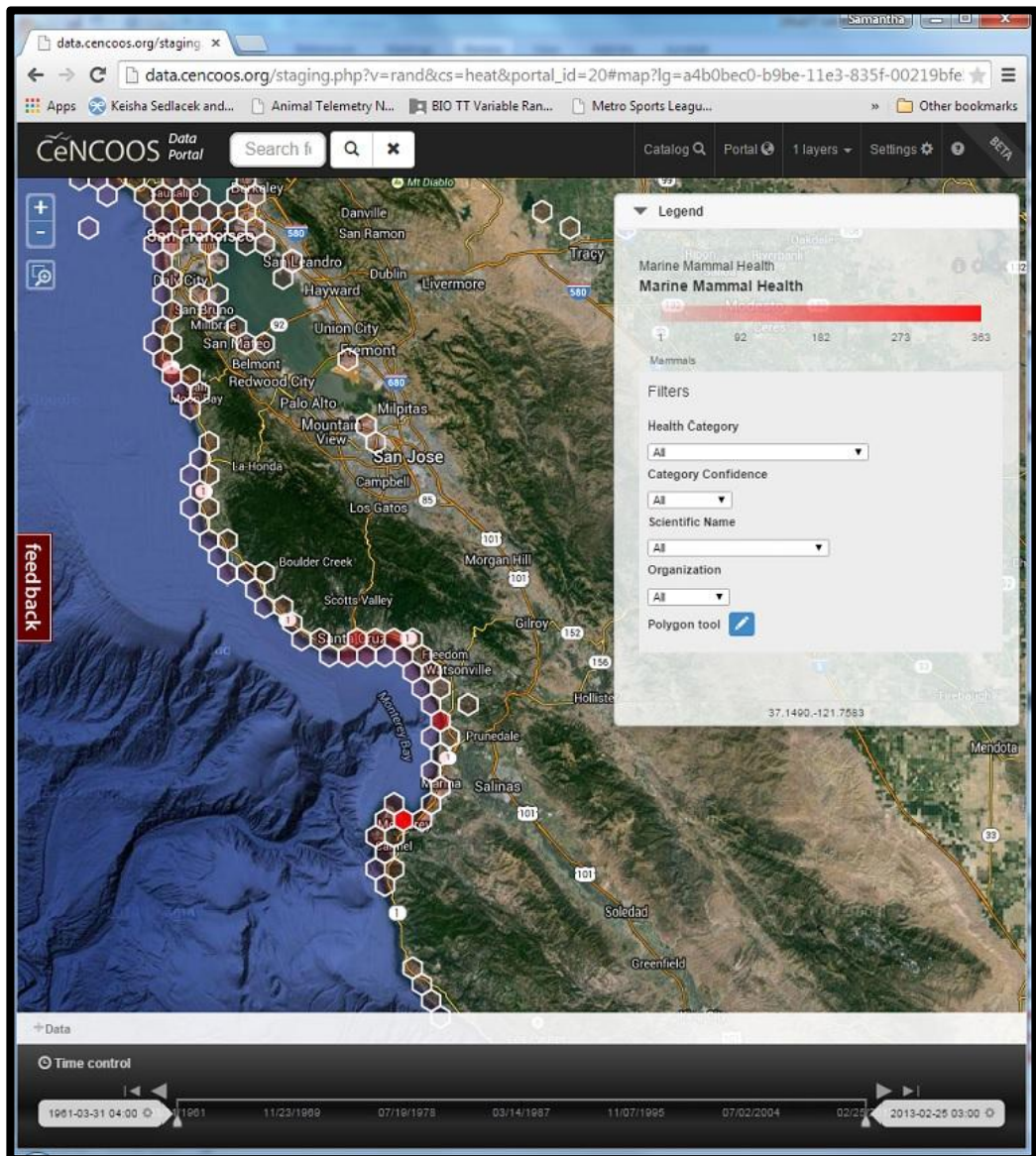
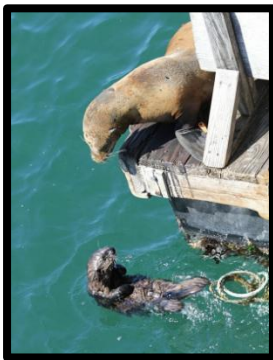




Marine Mammal Health Monitoring and Analysis Platform (MMHMAP)

3-Year Strategic Plan: 2015-2017



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Mission & Vision

This project's mission is to bring together measures of ocean and marine mammal health using a web-based data management platform, the "Marine Mammal Health Monitoring and Analysis Platform (MMHMAP)," that will give the public, scientists and resource managers an unprecedented ability to detect potential public and animal health risks in our changing ocean environment and to prioritize management and conservation efforts. As part of this mission, MMHMAP will provide:

- A readily accessible, interactive tool to evaluate changes in marine mammal health by geographic location and time. Additional data will be available to scientists and managers to aid with research and decision-making
- Integrated marine mammal health data from a variety of sources including strandings, entanglement response, live capture-release and other research studies, fisheries bycatch, and subsistence monitoring
- Marine mammal health data as data layers for integration with ecosystem and oceanographic data through a web-based portal such as the Integrated Ocean Observing System (IOOS). More detailed health information will be readily available for emergency management through such applications as the Emergency Response Management Application (ERMA), and
- A platform for rapid communication, visualization, and analysis of marine mammal health data with physical, chemical, and biological environmental data.

The MMHMAP further enhances the goals of the Marine Mammal Health and Stranding Response Program (MMHSRP) as outlined in Title IV of the Marine Mammal Protection Act (MMPA). While the currently proposed project initially focuses on data from the United States, in the future it may be applicable to a more global assessment of the status of marine mammal health.

Vision:

For everyone to understand interactions between marine mammal health, ocean health, & humans

Why Now?

Ocean health may be deteriorating as evidenced by increases in the reporting of diseases in marine organisms (Harvell *et al.* 2004, Gulland and Hall 2007). During the past five years, federally declared marine mammal unusual mortality events, or UMEs, have occurred along U.S. coastlines of the Northeast, Southeast, Southwest, Gulf of Mexico, and Alaska. These UMEs have been associated with a wide variety of health threats, including emerging infectious diseases, oil spills, and habitat and prey loss (See Inset). Other current and emerging health concerns in marine mammals include a high prevalence of reproductive cancers in California sea lions, long term implications of infectious disease or contaminant exposures, and impacts of biotoxin exposure from expansion of marine and freshwater harmful algal blooms.

Climate change will likely have direct and indirect effects on marine mammal health due to changing prey quality and availability, home ranges, host and pathogen/chemical dynamics and distributions, and host susceptibility. Detection of these changes, particularly the interactions of multiple factors, requires baseline data and a coordinated health monitoring system (Burek *et al.* 2008, Moore and Gulland 2014). Marine mammals are “ecosystem indicators:” generally they are long-lived, feed at high trophic levels, have fat stores that accumulate anthropogenic toxins, and are vulnerable to many of the same pathogens and toxins as humans. The concept of “One Health” is becoming more widely accepted but needs to be extended from the terrestrial to the marine realm. Human and animal health are intimately associated and both are affected by physical, chemical and biological environmental changes. As a case in point, 60% of emerging infectious diseases affecting humans were present in animals first (Patz *et al.* 2011).

While some limited long-term marine mammal health monitoring datasets exist, much information on the true incidence or trends in marine mammal diseases is lacking or unavailable. To better inform the public and facilitate science-based decision making related to ocean, public, and marine mammal health, there is a need to integrate marine mammal and ocean health data at local, regional, and national scales. Recognizing these needs, the **U.S. Commission on Ocean Policy stated that a sustained and appropriately funded response and analysis program could help identify causes of marine mammal strandings and actions to prevent further deaths.** MHMAP is being developed to help meet these and other pressing needs.

Marine Mammal Unusual Mortality Events, 2010-2014

Federally declared marine mammal unusual mortality events (UMEs) continue to occur with ocean changes, including the following:

- Sudden loss of sea-grass beds and prey were associated with emaciated bottlenose dolphins in the Indian River Lagoon, Florida
- An avian influenza virus was associated with deaths of harbor seals along New England’s coastlines.
- The Deepwater Horizon oil spill likely contributed to the largest and longest dolphin die-off in the Gulf of Mexico on record.
- Ice seals and walrus in Alaska developed ulcerative skin lesions from an unknown cause.
- An outbreak of morbillivirus, a dolphin measles virus, infected dolphins and rapidly spread south along the U.S. eastern coastline.

Many UMEs also had public health concerns that needed to be addressed.

An example of MMHMAP's [visual presentation of marine mammal health data](#) can be viewed at the Central and Northern California Ocean Observing System (CeNCOOS) data portal.

What Are The Benefits of MMHMAP?

MMHMAP will:

- Provide a **consistent platform** for collecting, collating, and visualizing marine mammal health data;
- Enhance visual **identification of “hot spots”** of marine mammal disease and health;
- **Enable management decisions** and evaluations through a dynamic, user-friendly tool;
- **Aid emergency management responses** to natural (e.g., hurricanes, disease outbreaks) and anthropogenic emergencies (e.g., oil spills) by assessing changes in marine mammal health before, during, and following the event;
- **Enhance communication and collaboration** amongst marine mammal health scientists and oceanographers, resulting in better understanding of the relationship between health and environmental factors;
- **Facilitate forecasting of challenges to marine mammal health** via oceanographic signals by integrating ocean and marine mammal health data

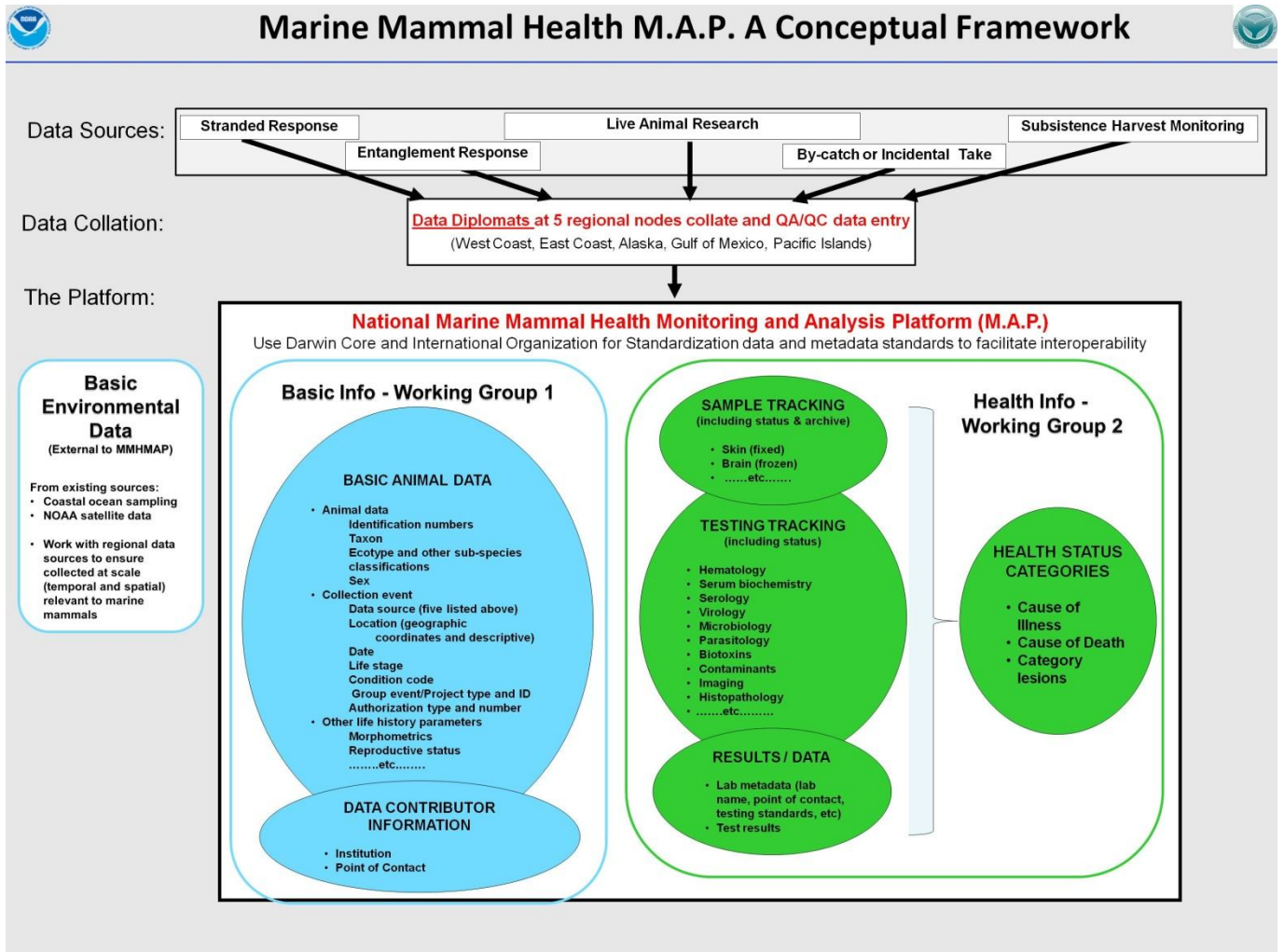
MMHMAP Objectives: 2015-2017

During the next three years, MMHMAP tasks are focused on development and implementation of a national data management platform.

Objective 1. Develop a marine mammal health monitoring and analysis platform with consistent and standardized fields and terminology by collaborating with potential data providers (Figure 1).

- a. Identify five regional data diplomats (one each for west coast, Alaska, Pacific Islands, Atlantic coast and Gulf of Mexico nodes) who will liaise with data providers, facilitate data entry into MMHMAP, and provide data quality assurance and quality control at the regional level;
- b. Obtain basic animal and health data on marine mammals from data collectors nationally (federal and state agencies, academic institutions, non-government organizations, Alaska Native Organizations, and tribal communities);
- c. Establish data and metadata standards for all parameters;
- d. Establish flow of data from collector to a central data repository for distribution, archiving and subsequent data synthesis while avoiding duplicate entries and ensuring interoperability with existing databases (e.g., ERMA, OBIS, MMHSRP).

Figure 1. MMHMAP Conceptual Framework



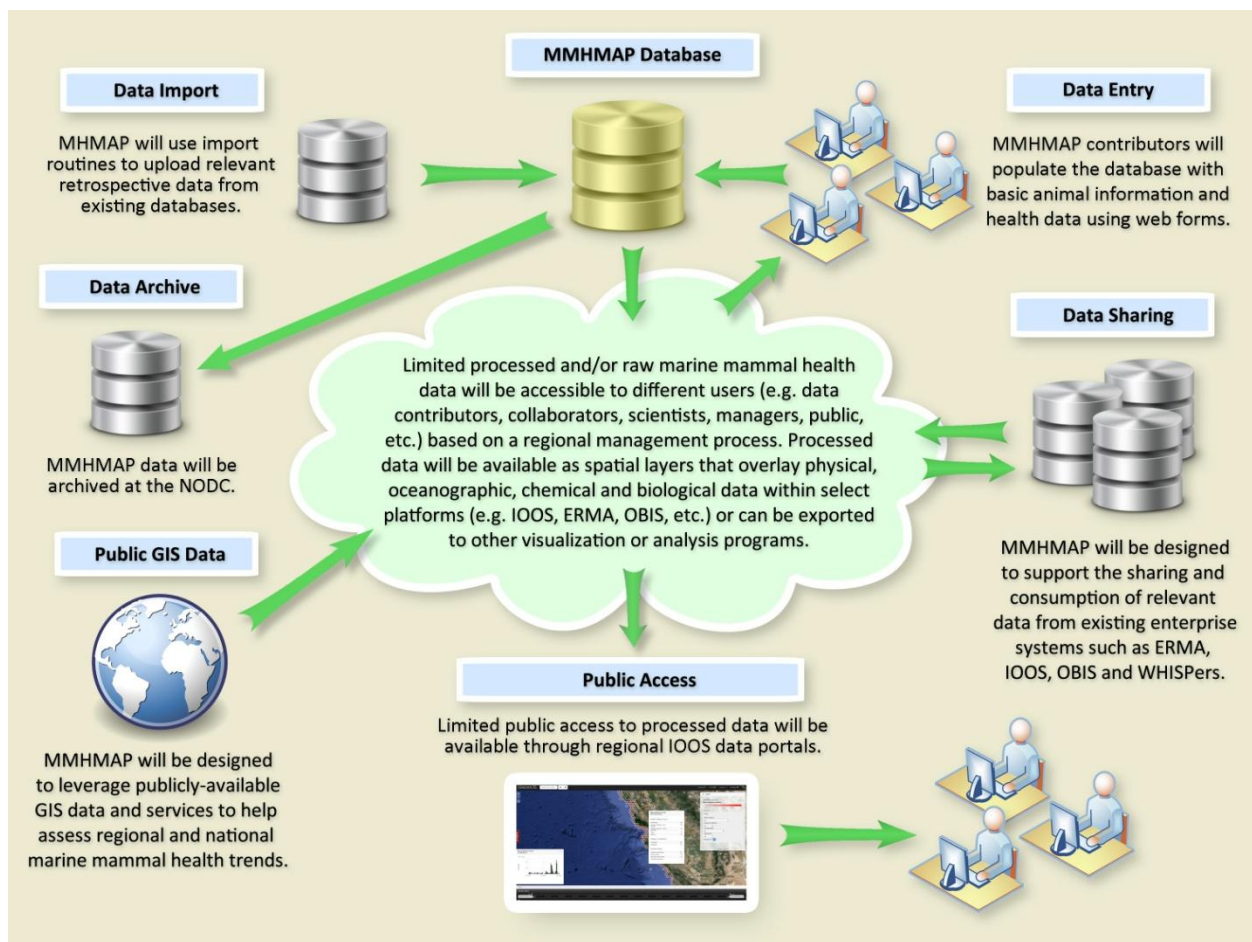
Objective 2. Promote collaborations and ensure marine mammal health data are readily available to scientists, managers and the public (Figure 2)

- Establish a user friendly visualization tool via the IOOS Regional Association data portals for public access and distribution;
- Establish tiered data sharing and accessibility based on user type (data contributors, collaborators, scientists, managers, and the public) through a regional management process;
- Maintain a database of health parameters, results, and sample types and contact information for further analytic results (collaboration benefit).

Objective 3. Correlate marine mammal health trends with biological, chemical and physical environmental parameters

- a. Present marine mammal health data in layers that overlay oceanographic and/or physical, chemical and biological data within IOOS, ERMA, or which may be exported to other visualization or analysis programs;
- b. Interface with other animal health data resources (such as WHISPers)¹. By completing the above three objectives, MMHMAP will meet some of the statutory requirements of Section 16 USC. 1421 of the MMPA as amended in 1992.

Figure 2. MMHMAP data access and archiving



¹ <http://www.nwhc.usgs.gov/whispers/>

MMHMAP Tasks & Timeline: 2015-2017

Phase 1: Develop MMHMAP (2015)	
Core Group	Oversee and coordinate MMHMAP activities and budgets
	Develop use cases to be incorporated into the database architecture
Basic Marine Mammal Data	Develop data fields and data standards for basic information to be collected as part of MMHMAP (Figure 1)
Marine Mammal Health Data	Organize and hold a workshop in March of 2015 to develop definitions for health status categories, analytical results formats, and the final health fields and standards
Database Architecture	Design and begin building data architecture for all elements of MMHMAP
	Integrate data from different sources, build the MMHMAP platform, incorporate layers of data access, identify a process for archiving the data contained within the platform, and ensure interoperability and ease of access to multiple end-users.
	Develop data infrastructure and use cases in conjunction with the MMHMAP core group and invited experts
Policy & Funding	Work collaboratively with multiple partners and project leads to develop the data access and data sharing policies and processes
Phase 2: Implement MMHMAP (2016-2017)	
2016	Begin population of the data infrastructure initially with the use cases. Use cases will be designed to represent different sources of data anticipated to come into MMHMAP and, have a variety of information types within them to broadly test platform functionality including delivering products for a variety of users.
2017	Introduce more datasets involving iterative testing of the infrastructure system from end-to-end. The system will be developed regionally and this would be a time to scale up “nationally.”

MMHMAP Team

Steering Committee

Dr. Teri Rowles, Marine Mammal Health and Stranding Response Network, NOAA Fisheries
Dr. Frances Gulland, Marine Mammal Commission, The Marine Mammal Center
Dr. Samantha Simmons, Marine Mammal Commission

Core Team

Dr. Stephanie Venn-Watson, National Marine Mammal Foundation
Dr. Andrea Bogomolni, Woods Hole Oceanographic Institution/ Marine Mammal Health and Stranding Response Network, NOAA Fisheries
Dr. Claire Simeone, The Marine Mammal Center/ Marine Mammal Health and Stranding Response Network, NOAA Fisheries
Dr. Deborah Fauquier, Marine Mammal Health and Stranding Response Network, NOAA Fisheries
Mr. Jeff Adams, Marine Mammal Health and Stranding Response Network, NOAA Fisheries
Ms. Katie Brill, Marine Mammal Health and Stranding Response Network, NOAA Fisheries
Ms. Sarah Wilkin, Marine Mammal Health and Stranding Response Network, NOAA Fisheries
Ms. Tenaya Norris, The Marine Mammal Center

Glossary of terms

Anthropogenic – of, relating to, or resulting from the influence of human beings on nature

Baseline – an initial set of critical observations or data that are used as a starting point or control for comparisons, to detect changes, and evaluate impacts.

Biotoxin – a toxic substance of biological origin

Contaminant – something that is dangerous, dirty, or impure and does not belong in the environment in question

Ecosystem – a community of different species interdependent on each other and their non-living environment, which is relatively self-contained in terms of energy flow and distinct from neighboring communities.

Entanglement response – efforts mounted to assist marine mammals that become wrapped up in fishing gear or other marine debris

Fisheries bycatch – animals which are harvested in a fishery, but which are not sold or kept for personal use

Home range – the territory or most commonly used space of an organism or species

Host - a living animal on or in which a parasite lives

Pathogens – specific agents (e.g. a bacterium or virus) that cause disease

Strandings – occur when marine mammals swim or float into shore and become "beached" or stuck in shallow water or on land

Subsistence monitoring – records of the taking of marine mammals by Native communities

Trophic level – a level in a food chain that is defined by the method of obtaining food, and in which all organisms are the same number of energy transfers away from the original source of the energy (i.e. photosynthesis) entering the system

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