outcomes, and timeline of CMAP: Presented by Steve Giordano (NOAA)

Summary:

CMAP Goals

- Comprehensive plan for healthy Gulf ecosystem using science-based decision making, measure and deliver results, adaptive management (AM)
- Will build on existing work
- Improve coordination
- Recommend consistent methods and protocols
- Develop data quality, management, and accessibility standards
- Make information gathered usable by community
- Evaluating Restoration Outcomes - how and what to monitor and how to monitor restoration activities?

Program Activities:

- Inventory existing habitat/water quality monitoring programs
- Identify minimum standards or attributes across programs
- Evaluate suitability of programs to support needs
- Data portal-georeferenced tool for program metadata discovery
- Gap analysis
- Inventory baseline condition assessments
- Developed a governance structure
    - Program Advisory Team (PAT)
    - Council Monitoring and Assessment Work Group (CMAWG)
    - Monitoring Coordination Committee (MCC)
    - Monitoring Community of Practice (CoP)

Future Program Activities

- Fill gaps
- Look at other data types beyond habitat and water quality, such as natural resources

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Monitoring Community of Practice
First Workshop June 11, 2018, prior to Gulf of Mexico Alliance All-Hands meeting

- Visioning exercises
- Identify stakeholder needs
- Stakeholder input/feedback
- CoP is larger than CMAP, but will support
- Coordination effort for all needs Gulf wide and into the future
- Good starting point is working with Submerged Aquatic Vegetation (SAV) CoP that just started meeting

Discussion Comments

- What is meant by levels of overlap? There is designed overlap between CMAP and Natural Resource Damage Assessment (NRDA) efforts; taking advantage of every opportunity for cross-communication. The council and NRDA have different mandates, but there is the intention to cross over where possible; in the CMAWG we're going to try and build off of the work NRDA did with the cross--Trustee Implementation Group (TIG) Monitoring and Adaptive Management (MAM) manual version 1.
- How is baseline defined? The National Estuary Program (NEP) status reports could be a good start. Need to work on the definition
- Coordination: All these moving parts is going to be a challenge; asimilar effort took Louisiana Coastal Protection and Restoration Authority nearly 8 months to accomplish.
    - CMAP focus is to build on existing programs (such as the MMP) and define purpose of getting it together and frame how we use this for purpose of restoration planning and resource management.

Logic Model

Objective: Share the integrated logic model with attendees

Discussion Notes:

- What do you mean by logic model?
    - Purpose and need, big picture, process steps, crosswalk of CMAP and MMP objectives. Developed to give users an idea of "where they fit in to this process".

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Large Group Discussion: Questions and Reactions

Objective: Address attendees' questions and get initial / overall reactions to plans for CMAP and the MMP

Discussion Notes:

- What do you mean by "accurate" map?
    - Accurate representation of what is being mapped. Scale is a huge issue. This was a huge discussion at the Florida Coastal Mapping Program Workshop.
- Is the goal here to combine with existing efforts (i.e., Gulf of Mexico Coastal Ocean Observing System (GCOOS) or DIVER) or are you trying to make something new?
    - CMAP is integrating with other activities as appropriate, not going to duplicate effort.
- Long-term maintenance is a big question.
    - Need an action item or memorandum of understanding (MOU) that keeps this relevant and the place to go to after funding is gone.
- What is a habitat map?
    - We want to figure out what the participants definitions are and what you use. This project is a metadata project, in that sense we aren't too hung up on the definition. We will identify commonalities across programs to allow for more efficient coordination. Scale will be the driver, estuary- or basin-scale.

Large Group Discussion: Overall Reactions

Objective: Get overall reactions to plans for CMAP and the MMP. Start to learn how attendees use habitat mapping and monitoring information, and how MAM are being or should be incorporated in restoration efforts.

Discussion Notes:

Who do you represent? How do you see this effort helping you? What kind of near-real time information do you see as important for making resource decisions in your state/area?

- **The Nature Conservancy**: Monitoring oyster reef breakwaters; density, water quality, depth, etc.; CMAP is important to compare what is happening in project to what is happening in the Gulf; specifics include knowing what is being monitored in the Gulf and to ensure consistency; trying to strategize AM.
    - ***Q: Do you do any pre-project monitoring?***
    - Yes, we're required to do pre-restoration monitoring; we have to do habitat mapping prior to restoration and SAV mapping and shoreline position; etc. and will monitor post-construction for 5 years
    - **Q: Where is your data? Is it accessible to others?**
    - Should be accessible soon, through Dauphin Island Sea Lab

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- **USGS Coastal Mapping Program**: Lidar and bathymetry data coordination across the United States needs temporal and spatial information from others on their needs; knowing what standards are needed according to target habitats (i.e., corals); CMAP is important to know how to support users and get the data they need.

- **NOAA/Dauphin Island Sea Lab**: Access to high resolution digital elevation models and habitat maps will be better through a project like this. Expense often occurs at knowing where you're starting; need access to high resolution models and habitat maps as starting point.

- **Texas Parks & Wildlife:** A lot of the Texas mapping has been reactive; mostly doing oysters, structural, SAVs for management decisions; CMAP might help us reduce duplication and be more proactive. Just had first TX-wide CoP mapping meeting; had good turnout of State agencies but lacked Federal participation. CMAP might help us unify with the State folks.

- **Louisiana Coastal Protection and Restoration Authority:** We monitor at the basin and project level. Where adaptive management plays a huge role is the Mississippi delta because there's not a historical level to restore. CMAP will help us know what to do to move forward regarding gaps. Science doesn't respect political boundaries; we have to look at the Gulf of Mexico as a whole.

- **Univ. Southern Miss/Centers of Excellence:** Having access to these data allows the development of research questions. As an administrator this would allows us to reduce duplication.

- **MS/AL SeaGrant:** Red Snapper abundance estimates; significant portion of budget is data mining and investigating bottom type/consolidated reefs. Non-monitoring organization needs a place for data housing and currently no single place to find these data.

- **USGS**: One thing that CMAP can do is proactively connect the dots across the Gulf and put people in touch with each other for future efforts.

- **Ocean Conservancy**: develop science based planning tools for restoration community. We don't do onsite restoration activities, but are interested in integration of Gulf-wide restoration and ecosystem assessment efforts. We want to see at the high level a successful effort and to do that we need to tell success stories; we need access to monitoring data to communicate and synthesize that data for dissemination to the broader community

If you're going to be doing true AM, do we need different types of data/information than what is available?

- **NOAA Restoration Center:** NRDA AM can happen at different scales; looking at larger scale, we need some sort of agreement regarding what are the most important things that we can collect from every mapping dataset.

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- **U.S. Dept of Agriculture:** Private/developed land context; start to incorporate the kind of monitoring/mapping data into what we're doing; need to look at the trends of urban and agricultural contexts.

- **NatureServ:** Scale is important; are we moving the needle at the Gulf level is a different question than site-level questions and needs to be taken into account

- **NOAA/Dauphin Island Sea Lab** This is a platform that will bring together things other than just mapping; inclusion of habitat monitoring and assessment as well should capture additional information many of the mapping inventory efforts have missed.

- **NOAA:** Thinking about AM and projects that might be underperforming; may have more to do with underlying processes that are driving conditions that are unfavorable to restoration than restoration methodologies.

- **The Nature Conservancy:** Reiterate understanding of system stressors; i.e. loss of shell and we don't know why despite success in the first three years; maybe there's something we didn't measure, but we need to look at other kinds of stressors.

- **Texas Parks & Wildlife:** Caution in scaling up because local stressors are so different; defining success criteria in some regions and not the entire Gulf of Mexico is going to be important for AM.

- **MS/AL SeaGrant:** Adaptive means adapting from one thing to something else because something didn't work; need to capture methods; how do we transfer best practices? Will there be an education program to teach best practices?

- **USGS:** Adaptive management means considering recurring decisions; what are those decisions? How do we communicate those across programs; RESTORE Council has a requirement for AM and CMAP will help; taking lessons learned and levels of training and making that available to stakeholders; how are monitoring data looped back in the feedback mechanisms for AM? RESTORE Council will be kicking off those discussions this year

- **Florida Institute of Oceanography:** how are you actually monitoring – possibly started without good underlying mapping information. To what extent will these legacy monitoring programs adapt with habitat mapping. Measure of this team will be if we can get change in those places.

CMAP: How can you all use the monitoring information we gather to plan/design/implement projects? Is there some utility for that purpose?

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- **Florida Fish & Wildlife Commission:** reef fish populations in the Gulf; looking at fisheries stock assessments and monitoring occurring at the same time so the type of information collected here will be useful for our projects regarding representative habitats.

- **NOAA/National Center for Environmental Information (NCEI)**: We're here to help source data that exists in the archives; this data that you all are looking for, what does that data need to look like? What do you need to know about the data? Do we need to create derived products? What are your needs?

- **NOAA Restoration Center**: mesophotic/deep water coral habitats under NRDA; mapping will help ID restoration site planning need to collect data at very high resolution and is a sampling design challenge; DIVER/Environmental Response Management Application (ERMA) and other clearing houses of data and identifying them all is a huge endeavor in and of itself.
    - **CMAP/MMP:** We are taking into account other inventories and we're picking those inventories up and taking them further; we know that there's other information out that we haven't gotten to yet. This program is inventorying and assessing program metadata, not actual monitoring data. We provide access to this information from one place with linkages to the actual data.
    - **Q**: Is the Environmental Systems Research Institute (ESRI) tool we heard about at Gulf of Mexico Oil Spill and Ecosystem Science (GoMOSES) Conference still on the table?
    - **CMAP:** There is some exploration with ESRI, we may be able to test it with the Alabama SAV pilot.

- **U.S. Department of Agriculture:** Really looking forward to using the different screening criteria option; U.S. Environmental Agency (EPA) has mandate for environmental justice and incorporate CMAP goals with that mandate

- **Ocean Conservancy:** Important for AM practitioners to characterize as value added benefit; The Ocean Conservancy just finished case study for how AM has benefitted restoration programs https://oceanconservancy.org/restoring-the-gulf-of-mexico/take-deep-dive/adaptive-management/

Are you aware of monitoring currently taking place for RESTORE, NRDA, etc. restoration projects in your state and how is monitoring enforced for these efforts?

- **NOAA Restoration Center:** Most of the NRDA data are stored in DIVER; looking to automate so system can send data update reminders; mostly early restoration.

- **LA Coastal Protection & Restoration Authority:** restoration programs with program-wide monitoring but don't know how individual projects affect the larger system; what to do with the data, e.g., Louisiana Sand Resources Database (LASARD); trying to synthesize data to assess how much and what is really needed via AM.

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- **The Nature Conservancy:** monitoring 1.7 mile reef tract with NOAA; we are required to monitor some things U.S. Army Corps of Engineers (USACE) permitted project requirements but most of what we do is on our own

- **CMAP**: USACE has requirements for monitoring and AM for mitigation and ecosystem restoration projects.

- **RESTORE Council**: RESTORE funded projects; documentation for project success is done on a project by project basis; data are reported out to databases of the practitioner's choosing; one of the goals of the CMAP project is to come up with recommendations for what should be collected/monitored.

- **NatureServe:** Has a Restore Science Program project that developed key sets of ecosystem indicators for five ecosystems - has a draft list available.

- **NOAA Restoration Center**: Cross-fertilization should help with coordination and duplication
    - Cross-TIG MAM isn't just feds, does have heavy state participation. Good source for knowing what is going on
    - Two region-wide TIGs would be relevant
    - Nature of activities for the different groups could be quite different

- **NOAA/Dauphin Island Sea Lab**: AM reflection; Alabama Real Time Coastal Observing System serves data for over a decade; it's important to remember lessons learned of ease of access, relevancy, trust, and bringing something into the culture of decision making; setting realistic expectations for incorporation of this project into the field of AM is important
    - important to highlight success stories and failures/challenges

- **Florida Dept of Environmental Protection:** Statewide assessment of coastal and aquatic resources - same habitats that NatureServ used - starting with Ocean Conservancy datasets and creating a database that will link with other databases for each of the indicators.

- **Nova Southeastern University:** Habitat mapping on west Florida shelf; a lot of discussion about monitoring/mapping data and want to caution/have folks assembling the data provide data limitations as part of the assembly to prevent inappropriate use of the data or out of context use
    - Where applicable, inventory can note quality controls and use limitations

Breakout Groups: How Can CMAP and the Master Mapping Plan Address User Needs for Gulf of Mexico Habitat Monitoring and Habitat Mapping Information and Tools
Objective: Get more detailed information on users' objectives, challenges, and needs

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Discussion Notes:

Question 1. What are the top habitat issues of your organization, and what monitoring/mapping data do you use and/or need to make informed decisions and meet your management goals? Participants answers were grouped by general topical areas to better capture the information.

ISSUES

Habitat Related

- Sea level rise
- Shoreline/wetlands erosion/accretion
- Living shorelines/breakwaters
- Lack of high resolution mapping products
- Poor SAV, oyster, wetlands, mangrove maps
- Mississippi/Louisiana delta
- Beach management
- Unpermitted reefs
- Cost prohibitive surveys
- Funding for mapping

Habitat Use limitations

- Birds
- Fish
- Sponges
- Sturgeon
- Corals
- Mammals
- Turtles

Activities

- Restoration planning/priortization/siting
- Land use
- Regulatory vs restoration issues
- Poor management
- Conservation prioritization
- Conflicts with stakeholders
- Lack of education/outreach
- Funding

Data

- Availability
- Quality
- Storage
- Funding
- Resolution issues
- Standards
- Habitat classification issues
- Too many gaps
- Inconsistent mapping schedules
- Scale
- Modeling
- Lack of baseline for decision making, siting

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Coordination

- Lack of
- Duplication of effort
- Funding

Other

- Cultural resources
- Restoration monitoring

Uses of Monitoring & Mapping data

State and Federal monitoring programs

- Oysters
- Seagrass
- Mangroves
- Wetlands
- Harmful algal blooms (HABs)

Mapping data

- Aerial imagery
- Lidar
- Multibeam/backscatter
- Topobathymetry
- Bureau of Ocean Energy Management submeter data

Infrastructure

- Vessels
- Aircraft
- Drones
- Remotely operated vehicles

Other Programs

- National Estuarine Research Reserves (NERRS)
- NOAA Archive
- Louisiana System Wide Monitoring Program (SWMP)
- Gulfwide surface elevation table data
- US EPA

Needs

Mapping

- Higher resolution multibeam w/ backscatter
- More topobathymetry
- Higher resolution DEMs
- Consistent temporal/spatial resolution
- More recent mapping data
- Substrate
- Sub-meter info in mesophotic/deep
- Mangrove
- Light pollution
- Coastal, urban and riparian forest
- Offshore sand distribution
- Tide and current information
- Coastal lidar
- Storm surge inundation
- Land use
- Inventory of what's available

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Habitat use information

- Birds
- Sturgeon
- Fish
- Deep coral communities
- Living marine resources
- ROV data for characterization/ground-truthing

Other informational

- Wave energy
- Harmful algal blooms
- Affects of turbidity to mapping
- Water quality trends
- Cultural resource surveys
- Sea level rise scenarios

Planning & Management

- Educating public/stakeholders
- Outreach
- Research and Development
- Monitoring information integrated with models
- Downstream effects from upstream events
- Watershed management planning
- Restoration planning
- Better coordination/communication

Question 2. What has been the biggest challenge to developing/implementing MAM in your organization?

- no prior knowledge; learning by experience
- working with other agencies
- scale
- lack of guidance?
- time to develop MAM for ecosystem restoration
- Politics/state needs
- communication break down
- AM for data management and protocols; not restoration goals
- limited by governance structure
- Ability to use legacy/historical data for current issues
- "we've always done it this way"
- local/state coordination is limiting
- Management and science disconnects

Recommendations:

- National Estuary Program (NEP) has a good MAM model; suggest compiling NEP and look at minimum monitoring data requirements and best management practices (BMPs)
- Goals should relate to ecological integrity; recommendations for design, monitoring, and restoration

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- Lack of guidance for artificial reefs; could look at monitoring or BOEM's rig removal program
- Use existing restoration/monitoring information if it exists, no need to reinvest in data collection
- Ensure data collection methods are consistent
- Need to account for natural variability with respect to adaptive management

Question 3. How can CMAP/MMP address user needs?

Who are the users?

- RESTORE COUNCIL Staff and Members
- Resource managers at all levels
- Congress/State Governments
- Academics
- Public
- Citizen scientists
- Restoration practitioners

Ranked CMAP/MMP benefits:

- Leveraging opportunities/funds/equipment
- Preventing duplication of effort
- Restoration planning/prioritization
- Highlight gaps
- Help with trend detection
- CMAPs recommendations and guidelines
- Adaptive management
- Reference sites from other projects
- Enhancing communication
- Data discovery
- Help update monitoring design
- Baseline standards
- Damage assessment

Question 4. Does your organization have a process for adaptive management that incorporates monitoring and are there any additional challenges?

- No process: USGS, Ocean Conservancy, Florida Department of Environmental Protection, Texas Parks and Wildlife Department, other Florida agencies. Louisiana SWMP
- Yes to process: Sea Grant, Coastal Protection and Restoration Authority, Florida Reef Program, EPA, NRDA, USDA, Governor's Oyster Action Plan, Mobile Bay NEP
- Similar process: NOAA Sanctuaries, The Nature Conservancy, Sentinel Site Cooperative

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Challenges

- Consistency
- Continuity
- Application of collected monitoring data
- Need better monitoring
- Loss or not transferring institutional knowledge
- Are we asking the right questions? More thorough objective delineation

Question 5. What scale of monitoring and mapping is needed for what you do?

- Florida: bathy/topo for shoreline to 20 m preferred 1-3 m resolution
- Florida Institute of Oceanography: 1 m bathymetry resolution; could be multiscale in a nested framework
- FDEP: field work done at 10m resolution
- Mississippi/Alabama Sea Grant planning occurs at sub-regional scale
- Mississippi Center of Excellence & Department of Marine Resources operate at the scale of the Mississippi sound, but some finer resolution at project scale
- Texas: 100-2500 m^2 is acceptable at state resolution, 1 m^2 preferred for habitat mapping or resource utilization
- LA CPRA, SWMP, Coastwide Reference Monitoring System (CRMS) basin scale, but many project scale require finer resolution
- USDA: Hydrologic Unit Code (HUC) 12 level to detect changes from restoration
- USGS: elevation mapping 1 m^2 DEM
- NOAA fisheries: 1 km^2 for highly migratory species, high resolution for benthic species
- NOAA Coastal Change Analysis Program: 15m resolution, also county and watershed level
- Ocean Conservancy and Nature Conservancy: mostly Gulf-wide, state and finer depending on objective
- NatureServ: regional to national
- EPA: estuary to regional

How does the use of monitoring and mapping vary at different scales?

- Spatial and temporal scale varies according to needs/application
- Need reference materials that outline acceptable resolution based on project scale and target user group
- Best available data typically used-preferably high resolution, most cost effective
- Needs for both high and low scale application
- Broad planning level can have low level scale; project/monitoring level needs higher resolution, sometimes sub-meter
- Council: Multiple scales to inform adaptive management; finer scale (temporal and spatial) projects important to informing bigger picture
- Gulf bathymetry mapping 10x10 m^2 is ok; too coarse for fisheries assessments

- Examples
    - Sub-meter needs (inshore, oysters)
    - USACE: regional sediment management requires use of highest resolution data available
    - The Nature Conservancy: needs for high resolution data for habitat mapping, habitat change assessments, and decision-making at a regional scale
    - Apalachicola National Estuarine Research Reserve habitat delineation - highest resolution available
    - LA: 30-500 m grids for modeling hydrodynamics, vegetation
    - USACE: regional sediment management – highest resolution available
    - U.S. Fish and Wildlife Service habitat mapping (sub-meter), other non-habitat work at 30 m
    - Florida Fish and Wildlife Research Institute: fisheries surveys (1-10 m)
    - TNC: habitat mapping, change assessments, decision making

Temporal Issues

- event based scales (hurricanes)
- project/needs dependent
- tidal, seasonal, environmental factors
- NERR monitoring done 4 times per year
- Texas mapping? Updated every 10 years

BREAKOUT 5: What webtools, websites, or web services do you use for discovering or identifying habitat mapping and monitoring data? In searching for data, what functionality do you find most useful. What types of queries do you use or would you like to use to help find data resources (e.g. spatial query, keyword search, temporal search)?

Needs:

- map with data/metadata that are available for restoration monitoring (footprints vs single dots)
- Python code access
- Representational State Transfer Services
- all land acquisition NRDA
- digitizing legacy data
- Web sites for discovery

Functions:

- time series of change
- structure of habitat
- visualize
- ability to download data/modify
- good system to view data
- good metadata
- raw and processed data (different needs for different projects
- Python code access
- REST Services
- Species occurrence over time and map (e-Bird but better)
- planning and coordination

- spatial queries
- immediate output to get data
- responsiveness
- webmap, sensor observational services (how data gets to Gulf of Mexico Coastal Ocean Observation System
- user friendly
- intuitive

Websites/portals/tools

The breakout group listed 93 sites that provide tools or data discovery. This list is provided as an attachment to this summary.

Adaptive Management topics

- Adaptive management process must be defined from beginning with scenarios and responses; monitoring indicates process so take corrective actions – this is not AM
- Some organizations do not have formal process or call that process AM but follow concept
- Some funding streams are starting to require AM
- Participate in discussions but no particular process
- NRDA has but no true requirement; lacks teeth; varies within TIGs
- Culture of AM across organizations but not formal AM process

Day 2 Wednesday April 4

Review of Day 2 Agenda, Reflections from Day 1

Large Group Discussion: Ongoing Monitoring and Mapping Inventory Efforts, and Monitoring Program Attributes for CMAP

State representatives share status of habitat monitoring and mapping activities. *Presentations available upon request*

Steve Jones - Geological Survey of Alabama

- Many sources of data within the state; Websites available in presentation. Steve can be POC for further questions

Emma Clarkson – Texas Parks and Wildlife

- Just had a workshop to create an instate network of mapping;
    - focused on larger scale
    - product will be document outlining who, what, when, where of Texas mappers
    - will include unofficial set of products
    - Water Development Board, responsible for aerial acquisition
    - many missing orgs, including Federal agencies, need a round 2
- Will send a list of Texas programs to inventory team

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Syed Khalil – Louisiana Coastal Protection and Restoration Authority

- Coastal Information Monitoring System website to access info on different programs
    - System Wide Assessment & Monitoring Program (SWAMP)
    - Coastwide Reference Monitoring Program (CRMS)
    - Barrier Island Comprehensive Monitoring Program (BICM)
    - Louisiana Sand Resource Database (LASARD)

Karen Clark – Mississippi Department of Marine Resources

- most data in MS comes from Grand Bay NERR, Sentinel Site Program, and oyster program
- most data not publicly available right now but working on developing a portal for access

Cheryl Hapke - USGS

- Development of Florida Coastal Mapping Program
- Established technical and steering committee (includes NOAA and BOEM)
- Goal: modern, high res topo bathy for entire coast of FL
- Divided Florida into 6 regions for gap analyses
- Next steps will include bringing on state coordinator (sit at FWRI)
- 230 programs in FL related to the 5 submerged habitats of focus
- Question: What is the tie-in with CMAP? The overlap is inventory; still a work in progress; info from breakout groups from this workshop will help with direction and feed into Gulf of Mexico Alliance All Hands meeting. Not just mapping, monitoring also

CMAP Habitat Monitoring & Mapping Overview/Status

Criteria to filter the inventory

- Temporal criteria
    - 1980-present
    - active and inactive monitoring
    - 5-year recurrent sampling or 2 sampling events within 5 years
    - not focusing on non-habitat forming resources
    - some exceptions (data limited area, foundation dataset)
- Spatial criteria:
    - HUC10 boundaries through Exclusive Economic Zone
    - Programs could extend outside of GOM

Habitat monitoring parameters – 4 general levels:

- submerged hab building animals - population dynamics, composition metrics, health, morphometric
- plants- population dynamics, composition metrics, health, morphometric
- soil/sediment chemistry
- physical

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Mapping

- Imagery for benthic/terrestrial habitat classification, navigation, etc.
- Programs to include:
    - Gauge the conditions or state through remotely sensed measurements
        - LiDAR
        - SONAR
        - Satellite
        - Aerial
    - Primary data used to develop habitat maps
    - Develop recurrent or foundational map products
- Parameters:
    - Area of habitat types
    - Topographic
    - Bathymetric
    - Topobathymetric
    - Imagery
    - Shoreline profile
    - Accretion
    - Subsidence

Status

- used Ocean Conservancy Monitoring Atlas inventory and USGS Global Change Monitoring Portal as starting points
- currently have 322 programs
- most were accepted based on criteria though some were accepted with exceptions
- will reach out to Community of Practice and program POCs to help fill inventory gaps
- Longterm maintenance is a concern

User Interface

- Hope to have all programs georeferenced
- Users can browse by map or tabular search
- customized or predefined options
    - programmatic or site level
    - water quality, habitat monitoring, or mapping program
    - aquatic setting and habitat types
- uses CMECS where appropriate for all attributes
- all parameters/attributes will have controlled vocabulary
- monitoring parameter search w/ attributes
- also tying programs to NRDA restoration projects

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Displayed examples of spatial outputs

- Q1. Why does the boundary extend to east coast of FL?
    - Using RESTORE Council boundary which extends to east coast
- Q2. CMAP seems to really be focused on benthic?
    - No CMAP includes terrestrial and water column.
- Q3. What about the deep water?
    - CMAP will also cover deep water pelagic and benthic.
- Q4. Didn't see sargassum, is it included?
    - It is included but grouped into SAVs.
    - **SUGGESTION**: Participants recommend sargassum being a stand alone category.
- Q5. why porewater and groundwater are classified as "habitat"? **SUGGESTION** Remove
  SUGGESTION: Should touch base with Jim Gibeaut (Texas A&M Corpus Christi) and Gulf of Mexico Research Initiative Information & Data Cooperative
  SUGGESTION: would encourage recognition of urban areas as a habitat, as well as agricultural

Breakout Group #2

Q1. Is CMAP collecting information that is useful?

- Useful for siting prioritization
- will be helpful only if it remains active/sustainable/maintained
- Making connections with potential partners
- CMAP has greater resources and needs broad community buy in
- Optimizing project to benefit multiple groups
- Connecting Deepwater Horizon projects
- Building solid foundation (CoP) to increase buy-in and support
- Sets the stage for future data synthesis (modeling)
- Challenge: capturing a wide range of domains-might lead to a complicated, clunky system
- not useful if data isn't current and obsolete
- may not be able to scale up for purposes other than the original intent.
- keep information handy that doesn't make the first cut

Q2. Is the attribution correct?

- Most agreed
- Suggest adding light pollution maps
- Add pelagic and mesophotic habitats
- Avoid too many attributes to avoid cumbersome system

Q3. What is missing? Suggestions for discovery.

- Reach out to Christine Shepard TNC
- NERRS Sentinel Sites
- Mike Osland SET Database
- Keep Florida east coast in the domain
- Prop scar mapping in Florida; Texas has a discrete program

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- Mobile Bay NEP has habitat mapping
- Swift track? (Renee Collini)
- touch base with all Centers of Excellence
- Emma will send Texas programs
- Just Cebrian has a lot of marsh data
- Dauphin Island Sea Lab Data Mgmt Center
- Private industry data?
- BOEM data
- Urban/agricultural lands
- NCEI archived data

Suggestions General

- Suggestions for better coordination?
- CMAWG should help us coordinate in state, but need to know the appropriate people. Maybe we need a key POC in each state?
- maybe put structure in place to facilitate communication?
- A lot of state reps don't participate in GOMA
- leverage frameworks with state frameworks
- need to disseminate this info back to states, all agencies
- MS AL SEAGRANT has guidance on data reporting and public access
- thought put into query capability for faceted searches
- combining searches will be important, include both habitat and water quality programs
- Policymakers are going to want to know what progress is being made – could use iterative gap analysis to show that. The inventory should be available through NCEI archive; accessibility is key.

Q4. How to keep the inventory relevant over time?

- Link to funding sources; put data in one place
- make it as accessible as possible
- Make direct links to the data
- Need a champion
- Keep relevant with new technology
- Connect to state web mapping services
- Require new programs to be required to be part of the inventory
- Need to think beyond end of DWH funds (20-25 yrs)
- Data management plans and requirements to ensure that data is useful and accessible

BREAKOUT #3

GAPS

- **Monitoring**
  - Reef species composition and condition
  - Water quality parameters (pH)
  - Gaps in SETS between NERRs/Refuges
  - Subsidence
  - Consistent bathy-topo 'frequency/routine cycle"
  - Blue water
  - Lack of region wide collaboration; prohibitive to assessing baseline

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- Lack of unified data management, monitoring parameters and standards
- Water quality gaps between NERRS
- Living shorelines
- Islands and dredge spoil
- Coordinated SAV maps
- Lack of comprehensive offshore water quality
- Macroalgae
- Oil platforms
- SETs
- Subsidence
- Proprietary data
- Deep benthic communities
- Concurrent fisheries/habitat data
- Components needed to build habitat suitability models
- Gulf-wide indicators
- Hydrodynamics

- **Mapping**
  - Reef habitat
  - Oyster reefs (present/historic)
  - Estuarine (bathy/topo)
  - Mangroves
  - Remotely sensed data analysis (satellite imagery vs. side scan)
  - Shoreline armoring/change
  - Land classification (dredge/spoils)
  - Oil platform mapping (BOEM)
  - Benthic offshore
  - Blue water
  - Existing satellite data for habitat
  - Cultural mapping (ancient burial sites or forests)
  - Proprietary data
  - High resolution sediment maps
  - High resolution DEM
  - Light pollution
  - coordinated SAV mapping
  - “unprocessed” data - existing NOAA navigation data
  - high resolution bathy (prioritized)
- **Causes for Gaps**
  - Coordination/redundancy
  - Technology application
  - Satellite application
  - Access/complexity/logistics
  - Political boundaries - sharing/pooling funds (MOAs)
  - Data acquisition $ (decrease) causes (increase) in programs
  - Accountability/mandates
  - Staff turnover/champion loss
  - Legality
  - Capacity and capability (collection and processing)
  - Extensive coverage
  - Data not readily accessible
  - Dynamic resources
  - Logistics/cost
  - Willingness to share
  - Mandate and/or need - including awareness of need
  - Data compatibility
  - Coordination/communication across groups
  - Technology
  - State gaps
  - Awareness

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- **Challenges**
  - Subsidence, especially in LA
  - Coordination is huge gap
  - Technology
  - Political boundaries
  - Lack of accountability/mandate
  - Staff turnover and loss of champions
  - Cost of data acquisition has decreased allowing for more collection but reduced coordination

- **Approach to Filling Gaps**
  - Coordinate mission requirements => multiple techs on vessel/array/optimization
  - Feedback/adaptive strategy
  - Develop a process of implementation – short & long term
  - Shared resource planning
  - Inventory capacity
  - Facilitate data standards
  - Cross-mission training
  - reprocessing existing data with modern tech
  - Further application of satellite imagery
  - Mini-CoPs
  - Dedicated funding source for monitoring
  - Marketing
  - Citizen science (sea turtles, manatee, eBird)
  - Private/public partnerships
  - Sampling optimization for multiple user efficiency
  - SET platforms/vessels of opportunity
  - Education for technology transfer from NERR
  - Using modelling more effectively
  - Versatility/usefulness
  - Leveraging/efficiency (equipment)
  - Political support
  - Crowdsourcing

Breakout #4. Prioritizing Gaps

Q1. What are the criteria to prioritize gaps?

- Management needs
- Multi-use
- Needs assessment
- Cost benefit analysis
- Biggest bang for the buck
- Leverage opportunities, common objectives
- Develop detailed scope of work with short/long term activities aka Louisiana Master Plan
- Use a planning portal like Seasketch
- Develop a framework like the SET cooperative
- Consistent standards
- Need dedicated funding for monitoring
- Increase capacity (people, vessels)
- Marketing – value of monitoring

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- **If ample funding was available, we could…**
    - map entire Gulf Coast, all sediment distribution map, divide whole map into planning units
    - all low hanging fruit, bring together all habitat monitoring and mapping data, leading to gap analysis
    - create first topographic/bathymetric map for entire Gulf
    - create DEMs for southwest Florida and some in Louisiana and determine uncertainty
    - focus on foundation data – expanding or creating baseline
    - prepare baseline for emergency or catastrophic events
    - fill needs in data management and processing, synthesis, analysis, cataloguing, and archiving
    - provide training guidance for implementing protocols and standards with a communication plan
    - set up a communication network for collaboration and cooperation, i.e., former SeaSketch
    - create demonstration projects for a programmatic approach, show life-cycle of process
    - identify existing and future user needs
    - establish instantly accessible database to users

<u>Concerns about creating a new portal or joining an existing one:</u>

- How to promote/solve continuity
- How will this fit into National effort
- This will be guidance for council
- coordinated with NRDA and National Fish and Wildlife Federation we will adopt output of CMAP
- Provide visualization for where all of the data portals are on landscape
- Hopefully greater resources for this effort and greater community buy-in/use
- GoM-centric and responsive to funder
- Must demonstrate to council where gaps exist to guide future phases for gap filling funding
- Council-funded restoration projects that require monitoring - CMAP to develop foundation information to guide recommendations

Thursday, April 5th
Moving Forward Holistically on CMAP and the Master Mapping Plan

Objective: Reflect back on input received over first two days and how that informs the logic model, frame up discussion for day 3

CMAP and MMP staff summarized some of the recommendations and feedback that were received.

Ali Robertson talked about the upcoming Monitoring Community of Practice workshop to be held June 11, 2018, prior to the Gulf of Mexico Alliance All Hands meeting in St. Petersburg, FL.

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

- Lack of unified data management, monitoring parameters and standards
- Water quality gaps between NERRS
- Living shorelines
- Islands and dredge spoil
- Coordinated SAV maps
- Lack of comprehensive offshore water quality
- Macroalgae
- Oil platforms
- SETs
- Subsidence
- Proprietary data
- Deep benthic communities
- Concurrent fisheries/habitat data
- Components needed to build habitat suitability models
- Gulf-wide indicators
- Hydrodynamics

- **Mapping**
  - Reef habitat
  - Oyster reefs (present/historic)
  - Estuarine (bathy/topo)
  - Mangroves
  - Remotely sensed data analysis (satellite imagery vs. side scan)
  - Shoreline armoring/change
  - Land classification (dredge/spoils)
  - Oil platform mapping (BOEM)
  - Benthic offshore
  - Blue water
  - Existing satellite data for habitat
  - Cultural mapping (ancient burial sites or forests)
  - Proprietary data
  - High resolution sediment maps
  - High resolution DEM
  - Light pollution
  - coordinated SAV mapping
  - “unprocessed” data - existing NOAA navigation data
  - high resolution bathy (prioritized)
- **Causes for Gaps**
  - Coordination/redundancy
  - Technology application
  - Satellite application
  - Access/complexity/logistics
  - Political boundaries - sharing/pooling funds (MOAs)
  - Data acquisition $ (decrease) causes (increase) in programs
  - Accountability/mandates
  - Staff turnover/champion loss
  - Legality
  - Capacity and capability (collection and processing)
  - Extensive coverage
  - Data not readily accessible
  - Dynamic resources
  - Logistics/cost
  - Willingness to share
  - Mandate and/or need - including awareness of need
  - Data compatibility
  - Coordination/communication across groups
  - Technology
  - State gaps
  - Awareness

Appendix 3: CMAP Habitat Monitoring and Mapping User Needs Workshop Summary

Data Management and Product Delivery Issues

Objective: Discuss issues related to data management and delivery of products

Discussion Notes:

Query Suggestions

- Products
- Data accessibility
- Software requirements – suggestion to use open data standards, open platforms to avoid issues
- Query by date
- Data type (e.g. elevation) – would be under parameters
- Taxonomy – not to that level
- **ACTION**: Add controlled vocabulary and schema to items that will be sent out

Good Examples of data discovery platforms

- Marine Cadastre (BOEM/NOAA)
- Gulf Tools for Resilience Exploration Engine
- Louisiana sand resources database

Ongoing Communication/Meetings

- MCoP
- GOMA All Hands

Meeting adjourned

Appendix 4: Council Monitoring and Assessment Program Documented Assumptions

I. Monitoring Program Types

Water Quality Monitoring

Programs to include those which:

- Implement recurrent monitoring of water quality as a complementary data stream to a biological or other monitoring program

*Will use a field titled "Medium" to designate the sample medium (water column, porewater, or tissue) from which parameters are collected

General Parameters	Detailed Parameters
Nutrients	Total nitrogen Nitrite Nitrate Nitrite + nitrate Ammonia Ammonia + organic nitrogen Total phosphorus Soluble phosphorus Phosphate Orthophosphate Silicate
Pathogens	*Escherichia coli* *Enterococcus* Fecal coliforms Total coliforms *Giardia* *Cryptosporidium* *Vibrio*
Aquatic Primary Producers	Phytoplankton Chlorophyll
Harmful Algal Bloom Indicators	Cyanobacteria Algal toxins
Sediment	Suspended sediment concentration Total suspended solids
Mercury	Total mercury Methylmercury
Freshwater Inflow	Discharge Stage
Field Parameters	Water temperature Conductance Dissolved oxygen Turbidity pH Light attenuation Currents Water level
Carbon	Organic carbon Polycyclic aromatic hydrocarbons (PAHs)

Appendix 4: CMAP Documented Assumptions

Habitat Monitoring

Programs to include those which:

- Gauge the condition or state of habitat through in-situ measurements
- Where possible, habitat data associated with important gulf faunal species-specific monitoring (based on the National Resource Damage Assessment (NRDA) restoration types)
    - Fish and water column invertebrates
    - Sea turtles
    - Marine mammals
    - Birds
    - Estuarine and marine benthics

General Parameters	Parameter Groups	Parameter Subgroups
Submerged habitat building animals	Physiology/Health	Disease Size Bleaching Growth
	Population dynamics	Settlement/Recruitment Survivorship Larval transport Spawning Mortality
	Ecological metrics	Composition Abundance Coverage Density Distribution Biomass
Plant/Macroalgae	Ecological metrics	Composition Abundance Distribution Biomass Cover Density
	Physiology	Canopy extent/structure Size Growth Litterfall
	Population dynamics	Recruitment Survivorship Mortality Reproductive effort Primary production
Abiotic	Substrate metrics	Substrate geochemistry Substrate composition Topographic complexity Sediment classification Substrate depth
	Coastal processes	Vertical accretion Subsidence

Appendix 4: CMAP Documented Assumptions

Mapping

Programs (or platforms/satellites/datasets) to include those which:

- Gauge the condition or state of water quality or habitat through remotely-sensed measurements (e.g., lidar, sonar, satellite, aerial, etc)
- Collect primary data that can be used to develop derived products needed to produce a habitat map
- Develop recurrent or foundational map products for one of a variety of targeted habitat types
    * Notes: Records falling under the “Mapping” program type category should:
        - Be constrained to the temporal limitation of 1980 to present (listed below)
        - By default meet duration requirements (listed below) as these datasets provide a “principal source of information”

Mapping Technology/Tools

Programs/projects will be documented as collecting data using one or many of the following technologies or tools:

Multibeam echosounder (MBES)
Single beam echosounder (SBES)
Split beam echosounder
Side scan sonar
Seismic
Subbottom
Acoustic doppler current profile (ADCP)
Light detection and ranging (Lidar)
Digital photography
Radar
Synthetic aperture radar (SAR)
Interferometric synthetic aperture radar (IFSAR)
Real-time kinematic global positioning system (RTK GPS)
Total station

Mapping Parameters

Programs/projects will be documented as collecting one or many of the following parameters:

Area of habitat types
Hyperspectral imagery
Multispectral imagery
Digital photography
Surficial elevation
Backscatter intensity
Reflectivity
Vertical accretion
Subsidence
Land use/land cover
Sediment depth
Sediment grain size
Soil type
Water temperature
Sea surface temperature
Chlorophyll
Turbidity
Salinity
Currents
Water column profiling

Appendix 4: CMAP Documented Assumptions

II. Habitat Type and Aquatic Setting

Habitat Type

Programs/projects will be documented as falling within one or more of the following habitat types:

- Water column (includes groundwater)
- Oyster/Bivalve bed
- Emergent wetland
- Forest
- Grassland
- Beach/dune
- Barrier island
- Mangrove
- Tidal flat
- Hard bottom
- Coral reef
- Soft bottom
- Submerged aquatic vegetation-SAV (includes seagrass beds and benthic macroalgae)
- Sargassum/Floating macroalgae
- Deep sea benthic communities
- Artificial reef
- Urban
- Agriculture

Aquatic Setting

Each habitat type documented for programs/projects will fall within one or more of the following aquatic settings:

- Upland
- Riverine
- Palustrine
- Lacustrine
- Estuarine
- Marine Nearshore (0-30 m depths)
- Marine Offshore (30 - 100/200 m depths - cont. shelf break)
- Marine Oceanic (100/200 - 11000 m depths - deep ocean)

III. Temporal Limitations

- 1980 to present
- Active or inactive monitoring efforts
- Program duration (Adoption of the Ocean Conservancy's inventory criteria):
    - Minimum data record of 5 years of recurrent sampling; or
    - Minimum of 2 sample years that will span the 5 year range; or

Appendix 4: CMAP Documented Assumptions

- Discrete programs which provide a principal source of information for resource assessment or management meeting 1 of 5 criteria:
  1) Geographic scope
  2) Primary data source
  3) NRDA resource category
  4) Foundational data source
  5) Limited data availability

IV. Spatial Extent

- Minimum mapping unit
  - To be determined based on the data available
- Proposed project boundary
  - Will use a boundary which includes Hydrologic Unit Code (HUC) 10 boundaries (See map below - orange line)
  - If a program has monitoring sites falling:
    - Within and outside of the boundary, we will only include sites for that program which fall within project boundary
    - Mostly outside of the boundary, we will investigate on a case-by-case basis
    - Along the US/Mexico border or the Gulf of Mexico/Atlantic Ocean boundary, we will investigate on a case-by-case basis

In the figure above, AOI refers to area of interest. HUC refers to U.S. Geological Survey's (USGS) Hydrologic Unit Codes. These data are available via the USGS's Watershed Boundary Dataset (USGS and U.S. Department of Agriculture, Natural Resources Conservation Service, 2013). The inland boundary is represented the intersection of a 25-mile buffer from the Coastal Management Zone Boundary (CMZA; Office for Coastal Management, 2019). The seaward boundary is represented by the U.S. Exclusive Economic Zone (EEZ; 48 FR 10605, 3 CFR, 1983 Comp., p. 22).

Appendix 4: CMAP Documented Assumptions

V. Collection of Descriptive Metadata

- Only collecting descriptive metadata about monitoring programs (rather than raw monitoring data)
- Information collected will generally include:
    - Program objectives
    - Program duration
    - Monitoring frequency
    - Geographic extent
    - Funding source
    - Funding amount
    - Observational accuracy and precision
    - Standard operating procedures
    - Data access (linking to an outside source where the data is served)
    - Program contacts

VI. Granularity of Spatial and Attribute Data

- Three potential representations:
    - Polygons + Program-Level Metadata
        - Could be represented by general extent or custom polygon
    - Points + Program-Level Metadata
    - Points + Site-Level Metadata

VII. Database Management

- The monitoring program inventory and database/webtool will be a one-time snapshot within the 3-year time frame of the project.
    - A potential opportunity for future updates could involve requirement of future grantees to enter descriptive metadata for their projects upon completion.

References

U.S. Geological Survey (USGS) and U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NCRS). 2013. Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (4 ed.): Techniques and Methods 11–A3, 63 pp. https://pubs.usgs.gov/tm/11/a3/

National Oceanic and Atmospheric Administration Office for Coastal Management (NOAA/OCM). 2019. Coastal Zone Management Act Boundary. Available at https://inport.nmfs.noaa.gov/inport/item/53132.

Appendix 5: Council Monitoring and Assessment Program Glossary of Terms

Executing Agency Type: The type of agency leading the program (i.e., Federal, State, Academic, NGO, etc)

Federal: An administrative unit of the United States Federal government established for a specific purpose.

State: An administrative unit of a State government established for a specific purpose.

Regional: An organization or agency that operates at a regional level (e.g., Migratory Bird Joint Ventures).

Local: An administrative unit of a county or city government established for a specific purpose.

Private: A company owned either by non-governmental organizations or by a relatively small number of shareholders or company members that does not trade its company stock to the general public on the stock market exchanges.

Non-governmental Organization (NGO): A non-profit, voluntary citizen's group organized on a local, national, or international level.

Consortium: An association of several businesses or agencies.

International: An organization that works in more than one country, generally funded by contributions from national governments.

Academic: An institution dedicated to education and research that grants academic degrees.

Tribal: A governing body of a tribe, band, pueblo, community, village, or group of native American Indians.

Program Type

Aquatic setting: Hydrologic setting/stratum falling within program extent.

Upland: Environment above the extreme high water spring (EHWS) level (Cowardin et al., 1979).

Riverine: The Riverine System includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts of 0.5 ppt or greater (Cowardin et al., 1979). For more information, see https://www.fgdc.gov/standards/projects/wetlands/nwcs-2013.

Palustrine: The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand (ppt). It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2.5 m (8.2 ft) at low water; and (4) salinity due to ocean-derived salts less than 0.5 ppt. (Cowardin et al., 1979). For more information see, https://www.fgdc.gov/standards/projects/wetlands/nwcs-2013.

Lacustrine: Environment associated with lakes; shoreline areas of lakes with less than 30 percent areal coverage by trees, shrubs, and persistent emergents. In areas with a greater than 30 percentage of vegetative cover, the Palustrine classification should be used (FGDC, 2012). For more information, see https://www.cmecscatalog.org/cmecs/classification/aquaticSetting/3.html.

Estuarine: The Estuarine System is defined by salinity and geomorphology. This System includes tidally influenced waters that (1) have an open-surface connection to the sea, (2) are regularly diluted by freshwater runoff from land, and (3) exhibit some degree of land enclosure (FGDC, 2012). For more information, see https://www.cmecscatalog.org/cmecs/classification/aquaticSetting/2.html.

Marine: The Marine System is defined by salinity, which is typically about 35 ppt, although salinity can measure as low as 0.5 ppt during the period of average annual low flow near fresh outflows. This system has little or no significant dilution from fresh water except near the mouths of estuaries and rivers. The Marine System includes all non-estuarine waters from the coastline to the central oceans. The landward boundary of this system is either the linear boundary across the mouth of an estuary or the limit of the supratidal splash zone affected by breaking waves. Seaward, the Marine System includes all ocean waters. The marine zone includes three subzones based on depth range (i.e., Marine, nearshore; Marine, offshore; and Marine, oceanic). For more information, see https://www.cmecscatalog.org/cmecs/classification/aquaticSetting/1.html.

Marine nearshore (0-30 m depths): Marine area extending seaward from the landward limit to a depth of 30 m.

Marine oceanic (100/200-11000 m depths; deep ocean): Marine area of the open ocean extending seaward of the continental shelf break to the deep ocean; salinity levels of typically 36 ppt.

Marine offshore (30-100/200 depths; cont. shelf break): Marine area extending from a depth of 30 m to transition between continental shelf and continental slope, generally ~ 100/200 m.

Habitat: Abiotic (e.g., rocky shorelines or mud flats) or biotic (e.g., coral reefs or seagrass beds) environments or structures where organisms live, are most likely to be found, or where key life cycle phases must be completed.

Appendix 5: CMAP Glossary

Habitat Type: Detailed habitat types monitored/mapped/observed within the program extent.

- **Agriculture:** Land areas used for the cultivation or breeding of animals and plants to provide food, fiber, medicinal plants and other products to sustain and enhance life.
- **Artificial reef:** An underwater structure built by humans to promote marine life.
- **Barrier island:** A long broad sandy island lying parallel to a shore that is built up by the action of waves, currents, and winds and that protects the shore from the effects of the ocean.
- **Beach/dune:** The area above the low-water mark extending across the backside of the associated sand ridges, which may, or may not be vegetated.
- **Coral reef:** Ecosystems held together by structures formed by the growth and deposition of calcium carbonate by coral.
- **Deep sea benthic communities:** The assemblage of organisms that live in and above the sediments forming the deep ocean floor, including corals, worms, clams, crabs, lobsters, sponges, and microorganisms.
- **Emergent marsh:** An area of low-lying land dominated by erect, rooted, herbaceous plant species rather than woody plant species that is flooded in wet seasons or at high tide, and typically remains waterlogged at all times.
- **Forest:** A large area dominated by trees, and can include upland (dry) and riverine forests and swamps. The aquatic zone selected will be indicative of the type of forest based on the aquatic zone(s) selected. For example, palustrine forest would indicate swamp habitat.
- **Hard bottom:** Nearshore/offshore areas dominated by a hard substrate.
- **Karst/Barren:** Includes barren rock outcrops (exposures of rock, either natural or due to mining or construction), and karst formations (caves and sinkholes). Sinkholes may be barren, grass- or water-filled, or forested.
- **Mangrove:** Coastal wetlands dominated by mangrove species.
- **Oyster/Bivalve bed:** Large aggregations of aquatic mollusks that have a compressed body enclosed within a hinged shell; can occur in either fresh or marine environments.
- **Sargassum/floating macroalgae:** Genera of large brown algae that float in island-like masses.
- **Shrub/Grassland:** Non-saline, grass-dominated sections of the coastal plain, generally associated with the occurrence of heavy clay soils.
- **Submerged aquatic vegetation (SAV):** Benthic macroalgae and aquatic plants that grow to the surface of the water but do not emerge from it. Seagrasses are submerged monocotyledonous plants with narrow grass-like leaves often occurring in dense underwater meadows. Benthic macroalgae are large aquatic photosynthetic organisms attached to the benthos and often occurring in dense beds. Can occur in both freshwater and saltwater.
- **Soft bottom:** Nearshore/offshore areas dominated by a soft substrate.
- **Tidal flat:** Unvegetated coastal wetlands within/slightly above the intertidal zone, usually characterized by mud deposited by tides.
- **Urban:** Land areas used primarily for human settlement, often with large population sizes and infrastructure built on the environment.
- **Water column:** Conceptual column of water that extends from the water's surface to porewater amongst sediment grains and groundwater.

Accessibility

Machine-Readable Format: Data in a format that can be automatically read and processed by a computer, such as CSV, JSON, XML, etc. Machine-readable data must be structured data. For more information, see https://www.data.gov/developers/blog/primer-machine-readability-online-documents-and-data

Metadata: A record that provides information about data with regards to the location the data were collected, who created the data, why the data were collected, and how the data are organized.

Metadata Standard: A requirement that is intended to establish a common understanding of the meaning or semantics of the data, to ensure correct and proper use and interpretation of the data by its owners and users.

Procedures and Quality Assurance

Documented collection procedures: Documentation of the methodologies employed in monitoring data collection.

Documented analytical procedures: Documentation of the methodologies employed in monitoring data analysis.

Protocol: A description of the survey or collection methodologies including the timing and nature of the data collection procedures. Protocols ensure continuity of quality data collection techniques for both the duration of collection and between projects and programs. A detailed protocol is required for others to analyze, interpret and assess the resulting data.

Appendix 5: CMAP Glossary

Quality assurance: Proactive process employed to maintain data integrity and is a continuous effort to prevent (e.g., training, calibration, proper technique), detect (e.g. on-plot data review), and correct measurement errors (e.g., readjustments in response to data review). For more information, see http://aim.landscapetoolbox.org/learn-3/glossary/).

Quality control: Reactive process to detect measurement errors after the data collection process is complete. For more information, see http://aim.landscapetoolbox.org/learn-3/glossary/).

Water Quality Monitoring
The repeated observation of one or more of a suite of parameters within a particular body of water to describe the condition of that water body.

Algal toxins: A toxin produced by aquatic microorganisms mainly true algae, dinoflagellates, and cyanobacteria. Algal toxins can be produced in large quantities during algal bloom events and can pose a serious environmental threat. Within the CMAP application, the algal toxins parameter includes brevetoxins, microcystins, and domoic acid and is a detail parameter of the general parameter group, harmful algal bloom indicators.

Ammonia: A common form of nitrogen (N) that exists in aquatic environments that can cause toxic effects on aquatic life. Ammonia (NH_3) is naturally produced through decomposition of organic matter, nitrogen fixation, as waste products from organisms, and other processes. This parameter includes data expressed as either ion mass (milligram/liter (mg/l) as ammonium(NH_4) or as nitrogen mass per unit volume (mg/l as N), and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, ammonia is a detail parameter of the general parameter group, nutrients. For more information, see https://www.epa.gov/wqc/aquatic-life-criteria-ammonia.

Ammonia + organic nitrogen: Total concentration of ammonia and organic nitrogen. In water chemistry, this summation is often used to express the amount of unoxidized nitrogen. This sum, when expressed as nitrogen mass per unit volume, (NH_3 - N + NH_4^+ - N + Organic nitrogen as N), is often referred to as the total Kjeldahl nitrogen (TKN). This parameter includes data expressed as either compound mass or as nitrogen mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, ammonia + organic nitrogen is a detail parameter of the general parameter group, nutrients.

Aquatic primary producers: The organisms responsible for primary production of organic matter. These form the basis of the food chain. Within the CMAP application, aquatic primary producers is a general parameter group which consists of the detail parameters chlorophyll and phytoplankton.

Brevetoxins: A suite of cyclic polyether compounds produced naturally by certain species of dinoflagellates. Brevetoxins are commonly associated with "red tide" algal blooms and can cause large scale fish kills. In addition, large concentrations may accumulate in shellfish, posing significant health risk when consumed by humans or wildlife. Within the CMAP application, brevetoxins are included in the detail parameter, algal toxins.

Chlorophyll: A green pigment that allows plants and algae to photosynthesize and can be used as a measure of the amount of algae or phytoplankton growing or the trophic condition of a waterbody. Within the CMAP application, chlorophyll is a detail parameter of the general parameter group, aquatic primary producers, and includes all types of chlorophyll (i.e., A, B, C, etc.). Since phytoplankton produce chlorophyll and contain chlorophyll within their cells, phytoplankton and chlorophyll are very closely related terms, differing often only by methodology. Chlorophyll data, analyzed by various methods, are generally expressed as a mass of chlorophyll per unit volume, where phytoplankton data may be expressed by total biomass, biovolume, cell count, or diversity.

Conductance: Conductance is one of the most useful and commonly measured water quality parameters. In addition to being the basis of most salinity and total dissolved solids calculations, conductivity is an early indicator of change in a water system. Most bodies of water maintain a fairly constant conductivity that can be used as a baseline of comparison to future measurements. Within the CMAP application, salinity is included in the detailed parameter of conductance.

***Cryptosporidium*:** A small parasite present in fecal material with pathogenic effects in humans. Within the CMAP application, *Cryptosporidium* is a detail parameter included in the general parameter group, pathogens.

Currents: The rate of movement in the water.

Cyanobacteria: A phylum of bacteria that obtain their energy through photosynthesis, and are the only photosynthetic prokaryotes able to produce oxygen. Cyanobacteria (which are prokaryotes) used to be called "blue-green algae". They have been renamed 'cyanobacteria' in order to avoid the term "algae", which in modern usage is restricted to eukaryotes. These bacteria can form dense mats and produce cyanotoxins, such as microcystin and domoic acid, that can be health hazards to humans and wildlife during harmful algal blooms. Cyanobacteria data, analyzed by various methods, are generally expressed as a mass cyanobacteria per unit volume, where phytoplankton data may be expressed by total biomass, biovolume, cell count, or diversity. Within the CMAP application, cyanobacteria is a detail parameter of the general parameter group, harmful algal bloom indicators.

Appendix 5: CMAP Glossary

Discharge: Rate of fluid flow passing a given point at a given moment in time. Within the CMAP application, discharge is a detailed parameter of the general parameter group, freshwater inflow.

Dissolved organic carbon: Broad classification of organic molecules of varied origin (often the result of decomposition of plant/animal material) and composition within aquatic systems. Within the CMAP application, dissolved organic carbon is included in the organic carbon detailed parameter of the carbon general parameter group.

Dissolved oxygen: The amount of gaseous oxygen dissolved in water. Dissolved oxygen may be expressed as a concentration or as a percent saturation. Low dissolved oxygen is related to an excess of nutrients which can lead to excessive growth of vegetation. Within the CMAP application, dissolved oxygen is a detail parameter of the general parameter group, field parameters.

Domoic acid: A neurotoxin that causes amnesic shellfish poisoning (ASP). It is produced by algae and accumulates in shellfish, sardines, and anchovies. When higher trophic level predators ingest the contaminated animals, poisoning may result. Exposure to this compound affects the brain, causing seizures, and possibly death. Within the CMAP application, domoic acid is included in the detail parameter, algal toxins.

***Enterococcus*:** A large bacterial genus present in human and animal feces and used as an indicator of fecal pollution of water bodies. *Enterococcus* are highly tolerant in the environment of temperature, pH and salinity. Within the CMAP application, *Enterococcus* is a detail parameter included in the general parameter group, pathogens.

Escherichia coli: A large and diverse group of bacteria found in the environment, foods, and intestines and feces of people and animals and used as an indicator of fecal pollution of water bodies. Within the CMAP application, *Escherichia coli* (*E. coli*) is a detail parameter included in the general parameter group, pathogens.

Fecal coliforms: A subset of total coliforms, fecal coliforms are distinguished by their tolerance for warmer temperatures. The fecal coliform group includes *Escherichia coli*. The fecal coliform parameter is used as a broad indicator of environmental contamination by human or animal waste. Within the CMAP application, fecal coliforms is a detail parameter included in the general parameter group, pathogens.

Field parameters: Parameters that are typically collected through observation or instrumentation at a sampling site. Within the CMAP application, this general parameter group consists of the detail parameters: water temperature, conductance, dissolved oxygen, pH, turbidity, and light attenuation.

Freshwater Inflow: Freshwater inflow is the freshwater that flows into an estuary.

***Giardia*:** A protozoan parasite present in human and animal wastes that has pathogenic effects in both children and adults. Within the CMAP application, *Giardia* is a detail parameter included in the general parameter group, pathogens.

Harmful algal bloom (HAB) indicators: An algal bloom is a rapid increase or accumulation in the population of algae in freshwater or marine water systems, and is recognized by the discoloration in the water from their pigments. Cyanobacteria were mistaken for algae in the past, so cyanobacterial blooms are sometimes also called algal blooms. Blooms that can injure animals or the ecology are called harmful algal blooms (HAB) and can lead to fish die-offs, cities cutting off water to residents, or states having to close fisheries. Within the CMAP application, harmful algal bloom indicators is a general parameter group which consists of the detail parameters, cyanobacteria and algal toxins.

Light attenuation: Light attenuation refers to field methods which evaluate the penetration of ambient sunlight below the water surface. Light attenuation includes methods such as Secchi disk and photosynthetic active radiation (PAR). Within the CMAP application, light attenuation is a detail parameter of the general parameter group, field parameters.

Measurement schedule: Within the context of CMAP, this refers to either continuous or discrete monitoring. Continuous monitoring refers to data automatically generated via real-time instrumentation (i.e., buoys or satellites). Discrete monitoring refers to data collection occurring manually via handheld devices rather than automated instrumentation.

Measurement frequency: Within the context of CMAP, this refers to the frequency in which measurements are collected (i.e., hourly, daily, weekly, monthly, etc.).

Medium: Medium type refers to the specific environmental medium that was sampled and analyzed. Media types include water, bottom sediment, pore water, tissue, and others.

Mercury: A bioaccumulative environmental toxicant that has negative effects on humans and wildlife even at low concentrations. Within the CMAP application, mercury is a general parameter that includes the detail parameters, methylmercury and total mercury.

Methylmercury: An organic form of mercury that acts as a bioaccumulative environmental toxicant. Methylmercury accumulates in fish tissue that is transferred to humans upon consumption. Within the CMAP application, methylmercury is a detail parameter of the general parameter group mercury.

Microcystin: A class of toxins produced by freshwater cyanobacteria. Microcystins can be produced in large quantities during algal bloom events and can pose a serious environmental threat. Within the CMAP application, microcystins are included in the detail parameter, algal toxins.

Appendix 5: CMAP Glossary

Nitrate: Nitrogen in its fully oxidized form (NO_3), which is readily assimilated by plants and algae through photosynthetic processes. Excess nitrate in water can cause health problems in infants and contribute to eutrophication in water bodies. This parameter includes data expressed as either nitrate mass per unit volume or as nitrogen mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, nitrate is a detail parameter of the general parameter group, nutrients.

Nitrite: Nitrogen in an intermediate form of oxidation (NO_2). Nitrite is further oxidized to nitrate through biological oxidation (nitrification). This parameter includes data expressed as either nitrite mass per unit volume or as nitrogen mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, nitrite is a detail parameter of the general parameter group, nutrients.

Nitrite + nitrate: A measure of the combined concentrations of nitrite and nitrate. In water chemistry, this summation is often used to express the amount of inorganic nitrogen available for biological uptake. This parameter includes data expressed as either ion mass per unit volume or as nitrogen mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, nitrite + nitrate is a detail parameter of the general parameter group, nutrients.

Nitrogen: An essential nutrient for plant and animal growth and nourishment. Overabundance in water can cause a number of adverse health and ecological effects. Nitrogen assumes many forms: organic nitrogen, which includes proteins and amino acids, inorganic nitrogen, which includes nitrate (NO_3), and nitrite (NO_2), ammonia (NH_3), and ammonium (NH_4^+). Within the CMAP application, nitrogen is a detail parameter of the general parameter group, nutrients. Note that concentration data of nitrogen is commonly expressed in one of two forms, the mass of the ion or compound per unit volume, or by the mass of the nitrogen per unit volume. For example, a nitrate result may be reported mg/l NO_3 or mg/l NO_3 as N. (The difference between these two results will be a conversion factor accounting for the mass of oxygen.) Both of these conventions are included in the CMAP application.

Nutrients: Molecules that are essential for the growth and nourishment of organisms within the environment. Within the CMAP application, nutrients are a general parameter group that consists of the detail parameters: total nitrogen, nitrite, nitrate, nitrite + nitrate, ammonia, ammonia + organic nitrogen, total phosphorus, soluble phosphorus, phosphate,orthophosphate, and silicate.

Organic carbon: Within the CMAP application, organic carbon is a detail parameter of the general parameter group, carbon. The organic carbon parameter includes total organic carbon and dissolved organic carbon.

Organic nitrogen: Nitrogen that exists in compounds such as proteins or amino acids that have been produced through metabolic processes. Organic nitrogen is in an unoxidized form that can not be readily consumed by most plants and animals. Within the CMAP application, this parameter includes data expressed as either compound mass per unit volume or as nitrogen mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, organic nitrogen is a detail parameter of the general parameter group, nutrients.

Orthophosphate: A term used to describe the phosphate molecule alone without any associated chemical species (PO_4^{3-}) Orthophosphate is readily consumable by the biological community and is usually the limiting factor of biological growth. This parameter includes data expressed as either PO_4^{3-} mass per unit volume or as phosphorus mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, orthophosphate is a detail parameter of the general parameter group, nutrients.

Parameters: A measurable factor forming one of a set that defines a system or sets the conditions of its operation.

Pathogen: Disease causing bacteria, virus, or protozoan that can contaminate water resources making it unsafe for humans. Within the CMAP application, the general parameter pathogen consists of the detail parameters: *Escherichia coli, Enterococcus*, fecal coliforms, total coliforms, *Giardia*, *Cryptosporidium* and *Vibrio*.

pH: The negative logarithm of the hydrogen ion concentration of a solution that is used as a measure of the acidity or alkalinity of a liquid. Within the CMAP application, pH is a detail parameter of the general parameter group, field parameters.

Phosphate: A phosphorus-containing anion that is often a limiting nutrient in environment (especially freshwater environments) and is widely used in fertilizers and detergents. This parameter includes data expressed as either ion mass per unit volume or as phosphorus mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, phosphate is a detail parameter of the general parameter group, nutrients.

Photosynthetic active radiation (PAR): A passive measurement of the photosynthetically active range of sunlight. In water quality applications PAR can be used to delineate the photic zone of a body of water. Within the CMAP application, PAR is included in the detail parameter light attenuation of the general parameter group, field parameters.

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Phytoplankton: The term phytoplankton encompasses all photoautotrophic microorganisms in aquatic food webs. Phytoplankton serve as the base of the aquatic food web, providing an essential ecological function for all aquatic life. Phytoplankton are a diverse group, incorporating protistan eukaryotes and both eubacterial and archaebacterial prokaryotes. Note that phytoplankton and chlorophyll are very closely related terms, differing only by methodology. Chlorophyll results, analyzed by various methods, are generally expressed as a mass of chlorophyll per unit volume, where phytoplankton results may be expressed by total biomass, cell count, or diversity. Within the CMAP application, phytoplankton is a detail parameter of the general parameter group, aquatic primary producers.

Polycyclic aromatic hydrocarbons (PAHs): PAHs are a large family of compounds including anthracene, phenanthrene, tetracene, chrysene, and others that occur naturally in coal, crude oil, and gasoline. Within the CMAP application, PAHs are a detail parameter of the general parameter group, carbon.

Salinity: A measure of the amount of salts dissolved in a body of water. Within the CMAP application, salinity is included in the conductance detailed parameter of the field parameters general group.

Secchi disk: A passive measurement of the penetration of sunlight below the surface of a body of water. Secchi disk measurements are used to evaluate the photic zone of a body of water.

Sediment: Solid particulate material suspended, transported and deposited by wind or water. In aquatic environments evaluation of sediment quantity, size distribution, suspension, transport and deposition is an important component of both the hydrology and ecology of the environment. Within the CMAP application, the general parameter sediment includes quantification of suspension, transport, deposition and size distribution. Suspended sediment concentration (SSC) and total suspended solids (TSS) are additionally included as detail parameters due to their common usage. The distinction between these two parameters is maintained due to differences in methodology that produce results of limited comparability.

Silicate: Silicate, or silicic acid (H_4SiO_4), is an important nutrient in the ocean and estuaries. Unlike the other major nutrients such as phosphate, nitrate, or ammonium, which are needed by almost all marine plankton, silicate is an essential chemical requirement for very specific biota, including diatoms, radiolaria, silicoflagellates, and siliceous sponges. These organisms extract dissolved silicate from open surface waters for the buildup of their particulate silica (SiO_2), or opaline, skeletal structures. This parameter includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, silicate is a detail parameter of the general parameter group, nutrients.

Soluble phosphorus: Hydrated phosphate ions that are dissolved in water through weathering or in the production of fertilizers that plants can use. This parameter includes data expressed as either ion mass per unit volume or as phosphorus mass per unit volume. Within the CMAP application, soluble phosphorus is a detail parameter of the general parameter group, nutrients.

Stage: The height of the water surface above an established datum plane, such as in a river above a predetermined point that may or may not be near the channel floor. Within the CMAP application, stage is a detail parameter of the general parameter group, freshwater inflow.

Suspended sediment concentration (SSC): A measure of how much sediment is suspended and transported in a body of water. Within the CMAP application, the detail parameter suspended sediment concentration (SSC) is included in the general parameter group, sediment.

Total coliforms: A large group of bacterium that generally originate in the intestines of warm-blooded animals. This group includes *Citrobacter*, *Enterobacter*, *Hafnia*, *Klebsiella* and *Escherichia*. The total coliform parameter is used as a broad indicator of environmental contamination by human or animal waste. Within the CMAP application, total coliforms is a detail parameter included in the general parameter group, pathogens.

Total mercury: A measure of the concentration of mercury compounds, organic and inorganic in an environment or the tissues of an organism. Within the CMAP application, total mercury is a detail parameter of the general parameter group, mercury.

Total nitrogen: The sum of organic nitrogen, nitrate (NO_3), and nitrite (NO_2), ammonia (NH_3), and ammonium (NH_4^+). Excess nitrogen in aquatic environments can result in eutrophication, algal blooms, and low levels of dissolved oxygen. This parameter includes data expressed as either compound mass per unit volume or as nitrogen mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the CMAP application, total nitrogen is a detail parameter of the general parameter group, nutrients.

Total organic carbon: The amount of carbon found in organic compounds that can be used as an indicator of water quality. Within the CMAP application, total organic carbon is included in the organic carbon detailed parameter of the carbon general parameter group.

Total phosphorus: A measure of the sum of all phosphorus compounds. This parameter includes data expressed as either compound mass per unit volume or as phosphorus mass per unit volume, and includes the fractional results, dissolved (filtered), total (unfiltered), or suspended (unfiltered - filtered). Within the

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CMAP application, total phosphorus is a detail parameter of the general parameter group, nutrients.

Total suspended solids (TSS): The dry weight of solids suspended in water that can be trapped by a filter. This can include silt, decaying plant/animal matter, sewage, industrial waste, etc. Within the CMAP application, total suspended sediment (TSS) is a detail parameter of the general parameter group, sediment.

Turbidity: A measure of relative clarity of a liquid. Turbidity is measured by illuminating the water with a light source of specific wavelength, the sensor measures the scatter of light, giving a light attenuation measurement that is independent of ambient light. Due to the specificity of the instrument's light source and sensor, turbidity measurement from different models of turbidity sensors can vary significantly. Additional variation can be attributed to the use of different standards of calibration. To overcome this difficulty, many different unit designations have been created, each defined to a specific instrument type and method of calibration. Examples include Nephelometric Turbidity Unit (NTU), Formazin Nephelometric Unit (FNU) and many others. Measurements that share the same unit designation can be considered comparable, but are not readily comparable to other unit designations. For more information, see https://water.usgs.gov/edu/turbidity.html and https://or.water.usgs.gov/grapher/fnu.html. Within the CMAP application, turbidity is a detail parameter of the general parameter group, field parameters, and the term turbidity includes all unit variations of turbidity measurements.

Vibrio: Bacterial genus found in warm coastal waters that can cause human illness when raw/undercooked shellfish is contaminated or if an open wound is exposed to brackish/salt water. Within the CMAP application, *Vibrio* is a detail parameter included in the general parameter group, pathogens.

Water level: The height reached by the water in a reservoir, river, etc.

Water temperature: A measure of water temperature. Water temperature can include temperature measures taken at the surface and throughout the water column. Within the CMAP application, water temperature is a detail parameter of the general parameter group, field parameters.

Habitat Monitoring

Habitat monitoring refers to the collection of in situ measurements of various parameters with regards to the condition and/or state of habitats for broad categories such as corals, oysters, plants, sediment, and other physical characteristics of the environment.

Abiotic: The non-living chemical and physical aspects of the environment that affect living organisms and the functioning of ecosystems. Within the CMAP application, abiotic is a general habitat monitoring parameter that includes substrate metrics and coastal processes parameter groups.

Abundance: A measure of the number of individuals of a species that exist within a community. Within the CMAP application, abundance is a habitat monitoring parameter subgroup within the general parameters associated with submerged habitat building animals and plants/macroalgae.

Animal/plant height: A measure of the height of an animal (coral colony, oyster, sponge, etc.) or plant. Within the CMAP application, animal/plant height is included within the size parameter subgroup of the submerged habitat building animals and plants/macroalgae general parameters.

Animal/plant weight: A measure of the weight of an animal (coral colony, oyster, sponge, etc.) or plant. Within the CMAP application, animal/plant weight is included within the size parameter subgroup of the submerged habitat building animals and plants/macroalgae general parameters.

Basal area: The area of a given section of land that is occupied by the cross-section of tree trunks and stems at the base. Within the CMAP application, basal area is included in the cover parameter subgroup of the plants/macroalgae general parameter.

Biomass: The total mass of organisms in a given area or volume. Within the CMAP application. Biomass is a habitat monitoring parameter subgroup within the general parameters associated with submerged habitat building animals and plants/macroalgae. Biomass includes any measures of biomass (i.e., above ground plant biomass, wet/dry biomass, oyster biomass).

Bleaching: Process whereby coral colonies or sea anemones lose their color, either due to the loss of pigments by microscopic algae (zooxanthellae) living in symbiosis with their host organisms (polyps/anemones) or because the zooxanthellae have been expelled. Within the CMAP application, bleaching is a parameter subgroup within the general parameter submerged habitat building animals.

Bulk density: The weight of soil/sediment in a given volume that depends on soil/sediment composition and degree of compaction. Within the CMAP application, bulk density is included in the sediment classification parameter subgroup of the abiotic general parameter.

Canopy extent/structure: The organization or spatial arrangement of a plant canopy. Within the CMAP application, canopy extent/structure is a parameter subgroup contained in the plants/macroalgae general parameter.

Coastal processes: Physical processes influencing the coastal zone. Within the CMAP application, coastal processes is a parameter group within the abiotic general parameter and includes vertical accretion and subsidence subgroups.

Colony diameter: A measure of the diameter of a coral colony. Within the CMAP application, colony diameter is contained in the size parameter subgroup under the submerged habitat building animals general parameter.

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Composition: The makeup or contribution of all the groups of organisms living together in the same area. Within CMAP application, composition is a parameter subgroup of submerged habitat building animals and plants/macroalgae general parameters. Composition includes species and community composition.

Cover: A measure of the amount of area covered by organisms or substrate types within a given extent. Within the CMAP application, cover is a parameter subgroup of the submerged habitat building animals and plants/macroalgae general parameters. Cover includes percent cover, acreage, basal area measurements.

Density: The number of organisms per unit area. Within the CMAP application, density is a parameter subgroup of the submerged habitat building animals and plants/macroalgae general parameters and includes all instances of density.

Diameter at breast height (DBH): Measure of tree diameter at 4.5 ft above the ground. Within the CMAP application, DBH is contained under the size parameter subgroup of the plants/macroalgae general parameter.

Disease: Any condition that results in the disorder of a structure or function in a living organism that is not due to any external injury. Within the CMAP application, disease is a parameter subgroup contained under the submerged habitat building animals general parameter. Examples of disease include dermo disease (oysters) and black band disease (corals).

Distribution: Measures of how organisms are spread out over a given area. Within the CMAP application, distribution is a parameter subgroup contained under the submerged habitat building animals and plants/macroalgae general parameters.

Ecological metrics: Parameters or measures of how biological communities are structured or composed in a particular area (both animal and plant communities). Within the CMAP application, ecological metrics is a parameter group contained under the submerged habitat building animals and plants/macroalgae general parameters. Ecological metrics includes composition, species abundance, percent cover, density, biomass parameter subgroups.

Growth: A measure of how quickly an organism grows during a given time frame. Within the CMAP application, growth is a parameter subgroup contained under the submerged habitat building animals and plants/macroalgae general parameters.

Larval transport: A measure of the distance larval organisms are transported from natal populations to settlement sites. Within the CMAP application, larval transport is a parameter subgroup contained under the submerged habitat building animals general parameter.

Litterfall: Dead plant material that has fallen to the ground. Within the CMAP application, litterfall is a parameter subgroup contained within the plants/macroalgae general parameter.

Mast/seed production: Measure of mast or seed yield in a given area. Within the CMAP application, mast/seed production is contained under the reproductive effort parameter subgroup of the plants/macroalgae general parameter.

Measurement schedule: Within the context of CMAP, this refers to either continuous or discrete monitoring. Continuous monitoring refers to data automatically generated via real-time instrumentation (i.e., buoys or satellites). Discrete monitoring refers to data collection occurring manually via handheld devices rather than automated instrumentation.

Measurement frequency: Within the context of CMAP, this refers to the frequency in which measurements are collected (i.e., hourly, daily, weekly, monthly, etc.).

Metal concentration: Concentration in substrate of relatively dense metals (i.e., mercury, lead, cadmium, etc.) that can have toxic effects. Within the CMAP application, metal concentration is contained under the substrate geochemistry parameter subgroup of the abiotic general parameter.

Moisture level: A measure of the amount of water that is held in the spaces between soil particles. Within the CMAP application, moisture level is contained under the sediment classification parameter subgroup of the abiotic general parameter.

Mortality: A measure of how many organisms die over a given time frame. Within the CMAP application, mortality is a parameter subgroup contained under the submerged habitat building animals and plants/macroalgae general parameters. Mortality includes all measures related to mortality (i.e., mortality rate, percent recent mortality, percent dead shell, percent dead cover).

Nutrients: Molecules that are essential for the growth and nourishment of organisms within the environment. Within the CMAP application, nutrients is contained under the substrate geochemistry parameter subgroup of the abiotic general parameter. Nutrients includes concentrations of carbon, nitrogen and phosphorous as they pertain to the geochemistry of sediment.

Organic pollutants: The concentration of organic pollutants in the sediment, including oil contaminants. Within the CMAP application, organic pollutants is contained under the substrate geochemistry parameter subgroup of the abiotic general parameter.

Organic content: Amount of plant material in a sediment sample; generally assessed by burning at 550°C. Within the CMAP application, organic texture content is contained under the substrate geochemistry parameter subgroup of the abiotic general parameter.

Percent cover: A measure of the relative abundance (i.e., the percentage of space covered) of a particular species or group of species within a given area. Within the CMAP application, percent cover is contained under the cover parameter subgroup of the submerged habitat building animals and plants/macroalgae general parameters.

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Physiology/Health: Parameters or measures detailing animal physiology or health information (i.e., presence of coral disease or bleaching). Within the CMAP application, physiology/health is a parameter group within the submerged habitat building animals general parameter. Physiology/health includes disease, size, bleaching, and growth parameter subgroups.

Plants/Macroalgae: Terrestrial or submerged plants and macroalgal species within the environment that act as biological habitat and/or food sources for animal and other plant species. Within the CMAP application, plants/macroalgae is a general parameter and includes ecological metrics, physiology, and population dynamics parameter groups.

Population dynamics: Study of how and why populations change in size and structure over time (for animal and plant populations). Within the CMAP application, population dynamics is a parameter group contained under the submerged habitat building animals and plants/macroalgae general parameters. Population dynamics groups includes settlement/recruitment, survivorship, larval transport, spawning, mortality, reproductive effort, and primary production.

Primary production: The synthesis of organic compounds from atmospheric or aqueous carbon dioxide, primarily through photosynthesis. It can also occur through chemosynthesis via oxidation or reduction of inorganic chemical compounds. Within the CMAP application, primary production is a parameter subgroup contained under the plants/macroalgae general parameter.

Redox potential: Oxygen-reduction potential, often used to quantify the degree of electrochemical reduction of wetland soils under anoxic conditions. Within the CMAP application, redox potential is contained under the substrate geochemistry parameter subgroup of the abiotic general parameter.

Reproductive effort: The proportion of the total energy budget of an organism devoted to reproductive processes. Within the CMAP application, reproductive effort is a parameter subgroup contained under the plants/macroalgae general parameter. Reproductive effort includes mast/seed production, flowering, fruiting, seedling production.

Rugosity: A measurement of complexity of benthic habitat relating to variations of amplitude in the height of a surface. Within the CMAP application, rugosity is contained under the topographic complexity parameter subgroup of the abiotic general parameter.

Sediment classification: Measures of physical characteristics of sediment used for classification. Within the CMAP application, sediment classification is a parameter subgroup contained under the abiotic general parameter. Sediment classification includes bulk density, grain size, texture, moisture levels, soil type.

Settlement/Recruitment: For animals, settlement refers to the number of individuals that settle from the water column onto appropriate substrate. Recruitment is a measure of how many individuals (animal or plant/macroalgae) are added to a population. Within the CMAP application, settlement/recruitment is a parameter subgroup contained under the submerged habitat building animals and plants/macroalgae general parameters.

Seedling survival: Survival rate of plant seedlings over a given time period. Within the CMAP application, seedling survival is contained under the survivorship parameter subgroup of the plants/macroalgae general parameter.

Size: Measures of animal or plant/macroalgae size. Within the CMAP application, size is a parameter subgroup of the submerged habitat building animals and plants/macroalgae general parameters. Size includes animal/plant height, animal/plant weight, animal diameter, diameter at breast height (DBH).

Soil type: Descriptive designations of soil based on characteristics such as texture, organic content, and chemical composition. Within the CMAP application, soil type is contained under the sediment classification parameter subgroup of the abiotic general parameter.

Spawning: The release of sperm, eggs, or planula into the water column by sessile aquatic organisms. Within the CMAP application, spawning is a parameter subgroup contained under the submerged habitat building animals general parameter.

Subsidence: The gradual caving in or sinking of an area of land. Within the CMAP application, subsidence is a parameter subgroup contained under the abiotic general parameter.

Submerged habitat building animals: Animals such as corals, bivalves, sponges, or tube worms that create structure on the benthos. Within the CMAP application, submerged habitat building animals is a general parameter. Submerged habitat building animals includes the physiology/health, population dynamics, and ecological metrics parameter groups.

Substrate composition: The makeup of the substrate in a given area (i.e., % bedrock, % silt, etc.). Within the CMAP application, substrate composition is a parameter subgroup contained under the abiotic general parameter.

Substrate depth: A measure of how deep the substrate in a given area is. Within the CMAP application, substrate depth is a parameter subgroup contained under the abiotic general parameter.

Substrate geochemistry: Measures related to the chemical composition of the sediment in a given area. Within the CMAP application, substrate geochemistry is a parameter subgroup contained under the abiotic general parameter. Substrate geochemistry includes nutrient concentrations, redox potential, metal concentration, organic pollutants, and organic content.

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Substrate metrics: Parameters used to describe or classify the substrate in a given area. Within the CMAP application, substrate metrics is a parameter group contained under the abiotic general parameter. Substrate metrics include substrate geochemistry, substrate composition, topographic complexity, sediment classification, and substrate depth.

Survivorship: A measure of the number or proportion of individuals surviving to each life stage for a given species or group. Within the CMAP application, survivorship is a parameter subgroup contained under the submerged habitat building animals and plants/macroalgae general parameters.

Texture/Grain size: The shape, size, and three-dimensional arrangement of the particles that make up sediment or sedimentary rock. Grain size refers to the diameter of individual grains of sediment. Within the CMAP application, texture/grain size is contained under the sediment classification parameter subgroup of the abiotic general parameter.

Topographic complexity: Measures of the diversity and arrangement of three-dimensional structural elements on the benthos. Within the CMAP application, topographic complexity is a parameter subgroup contained under the abiotic general parameter. Topographic complexity includes rugosity and vertical relief.

Vertical accretion: A measure of the accumulation of sediment over time. Within the CMAP application, vertical accretion is a parameter subgroup contained under the abiotic general parameter.

Vertical relief of reef: A measure of the structural complexity of a reef. Within the CMAP application vertical relief of reef is contained under the topographic complexity parameter subgroup of the abiotic general parameter.

Mapping

Programs (including platforms/satellites/datasets) that gauge the condition or state of water quality or habitat through remotely sensed measurements (e.g., light detection and ranging (lidar), sound navigation and ranging (sonar, satellite, aerial imagery). These include programs that collect primary data that can be used to develop derived products needed to produce habitat maps and/or develop recurrent map products for one of a variety of targeted habitat types.

Acoustic doppler current profile (ADCP): A hydroacoustic current meter similar to a sonar, used to measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column.

Airborne: In reference to the "Platform Type" field; anything serving as the platform from which measurements are collected from an aerial perspective (i.e., airplane, drone, etc.).

Area of habitat types: The areal coverage of particular habitat types.

Autonomous underwater vehicle (AUV): Programmable, robotic vehicles that, depending on their design, can drift, drive, or glide through the ocean without real-time control by human operators.

Backscatter intensity: Backscatter intensity is a data type often collected alongside multibeam sonar (MBES) that provides insight into the texture, roughness, or complexity of the seafloor. Generally, a higher intensity of the returning signal can be associated with a harder, course-grained sediment or surface. However, a more complex surface (i.e., high rugosity, shipwrecks, etc.) often causes more interference with the signal hence are associated with a low intensity return.

Bathymetric/Bathymetry: The submerged equivalent of "topographic"; detailed mapping or charting of subaqueous features (i.e., on the ocean floor/submerged terrain [e.g., spot water depth data, digital elevation models, and contour lines]).

Beach renourishment: Application of sand to a beach to increase the recreational value, to restore the beach after a storm, or provide routine maintenance to prevent long-term gradual beach shore erosion. For more information, see http://www.marbef.org/wiki/Beach_nourishment

Chlorophyll: A green pigment that allows plants and algae to photosynthesize. Chlorophyll is often used as an indicator of the amount of algae or phytoplankton growing in or the trophic condition of a waterbody; Within the CMAP application, the chlorophyll parameter includes all types of chlorophyll, collectively (e.g., A, B, C, etc.).

Currents: In reference to the Mapping "Parameters" field; Ocean currents; directed movement of ocean water.

Digital photography: A form of photography that uses camera with electronic image sensors rather than film; includes photographic images of the Earth's surface captured via aircraft, drones, satellites, ROVs/underwater, etc. The "Platform Type" field will be used to indicate the type of digital photography.

Environmental monitoring: Monitoring that includes the systematic sampling of water, soil, and biota in order to study and assess the condition of the environment.

Fixed station: A permanent sampling location or site where measurements are collected at regular intervals.

Habitat classification: The process of producing maps that classify areas into a clearly defined habitat type or class. These products may include detailed habitat maps that provide information on the percent cover of specific habitats or vegetation types, community level habitat maps (e.g., National Wetland Inventory maps), and land use/land cover maps (e.g., National Land Cover Dataset, Coastal-Change Assessment Program, Cropland Data Layer).

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Human (observation or sampling): In reference to the "Platform Type" field; applies to monitoring or data collection employed via in situ measurements by a person.

Human use: Mapping of land use characteristics across a landscape.

Hydrocarbon detection: In reference to the Mapping "Activity" field; refers to the mapping of oil and gas resources for industry, research, or exploration.

Hyperspectral imagery: A type of imagery that captures information from across the electromagnetic spectrum; employed since the early 1980s in remote sensing technology; often captured remotely via sensors on satellites.

Interferometric synthetic aperture radar (IFSAR): A radar technique used in geodesy and remote sensing; uses two or more synthetic aperture radar (SAR) images to generate maps of surface deformation or digital elevation, using differences in the phase of the waves returning to the satellite, or aircraft.

Inundation modeling: The process of modeling the geographic coverage and levels of potential flooding via storm surge flooding or sea-level rise.

Land cover: The physical material at the surface of the earth; documentation of how much a region is covered by forests, wetlands, impervious surfaces, agriculture, and other land and water types; can be determined by analyzing satellite and aerial imagery. For more information, see https://oceanservice.noaa.gov/facts/lclu.html.

Land use: Broad categories that are often combined with land cover (i.e., habitats) classes to convey how people use the landscape (e.g., development, conservation, mixed use, agriculture).

Light detection and ranging (lidar): Light detection and ranging (lidar) is a remote sensing method that is similar to sonar, but instead uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. These light pulses—combined with other data recorded by the airborne system— generate precise, three-dimensional information about the shape of the Earth and its surface characteristics. For more information, see https://oceanservice.noaa.gov/facts/lidar.html.

Marine debris: Any persistent solid material that is directly or indirectly disposed of or abandoned into the aquatic environment. For more information, see http://www.marbef.org/wiki/Marine_debris.

Maritime heritage: In reference to Mapping "Activity" field; mapping of valuable historical, cultural, or archaeological resources (i.e., shipwrecks, prehistoric archaeological sites, etc.). For more information, see https://oceanservice.noaa.gov/facts/marheritage.html.

Mooring/Buoy: In reference to "Platform Type" field; a permanent anchor; equipped with a floating buoy to which vessels can moor; includes "data buoys" or buoys equipped with sensors for collection oceanographic data.

Multibeam echosounder (MBES): Multibeam echosounder (MBES) is a type of sound navigation and ranging (sonar), or sound transmitting and receiving system, used to used to estimate water depth and map the seafloor. These systems emit fan shaped swath of sound pulses through a transmitter beneath a ship's hull at a specific frequency. A receiver placed very close to the transmitter receives "echoes" of those pulses when they return after bouncing off the seafloor. A computer records how long it takes to receive the returning pulses which, when the transducers are pointed toward the seafloor, translates to depth. The more time it takes for the pulse to return, the farther away the seafloor or object is. For more information, see http://oceanexplorer.noaa.gov/explorations/09bermuda/background/multibeam/multibeam.html.

Multispectral imagery: A type of imagery that captures information from across the electromagnetic spectrum; produced by sensors that measure reflected energy within several specific sections (also called bands) of the electromagnetic spectrum.

Radar: An application of radar used to create two-dimensional images, typically of landscapes. Imaging radar is an active sensor that provides its light to illuminate an area on the ground and take a picture at radio wavelengths. It uses an antenna and digital computer storage to record its images. In a radar image, one can see only the energy that was reflected back towards the radar antenna. For more information, see https://airsar.jpl.nasa.gov/documents/genairsar/radar.html.

Real-time kinematic global positioning system (RTK GPS): A satellite navigation technique used to enhance the precision of position data derived from satellite-based Global Positioning System (GPS). Specifically, the process involves data collected by a rover station that is corrected using information received from base station that is transmitted via a Global Navigation System Satellite. While accuracy varies based on numerous factors, RTK GPS systems can have data with centimeter-level accuracy.

Reflectivity: A function of the wavelength used, which is most commonly in the near infrared wavelength range. The strength of the returns varies with the composition of the surface object reflecting the return. For more information, see http://desktop.arcgis.com/en/arcmap/10.3/manage-data/las-dataset/what-is-intensity-data-.htm.

Remotely operated vehicle (ROV): Unoccupied, highly maneuverable underwater robots operated by someone at the water surface.

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Salinity: A measure of the amount of salts dissolved in a body of water. Within the CMAP application, salinity for mapping programs refers to estimates of salinity produced via remotely sensed data.

Satellite: An artificial body placed in orbit around the Earth. Satellites are fitted with sensors to collect information.

Sea surface temperature: A measure of water temperature at the surface or the upper portion of the water column (i.e., upper few meters).

Seafloor characterization: The use of MBES sonar, backscatter, and visual observation data to assess abiotic and biotic characteristics of the seafloor such as sediment type, rugosity, slope, and percent cover of substrate-forming species such as corals.

Sediment depth: In reference to the Mapping "Parameters" field; a measurement of the depth of the sediment often collected using seismic or subbottom technology.

Sediment grain size: The size of loose, uncemented pieces of rocks or minerals (e.g., mixture of sand-, silt-, clay-sized particles). For more information, see https://geomaps.wr.usgs.gov/parks/misc/glossarys.html.

Seismic: Seismic mapping involves the use of sound vibrations to map patterns of rock formations below the surface of the Earth. An example of an application of seismic mapping is use of sound waves by geologists to locate rocks that may contain oil and/or natural gas. For more information, see http://www.earthsciweek.org/classroom-activities/seismic-mapping.

Ship/small boat: In reference to the "Platform Type" field; refers to monitoring technologies deployed and parameters measured from a small boat or ship.

Shoreline profile: A measure of the position or change in shoreline profile (e.g., erosion or accretion).

Shoreline: Mapping of the shoreline position or elevation.

Side-scan sonar: Marine researchers commonly use side-scan sonar technology to search for and detect objects on the seafloor. Side-scan sonar requires three components—a towfish that sends and receives acoustic pulses, a transmission cable attached to the towfish that sends data to the ship, and the ship's processing computer. Side-scan sonar continuously records the return echo, thus creating a "picture" of the seafloor. Side-scan sonar does not usually provide bathymetric data (i.e., depth estimates). For more information, see http://oceanexplorer.noaa.gov/technology/tools/sonar/sonar.html.

Single beam echosounder (SBES): Single beam echosounder (SBES) or sound navigation and ranging (sonar)— sensors are a type of sound transmitting and receiving system used to estimate water depth and map the seafloor. Single beam sonar functions similarly to MBES sonar, but the only a single, narrower sound wave swath is produced from the transmitter beneath a ship's hull and received by the receiver after bouncing off the seafloor. Like MBES sonar, a computer records how long it takes for the pulse of sound to return to the receiver allowing for depth determination.

Soil type: A classification or taxonomy of soils determined according to soil texture, color, organic content, and chemical composition. For more information, see https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/class/taxonomy/.

Split beam echosounder: Split beam echosounders are common instruments used in fisheries acoustics. Much like MBES or SBES, split beam echosounders are a type of sound transmitting and receiving system that produces multiple beams of sound from the transmitter from beneath a ship's hull that bounce off the seafloor or fish in the water column. Split beam echosounders use a transmitter and receiver system that is split into four quadrants which allow not only depth determination from how long it takes the pulses of sound to return but also the size and number of fish or other animals and objects present in the water column.

Sub-bottom: Sub-bottom profiling systems identify and measure various marine sediment layers that exist below the sediment/water interface. A sound source emits an acoustic signal vertically downward into the water. A receiver monitors the return signal that has been reflected off the seafloor. Sub-bottom profiling is typically used in mapping sediment stratigraphy, thickness of ash ponds, characterizing benthic habitats, detecting and measuring the thickness of dredged deposits, detecting hard substrate that has been covered by sedimentation, identifying buried objects (e.g., cables and pipelines), and defining the basement or bedrock layer. For more information, see http://geoviewinc.com/methods/marine/sub-bottom-profiling.

Subsidence: Land subsidence is a gradual settling or sudden sinking of the Earth's surface due to subsurface movement of earth materials including aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost. For more information, see https://water.usgs.gov/ogw/subsidence.html.

Surficial elevation: In reference to the Mapping "Parameters" field; measurements of bathymetric, topographic, or shoreline profile data.

Synthetic aperture radar (SAR): A type of mostly airborne or spaceborne radar. The technology allows for all-weather night or day data collection. These data can be used for coastal monitoring, particularly for inundation modeling and monitoring coastal impacts such as erosion and oil spills. For more informatin, see https://nisar.jpl.nasa.gov/technology/sar/

Topobathymetric: A seamless digital elevation model that includes both topography and bathymetry data (e.g., a topobathymetric digital elevation model).

Appendix 5: CMAP Glossary

Topographic/Topography: Mapping of the vertical distance between a standard reference point, such as sea level, and the top of an object or point on Earth; charting of subaerial features such as relief or elevation (e.g., spot elevation data, digital elevation models, and contour lines).

Total station: In reference to the Mapping "Technology" field; this equipment is used to for surveying elevations. This field will also include rod and level surveys.

Tripod: In reference to the "Platform Type" field; this will include data that is collected on tripods (e.g., terrestrial lidar and total station, rod and level surveys, and RTK GPS surveys).

Turbidity: Turbidity is the measure of relative clarity of water and involves the expression of the amount of light that is scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity. Material that causes water to be turbid include clay, silt, finely divided inorganic and organic matter, algae, soluble colored organic compounds, and plankton and other microscopic organisms. Within the CMAP application, turbidity for mapping programs includes estimates of turbidity produced via remotely sensed data. For more information, see https://water.usgs.gov/edu/turbidity.html.

Unmanned aerial vehicle (UAV): An aircraft piloted by remote control or onboard computers.

Vertical accretion: The process of growth or increase, typically by the gradual accumulation of additional layers of matter.

Water column hydrodynamics: In reference to the Mapping "Activity" field; mapping of ocean currents, wave energy, etc.

Water column profiling: In reference to the Mapping "Parameters" field; collection of oceanographic data throughout the water column.

Water temperature: Water temperature can include temperature measured at the surface and throughout the water column. These measurements may also be collected using remote sensing technologies.

Other Terms

Baseline: Pre-restoration baseline monitoring information provides a basis for planning and/or evaluating subsequent progress and related impacts (adapted from NAS, 2016).Baseline data may be estimated using historical data, reference data, control data, and/or data on incremental changes (e.g., number of dead animals), alone or in combination, as appropriate (Oil Pollution Act regulations at § 990.30)" (https://darrp.noaa.gov/sites/default/files/Injury%20assessment.pdf, p. 18).

Baseline assessments: Environmental assessments of the condition of water quality and/or habitats. CMAP will be focused on baseline assessments conducted in or after 1980 for defined regions or watersheds of the Gulf of Mexico.

References

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS-79/31. Washington, DC. 131 pp.

FGDC (Federal Geographic Data Committee). 2012. Coastal and Marine Ecological Classification Standard, Marine and Coastal Spatial Data Subcommittee, Federal Geographic Data Committee. FGDC-STD-018-2012. Online: https://www.fgdc.gov/standards/projects/cmecs-folder/CMECS_Version_06-2012_FINAL.pdf (Accessed 20 June 2019)

The National Academy and of Sciences, Engineering and Medicine (NAS), 2016. The National Academy of Sciences, Engineering and Medicine (NAS) Effective Monitoring to Evaluate Ecological Restoration in the Gulf of Mexico The National Academies Press, Washington, DC. 219 pp. doi: https://doi.org/10.17226/23476.

Appendix 6: Council Monitoring and Assessment Program Data Entry Manual and Procedures

Council Monitoring and Assessment Program (CMAP) Data Entry Manual and Procedures

Table of Contents

Appendix 6: CMAP SOP

Introduction

This document outlines the process of assessing, entering, and reviewing monitoring program information for the CMAP Monitoring Program Inventory (the Inventory). It is presented in five sections (and a Glossary), each presenting a specific component of the inventorying process. Each section contains both internal bookmarks/links as well as links to external reference documents.

Section 1 - Initial Assessment for Inventory Inclusion Procedure
This section provides step-by-step guidance for how to assess whether a program/project should be included in the Inventory.

Section 2 - Documented Assumption Criteria
This section provides descriptions and interpretations of the criteria (Documented Assumptions) used to determine if a program/project should be included in the inventory. These criteria originate from the Documented Assumptions which was developed by the CMAP Extended Program Advisory Team (Ex-PAT).

Section 3 - Initial Data Entry Procedure
This section provides a description of the process for entering a program into the Inventory. Links, notes, definitions, and tips are provided with regard to the overall process and for each individual attribute field to be populated within the Inventory.

Section 4 - Questionable/Deferred Programs List Entry
This section provides a description of how to process programs/projects that may need further discussion and agreement regarding the initial assessment for inclusion in the Inventory.

Section 5 - Inventory Record Review Process (First Review**,** Point of Contact Review**,** Second Review**,** Record Finalization**)**
This section outlines the process for reviewing the information for each inventoried program/project. This process will include several steps and is divided into multiple subsections.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Initial Assessment for Inventory Inclusion

Prior to entering a new program into the Inventory, two initial checks need to be made: 1) has the program already been entered, and 2) does it meet the Documented Assumptions. These checks will be made for every potential program by sequentially working through these two questions. Assessing the four categories of Documented Assumptions does not need to be done in any specific sequential order.

1. **Has this program/project already been entered into the inventory?***
    a. If *yes*, access the CMAP Online Database, search* for the program of interest, click edit, and check to see if any blank fields can be completed from the source you are reviewing.
    b. If *no*, move on to question 2.

2. **Does this program/project meet the Documented Assumptions?*** (Program must meet **ALL** of the documented assumptions for inclusion.)

    Does this program meet the Program Type documented assumption?
    Does this program meet the Spatial documented assumption?
    Does this program meet the Temporal documented assumption?
    Does this program meet the Duration documented assumption?

    a. If *yes* to ALL of the above, proceed to the Initial Data Entry Procedure.
    b. If *no* or you are uncertain to any of these, add this program to the Questionable/Deferred programs list. See Questionable/Deferred procedure for this process.

* **Notes:**
    - In order to determine if a program has already been entered into the Inventory, search for the program's name. There is a possibility that program naming conventions may differ. If nothing is returned, a few other searches can be performed (i.e., for the Managing Entity, Website, or Point of Contact) to make sure the program is not already included in the Inventory.
    - If the program/project you are reviewing appears to be a component of a program that needs to be either entered separately or merged with a pre-existing record, enter it into the Inventory, make a note in the Comments field, and add it to the Potential Mergers list for later review.
    - Document your review of source databases (i.e., Ocean Conservancy, GCMP, etc.) using the standard worksheet template. This standardized format will help in the Inventory Record Review Process.

If a program is not already in the Inventory and meets ALL of the Documented Assumptions, open a new webform and begin the Initial Data Entry Procedure.

Documented Assumptions Criteria

This section details four categories of the Documented Assumptions that a program must meet in order to be included in the Inventory: Program Type, Spatial, Temporal, and Duration. Programs must meet ALL of the Documented Assumptions for inclusion. If a program does not meet, or you are unsure if it meets the criteria, enter the program into the Questionable/Deferred programs list. **Programs that meet the documented assumptions, but do not have accessible data, should still be entered into the Inventory not the Questionable/Deferred programs list.**

- **Notes on Data Portals:**
  - Data portals that serve data from multiple sources and are managed by a program that does not collect the served data (i.e., STORET) should not be included in the Inventory.
  - If a data portal was included in a previously completed inventory (i.e., Ocean Conservancy's), it should be added to the Questionable/Deferred programs list and the Inventory of Inventories. In the Questionable/Deferred programs list, data portals should be listed as "Does not meet documented assumption" because they are not monitoring programs.
  - Some monitoring programs will serve their data via their own data portal (i.e., Texas Surface Water Quality Monitoring program). Enter the program and populate the Accessibility fields accordingly with the data access information.

- **PROGRAM TYPE**
  A program must meet requirements for water quality monitoring, habitat monitoring, and/or habitat mapping.

  Water Quality Monitoring
  - Documented Assumption
    - Programs that implement recurrent monitoring of water quality as a complementary data stream to biological or other monitoring
  - Interpretation/Tips
    - Programs should collect at least one of the detailed parameters listed in the Documented Assumptions document
    - Programs that collect water quality information but are not strictly water quality monitoring programs will be included
      - Example: Southeast Area Monitoring and Assessment Program (SEAMAP) Groundfish Surveys
      - This program focuses on faunal species monitoring but also collects water quality parameters
    - Include programs that measure water quality parameters via animal tissue samples

  Habitat Monitoring
  - Documented Assumptions
    - Programs that gauge the condition or state of habitat through in-situ measurements
    - Where possible, habitat data associated with important gulf faunal species-specific monitoring [based on Natural Resource Damage Assessment (NRDA) restoration types;

i.e., Fish and water column invertebrates, sea turtles, marine mammals, birds, estuarine and marine benthics]

- Interpretation/Tips
  - Programs should reference/monitor one or more of the habitat types listed in the Documented Assumptions
  - Programs should collect at least one of the parameter subgroups listed in the Documented Assumptions
  - Faunal species monitoring is only included for benthic, habitat forming groups (i.e., bivalves, corals, deep sea benthic communities, etc.)

Mapping

- Documented Assumption
  - Programs (including platforms/satellites/datasets) that gauge the condition or state of water quality or habitat through remotely-sensed measurements (i.e., LiDAR, SONAR, satellite, aerial imagery, etc.), collect primary data which can be used to develop derived products needed to produce habitat maps, and/or develop recurrent map products for one of a variety of targeted habitat types
- Interpretation/Tips
  - Programs should collect at least one of the detailed parameters listed in the Documented Assumptions
  - Programs should use at least one of the mapping technologies listed in the Documented Assumptions
  - Programs/platforms/satellites/datasets should, by default, meet the Duration documented assumption (below) as these datasets provide a “principal source of information”
  - Programs that produce interpolated map products would be included in the Documented Assumptions (i.e., a sea surface temperature surface from satellite data)

- **SPATIAL**
  - Documented Assumptions
    - Minimum mapping unit - HUC 10 level, but some programs that cover a smaller area (e.g., coral reef) were included if they served as the primary data source for that system.
    - Program/project spatial extent must fall within or intersect the CMAP project boundary
      - Will use boundary which includes Hydrologic Unit Code (HUC) 10 boundaries
      - If a program has monitoring sites falling:
        - Within and outside of the boundary, we will only include sites for that program which fall within the project boundary.
        - Mostly outside of the boundary, we will investigate on a case-by-case basis.
        - Along the US/Mexico border or the Gulf of Mexico/Atlantic Ocean boundary, we will investigate on a case-by-case basis.
  - Interpretation/Tips
    - The project boundary uses the HUC 10 boundaries to delimit the CMAP’s inland boundary and the Exclusive Economic Zone (EEZ) for the marine boundary

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- **TEMPORAL**
  - Documented Assumption
    - Program must be/have been active during the 1980 - present time period
  - Interpretation/Tips
    - Inactive programs are included as long as they meet the Temporal documented assumption

- **DURATION**
  - Documented Assumptions
    - Program duration should encompass:
      - Minimum data record of 5 years of recurrent sampling; or
      - Minimum of 2 sample years that will span the 5 year range; or
      - Discrete programs which provide a principal source of information for resource assessment or management meeting 1 of 5 criteria:
        1. Geographic scope
        2. Primary data source
        3. NRDA resource category
        4. Foundational data source
        5. Limited data availability
  - Interpretation/Tips
    - Regarding the “minimum of 2 sample years,” this should only apply to currently active programs
      - Example: Apalachicola Bay State-Funded Oyster Monitoring - This program started in 2015 and is still operating, thus would meet the “minimum of 2 sample years that span the 5 year range” assumption
    - Use the start/end years to determine duration (i.e., a program running from 2000 - 2004 would meet the duration assumption because it’s been running for 5 years)

Initial Data Entry Process

This section serves as a guide to entering a program's information into the Inventory. Directions and tips are included for each field.

General Directions:

- Log in to the online platform located on the Restore the Gulf website and fill in the webform as completely as possible
  - If you are having trouble accessing the webform, contact Kevin Suir (suirk@usgs.gov)
- Aim for a max of 30-45 minutes spent on each record
- Work through each field one at a time
- When fields cannot be populated, or you are unsure of how to populate, **leave them blank**
  - If metadata can't be found online, leave the field blank rather than marking "No"
  - Only select "No" if POC confirms that metadata (or other examples) are not available
- Acronyms should be placed in parentheses after the first usage (see OCEANSAT-2 example below)
- In the case of programs that could potentially be merged, use your best judgement. If you are unsure, discuss with the data entry and review team prior to entering the record into the database.
  - Add program to the Potential Mergers tab within the Questionable/Deferred Programs spreadsheet
- Use semicolons as the standard delimiter to separate strings of text
- For fields with open text, use the Tab button to enter (*However, this is not true for the Executing Agency field - use the Enter key)
- **When the initial round of data entry has been completed, the person entering the data should click the "Submit for review" button on the webform**

Tips:

- If unsure of how to populate a field, reference existing records in the Inventory to view examples of the type of information that is needed.
- When searching for information to populate fields, there are a few potential sources of information:
  - A first initial resource should be the source inventory (i.e., Ocean Conservancy, GCMP, etc.) you may be working from
  - Program websites can potentially be the easiest source of information.
  - In cases where a program from a source inventory does not have a website listed, search by placing the program name in quotation marks - this can potentially return relevant results
  - Searching within an Executing Agency's website or searching for the listed point of contact can help as well.
  - Metadata sources, reports, publications, or digging into the raw data, in some cases, may help populate many fields.

Descriptions and Tips for Field Population

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GENERAL PROGRAM INFORMATION

All of these fields should be completed as much as possible in the first round of data entry.

FIELD	FIELD DESCRIPTION	TIPS
Program Name	*Name of monitoring program*	• The name of the monitoring program should be unique to prevent duplication of records • For satellites/instruments, the name format should follow "platform + instrument name" • Example: OCEANSAT-2 Ocean Color Monitor (OCM) • The first letter of all words other than "a, an, and, the, of, etc." should be capitalized • Limit the program name to only text relevant to the name - leave additional text or qualifiers for the Description field
Program Description	*Abstract or brief description of the program*	• Description should focus on the program doing the monitoring, not the Executing Agency • This field may be best left to the POC, especially if there is not an easily accessible or clear description available online • If you are writing the description, focus on the who, what, when, where, and how.
Program Description Source	*Source of the program description*	• Multiple selections can be made • "Synthesized by CMAP" should be chosen when CMAP staff draft the description • If CMAP staff edit an existing description on a website or metadata file, both "Synthesized by CMAP" and "Pulled from program/project website" or "Pulled from program/project metadata" should be selected • If a specific document is used as the source, provide a link to that document.
Website URL	*URL of program's website*	• Attempt to find the most direct link to the program possible • If direct link is not available, make a note in the "Comments" section as to why a particular link was included
Executing Agency	*Agency or organization leading the program*	• Multiple selections can be made • Use provided dropdown items at the top of the list before typing the agency name yourself • If an agency or organization is not contained in the provided list, type the name into the box and press "Enter" (Tab will not work) • Enter each agency separately • In the case of a "nested" organization, select all that apply (i.e., National Oceanic Atmospheric Administration (NOAA), National Ocean Service (NOS), National Center for Coastal Ocean Science (NCCOS)) • If a county is the Executing Agency, use the format "Sarasota County" when entering • Do not include the state after the county (i.e., use Sarasota County instead of Sarasota County, Florida) • Use the Enter key to submit new text not found in the dropdown list

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Executing Agency Type	*Type of agency leading the program*	• Multiple selections can be made
Funding Agency	*Agency or organization funding the program*	• Multiple selections can be made • In the case of a "nested" organization, select all that apply (i.e., NOAA, NOS, NCCOS) • If an agency or organization is not contained in the provided list, type the name into the box and press "Enter" • Funding information may be best left to the POC to fill in • If a county is the Funding Agency, use the format "Sarasota County" when entering • Do not include the state after the county (i.e., use Sarasota County instead of Sarasota County, Florida)
Funding Source	*List of funding source for the program*	• Multiple sources are allowed • Use semicolons to delimit multiple funding sources • Funding information may be best left to the POC to fill in
Funding Amount	*Funds allotted to the program*	• Multiple amounts are allowed • Use semicolons to delimit multiple funding sources • Funding information may be best left to the POC to fill in
Program Type	*Is the program a water quality, habitat monitoring, or mapping program?*	• Multiple selections can be made • Parameters collected for each Program Type can be found here, here, and here • This field must be entered in order to view the relevant Program Type specific fields (i.e., parameters, measurement frequency, etc.)
NRDA Injury Categories	*Natural Resource Damage Assessment restoration categories to describe targets of the program*	• Multiple selections can be made • Select all that are directly relevant to the monitoring or mapping activity • Checking metadata files may help identify some of these
Habitat Type	*Habitat types monitored/mapped/observed within the program extent*	• Multiple selections can be made • Each Habitat Type will have at least one Aquatic Setting selected for it • For programs that solely monitor water quality, only choose "Water Column" as the habitat type. Exceptions could include: ○ Tissue taken from organisms for analysis ○ Atmospheric deposition (i.e., precipitation collected before it joins a body of water)
Aquatic Setting	*Hydrologic setting/stratum falling within program extent*	• Multiple selections can be made for each Habitat Type • Each Habitat Type will have separate Aquatic Setting dropdown menus • For the Beach/Dune habitat type, both Upland and Marine Nearshore aquatic settings can be selected

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Collection Type	*Does this program incorporate volunteer or citizen science?*	• This field is "Yes" or "No" • Only one option can be selected

POINT OF CONTACT INFORMATION

All of these fields should be completed as much as possible in the first round of data entry.

FIELD	FIELD DESCRIPTION	TIPS
POC Name	*Name of the primary point of contact for the agency/organization implementing the program/project*	• Limit to a single person • Inclusion of titles (Dr., Mr., Mrs., etc.) is not necessary
POC Office	*Office name where the point of contact is based*	• Example: NOAA/NOS/NCCOS/Marine Spatial Ecology Division/Biogeography Branch • A physical address is not needed • Mimic the format used in the "Executing Agency" list when possible
POC Phone Number	*Phone number of point of contact*	• Use the format: xxx-xxx-xxxx • For extensions use: ext. xxx • This is one of the most important fields -be sure to populate this as accurately as possible.
POC Email Address	*Email address of point of contact*	• This is one of the most important fields -be sure to populate this as accurately as possible.
POC Title	*Title of the point of contact for the agency/organization implementing the program/project*	• Don't spend a lot of time trying to search for this information • May be populated during the review process

TIMELINE INFORMATION

All of these fields should be completed as much as possible in the first round of data entry.

FIELD	FIELD DESCRIPTION	TIPS
Status	*Is the program active or inactive?*	• Only one option can be selected
Start Date	*The start date of data collection of the program*	• Use the format MM/DD/YYYY or YYYY • Check "Complete Date" if a full MM/DD/YYYY date is used • If only a month and year are found for a program, include 01 as the DD part of the date • If data collected prior to the program's inception is included, use the data contained in the documentation for the program itself
End Date	*The end date of data collection of the program*	• Use the format MM/DD/YYYY or YYYY • Check "Complete Date" if a full MM/DD/YYYY date is used • If the program is "Active", enter the end date of the data collection if it is known; otherwise, use "Current" for the end date. Type "Current" and hit tab (hitting enter will input today's date which is incorrect) • If only a month and year are found for a program, include 01 as the DD part of the date

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SPATIAL INFORMATION

FIELD	FIELD DESCRIPTION	TIPS
Coverage	*Geographic coverage of the program*	• Choose “International” if a program operates in at least one other country than the United States • Choose “Nationwide” if a program operates throughout the United States • Choose “Atlantic” if a program operates on the Atlantic coast of Florida • Choose “Gulfwide” if a program is found in every gulf state • Choose “Multistate” if a program operates in multiple, but not all, gulf states • Choose “Statewide” if a program operates throughout all or most of a single state • Choose “Local” if a program operates at a smaller scale than “Statewide”
State	*State(s) where the program/project operates*	• If outside of state boundaries, select “Federal-Marine” • Multiple selections allowed
County	*County(ies) where program/project operates*	• This field will be autopopulated
Ecoregions	*Omernik Ecoregions Level III where program/project operates*	• This field will be autopopulated
HUC10	*Watershed HUC10 ID where program/project operates*	• This field will be autopopulated
Waterbody	*Sea areas, water bodies, etc. where program/project operates*	• This field will be autopopulated

SPATIAL EXTENT INFORMATION

FIELD	FIELD DESCRIPTION	TIPS
Spatial Data	*Will this program be represented by a custom polygon?*	• This field is “Yes” or “No”
North	*North bounding coordinates in decimal degrees of the program*	• This field will be autopopulated
South	*South bounding coordinates in decimal degrees of the program*	• This field will be autopopulated
East	*East bounding coordinates in decimal degrees of the program*	• This field will be autopopulated
West	*West bounding coordinates in decimal degrees of the program*	• This field will be autopopulated

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ACCESSIBILITY INFORMATION

FIELD	FIELD DESCRIPTION	TIPS
Access	*Are any of the raw data accessible?*	• Only select one option
Data URL	*URL or contact info for data source*	• Paste the link to the website leading to access point of raw data
Data Format	*Is the data available in a machine readable format?*	• This field is "Yes" or "No" • You may have to download or access the data to accurately complete this field.
Metadata	*Are metadata files available for the program?*	• Metadata files may be difficult to find on websites alone • They may also be attached to individual data files when programs report/serve data to larger data portals such as the National Estuarine Research Reserve's (NERR) Centralized Data Management Office (CDMO) • This field is "Yes" or "No"
Metadata Standard	*What metadata standard is used?*	• Only select one option • If metadata does not conform to FGDC or ISO standards, choose "Other"
Metadata Source	*URL or how to obtain program's metadata*	• Paste link to where to obtain metadata
Publications	*List of a program's publications*	• Paste link to publications related to the data and/or program • If multiple publications are available, try to include a link to a page listing those publications rather than multiple links

PROCEDURES AND QUALITY ASSURANCE

FIELD	FIELD DESCRIPTION	TIPS
Collection Procedures	*Does the program/project have documented collection procedures for the majority of parameters?*	• This field is "Yes" or "No"
Collection Procedures URL	*URL for documented collection procedures*	• Paste the link to documented collection procedures • This field will only be completed if "Collection Procedures" is filled as "Yes"
Analytical Procedures	*Does the program/project have documented analytical procedures for the majority of parameters?*	• This field is "Yes" or "No"
Analytical Procedures URL	*URL for documented analytical procedures*	• Paste the link to documented analytical procedures • This field will only be completed if "Analytical Procedures" is filled as "Yes"
QA Documentation	*Does the program have quality assurance (QA) protocols?*	• This field is "Yes" or "No"
QA Protocol URL	*URL for quality assurance protocols*	• Paste the link to the documented quality assurance protocols • This field will only be completed if "QA Documentation" is filled as "Yes"

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WATER QUALITY MONITORING INFORMATION

FIELD	FIELD DESCRIPTION	TIPS
Parameters	*List of general and detailed water quality parameters*	• Select any of the general and/or detailed water quality parameters the program collects, defined in the glossary • Select both general and detailed parameters • Select a general parameter if a detailed parameter is not listed in the program's data or metadata • Multiple selections allowed
Measurement Schedule	*What is the measurement schedule of the program?*	• Select "Continuous" when the data is automatically generated via real-time instrumentation (i.e., buoys or satellites) • Select "Discrete" when the data is collected manually via handheld devices rather than automated instrumentation • Both "Continuous" and "Discrete" can be selected if both types of data are collected
Measurement Frequency	*What is the measurement frequency of the program?*	• Multiple selections are allowed • Different parameters measured by the same program may have different measure frequencies • This field refers to targeted time frames rather than time of year
Medium	*Is the monitoring parameter collected in the water column, porewater, or tissue?*	• Multiple selections allowed • For tissue medium, tissue from any organism can be used
Units	*Are data units clearly defined and labeled?*	• Completing this field may require downloading raw data to investigate • This field is "Yes" or "No"

HABITAT MONITORING INFORMATION

FIELD	FIELD DESCRIPTION	TIPS
Parameters	*List of general habitat monitoring parameters*	• Select any of the general, group, or subgroup habitat monitoring parameters that the program collects, defined in the glossary • Select both general and detailed parameters • Select a general parameter if a detailed parameter is not listed in the program's data or metadata • Multiple selections allowed
Activity	*Types of monitoring activities done within program/project*	• Multiple selections allowed
Measurement Schedule	*What is the measurement schedule of the program?*	• Select "Continuous" when the data is automatically generated via real-time instrumentation (i.e., buoys or satellites) • Select "Discrete" when the data is collected manually via handheld devices rather than automated instrumentation • Both "Continuous" and "Discrete" can be selected if both types of data are collected
Measurement Frequency	*What is the measurement frequency of the program?*	• Multiple selections are allowed • Different parameters measured by the same program may have different measure frequencies

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MAPPING INFORMATION

FIELD	FIELD DESCRIPTION	TIPS
Parameters	*List of parameters*	• Select the parameters, raw quantifiable measurements, or derived products the program collects or produces; found here • Multiple selections allowed
Technology	*Technology or tools used to collect data*	• Select the type of mapping technology used to collect and measure the parameters • Multiple selections allowed
Activity	*List of mapping activities*	• Select the mapping activity/purpose of data collection of the program/project • Multiple selections allowed
Classification Scheme	*What habitat classification scheme is used?*	• Select the classification scheme used (if applicable) in the map product(s) • If the classification scheme used is not contained in the pre-populated list, it can be added via the "Other" option • Use semicolons as the delimiter between multiple classification schemes in the "Other" option
Platform Type	*Type of platform technology or tool were deployed*	• Select the type of platform (i.e., boat, ROV, Mooring, etc.) in which the technology is deployed and the parameters are collected • Multiple selections allowed
Spatial Resolution	*Spatial resolution of map products; If produced from scanned analog photography what was scale and dpi?*	• What is the spatial resolution of the map products? • If produced from scanned analog photography, what was the scale and dpi (if available)? • Include units of resolution where appropriate • Leave a space between the numerical resolution value and it's unit (i.e., 100 km) • Use the abbreviated form of the unit (i.e., km instead of kilometer) • Use semicolons as delimiters between multiple resolutions
Temporal Resolution	*Temporal resolution of the mapping data*	• If only a single mapping event is catalogued put "Single event" • For recurrent mapping events, use discrete periods of time when possible (i.e., Annually, Monthly, Every 2 days, etc.)
Date(s)	*List of the years in which mapping data was collected*	• Provide relevant date format as specifically as possible (including MM/DD/YYYY, YYYY, or a date range) • If multiple ranges or disparate single year efforts are included a single program, use semicolons as the delimiter

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INTERNAL WORKING FIELDS

FIELD	FIELD DESCRIPTION	TIPS
UID	*The unique ID (UID) from the Google spreadsheet*	• Enter the UID from the Google spreadsheet if the program was entered prior to the new web form being developed
Crosswalk	*ID or other information that allows a program to be crosswalked to other inventories*	• If the program being entered comes from or is already contained in another inventory (i.e., Ocean Conservancy or Global Change Monitoring Portal) populate this field with the source ID's to allow crosswalking
Comments	*An internal comments/notes field*	• Include information about potentially merging records here • Include any other pertinent information here
Baseline	*Would this monitoring program be helpful in the search for baseline assessments*	• This field is "Yes" or "No" • Only check "yes" if it is clear the program/project has conducted a baseline assessment • If there is a link to a program's baseline assessment, add it to the Baseline Assessment Inventory spreadsheet
Documented Assumptions - Program types?	*Does the program meet our program type criteria?*	• Select Y/N • Program shouldn't be entered if No
Documented Assumptions - Spatial extent?	*Does the program extent fall within the CMAP area of interest?*	• Select Y/N • Program shouldn't be entered if No
Documented Assumptions - Temporal limitations?	*Has the program been active post 1980?*	• Select Y/N • Program shouldn't be entered if No
Documented Assumptions - Duration?	*Has the program been actively monitoring for at least 5 years?* (See Documented Assumptions for further clarification)*	• Select Y/N • Program shouldn't be entered if No

*****Hit the "Submit for Review" button at the top of the webform when you are finished with the entry*****

Questionable/Deferred Programs List Entry Process

This section focuses on entry of records into the Questionable/Deferred Programs list. Programs that only collect atmospheric monitoring data, conduct faunal species monitoring, or other monitoring targets outside of the Documented Assumptions should not be added to the inventory and should instead be added to the Questionable/Deferred programs list. Directions and tips are included for each field.

1. **Assessment of Questionable/Deferred Programs**
   If after the Initial Assessment of a program, you are uncertain if a program meets the Documented Assumptions (Questionable) or determine a program does not meet the Documented Assumptions (Deferred) add the program to the Questionable/Deferred Programs list and complete the fields defined in the table below..

   Be sure to document the reason for a program being Questionable or Deferred within the Issue field. The six themes provided as dropdowns are defined below.
   - Faunal species monitoring: A program/project that only monitoring faunal species (no habitat or water quality data collection)
   - Atmospheric monitoring: A program/project that collects atmospheric data (i.e., precipitation, winds, air temperature, etc.)
   - Other monitoring targets: A monitoring program/project that does not monitor habitat or water quality condition
   - Geographic coverage: A program/project in which the spatial extent does not overlap with the CMAP boundary
   - Temporal coverage: A program/project that does not meet the temporal Documented Assumption
   - Lack of information: A program/project you cannot assess comprehensively due to a lack of information

2. **Review of Questionable/Deferred Programs**
   Questionable records must be reviewed by an additional person once added to the Questionable/Deferred Programs list. Once a record is deferred, no further action needs to be taken. After the second review of a Questionable record, the record may fall into one of three categories:

   i. ***Meets the Documented Assumptions***
   If, after the second review, a Questionable record is determined to meet the Documented Assumptions the record should be entered into the Inventory and removed from the Questionables/Deferred Programs list. When the program is entered into the Inventory, the data entry staff should change the designations and color schemes for those records in the appropriate source database spreadsheets in the Inventory Sources folder.

   ii. ***Deferred***
   If, after the second review, a Questionable record is determined to not meet the Documented Assumptions, iitsdesignation in Documented Assumptions column should be changed to “Does not meet documented assumptions,” designating it as “Deferred.” Once the record is marked as Deferred, no further action is required.

iii. Remains Questionable

If, after the second review, no clarifying information can be found to either accept or defer the record, no further action is needed as these Questionable records have been reviewed by a minimum of two CMAP staff members. The records will remain on the Questionable/Deferred Programs list until potential future reiterations of this project.

FIELD	TIPS
Inventory Source	• If the program being entered comes from a previously compiled inventory (i.e., Ocean Conservancy), choose the appropriate inventory from the dropdown • If the program being entered does not come from a previously compiled inventory, leave this field blank
Inventory Source ID	• If the program being entered comes from a previously compiled inventory (i.e., Ocean Conservancy), input the program's ID from that inventory in this cell for crosswalking purposes • If possible, link to the program's entry in the previously compiled inventory in this cell • If the program being entered does not come from a previously compiled inventory, leave this field blank
Name	• Paste the name of the program being entered here
Summary	• Paste or craft a summary of the program being entered
1st Reviewer	• Put your initials here if you are the person entering the program for the first time in the Questionable/Deferred list
2nd Reviewer	• Put your initials here if you are reviewing a record within the Questionable/Deferred list
Is this program already in the CMAP inventory?	• If the program being entered has already been entered into CMAP inventory, put "Y" • If the program being entered has not already been entered into CMAP inventory, put "N"
CMAP ID	• If the program being entered has already been entered into the CMAP inventory, put the CMAP inventory ID here
Documented Assumptions	• If the program does not meet one or more of the documented assumptions, choose "Does not meet documented assumptions" • If you are unsure if the program should be entered into the inventory or not, choose "Questionable"

Issue	• Choose the appropriate "Issue" from the dropdown list to describe why a program does not meet documented assumption or is questionable. Options include:
	  ○ Faunal species monitoring
	  ○ Atmospheric monitoring

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	○ Other monitoring targets ○ Geographic coverage ○ Temporal coverage ○ Lack of information ○ Lack of information - POC needed to confirm ○ Data Portal ○ Not a monitoring program ○ None
Potential "principal source of information"	● Could this program potentially meet the below exception for meeting the Documented Assumptions? ○ Discrete programs which provide a principal source of information for resource assessment or management meeting 1 of 5 criteria: 1. Geographic scope 2. Primary data source 3. NRDA resource category 4. Foundational data source 5. Limited data availability
Notes	● Add notes or comments giving further information about the program ● Including the kinds of parameters the program collects can help during the review process ● Links to websites are also helpful

Inventory Record Review Process

The Inventory record review process will involve four stages:

1. First Round of Record Review
2. Point of Contact Review
3. Second Round of Record Review
4. Record Finalization

These are defined and outlined below.

First Round of Internal Record Review

This section focuses on the review process for records that have been entered into the CMAP inventory.

General Notes:

- Records should not be reviewed by the same person who initially entered the record into the inventory
- Reviewers should check who marked the record as ready for first review (under the Internal tab) to ensure they don't review a record they entered
- Reviews will be done in the database webform found here

First Step

- Prior to beginning a review, reviewers should search the database for potential duplicates or records that could be combined
  - For duplicate records, ensure that all the relevant information is captured in one of the two records and add the other to the list for deletion
  - For potential mergers, the reviewer should make note of them and bring them up at the next group meeting for discussion
- Reviewers should select "View" on the splash page of the database next to the program being reviewed
- When the record's information is displayed on the screen, select "Start first review" in the upper right corner to begin the review process

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Second Step

- Reviewers should first view the "Internal" tab on the record they're reviewing
- Reviewers should check the UID and Crosswalk fields and open the appropriate spreadsheets
    - For records with a UID, reviewers should check the Task 2 spreadsheet to ensure data was imported completely (older records initially entered in Google will likely have blank Program Type, Aquatic Setting, and Habitat Monitoring parameters)
    - Reviewers should check the appropriate Crosswalked spreadsheets (i.e. the Ocean Conservancy inventory) when they are unable to verify record information via the internet as the information may have come directly from the original spreadsheet
- Reviewers should ensure that the record meets all four Documented Assumptions
    - If the reviewer comes to a different conclusion than the person who entered the data, those two people should work together for a consensus
    - If the consensus is that the record **does not** meet the Documented Assumptions, make the appropriate selections on the webform, save the page, and submit first review

Third Step

- Reviewers should check the content of every field in the record
    - Before removing information from an existing record, the reviewer should contact the person who initially entered the record to ensure that such edits are warranted
    - Reviewers should make note of substantial changes to existing information in the Comments field
- If reviewers come across fields that have been left blank (outside of those that will be autopopulated with spatial data), the reviewer should attempt to fill them in
    - If the reviewer cannot definitively populate a blank field, it should be left blank for the POC to populate
- Reviewers should check for and correct typos and other grammatical errors
- Reviewers should check that semicolons have been used as the text delimiter throughout
- Reviewers should ensure that record titles and descriptions adhere to the below formatting rules
    - *Formatting Rules:*
        - Formatting titles and descriptive text should be consistent using the table below to assist in this standardization. There are <u>three</u> main components for formatting to follow as each entry is reviewed.
            - General (ampersands, text, spacing, capitalization, etc.)
            - Acronyms
            - Title consistency

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GENERAL

'And' and ampersand	Don't use ampersand in the title or text unless it is a part of an 'official' name (i.e., Texas A&M) *Incorrect:* Texas Parks & Wildlife Department Fishery Independent Sampling *Correct:* Texas Parks and Wildlife Department Fishery Independent Sampling
All titles should have proper title formatting	*Incorrect:* Dunes_Lakes_Management *Correct:* Dunes Lakes Management *Stormwater Bacti/TMDL/10-1013 TMDL #1*
Extra spaces (spacing)	Remove extra spaces at the beginning of titles, middle of text, at the end of titles. Remove any extra spacing within the descriptive text.
Capitalize all words in title	*Incorrect:* Gulf-wide assessment of habitat use and habitat-specific production estimates of nekton in turtlegrass (Thalassia testudinum) *Correct:* Gulf-wide Assessment of Habitat Use and Habitat-specific Production Estimates of Nekton in Turtlegrass (Thalassia testudinum)
For name format, use what is contained in the program's documentation or website	*Incorrect:* OCEANSAT *Correct:* Oceansat

ACRONYMS

Any acronym in the record title MUST be spelled out	*Incorrect:* National Marine Sanctuary Program (SWiM) *Correct:* Sanctuary-wide Monitoring (SWiM) Program *Incorrect:* Bullfrog Creek Estuary MFL *Correct:* Bullfrog Creek Estuary Minimum Flows and Levels (MFL)
Do not include acronyms not in the title.	*Incorrect:* Consumer Stocks: Wet weights from Everglades National Park (FCE) *Correct:* Consumer Stocks: Wet weights from Everglades National Park
If acronym is commonly used/accepted for program or description, include it in the title	*Incorrect:* Weeks Bay National Estuarine Research Reserve Surface Elevation Monitoring *Correct:* Weeks Bay National Estuarine Research Reserve (WBNERR) Surface Elevation Monitoring
Do not spell out US	For federal agencies, do not spell out "United States" instead use U.S.

TITLE CONSISTENCY

Do not include agency/entity in the title unless the program name is not descriptive enough	"Water Quality Monitoring" change to "Hillsborough County Water Quality Monitoring"
When splitting an overarching program into multiple subsets (i.e. CRMS), put the program name first (with acronym, if applicable) then use a dash for subset	*Incorrect:* Coastwide Reference Monitoring System Forested Vegetation *Correct:* Coastwide Reference Monitoring System (CRMS) - Forested Vegetation
Records from CRMS	For Coastwide Reference Monitoring System records, acronym should only be used for CRMS and not the type of monitoring (see above)

Final Step

- Reviewers should click the "Save Program" button at the bottom of the webform when they are finished reviewing (or if they need to leave the webform for any reason prior to finishing)
- Reviewers should navigate back to the record they were reviewing and click the "Submit First Review" button at the top of the webform to complete their review
- **Do not** click the "Create PDF and Update Record Status" button.

Point of Contact Review

This section focuses on the process of engaging points of contact (POC) for the formal review of their program/project(s).

1. **Pilot test**
    - **A.** The POC review process will be pilot tested on a total of X records.
        1. 5 programs with POCs that CMAP staff work closely with and have directly asked to participate in a pilot test
    - **B.** The pilot test will follow the below steps (Steps 2B - 2D).
    - **C.** Pilot test respondents will be asked for feedback and suggestions on how to improve the process. Add feedback to Test POC comments

2. **POC Review**
    - ***A. Does the record have a POC listed?***
        1. If No, add to this worksheet, which is a list of programs for the internal CMAP leadership team (Program Advisory Team (PAT), Expanded Program Advisory Team (Ex-PAT), Council MOnitoring and Assessment Workgroup (CMAWG), Monitoring Community of Practice (MCoP) to review and potentially provide further clarifying information.
        2. If Yes, proceed to step 2B.

B. *POC Engagement - Round 1*

1. Ensure that the program/project being reviewed does not have any duplicates in the database
2. Enter the record in the POC Contact Log. Ensure that the POC does not have any additional programs in the database. In column H, select either “single” or “multiple” from “POC Programs” dropdown list under “POC Info”
    a) If the POC is listed on more than one project, list all additional records in subsequent rows. Allow more time for the review (3 weeks).
3. In the webform, press the button “Create PDF and Update Record Status” to obtain editable PDF and updating the record status to “In POC review”
4. Send an email from the RESTORE email account to the primary POC, cc Claudia Laurenzano, Katie Watson, Heidi Burkart, Jacob Howell, Nicholas Enwright, and Rheannon Hart for potential follow-ups; attach the following documents:
    a) Customized email body letter with information about CMAP
        (1) Include POC name in greeting
        (2) Enter program name in 2 bold place holders
        (3) Allow more time if POC has multiple programs
    b) Editable PDF form containing cover letter and program/project descriptive metadata (from webform)
    c) CMAP glossary of terms
5. Feedback will be requested within 2 weeks (3weeks for POCs on multiple programs)
6. Add original PDF to Review PDF - ORIGINALS folder for future reference. Rename PDF to CMAP_POC_Review_PID_XXX
7. Document in contact log
    a) Enter program info and POC info (columns A through I)
    b) Enter date you contacted POC (column J) and select your name from the dropdown list (column K)
    c) Enter the Response due date (column U); an easy way to do this is using the formula “=Jx + 14”, where x denotes the row number. If POC has multiple programs, use the formula “=Jx + 21”

C. *POC Engagement - Round 2*

1. If the POC has provided feedback:
    a) Document in contact log
        (1) Enter date of feedback received (column V); this will turn red due dates gray and highlight the program name (column B) in red.
        (2) Mark if the review includes updates (column W)
        (3) Mark if the POC indicated he/she is willing to share collection/analytical/QA protocol documentation (column X), spatial data (column Y) and/or spatial data with attribute metadata (column Z). If the POC provided a link to any of these resources, this can be marked by selecting URL from the dropdown lists. See section 2. E
        (4) Mark if the POC has shared files as attachments (column AD). See section 2. E.

(5) Mark if there are any questions for the POC (column AF), record these in the Notes column (AI)
(6) Select your name in the dropdown list in column AG
(7) Enter CMAP response due date by when to follow up/send Thank you letter (column AH) to three weeks after the POC's most recent correspondence; an easy way to do this is using the formula "=Vx + 21" or "=ACx + 21", where x denotes the row number.
(8) Mark record as ready for final review (column AJ)

b) Follow up with any questions about information received (within 3weeks)
(1) Record the date you contacted the POC (column AA) and how often you sent a follow up (column AB). Column A with the project identification (PID) will turn purple. Delete the CMAP response due date for this entry (column AH), and replace it with an updated date once the POC has responded.
(2) If there are no more questions/follow ups, mark record as ready for Thank you letter (column AL). Column A with the PID will turn blue.

c) Conclude POC correspondence by replying with Thank you letter
(1) Add date in column AM. Column A with the PID will turn green to reflect concluded correspondence for the program.

d) Add returned PDF to RETURNED PDFs folder. Rename PDF to CMAP_POC_Review_PID_XXX_returned

e) If provided, add spatial data to folder. Make sure to reference the PID in the naming convention (PID_###). See section 2. E.

f) If provided, add quality assurance and standard operating procedure (SOP) documents to the Monitoring Protocols Library. See section 2. E.
(1) Name the files appropriately: "PID_###_type of document"

g) Proceed to Final Record Review

2. If POC requests meeting:
a) Assign CMAP staff members Heidi Burkart, Jacob Howell, Claudia Laurenzano, or Katie Watson in contact log
b) Responding CMAP staff member: select your name in "Meeting: CMAP staff" dropdown list (column R) and provide "Meeting: Date" info (column S)
c) Document updates

3. If POC responds he or she is not the correct POC for that record:
a) Update POC info and document in "Notes" under "POC Info" in contact log (columns D through I).
b) Proceed to contact correct POC and document correspondence in contact log.

4. If POC has not responded within 2 weeks (Response due date (column U) will turn blue on due date, red after the due date; the POC name (column D) and email address (column G) will be highlighted yellow):
a) Verify the correct POC or email address is listed for that record.
b) Resend initial email and attachments.
c) Feedback will be requested back within 2 weeks (3 weeks for POCs on multiple programs).
d) Document in contact log

(1) Fill out Contact round 2 (columns N through Q).
(2) Update “Response due date” under “POC review” (column U); an easy way to do this is using the formula “=Nx + 14” or =”Nx + 21”, where x denotes the row number.

D. POC Engagement - Round 3

1. If the POC has provided feedback:
    a) See section 2. C. 1.
2. If POC has not responded within 2 weeks (PID, Program name, and Response due date (columns A, B, and U) will be highlighted gray):
    a) Verify the correct POC or email address is listed for that record.
    b) If a phone number exists, reach out via phone call.
    c) If no response was received, add record to list of programs for the internal CMAP leadership team (Ex-PAT, PAT, CMAWG, MCoP) to review and potentially provide further clarifying information.
    d) Document in contact log.

E. *POC provided data*

1. Make sure any data provided by the POC is properly recorded in the contact log. In the Correspondence tab:
    a) Add the date when data was received (Correspondence!AC).
    b) Mark if the POC provided files as attachments that require uploading to our Google Drive (as opposed to web links) (Correspondence!AD). Staff members who are authorized to create files in the Google Drive will upload the data in the appropriate folders, name to according to convention (see section C. 1. d-f), and provide access URLs in the contact log Data sheet.
2. Record all data received from POCs in the Data tab:
    a) Provide PID and POC name (Data!A, Data!B).
    b) Provide access to the data via weblink (Data!C).
    c) If the POC provided data via file (see Correspondence!AD), upload the file to the appropriate folder(s) , record your name (Data!D), and provide a link to the file/folder (Data!C).
    d) If the POC provided multiple resources (e.g., a protocol and spatial data), input the information in separate rows for each resource and mark the type of the resource (Data!E:G).
3. Inspect the data
    a) Data that require checking (i.e., there is no conclusion entered in Data!J) are highlighted light blue.
    b) Mark the type by selecting Yes in the appropriate columns (Data!E:G).
    c) Record your name (Data!H) and the date (Data!I).
    d) Comment in Conclusion (Data!J) if the data are sufficient for our purposes, or if we need to reach out to the POC for further information/details. This action will revert the blue highlight to a white background.

Quality Assurance Check

This section focused on a two-step process of quality assurance checks which should occur in both the Final Review and Record Completion phases of record review described in the following sections.

Phase I Quality Assurance Check
This phase of QA should be implemented during the Final Review phase (outlined in the following pages). As each record enters “In Final Review” status, CMAP staff should check each record according to the formatting guidelines and specified “QA Check Fields” outlined below.

Phase II Quality Assurance Check
This phase of QA should be implemented during the Record Completion phase (outlined in the following pages). As each record enters “Record Complete” status, a database-wide, automated check will be completed according to the formatting guidelines and specified “QA Check Fields” outlined below. This phase may only require CMAP staff to access individual records if major errors are identified.

I. **Formatting Guidelines**
   A. Ensure that record titles and descriptions adhere to the formatting rules listed in **Third Step** of the **Internal Record Review** in the previous section.
      1. Formatting titles and descriptive text should be consistent using the table below to assist in this standardization. There are three main components for formatting to follow as each entry is reviewed.
         - General (ampersands, text, spacing, capitalization, etc.)
         - Acronyms
         - Title consistency

II. QA Check Fields

GENERAL PROGRAM INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Program Name	*Ensure formatting follows guidelines outlined in the Formatting Rules table.*	• See Formatting Rules table	X	X
Program Description	*Ensure formatting follows guidelines outlined in the Formatting Rules table.*	• See Formatting Rules table	X	
Program Description Source	*Ensure correct selection made*	• If POC entered description, change this field	X	
Website URL				
Executing Agency	*Ensure formatting guidelines were followed and naming conventions are consistent across the database*	• Database-wide search and correction	X	X
Executing Agency Type				
Funding Agency	*Ensure formatting guidelines were followed and naming conventions are consistent across the database*	• Database-wide search and correction	X	X
Funding Source				
Funding Amount				
Program Type	*Ensure all applicable types are selected*	• There were import errors with this field causing field to be left blank • If any fields within Water Quality, Habitat Monitoring, or Mapping tables are populated, Program Type should be populated.	X	X
NRDA Injury Categories	*Check for consistency in selections*	• Database-wide check for keywords in description, habitat types, and parameters selected	X	X
Habitat Type/Aquatic Setting	*Ensure that only possible aquatic settings/habitat combinations are selected.*	• Matrix only suggests possible combinations of habitats and aquatic settings. Actual selections of aquatic settings may include one or many of suggested possible combinations depending on the monitoring site and parameters. • The matrix is a guide to finding outliers that need to be addressed (i.e., Mangrove - Marine Oceanic would not be accurate and need to be addressed). This process may be best done via database-wide search for inaccurate selections.	X	X
Collection Type				

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POINT OF CONTACT INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
POC Name				
POC Office	*Ensure formatting guidelines were followed*	• Should follow format of agency fields	X	X
POC Phone Number	*Ensure formatting guidelines were followed*	• Database-wide search and correction		X
POC Email Address				
POC Title				

TIMELINE INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Status	*Ensure field is completed*	• Must be selected as Active or Inactive		X
Start Date				
End Date	*Ensure field is completed correctly*	• If a program is marked as "Active" the "End Date" field should be marked as "Current" unless the forecasted end date is known		X

SPATIAL EXTENT INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Spatial Data	*Check if the record has accompanying spatial data* here	• Examination and processing of spatial data will be conducted by the spatial data team		X
Coverage	*Field needs to be checked against spatial data*		X	X
State	*Field needs to be checked against spatial data*		X	X
County	*Field needs to be populated using spatial data*			X
Ecoregions	*Field needs to be populated using spatial data*			X
HUC10	*Field needs to be populated using spatial data*			X
Waterbody	*Field needs to be populated using spatial data*			X
North	*Field needs to be populated using spatial data*			X
South	*Field needs to be populated using spatial data*			X
East	*Field needs to be populated using spatial data*			X
West	*Field needs to be populated using spatial data*			X

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ACCESSIBILITY INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Access				
Data URL				
Data Format				
Metadata				
Metadata Standard				
Metadata Source				
Publications				

PROCEDURES AND QUALITY ASSURANCE

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Collection Procedures	*'Yes' should only be selected if a hyperlink or file is accessible*		X	X
Collection Procedures URL	*Ensure files/links shared are what is expected*	• Make sure the webform reflects any additional documentation sent by POCs • If POC shares files, add the file to the Protocols Library and add text to this field "Contact POC for documents" • If CMAP has the file ensure that "CMAP has file" checkbox is selected	X	X
Analytical Procedures	*'Yes' should only be selected if a hyperlink or file is accessible*		X	X
Analytical Procedures URL	*Ensure files/links shared are what is expected*	• Make sure the webform reflects any additional documentation sent by POCs • If POC shares files, add the file to the Protocols Library and add text to this field "Contact POC for documents" • If CMAP has the file ensure that "CMAP has file" checkbox is selected	X	X
QA Documentation	*'Yes' should only be selected if a hyperlink or file is accessible*		X	X
QA Protocol URL	*Ensure files/links shared are what is expected*	• Make sure the webform reflects any additional documentation sent by POCs • If POC shares files, add the file to the Protocols Library and add text to this field "Contact POC for documents" • If CMAP has the file ensure that "CMAP has file" checkbox is selected	X	X

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WATER QUALITY MONITORING INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Parameters	*Ensure data was accurately transferred from Google Form database and properly reviewed*	• Habitat Indicators is a General Parameter often mistakenly selected due to import errors from Google Form; often selected due to Phytoplankton being regrouped	X	X
Measurement Schedule				
Measurement Frequency	*Ensure formatting guidelines were followed and naming conventions are consistent across the database*	• Database-wide search and correction		X
Medium	*Make sure something is selected*		X	
Units				

HABITAT MONITORING INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Parameters	*Ensure data was accurately transferred from Google Form database and properly reviewed*		X	X
Activity	*Check for consistency in selections*	• Selections based on parameters selected		X
Measurement Schedule				
Measurement Frequency	*Ensure formatting guidelines were followed and naming conventions are consistent across the database*	• Database-wide search and correction		X

MAPPING INFORMATION

FIELD	QA CHECK	NOTES	PHASE I	PHASE II
Parameters	*Ensure data was accurately transferred from Google Form database and properly reviewed*	• Import errors occurred from Google • This field should not be blank if mapping technologies or activities are selected	X	X
Technology				
Activity	*Check for consistency in selections*	• Selections based on parameters selected		X
Classification Scheme	*Ensure formatting guidelines were followed and naming conventions are consistent across the database*	• Database-wide search and correction		X
Platform Type	*Ensure something is selected*		X	
Spatial Resolution	*Ensure formatting guidelines were followed*			X
Temporal Resolution	*Ensure formatting guidelines were followed*			X
Date(s)	*Ensure formatting guidelines were followed*			X

Second Round of Internal Record Review

This section focuses on the final round of review for records that have been entered into the CMAP inventory. This review will incorporate any changes a POC requests for a record and Phase I of the Quality Assurance Check as described in the previous section. This final round of review should involve minimal to no changes beyond what the POC has provided and items identified during the QA process.

1. **If a record has received feedback review by a POC**
    1. Select your name in the dropdown list “Final review by” (column AK) in the POC Contact Log. The program name (column B) highlight will turn from red to green.
    2. Open the corresponding record in the CMAP database. On the Internal tab, navigate to the bottom and select a response whether or not we have received a response from the POC. Then press the "Proceed to final review" button. The record status will update to “In final review” and show your name as current owner.
    3. Correct or add any information received from the POC. At any time, you can save your progress by navigating to the bottom of the page and clicking the blue “Save program” button.
        A. Ensure that changes made by the POC are consistent with how the CMAP team has been operating and with the standard operating procedures (SOP’s) guidance for data entry. If you are unsure, consult the team and/or reach out to the POC and verify the validity of concerning changes.

   B. At this point, Phase I of the quality assurance (QA) check should be completed as outlined in the above Quality Assurance Check section (p. 34-43).
   C. If a POC does not check "Yes" or "No" for a particular field, check "No"
4. Click the "Submit Final Review" button. The record status will update to "Review Complete".

2. **If a record has not received feedback review by a POC**
   1. All records not receiving POC feedback should have been added to this worksheet
   2. Records not receiving POC feedback should be retained in the inventory as-is with a flag tagged on to the records to denote that they have not been reviewed outside of the CMAP team.
   3. These records should also go through the Phase I QA Check, be submitted to "Review Complete" status, and pass through the following Record Completion process.

Record Completion

A final check must be made to denote whether a program/project within the Inventory is completed and accurate. During this stage, the Phase II (final) QA check of records should occur. This phase of the QA check should primarily be conducted in a database-wide application. These steps must be taken for every record that will be used in the final product for the CMAP project. This includes all records that meet all the Documented Assumptions whether they received POC feedback or not. Ideally, minimal edits should be made to any records in the database.

Before a record can be considered complete, the following checks must be done:

1. Ensure that there are no duplicate records in the database; if so, follow standard protocol for handling duplicate records
2. Processing of spatial data and population of spatial fields
3. Quality assurance check as described on previous pages

At the end of this process, all records in the database should be designated as one of the following:

- Fully complete with spatial data
  - Records meet all documented assumptions
  - Every applicable field is filled in
  - POC edits have been incorporated
  - Spatial data (unique or stock) is processed
- Fully complete without spatial data
  - Records meet all documented assumptions
  - Every applicable field is filled in
  - POC edits have been incorporated
  - Spatial data (unique or stock) is not available
- Some missing information with spatial data
  - Records meet all documented assumptions
  - Some fields have not been filled in
  - POC edits have been incorporated
  - Spatial data (unique or stock) is processed

Appendix 6: CMAP SOP

- Some missing information without spatial data
  - Records meet all documented assumptions
  - Some fields have not been filled in
  - POC edits have been incorporated
  - Spatial data (unique or stock) is not available
- Fully complete no POC review with spatial data
  - Records meet all documented assumptions
  - Every applicable field is filled in
  - No POC review occured
  - Spatial data (unique or stock) is processed
- Fully complete no POC review without spatial data
  - Records meet all documented assumptions
  - Every applicable field is filled in
  - No POC review occured
  - Spatial data (unique or stock) is available
- Questionable
  - Records might not meet one or more documented assumptions
  - POC review may or may not have occured
  - Will not be displayed in final product
- Deferred
  - Records do not meet one or more documented assumptions
  - POC review may or may not have occured
  - Will not be displayed in final product

Appendix 7: Council Monitoring and Assesment Program Point of Contact Review Template-editable Program Information

RESTORE Council Monitoring and Assessment Program (CMAP)
Project/Program Information Review

This editable Portable Document Format (PDF) form has been populated with information describing the project/program,

We have included some general instructions as well as a glossary of terms to help complete the review and/or revision of this information. Once completed, the CMAP team will incorporate your edits for the project/program(s) records into the RESTORE CMAP database.

Please let us know if you have any questions regarding the process or technical issues with the PDF. We greatly appreciate your participation in the CMAP effort.

Instructions for review:

- PDF form may be opened and edited in Adobe Acrobat Reader (free download here)
- Review program information and make revisions as necessary
- Provide missing information
- Save your edits (if any)
- If no additions or changes are needed please confirm your review and let us know that no revisions are necessary
- Return modified PDF to RESTORECouncil_Monitoring@restorethegulf.gov along with any additional comments

Reviewer feedback:

Please specify one of the following options in the return email:

1. *Return with no changes necessary*
   Your program information will be considered final.

2. *Return includes updates*
   Your program information will be considered final once comments (if applicable) or edits are addressed.

Note: In the event that we do not receive a response from you after a follow up, then we will consider the current entry for the project/program as final.

If assistance is needed during this review process, please contact our CMAP project staff at RESTORECouncil_Monitoring@restorethegulf.gov.

Appendix 7: CMAP POC Review Template-editable Program Information

Overview

Program title

Provide the name of the program/project. Please spell out any acronyms.

Website URL

Please provide website link(s) relevant to the program/project

Program description

Please provide an abstract or brief description of the program (i.e., who, what, when, where, and how)

Appendix 7: CMAP POC Review Template-editable Program Information

Executing agency(ies)
Please provide the name of the leading agency and any partner agencies.

Executing agency type(s)
Select all that apply.

- ☐ Federal
- ☐ State
- ☐ Regional
- ☐ Local
- ☐ Private
- ☐ Non-Governmental Organization (NGO)
- ☐ Consortium
- ☐ International
- ☐ Academic
- ☐ Tribal

Funding agency(ies)
Agency(ies) or organization(s) funding the program. Please list all.

Funding source(s)
Funding source(s) for the program (i.e., Grant, legislation, etc)

Funding amount
Total funds allocated to the program

Appendix 7: CMAP POC Review Template-editable Program Information

Point of Contact

Please provide or correct the below information for the primary point of contact for this program/project.

Name

Office name

Phone number
(XXX-XXX-XXXX Ext. XXX)

Email address

Job title

Timeline

Status
Is the monitoring/data collection currently active or inactive?

- Active
- Inactive

Start date
What is the start date of data collection? (YYYY or MM/DD/YYYY if possible)

End date
What is the end date of data collection? (YYYY or MM/DD/YYYY if possible)

Program Type

Does this program incorporate volunteer or citizen science?

- Yes
- No

Appendix 7: CMAP POC Review Template-editable Program Information

Habitat types—and associated aquatic settings

Please select all habitat type-aquatic setting pairs which fall within the extent of the program/project.

	AQUATIC SETTING							
HABITAT TYPE	Upland	Riverine	Palustrine	Lacustrine	Estuarine	Marine nearshore (<30 m)	Marine offshore (30–200 m)	Marine oceanic (>200 m)
Water column (Groundwater)	☐	☐	☐	☐	☐	☐	☐	☐
Oyster/bivalve bed (Oysters, mussels)	☐	☐	☐	☐	☐	☐	☐	☐
Emergent marsh (Fresh marsh, saline marsh)	☐	☐	☐	☐	☐	☐	☐	☐
Forest (Swamp, upland forest, riverine forest)	☐	☐	☐	☐	☐	☐	☐	☐
Shrub scrub/Grassland	☐	☐	☐	☐	☐	☐	☐	☐
Beach/dune	☐	☐	☐	☐	☐	☐	☐	☐
Barrier island	☐	☐	☐	☐	☐	☐	☐	☐
Mangrove	☐	☐	☐	☐	☐	☐	☐	☐
Tidal flat	☐	☐	☐	☐	☐	☐	☐	☐
Hard/Rock bottom	☐	☐	☐	☐	☐	☐	☐	☐
Coral reef	☐	☐	☐	☐	☐	☐	☐	☐
Soft bottom	☐	☐	☐	☐	☐	☐	☐	☐
SAV (Seagrass bed, benthic macroalgae)	☐	☐	☐	☐	☐	☐	☐	☐
Sargassum/floating macroalgae	☐	☐	☐	☐	☐	☐	☐	☐
Deep sea benthic communities	☐	☐	☐	☐	☐	☐	☐	☐
Artificial reef	☐	☐	☐	☐	☐	☐	☐	☐
Urban	☐	☐	☐	☐	☐	☐	☐	☐
Agriculture	☐	☐	☐	☐	☐	☐	☐	☐
Karst/barren (Cave systems, barren, sinkhole, outcrop communities)	☐	☐	☐	☐	☐	☐	☐	☐

Appendix 7: CMAP POC Review Template-editable Program Information

Accessibility

Are the data accessible?

- ○ Web accessible
- ○ Send upon request
- ○ Not accessible

Data URL

If data are accessible, please provide the URL or contact info for the data source.

Are the data available in a machine-readable format?

- ○ Yes
- ○ No

Is metadata available?

- ○ Yes
- ○ No

Metadata standard

What metadata standard format is used? Select all that apply.

- ☐ ISO
- ☐ FGDC (CSDGM)
- ☐ Other

Metadata source

If metadata are available on the web, please provide a URL.

Publications

Provide a citation/link to any relevant publication(s) (or a link to publications page)

Appendix 7: CMAP POC Review Template-editable Program Information

Procedures and QA

Does the program have documented collection procedures for the majority of parameters?

- ○ Yes
- ○ No

Collection procedures URL

If documentation is available on the web, please provide a link to the website. If it is not available on the web, could you share the file with us?

Does the program have documented analytical procedures for the majority of parameters?

- ○ Yes
- ○ No

Analytical procedures URL

If documentation is available on the web, please provide a link to the website. If it is not available on the web, could you share the file with us?

Does the program have a Quality Assurance (QA) protocol?

- ○ Yes
- ○ No

QA protocol URL

If documentation is available on the web, please provide a link to the website. If it is not available on the web, could you share the file with us?

Before you move on...

The following sections (**Water Quality Monitoring**, **Habitat Monitoring**, and **Mapping**) refer to activities which may apply to your program or project. Please read the following definitions to help guide your selections. If you have questions or require further clarification, please review the provided glossary or reach out to the CMAP team.

- **Water Quality Monitoring**: Programs that implement recurrent or ancillary monitoring of water quality. Please select any of the listed parameters which are collected in water column, porewater, or tissue mediums.
- **Habitat Monitoring**: Programs that gauge the condition or state of habitat through in situ measurements, including ancillary data. Please select any of the listed parameters which are collected in relation to abiotic habitat characteristics, submerged habitat building animals (i.e., corals, oysters, etc.), or plants/macroalgae.
- **Mapping**: Programs, projects, activities, or products that gauge the condition or state of water quality or habitat through remotely sensed and/or groundtruth measurements. Includes the primary collection of mapping data (i.e., multibeam sonar, aerial imagery, etc.) and any derived products (i.e., bathymetry grid, sea surface temperature, habitat maps, etc.).

Appendix 7: CMAP POC Review Template-editable Program Information

Water Quality

Parameters

Please select all parameters from the following list collected within this program. Select all that apply.

- ☐ **Nutrients**
  - ☐ Total nitrogen
  - ☐ Nitrite
  - ☐ Nitrate
  - ☐ Nitrite + Nitrate
  - ☐ Ammonia
  - ☐ Ammonia + organic nitrogen
  - ☐ Total phosphorus
  - ☐ Soluble phosphorus
  - ☐ Phosphate
  - ☐ Orthophosphate
  - ☐ Silicate
- ☐ **Harmful algal bloom indicators**
  - ☐ Cyanobacteria
  - ☐ Algal toxins (Domoic acid, brevetoxins, microcystin, and others)
- ☐ **Pathogens**
  - ☐ Escherichia coli
  - ☐ Enterococcus
  - ☐ Total coliforms
  - ☐ Giardia
  - ☐ Cryptosporidium
  - ☐ Vibrio
  - ☐ Fecal coliforms
- ☐ **Sediment**
  - ☐ Suspended sediment concentration
  - ☐ Total suspended solids
- ☐ **Mercury**
  - ☐ Total mercury
  - ☐ Methylmercury
- ☐ **Freshwater inflow**
  - ☐ Discharge
  - ☐ Stage
- ☐ **Field parameters**
  - ☐ Conductance (salinity)
  - ☐ Water temperature
  - ☐ Turbidity
  - ☐ pH
  - ☐ Dissolved oxygen
  - ☐ Currents
  - ☐ Water level
  - ☐ Light attenuation
- ☐ **Carbon**
  - ☐ Organic carbon (Total organic carbon, dissolved organic carbon)
  - ☐ Polycyclic aromatic hydrocarbons (PAHs)
- ☐ **Aquatic primary producers**
  - ☐ Phytoplankton
  - ☐ Chlorophyll

Measurement schedule

Select "Continuous" if data is collected in real-time. Select all that apply.

- ☐ Continuous
- ☐ Discrete

Measurement frequency

Select all that apply.

- ☐ More frequently than hourly
- ☐ Hourly
- ☐ More frequently than daily
- ☐ Daily
- ☐ Every two days
- ☐ Twice a week
- ☐ Weekly
- ☐ Twice a month
- ☐ Monthly
- ☐ Every two months
- ☐ Quarterly
- ☐ Biannually
- ☐ Annually
- ☐ Biennially
- ☐ No set frequency
- ☐ Other

Medium

What medium are the parameters measured in? Select all that apply.

- ☐ Water column
- ☐ Porewater
- ☐ Tissue

Are the data units clearly labeled?

- ◯ Yes
- ◯ No

Appendix 7: CMAP POC Review Template-editable Program Information

Habitat Monitoring

Parameters

Please select all parameters from the following list collected within this program. Select all that apply.

☐ **Abiotic**

- ☐ *Substrate metrics*
  - ☐ Substrate composition
  - ☐ Substrate depth
  - ☐ Substrate geochemistry (Nutrients, redox, metal conc., organic pollutants/content)
  - ☐ Topographic complexity (Rugosity, vertical relief)
  - ☐ Sediment classification (Bulk density, grain size/texture, moisture levels, soil type)
- ☐ *Coastal processes*
  - ☐ Vertical accretion
  - ☐ Subsidence

☐ **Submerged habitat building animals**

- ☐ *Ecological metrics*
  - ☐ Abundance
  - ☐ Distribution
  - ☐ Composition (Species/community composition)
  - ☐ Cover (% cover, acreage)
  - ☐ Density
  - ☐ Biomass
- ☐ *Physiology/health*
  - ☐ Disease
  - ☐ Bleaching
  - ☐ Size (Animal height, animal weight, diameter)
- ☐ *Population dynamics*
  - ☐ Settlement/ recruitment
  - ☐ Survivorship
  - ☐ Mortality
  - ☐ Spawning
  - ☐ Larval transport

☐ **Plants/macroalgae**

- ☐ *Ecological metrics*
  - ☐ Abundance
  - ☐ Distribution
  - ☐ Composition
  - ☐ Cover (% cover, acreage, basal area)
  - ☐ Density
  - ☐ Biomass
- ☐ *Physiology*
  - ☐ Canopy extent/structure
  - ☐ Growth
  - ☐ Litterfall
  - ☐ Size (Height, weight, diameter at breast height (DBH))
- ☐ *Population dynamics*
  - ☐ Recruitment
  - ☐ Survivorship
  - ☐ Mortality
  - ☐ Primary production
  - ☐ Reproductive effort (Flowering, fruiting, seedling production)

Measurement schedule

Select "Continuous" if data are collected in real-time. Select all that apply.

☐ Continuous
☐ Discrete

Measurement frequency

Select all that apply.

- ☐ More frequently than hourly
- ☐ Hourly
- ☐ More frequently than daily
- ☐ Daily
- ☐ Every two days
- ☐ Twice a week
- ☐ Weekly
- ☐ Twice a month
- ☐ Monthly
- ☐ Every two months
- ☐ Quarterly
- ☐ Biannually
- ☐ Annually
- ☐ Biennially
- ☐ No set frequency
- ☐ Other

Appendix 7: CMAP POC Review Template-editable Program Information

Mapping

Parameters

Please select all parameters from the following list collected within this program. Select all that apply.

- ☐ Area of habitat types
- ☐ Sea surface height
- ☐ Tides
- ☐ Land use/land cover
- ☐ Subsidence
- ☐ Sediment grain size
- ☐ Soil type
- ☐ Water temperature
- ☐ Sea surface temperature
- ☐ Chlorophyll
- ☐ Turbidity
- ☐ Salinity
- ☐ Backscatter intensity
- ☐ Currents
- ☐ Digital photography
- ☐ Hyperspectral imagery
- ☐ Multispectral imagery
- ☐ Reflectivity
- ☐ Sediment depth
- ☐ Surficial elevation
- ☐ Vertical accretion
- ☐ Water column profiling

Technology

Technology or tools used to collect data. Select all that apply.

- ☐ Multibeam sonar (MBES)
- ☐ Single beam sonar (VBES)
- ☐ Split beam echosounder (SBES)
- ☐ Side scan sonar (SSS)
- ☐ Seismic
- ☐ Subbottom
- ☐ Acoustic doppler current profile (ADCP)
- ☐ Light detection and ranging (LIDAR)
- ☐ Digital photography
- ☐ Radar
- ☐ Synthetic aperture radar (SAR)
- ☐ Interferometric synthetic aperture radar (IFSAR)
- ☐ Real-time kinematic global positioning system (RTK GPS)
- ☐ Total station

Activity

Please select the mapping activities which are relevant to the program/project. Select all that apply.

- ☐ Bathymetry
- ☐ Topography
- ☐ Habitat classification
- ☐ Beach renourishment
- ☐ Marine debris
- ☐ Shoreline
- ☐ Inundation modeling
- ☐ Human use
- ☐ Seafloor characterization
- ☐ Environmental monitoring
- ☐ Hydrocarbon detection
- ☐ Maritime heritage
- ☐ Water column hydrodynamics
- ☐ Restoration

Platform type

If relevant, type of platform technology or tool that was deployed. Select all that apply.

- ☐ Ship/small boat
- ☐ Unmanned aerial vehicle (UAV)
- ☐ Autonomous underwater vehicle (AUV)
- ☐ Human occupied vehicle (HOV)
- ☐ Remotely operated vehicle (ROV)
- ☐ Airborne
- ☐ Satellite
- ☐ Tripod
- ☐ Human (Observation or sampling)
- ☐ Fixed station
- ☐ Mooring/buoy

Classification scheme

If relevant, please select all that apply. Please specify any additional classification schemes used.

- ☐ Anderson Land Cover Classification System
- ☐ Coastal and Marine Ecological Classification Standard (CMECS)
- ☐ Cowardin 1979
- ☐ National Vegetation Classification System (NVCS)
- ☐ Florida Land Use Cover and Forms Classification System
- ☐ Flower Garden Banks Habitat Classification Scheme
- ☐ NERRS Comprehensive Habitat and Land Use Classification System
- ☐ Other:

Appendix 7: CMAP POC Review Template-editable Program Information

Please provide general details on spatial resolution, temporal resolution, and dates for your program's map products in the following text fields. If your program produces multiple map products, please provide general details for each product separately. Alternatively, please let us know if you'd like a team member to set up a time to discuss these details with you over the phone.

Spatial resolution

If relevant, please provide the spatial resolution of map products. If produced from scanned analog photography what was scale and dpi (if available)?

Temporal resolution

If relevant, what is the temporal resolution of the data? Was it a single mapping event? Have there been any other year(s) mapped?

Dates

What year(s) correspond to the map(s)?

Spatial Information

Would you be willing to share spatial data for your program/project?

If so, we welcome any spatially referenced data outlining the program/project polygon footprint, site/station locations, and/or site/station locations with attribute information specifying details of what is measured at each site.

Please provide a link to a site for download or share the files (SHP, KML, CSV formats preferred) via email attachment.

- ○ Yes, I will share a footprint boundary polygon.
  - ☐ Website/download URL:
  - ☐ File(s) will be shared via email.
- ○ Yes, I will share sampling station/site locations.
  - ☐ Website/download URL:
  - ☐ File(s) will be shared via email.
- ○ Yes, I will share sampling station/site locations with attribute information for each site.
  - ☐ Website/download URL:
  - ☐ File(s) will be shared via email.
- ○ No, I cannot share any spatial data.

Appendix 7: CMAP POC Review Template-editable Program Information

Baseline Assessment (optional)

Does the program include any assessments of baseline conditions?

- ○ Yes
- ○ No

Baseline assessment documentation

If assessment information or reports are available on the web, please provide a link to the website.

Thank you!

Appendix 8: Weeks Bay NERR Program Example

Weeks Bay National Estuarine Research Reserve (WBNERR) System-Wide Monitoring Program (SWMP)

Description	*Abstract or brief description of the program*	Weeks Bay National Estuarine Research Reserve is part of a national network of coastal reserves established as living laboratories for long-term scientific research and estuarine education. The Reserve was designated in 1986 and is managed as a cooperative partnership between the Alabama Department of Conservation and Natural Resources (ADCNR) and the National Oceanic and Atmospheric Administration (NOAA), with additional support from the 500-member nonprofit Weeks Bay Foundation and volunteers. NOAA's National Estuarine Research Reserve System (NERRS) acknowledges the importance of both long-term environmental monitoring programs and data and information dissemination through the support of the NERRS System-wide Monitoring Program (SWMP). The goal of the SWMP is to "identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional and site specific coastal zone management". This comprehensive program consists of three phased components: 1) Estuarine water quality monitoring; 2) Biodiversity monitoring; and 3) Land-use and habitat change analysis.
DescriptionSrc	*Source of the program description*	POC entered
Website	*URL of program's website*	http://cdmo.baruch.sc.edu/
ExecutingAgency	*Agency or organization leading the program*	National Oceanic and Atmospheric Administration (NOAA); Weeks Bay National Estuarine Research Reserve (WBNERR); Alabama Department of Conservation and Natural Resources (ADCNR) State Lands Division
AgencyType	*Type of agency leading the program*	Federal; State
FundAgency	*Agency or organization funding the program*	National Oceanic and Atmospheric Administration (NOAA); Alabama Department of Conservation and Natural Resources (ADCNR) State Lands Division
FundSrc	*Funding source for the program*	
FundAmt	*Funds allotted to the program*	

Appendix 8: Weeks Bay NERR program example

GENERAL PROGRAM INFO		
ProgramType	*Does the program include the collection of water quality monitoring, habitat monitoring, or mapping data?*	Water Quality; Habitat Monitoring; Mapping
NRDA Injury Category	*NRDA restoration categories or keywords to describe targets of the program*	Wetlands/coastal/nearshore habitats; Water quality
Habitat Type	*Habitat types monitored/mapped*	Water column; Forest; Soft bottom; Emergent marsh
AquaticSetting	*Hydrologic setting/stratum falling within program extent*	Estuarine
CollectionType	*Professional data, citizen science, etc.*	No

POINT OF CONTACT INFO		
POC Name	*Name of the primary point of contact (POC) for the agency/organization*	Scott Phipps
POC Title	*Position or title*	Research Coordinator
POC Office	*Office name*	Weeks Bay National Estuarine Research Reserve (WBNERR)
POC Phone	*Primary POC phone number*	251-928-9792
POC Email	*Primary POC email address*	scott.phipps@dcnr.alabama.gov

TIMELINE		
Status	*Is the program active, not active, or uknown?*	Active
StartDate	*Start of program (MM/DD/YYYY)*	10/1/1995
EndDate	*End of program (MM/DD/YYYY); Current if still ongoing*	Current

Appendix 8: Weeks Bay NERR program example

SPATIAL EXTENT INFO		
WestBnd	*Spatial extent of program - West bounding coordinates (Decimal Degrees)*	TBD
EastBnd	*Spatial extent of program - East bounding coordinates (Decimal Degrees)*	TBD
NorthBnd	*Spatial extent of program - North bounding coordinates (Decimal Degrees)*	TBD
SouthBnd	*Spatial extent of program - South bounding coordinates (Decimal Degrees)*	TBD
Coverage	*Geographic coverage of the program*	Local
States	*State(s) where project occurs*	Alabama
Counties	*County(ies) where project occurs*	TBD
Ecoregion	*Omernik Ecoregions Level III*	TBD
HUC10	*Watershed HUC 10 ID*	TBD
Waterbody	*Sea areas, water bodies, etc.*	TBD

ACCESSIBILITY		
Access	*Is the data accessible (i.e., selection options of web accessible, send upon request, not accessible)*	Web accessible
AccessSource	*URL or contact info for data source*	http://cdmo.baruch.sc.edu/
Machine Readable Data	*Are the data available in a machine readable format?*	Yes
Metadata	*Is metadata available?*	Yes
MetadataStd	*ISO, FGDC, Unknown*	FGDC
MetadataSrc	*How to obtain metadata*	http://cdmo.baruch.sc.edu/data/metadata.cfm
Publication(s)	*Publication(s) related to the data and/or program; Link to publication(s) related to the data and/or program*	

Appendix 8: Weeks Bay NERR program example

PROCEDURES AND QUALITY ASSURANCE		
ProcDocCollection	*Does the program/project have documented collection procedures for the majority of parameters?*	Yes
ProcCollectionUrl	*Link to documented collection procedures*	http://cdmo.baruch.sc.edu/request-manuals/
Collection procedures file held by CMAP	*Documentation is in the CMAP library.*	Yes
ProcDocAnalytical	*Does the program/project have documented analytical procedures for the majority of parameters?*	Yes
ProcAnalyticalUrl	*Link to documented analytical procedures*	http://cdmo.baruch.sc.edu/request-manuals/
Analytical procedures file held by CMAP	*Documentation is in the CMAP library.*	Yes
QADoc	*Does program have a QA protocol?*	Yes
QAUrl	*Link to documented QA protocols*	http://cdmo.baruch.sc.edu/data/qaqc.cfm
QA protocol file held by CMAP	*Documentation is in the CMAP library.*	Yes

WATER QUALITY MONITORING		
ParametersGenWQ	*List of general parameters*	Nutrients; Sediment; Field Parameters; Aquatic Primary Producers
ParametersDetWQ	*List of detailed parameters*	Nitrite; Nitrate; Ammonia; Ammonia + Organic nitrogen; Total phosphorus; Soluble phosphorus; Phosphate; Orthophosphate; Nitrite + nitrate; Suspended sediment concentration; Total suspended solids; Conductance; Water temperature; Turbidity; pH; Dissolved oxygen; Water level; Chlorophyll
MeasSchedWQ	*Measurement schedule of the program (i.e., Continuous, Quarterly, Annually, Rotating)*	Continuous
MeasFreqWQ	*Measurement frequency (i.e., More frequent than hourly, hourly, daily, weekly, monthly, annually, less frequent than annually, no set frequency)*	More frequent than hourly
Medium	*From which medium are the measurements taken (Water column, Tissue, or Porewater)*	Water column
Units	*Are the units clearly labeled?*	Yes

Appendix 8: Weeks Bay NERR program example

HABITAT MONITORING		
Parameters – Level 1	*List of top tier parameters*	Abiotic; Plants/Macroalgae
Parameters – Level 2	*List of general parameters*	Substrate metrics; Coastal processes; Ecological metrics
Parameters – Level 3	*List of detailed parameters*	Substrate composition; Topographic complexity; Sediment classification; Vertical accretion; Subsidence; Composition; Abundance; Distribution; Biomass; Cover; Density
MonitoringActivity	*Types of monitoring activities done within program/project*	Environmental monitoring; Habitat classification; Restoration
MeasScheduleHabMo	*Measurement schedule of the program (i.e., Continuous, Quarterly, Annually, Rotating)*	Discrete
MeasFreqHabMo	*Measurement frequency (i.e., More frequent than hourly, hourly, daily, weekly, monthly, annually, less frequent than annually, no set frequency)*	Quarterly

MAPPING		
ParametersMap	*List of general parameters*	Area of habitat types; Land use/land cover; Digital Photography; Multispectral Imagery; Surficial elevation
MappingTechnology	*Type of technology used to collect the data*	Light detection and ranging (Lidar); Camera-based and/or satellite-based imagery; Real-time kinematic global positioning system (RTK GPS)
MappingActivity	*Types of mapping activities completed within program/project*	Bathymetry; Topography; Habitat classification; Shoreline; Restoration
ClassificationScheme	*What is classification scheme used? [e.g., CMECS, NVCS, Cowardin (NWI), Modified Anderson (C-CAP or NLCD)]*	NERRS Comprehensive Habitat and Land Use Classification System
Platform Type	*From which type of platform were the measurements taken?*	Ship/small boat; Airborne; Satellite; Tripod; Human (Observation or sampling)
SpatialResolution	*Spatial resolution of map products; If produced from scanned analog photography what was scale and dpi (if available)?*	
TemporalResolution	*What is the temporal resolution of the data? Was it a single mapping event? Have there been any other year(s) mapped?*	
MapDate	*Year(s) mapped*	

Appendix 8: Weeks Bay NERR program example

DOCUMENTED ASSUMPTIONS		
Program Type	*Program/project meets requirements for water quality monitoring, habitat monitoring, or habitat mapping criteria.*	Yes
Spatial	*Program/project spatial extent falls within the CMAP project boundary.*	Yes
Temporal	*Program/project meets temporal limitation of 1980 - present.*	Yes
Duration	*Program/project meets criteria of having a minimum data record of 5 years of contiguous sampling; or minimum of 2 sample years that will span the 5 year range; or discrete programs which provide a principle source of information*	Yes

INTERNAL WORKING FIELDS		
PID	*Unique ID of record*	116
Crosswalk	*Crosswalk to other databases; Linked data that may have inclusion in other databases such as Ocean Conservancy, NRDA, DWH Project tracker, etc.*	OC 356
Comment	*Internal comment field*	
Baseline	*Would this monitoring program be helpful in the search for baseline assessments?*	Yes
Baseline Assessment Info	*POC provided information on potential assessments to include in Task 7.*	
POC Response	*Did we receive a response from the POC?*	yes with edits

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Monitoring Inventory

Alabama Department of Conservation and Natural Resources (ADCNR)

Alabama Department of Conservation and Natural Resources (ADCNR) Marine Resources Division

Alabama Department of Conservation and Natural Resources (ADCNR) State Lands Division

Alabama Department of Conservation and Natural Resources (ADCNR) State Lands Division Coastal Section

Alabama Department of Environmental Management (ADEM)

Alabama Department of Public Health (ADPH)

Alabama Department of Public Health (ADPH) Seafood Branch

Alachua County Environmental Protection Department (ACEPD)

American Bird Conservancy (ABC)

Anadarko Petroleum Corporation

Angelina and Neches River Authority

Apache Deepwater LLC

Apalachicola National Estuarine Research Reserve (ANERR)

Atkins Global

Atlantic and Gulf Rapid Reef Assessment (AGRRA)

ATP Oil & Gas Corporation

Auburn University Water Resources Center

Avon Park Air Force Range

Barry Vittor and Associates, Inc.

Battelle Memorial Institute (Battelle)

Bay County

Bay County District Schools

Bayous Preservation Association (BPA)

BHP Billiton

Big Bend Seagrasses Aquatic Preserve (BBSAP)

Bigelow Laboratory for Ocean Sciences

BP Gulf Science Data

BP Inc

Brazos River Authority

Brevard County Stormwater Utility Department

Broward County Environmental Protection and Growth Management Department

Bureau of Ocean Energy Management (BOEM)

Bureau of Safety and Environmental Enforcement (BSEE)

C & C Technologies, Inc.

California Academy of Sciences

Cameron County

Centre National d'Etudes Spatiales (CNES)

Charlotte Harbor Aquatic Preserves (CHAP)

Charlotte Harbor Environmental Center

Charlotte Harbor National Estuary Program (CHNEP)

Chevron

Chicago Zoological Society

Choctawhatchee Basin Alliance (CBA)

City of Atlantic Beach

City of Bonita Springs

City of Cape Coral

City of Deltona, Florida

City of Fort Myers

City of Jacksonville

City of Jacksonville Beach

City of Lakeland

City of Naples

City of Naples Natural Resource Division

City of Neptune Beach

City of Orlando Streets and Stormwater Division

City of Punta Gorda

City of Sanibel

City of St. Petersburg

City of Tallahassee

Coastal and Great Lakes States

Coastal Bend Bays & Estuaries Program (CBBEP)

Coastal Data Information Program (CDIP)

Coastal Waters Consortium (CWC)

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Inventory

Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA)

Cobalt Energy

Collier County Coastal Zone Management (CZM) Section

Collier County Pollution Control Section

Columbia University (CU) Earth Institute (EI) Lamont-Doherty Earth Observatory

Conoco Phillips

Conservancy of Southwest Florida

Continental Shelf Associates, Inc.

CSA Ocean Sciences, Inc. (CSA)

Dartmouth College

Dauphin Island Sea Lab (DISL) Fisheries Ecology Lab

Dauphin Island Sea Lab (DISL) Richard C. Shelby Center for Ecosystems-Based Fisheries Management

Deep Gulf Energy

Deep Sea Systems International (DSSI)

Department of the Interior (DOI)

Dolphin Biology Research Institute (DBRI)

Droycon Bioconcepts, Inc.

Ducks Unlimited

Earth Observation Satellite Company (EOSAT)

El Paso E&P Company, L.P.

Emerson Associates International

ENI Petroleum

Enven Energy Corporation

Environmental Institute of Houston (EIH)

Environmental Protection Commission of Hillsborough County (EPCHC)

Environmental Science and Engineering, Inc.

Estero Bay Aquatic Preserve

Estuary Conservation Association (ECA)

European Commission (EC)

European Organization of the Exploitation of Meterological Satellites (EUMETSAT)

European Space Agency (ESA)

Everglades National Park

ExxonMobil

Federal Emergency Management Agency (FEMA)

Florida Atlantic University (FAU) Harbor Branch Oceanographic Institute (HBOI)

Florida Atlantic University (FAU) Harbor Branch Oceanographic Institute (HBOI) Cooperative Institute for Ocean Exploration Reserach and Technology (CIOERT)

Florida Coastal Everglades Long Term Ecological Research (FCE LTER) Program

Florida Department of Agriculture and Consumer Services (FDACS)

Florida Department of Agriculture and Consumer Services (FDACS) Division of Aquaculture

Florida Department of Environmental Protection (FDEP)

Florida Department of Environmental Protection (FDEP) Big Bend Seagrasses Aquatic Preserves (BBSAP)

Florida Department of Environmental Protection (FDEP) Central Panhandle Aquatic Preserves (CPAP)

Florida Department of Environmental Protection (FDEP) Division of Environmental Assessment and Restoration

Florida Department of Environmental Protection (FDEP) Division of Water Resource Management

Florida Department of Environmental Protection (FDEP) Florida Coastal Office (FCO)

Florida Department of Environmental Protection (FDEP) Florida Coastal Office (FCO) Northwest Florida Aquatic Preserves

Florida Department of Environmental Protection (FDEP) Florida Coastal Office (FCO) Tampa Bay Aquatic Preserves

Florida Department of Environmental Protection (FDEP) Florida Coastal Program

Florida Department of Environmental Protection (FDEP) Office of Coastal and Aquatic Managed Areas

Florida Department of Environmental Protection (FDEP) Office of Resilience and Coastal Protection

Florida Department of Environmental Protection (FDEP) St. Martins Marsh (SMMAP)

Florida Department of Health (FDOH)

Florida Department of Health in Lee County (DOH-Lee)

Florida Department of Health in Sarasota County (DOH-Sarasota)

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Inventory

Florida Department of Transportation (FDOT)

Florida Division of Emergency Management (FDEM)

Florida Fish and Wildlife Conservation Commission (FL FWC)

Florida Fish and Wildlife Conservation Commission (FL FWC) Division of Habitat and Species Conservation (HSC)

Florida Fish and Wildlife Conservation Commission (FL FWC) Florida Fish and Wildlife Research Institute (FWRI)

Florida Fish and Wildlife Research Institute (FWRI)

Florida Institute of Oceanography (FIO)

Florida Institute of Technology (FIT) Coastal Processes Research Group (CPRG)

Florida International University (FIU)

Florida International University (FIU) Southeast Environmental Research Center (SERC)

Florida Keys National Marine Sanctuary (FKNMS)

Florida Keys Water Watch

Florida LAKEWATCH

Florida Sea Grant

Florida State University (FSU)

Florida State University (FSU) Center for Ocean-Atmospheric Prediction Studies (COAPS)

Florida State University (FSU) Coastal and Marine Laboratory (CML)

Flower Garden Banks National Marine Sanctuary (FGBNMS)

Freeport-McMoRan

Galveston Bay Foundation

Geological Survey of Alabama (GSA)

George Mason University (GMU)

Georgia Adopt-A-Stream

Georgia Department of Natural Resources (GDNR) Coastal Resources Division (CRD)

Georgia Department of Natural Resources (GDNR) Environmental Protection Division (EPD)

Georgia Department of Natural Resources (GDNR) Wildlife Resources Division (WRD)

Georgia Institute of Technology (GIT)

Grand Bay National Estuarine Research Reserve (GNDNERR)

Greater Tampa Bay Marine Advisory Council PORTS, Inc (GTBMAC)

Guadalupe-Blanco River Authority (GBRA)

Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR)

Gulf Coast Bird Observatory (GCBO)

Gulf Coast Joint Venture (GCJV)

Gulf of Mexico Coastal Ocean Observing System (GCOOS)

Gulf of Mexico Fishery Management Council

Gulf Power Company

Gulf Reef Environmental Action Team (GREAT)

Gulf States Marine Fisheries Commission (GSMFC)

Harvard University

Helix

Hillsborough County

Houston-Galveston Area Council

Hydrologic Data Inc. (HDI)

Indian Space Research Organization

Institute for Marine Mammal Studies (IMMS)

International Argo Steering Team

International Boundary and Water Commission

Janicki Environmental Inc.

Japanese Ministry of Economy

JEA

Johnson Engineering

Kerr-McGee Oil and Gas Corporation

Lake Pontchartrain Basin Foundation (LPBF)

Lavaca-Navidad River Authority

Lee County

Lee County Department of Natural Resources

Lee County Hyacinth Control District (LCHCD)

Lehigh Acres Municipal Services Improvement District (LA-MSID)

Leon County

Leon County Public Works

LGL Ecological Research Associates, Inc.

LLOG

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Inventory

Louisiana Coastal Protection and Restoration Authority (LA CPRA)

Louisiana Department of Environmental Quality (LDEQ)

Louisiana Department of Environmental Quality (LDEQ) Water Planning and Assessment Division (WPAD)

Louisiana Department of Health (LDH)

Louisiana Department of Natural Resources (LDNR)

Louisiana Department of Wildlife and Fisheries (LDWF)

Louisiana Oil Spill Coordinator's Office (LOSCO)

Louisiana State University (LSU)

Louisiana State University (LSU) Coastal Studies Institute

Louisiana State University (LSU) Department of Environmental Sciences

Louisiana State University (LSU) Department of Geography and Anthropology

Louisiana State University (LSU) Department of Oceanography and Coastal Sciences

Louisiana Universities Marine Consortium (LUMCON)

Lower Colorado River Authority (LCRA)

Lower Neches Valley Authority

Loxahatchee River District (LRD)

Maersk Drilling USA

Manatee County

Manatee County Department of Environmental Management (MCDEM)

Manatee County Parks and Natural Resources Department (PNRD) Environmental Protection Division (EPD)

Marathon Oil

Marine Resources Council (MRC) of East Florida

Mariner Energy Inc.

Marubeni Oil and Gas Inc

Miami-Dade County

Miami-Dade County Environmental Resources Management

Mission-Aransas National Estuarine Research Reserve (MANERR)

Mississippi Department of Environmental Quality (MDEQ)

Mississippi Department of Environmental Quality (MDEQ) Office of Geology

Mississippi Department of Environmental Quality (MDEQ) Office of Pollution Control (OPC)

Mississippi Department of Environmental Quality (MDEQ) Office of Pollution Control (OPC) Surface Water Division (SWD) Nonpoint Source Management Branch

Mississippi Department of Marine Resources (MDMR)

Mississippi Department of Marine Resources (MDMR) Shellfish Bureau

Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP)

Mississippi State Department of Health (MSDH)

Mississippi State University (MSU)

Mississippi Wildlife Federation (MWF)

Mississippi-Alabama Sea Grant Consortium

Mobile Bay National Estuary Program (MBNEP)

Mobile County

Montana State University (MSU)

Mosaic Fertlizer, LLC

Mote Marine Laboratory

Murphy Exploration & Production Company

National Aeronautics and Space Administration (NASA)

National Aeronautics and Space Administration (NASA) Goddard Space Flight Center

National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL)

National Atmospheric Deposition Program (NADP) Executive Committee

National Oceanic and Atmospheric Administration (NOAA)

National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (CO-OPS)

National Oceanic and Atmospheric Administration (NOAA) Cooperative Institute for Ocean Exploration Research and Technology (CIOERT)

National Oceanic and Atmospheric Administration (NOAA) Deep-Sea Coral Research and Technology Program (DSCRTP)

National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI)

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Inventory

National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS)

National Oceanic and Atmospheric Administration (NOAA) National Geodetic Survey (NGS) Remote Sensing Division

National Oceanic and Atmospheric Administration (NOAA) National Institute for Undersea Science and Technology (NIUST)

National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS)

National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC)

National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS)

National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) National Centers for Coastal Ocean Science (NCCOS)

National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) National Centers for Coastal Ocean Science (NCCOS) Marine Biotoxins Program

National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) Office for Coastal Management (OCM)

National Oceanic and Atmospheric Administration (NOAA) National Ocean Service (NOS) Office of Coast Survey (OCS)

National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) National Centers for Environmental Prediction (NCEP)

National Oceanic and Atmospheric Administration (NOAA) Oceanic and Atmospheric Research (OAR) Office of Ocean Exploration and Research (OER)

National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management (OCM)

National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management (OCM) Coral Reef Conservation Program (CRCP)

National Oceanic and Atmospheric Administration (NOAA) Office of National Marine Sanctuaries (ONMS)

National Oceanic and Atmospheric Administration (NOAA) Office of National Marine Sanctuaries (ONMS) Florida Keys National Marine Sanctuary (FKNMS)

National Oceanic and Atmospheric Administration (NOAA) Office of National Marine Sanctuaries (ONMS) Flower Garden Banks National Marine Sanctuary (FGBNMS)

National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research (OER)

National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research (OAR) Atlantic Oceanographic and Meteorological Laboratory (AOML)

National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration (ORR)

National Park Service (NPS)

National Park Service (NPS) Inventory and Monitoring Division (I&M) Gulf Coast Network (GULN)

National Park Service (NPS) Inventory and Monitoring Division (I&M) South Florida/Caribbean Network (SFCN)

National Park Service (NPS) Inventory and Monitoring Division (I&M) Southeast Coast Network (SECN)

National Park Service (NPS) South Florida Natural Resources Center (SFNRC)

Naval Oceanographic Office (NAVO)

New College of Florida

Noble Energy, Inc.

Northeast Texas Municipal Water District

Northern Gulf Institute (NGI)

Northwest Florida State College (NWFSC)

Northwest Florida Water Management District (NWFWMD)

Nova Southeastern University (NSU)

Nova Southeastern University (NSU) National Coral Reef Institute (NCRI)

Nueces River Authority

Ocean Research and Education Foundation (ORE)

Oceaneering, Inc.

Office of the Secretary of State of Mississippi

Okaloosa County

Orange County Environmental Protection Division

Oregon State University (OSU)

Oyster Sentinel

P&C Scientific, LLC

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Inventory

Palm Beach County Environmental Resources Management Department

Pasco County Stormwater Management Division

Peace River Manasota Regional Water Supply Authority (PRMRWSA)

Pennsylvania State University (PSU)

Petrobras

Pinellas County

Pinellas County Department of Environmental Management

Pinellas County Environmental Management

Pinellas County Public Works Environmental Management

Pinellas County Public Works Natural Resources Coastal Management

Poarch Band of Creek Indians

Polk County Natural Resources Division

Red River Authority of Texas

Rio Grande Valley Chapter Texas Master Naturalists

Rookery Bay National Estuarine Research Reserve (RBNERR)

Sabine River Authority of Texas (SRA-TX)

San Antonio River Authority

Sanibel-Captiva Conservation Foundation (SCCF)

Sarasota Bay Estuary Program

Sarasota County

Sarasota County Environmental Protection Division

Sarasota County Public Utilities

Sarasota County Public Works Department Stormwater Division

Science Applications International Corporation (SAIC)

Scripps Institution of Oceanography (SIO) Integrative Oceanography Division (IOD) Ocean Engineering Research Group (OERG)

Seminole County

Seminole Tribe of Florida

Shell Oil

Smithsonian Institution

SMR North 70, LLC

South Florida Water Management District (SFWMD)

Southeast Environmental Research Center (SERC)

Southwest Florida Water Management District (SWFWMD)

Space Agency of Argentina (CONAE)

SRI International

St. Andrew Bay Resource Management Association (St. Andrew Bay Watch)

St. Johns River Water Management District (SJRWMD)

St. Martins Marsh Aquatic Preserve (SMMAP)

Statoil Hydro

Stone Energy

Sulphur River Basin Authority of Texas

Suwannee River Water Management District (SRWMD)

Talos Energy

Tampa Bay Estuary Program (TBEP)

Tampa Bay Watch

Tampa Bay Water

TDI-Brooks International, Inc.

Temple University (TU)

Tennessee Valley Authority (TVA)

Tesla Offshore, LLC

Texas A&M University

Texas A&M University (TAMU)

Texas A&M University (TAMU) Corpus Christi Conrad Blucher Institute (CBI)

Texas A&M University (TAMU) Department of Geosciences

Texas A&M University (TAMU) Geochemical and Environmental Research Group

Texas A&M University at Galveston (TAMUG)

Texas A&M University at Galveston (TAMUG) Seafood Safety Laboratory (SSL)

Texas A&M University Department of Oceanography

Texas A&M University Geochemical and Environmental Research Group

Texas Coastal Naturalists

Texas Commission on Environmental Quality (TCEQ)

Texas Department of State Health Services (DSHS)

Texas Department of Transportation (TDOT)

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Inventory

Texas General Land Office (TGLO)

Texas General Land Office (TGLO) Oil Spill Prevention & Response

Texas Parks and Wildlife Department (TPWD)

Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Division

Texas Sea Grant at Texas A&M University (TAMU)

Texas State University (TSU) Meadows Center for Water and the Environment

Texas Stream Team

Texas Water Development Board (TWDB)

Texas Water Development Board (TWDB) Texas Natural Resources Information System (TNRIS)

The Mosaic Company

The Nature Conservancy (TNC)

The PAST Foundation

Total USA, Inc.

Trade and Industry (METI)

Trinity River Authority of Texas

United States Air Force (USAF)

United States Environmental Protection Agency (US EPA)

United States Environmental Protection Agency (US EPA) Gulf Ecology Division

United States Environmental Protection Agency (US EPA) Gulf of Mexico Program

United States Environmental Protection Agency (US EPA) National Health and Environmental Effects Research Laboratory (NHEERL) Gulf Ecology Division

U.S. Environmental Protection Agency (US EPA) Office of Water (OW)

United States Army Corps of Engineers (USACE)

United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR)

United States Army Corps of Engineers (USACE) Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX)

United States Army Corps of Engineers (USACE) New Orleans District

United States Bureau of Land Management (BLM)

United States Department of Agriculture (USDA)

United States Department of Agriculture (USDA) Agricultural Research Service

United States Department of Agriculture (USDA) Farm Service Agency (FSA)

United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS)

United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)

United States Fish and Wildlife Service (USFWS)

United States Fish and Wildlife Service (USFWS) Southeast Region Inventory and Monitoring (I&M) Branch

United States Forest Service (USFS)

United States Geological Survey (USGS)

United States Geological Survey (USGS) Wetland and Aquatic Research Center (WARC)

United States Geological Survey (USGS) Coastal and Marine Geology Program (CMGP) St. Petersburg Coastal and Marine Science Center

United States Geological Survey (USGS) Coastal and Marine Hazards/Resources Program

United States Geological Survey (USGS) Earch Resources Observation and Science (EROS) Center

United States Geological Survey (USGS) National Geospatial Program (NGP)

United States Geological Survey (USGS) National Wetlands Research Center (NWRC)

United States Geological Survey (USGS) Wetland and Aquatic Research Center (WARC)

United States Naval Research Laboratory (US NRL)

University of Alaska Fairbanks (UAF)

University of California Santa Barbara (UCSB)

University of Connecticut (UConn) Northeast Underwater Research, Technology & Education Center (NURTEC)

University of Florida (UF)

University of Florida (UF) Institute of Food and Agricultural Sciences

University of Florida (UF) School of Forest Resources and Conservation (SFRC) Fisheries and Aquatic Sciences

University of Georgia (UGA)

Appendix 9: Monitoring Agencies and Organizations for Programs Included in the CMAP Inventory

University of Georgia (UGA) Joye Research Group

University of Georgia (UGA) Skidaway Institute of Oceanography (SIO)

University of Houston Clear Lake (UHCL)

University of Idaho

University of Louisiana at Lafayette (UL Lafayette)

University of Maine (UM)

University of Maryland (UMD) Center for Environmental Science (CES) Chesapeake Biological Laboratory

University of Maryland (UMD) Department of Environmental Science and Technology

University of Miami (UM)

University of Miami (UM) Cooperative Institute for Marine and Atmospheric Studies (CIMAS)

University of Miami (UM) Rosential School of Marine and Atmospheric Sciences

University of Miami (UM) Rosential School of Marine and Atmospheric Sciences (RSMAS)

University of Mississippi (UM) Center for Marine Resources and Environmental Technology (CMRET)

University of New Hampshire (UNH)

University of North Carolina (UNC)

University of North Carolina at Wilmington (UNC Wilmington)

University of North Carolina at Wilmington (UNC Wilmington) National Undersea Research Center (UNC-NURC)

University of North Carolina at Wilmington (UNCW)

University of South Alabama (USA) Department of Civil Engineering

University of South Alabama (USA) Department of Marine Sciences

University of South Florida (USF)

University of South Florida (USF) Coastal Research Laboratory

University of South Florida (USF) College of Marine Science

University of South Florida (USF) Florida Institute of Oceanography (FIO)

University of South Florida (USF) Ocean Monitoring and Prediction Lab (OMPL)

University of Southern Mississippi (USM)

University of Southern Mississippi (USM) Department of Marine Science

University of Southern Mississippi (USM) Gulf Coast Research Laboratory

University of Southern Mississippi (USM) Gulf Coast Research Laboratory (GCRL)

University of Texas (UT) at Austin's Bureau of Economic Geology (BEG)

University of Texas at Austin (UT Austin)

University of Texas at Austin (UT Austin) Bureau of Economic Geology (BEG)

University of Texas at Austin (UT Austin) Bureau of Economic Geology (BEG) Coastal Erosion Response Studies Group

University of Texas at Austin (UT Austin) Center for Research in Water Resources

University of Texas at Austin (UT Austin) Marine Science Institute

University of Texas Rio Grande Valley (UTRGV)

University of Texas Rio Grande Valley (UTRGV) School of Earth Environmental and Marine Sciences

University of West Florida (UWF)

University of Wisconsin at La Crosse (UW La Crosse)

University-National Oceanographic Laboratories System (UNOLS)

Universtiy of North Carolina at Wilmington (UNCW) National Undersea Reseach Center (NURC)

Volusia County Environmental Management

Walter Oil and Gas Corporation

Weeks Bay National Estuarine Research Reserve (WBNERR)

Williams

Woodward-Clyde Consultants

USGS
science for a changing world

RESTORE CMAP
Report Series - Task 2

COUNCIL MONITORING AND ASSESSMENT PROGRAM (CMAP)

Inventory of Existing Habitat and Water Quality Monitoring, and Mapping Metadata for Gulf of Mexico Programs

NOAA Technical
Memorandum
NOS NCCOS 262