MARINE MAMMAL COMMISSION

4 December 2015

Deepwater Horizon Natural Resource Damage Assessment Trustees
c/o U.S. Fish and Wildlife Service
P.O. Box 49567
Atlanta, Georgia 30345

Dear Trustees:

The Marine Mammal Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the Trustees' Draft Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS) for the Gulf of Mexico and associated notice (80 Fed. Reg. 60126). The Draft PDARP/PEIS summarizes the assessment of impacts of the Deepwater Horizon oil spill on Gulf natural resources and on the services those resources provide, and describes the Trustees' programmatic alternatives to restore natural resources, ecological services, and recreational use services injured or lost as a result of the spill.

The Commission commends the Trustees for the comprehensive assessment of impacts in the PDARP/PDEIS, especially considering the shortage of available information on pre-spill abundance, distribution, and vital rates for many of the Gulf's natural resources, including marine mammals. Determination of the extent of exposure and injury to marine mammals required an exhaustive analysis of information obtained from pre- and post-spill population surveys, behavioral observations, strandings, health assessments, toxicity testing, environmental and oceanographic studies, and the scientific literature. The number of marine mammals estimated to have been killed or injured due to exposure to oil and oil response activities is staggering and represents a significant challenge to the recovery of several marine mammal stocks.

The Commission has focused its comments and recommendations on the restoration and monitoring aspects of the PDARP/PEIS. The settlement agreement with BP directs the allocation of specific funding amounts among state, region-wide, and open ocean resources, and it is incumbent on the Trustees to ensure that marine mammal restoration and monitoring activities are designed and implemented to maximize recovery and minimize additional stress on impacted stocks.

The Trustees' preferred alternative

The guiding principle of the Trustees' restoration plan, as mandated by the Oil Pollution Act, is to restore the range of habitats, resources, and services injured by the Deepwater Horizon oil spill. The Trustees have proposed to address this mandate by allocating restoration funds to meet the following high-level goals—

- Restore and conserve habitat;
- Restore water quality;
- Replenish and protect living coastal and marine resources;

- Provide and enhance recreational opportunities; and
- Provide for monitoring, adaptive management, and administrative oversight to support restoration implementation.

The Trustees have proposed to meet those goals through an "integrated restoration portfolio" that emphasizes the broad ecosystem benefits that can be realized through coastal habitat restoration in combination with resource-specific restoration in the northern Gulf of Mexico ecosystem (the Trustees' preferred alternative). Other alternatives considered and evaluated by the Trustees were a resource-specific restoration portfolio that emphasizes close, well-defined relationships between injured resources and the restoration types (Alternative B), the deferral of restoration plan development in favor of continued injury assessment (Alternative C), and the natural recovery/no action alternative (Alternative D).

The Commission supports the implementation of the Trustees' preferred alternative as it combines large-scale habitat restoration projects for areas determined to have been directly and indirectly impacted by the oil spill with species-specific restoration projects. The Trustees' preferred alternative also provides for Gulf-wide monitoring and adaptive management to track restoration performance and guide changes in projects when needed to enhance effectiveness. The large-scale nature of the oil spill and the extent of impacts across numerous habitats and species necessitate an integrated, region-wide approach which would not be addressed adequately by a resource-specific approach (Alternative B), a delay in implementing restoration (Alternative C), or reliance solely on natural recovery (Alternative D). Therefore, the Commission recommends that the Trustees implement their preferred alternative to maximize the potential for broad-scale environmental benefits while also addressing resource-specific restoration goals.

Marine mammal restoration activities

Under the preferred alternative, the Trustees have proposed a suite of activities to restore marine mammals impacted by the spill. They were designed to address three top level goals—

- Restoration of injured marine mammal stocks across the diverse habitats and geographic ranges they occupy;
- Mitigation of key stressors to support resilient marine mammal populations by collecting and using information from population and health assessments and information on spatiotemporal distribution; and
- Accounting for the ecological needs of the stocks, improving resilience to natural stressors, and addressing human-caused threats.

The Trustees' proposed approaches to achieve marine mammal restoration goals include—

- Reducing commercial fishery bycatch through collaborative partnerships.
- Reducing injury and mortality of bottlenose dolphins from hook and line fishing gear.
- Increasing marine mammal survival through better understanding of causes of illness and death and early detection and intervention of anthropogenic and natural threats.
- Measuring noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals.

- Reducing injury, harm, and mortality to bottlenose dolphins by reducing illegal feeding and harassment activities.
- Reducing marine mammal takes through enhanced state enforcement of the Marine Mammal Protection Act (MMPA).
- Reducing injury and mortality of marine mammals from vessel collisions.
- Protecting and conserving marine, coastal, estuarine, and riparian habitats.

The proposed restoration approaches are focused on restoration of marine mammal stocks determined to have been directly or indirectly impacted by the spill, particularly bottlenose dolphins, with some activities (i.e., gaining a better understanding of the causes of illness and mortality) expected to also benefit marine mammal stocks beyond the oil spill direct-impact area. The Commission agrees that the proposed restoration activities meet the requirements of the Oil Pollution Act by addressing some of the most significant anthropogenic threats that could impede recovery of oil spill-affected marine mammals in the Gulf. The Commission also recognizes that options are limited for other, more direct marine mammal restoration activities, such as rehabilitation or replacement of injured resources or acquisition of equivalent resources.

With the exception of measuring and characterizing sound sources and reducing anthropogenic sound in areas of overlap with high densities of marine mammals, the Trustees have limited activities directed toward restoration of Bryde's whales, sperm whales, and other oceanic stocks of impacted marine mammals. In this regard, one additional restoration approach that the Trustees should consider to enhance restoration efforts in oceanic waters is the designation of marine protected areas. Marine protected areas have the potential to benefit marine mammal populations (and other marine species) that were impacted by the oil spill and for which few other restoration options are available. Depending on the mechanism used, the designation could provide protection for recovering marine mammals by restricting oil and gas activities, restricting certain types of fishing activities or fishing gear, providing targeted education and outreach, and monitoring resources and activities.

Two areas that the Trustees should consider designating as marine protected areas are the DeSoto and Mississippi Canyons. These areas provide important habitat for Bryde's whales and sperm whales, respectively, as well as for other oceanic marine mammals and deep-sea coral communities. The northern Gulf of Mexico stock of Bryde's whales inhabits DeSoto Canyon and adjacent continental slope waters extending east and south of the Canyon, and Bryde's whales are the only regularly occurring baleen whale in the Gulf (Waring et al. 2013, Rosel and Wilcox 2014). The northern Gulf of Mexico stock of sperm whales also represent a distinct stock in the Gulf. Sperm whales are found throughout offshore waters of the Gulf, but the Mississippi Canyon represents an important feeding area (Jochens et al. 2008). Both species of large whales were impacted by the oil spill, with estimates of 17 percent of the Bryde's whale population killed and 6 percent of the sperm whale population killed (DWH MMIQT 2015). Mississippi Canyon was subject to intense and prolonged oiling below and at the surface during the spill (Stout et al. 2015). DeSoto Canyon was less heavily contaminated but also experienced oiling at the surface and seafloor (Brooks et al. 2015). Other marine mammals found regularly or occasionally in these areas include Atlantic spotted dolphins, Blainville's beaked whales, Cuvier's beaked whales, Gervais' beaked whales, dwarf and pygmy sperm whales, oceanic and continental shelf stocks of bottlenose dolphins, pantropical spotted dolphins, Risso's dolphins, rough-toothed dolphins, short-finned pilot whales,

spinner dolphins, and striped dolphins (Waring et al. 2013). Less is known about the distribution of other oceanic marine mammals within these areas, such as Clymene's dolphins, Fraser's dolphins, killer whales, false killer whales, melon-headed whales, and pygmy killer whales.

The designation of marine protected areas was noted by the Trustees as a mechanism for addressing key threats to mesophotic and deep benthic communities (Section 5.5.13.3). However, no information was provided in the PDARP/PEIS on what specific areas in the Gulf the Trustees might be considering for such designation. The Commission believes that areas that provide protection for multiple species, including marine mammals, should be priorities for designation. The Commission therefore recommends that the Trustees consider designating as marine protected areas those marine mammal habitats that were significantly impacted by the spill and for which few other restoration activities exist, such as DeSoto Canyon and Mississippi Canyon.

Potential impacts of habitat restoration projects on marine mammals

The primary focus of the draft PDARP/PEIS is the restoration of wetlands and coastal and nearshore habitats impacted by the oil spill. Under the Trustees' preferred alternative (Section 5.5), this would include the creation and enhancement of ecologically connected coastal habitats, the controlled diversion of Mississippi River waters into adjacent wetlands, and restoration across a range of coastal habitats in the spill-impacted area including beaches, dunes, islands, barrier headlands, oyster reefs, and submerged aquatic vegetation (SAV). If executed properly, those projects should address the Trustees' restoration goals for many nearshore aquatic species impacted by the spill, including marine mammals such as bottlenose dolphins and manatees. However, as noted in the draft PDARP/PEIS, those projects also have the potential to result in unintended adverse impacts on inshore and nearshore marine mammals and their prey species.

Habitat restoration projects under the Trustees' preferred alternative would involve dredging, beach renourishment, restoration and construction of barrier and coastal islands, backfilling of canals, river and sediment diversions, and construction of living shorelines, groins, and breakwaters. Potential impacts on natural resources from these restoration activities were identified briefly in section 6.4 of the PDARP/PEIS, but the Commission would like to highlight the following specific concerns regarding potential impacts on marine mammals.

- Dredging of contaminated sediments can temporarily re-suspend pollutants into the water column where they may be ingested by marine mammal prey (Martins et al. 2012); re-suspended nutrients can contribute to the development of, or exacerbate, harmful algal blooms (Van Dolah 2000).
- Beach renourishment can alter benthic communities and affect the prey of marine mammals (Peterson and Bishop 2005).
- Backfilling of canals can trap marine mammals and block access to their natural habitat, requiring rescue and relocation of the "stranded" animals.
- River diversions can increase freshwater input into marsh habitat, exposing dolphins to low-salinity waters. Such exposure can compromise epidermal integrity (as evidenced by skin lesions), cause physiological stress, and contribute to secondary infections (Wilson et al. 1999; Holyoake et al. 2010; Mullin et al. 2015). Low-salinity conditions can also affect the distribution of dolphin prey (Barros and Odell 1990).

- Disturbance from construction activities and associated vessel traffic can increase sound levels and disrupt foraging, habitat use, daily or migratory movements, and other behavior (Nowacek et al. 2001, 2004). Increased vessel traffic can also increase the risk of vessel strikes (FWS 2001, Wells et al. 2008, Bechdel et al. 2009).

If not carefully managed, habitat restoration activities could present a significant impediment to the recovery of inshore marine mammals impacted by the oil spill, including bottlenose dolphin stocks in Barataria Bay, the Mississippi River Delta, Mississippi Sound, and Mobile Bay. The Trustees estimated that 12 to 59 percent of the total population of those stocks was killed due to the oil spill, and that the timespan for recovery of those stocks could be from 31 to 52 years (Section 4.9). Although impacts to Florida manatees were not quantified by the Trustees and were likely not as severe, habitat restoration projects in certain areas also have the potential to impact manatees. To prevent additional impacts to all marine mammals, the Commission recommends that the Trustees conduct site-specific analyses under the National Environmental Policy Act (NEPA) of proposed habitat restoration projects and associated activities to ensure that there has been a thorough evaluation of potential project-specific and cumulative impacts on marine mammals, their habitat, and prey. The Commission further recommends that the Trustees work with the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (FWS) to ensure that habitat restoration projects are sufficiently adapted and monitored to minimize adverse short- and long-term impacts on marine mammals.

The importance of comprehensive monitoring

As noted in the draft PDARP/PEIS, monitoring is a critical component to evaluate restoration outcomes and determine the need for any corrective actions. A comprehensive and well-designed monitoring program is critical to understanding the Gulf ecosystem, inform future decision-making, and gauge the effectiveness of restoration activities (see, for example, Goetz et al. 2004). A recent workshop convened by the National Academy of Sciences Gulf Research Program (2015) noted that—

> "Environmental monitoring information can be used to increase basic understanding, identify emerging problems and long-term trends, inform restoration projects, prioritize use of resources, and provide information to guide policy and management. For rapidly changing regions like the Gulf of Mexico, monitoring efforts also can yield reference data that flag emerging environmental and health concerns."

Both site-specific and broad-scale monitoring should be part of the adaptive management system used by the Trustees and its restoration partners. In general, restoration monitoring plans should be interdisciplinary and inter-institutional, with monitoring goals and long-term stable funding identified at the outset. Plans should include monitoring of key physical, biological, and ecological parameters before, during, and after restoration activities. Biological and ecological monitoring should include regular, systematic, and long-term surveys of a broad range of representative marine species, including plants, invertebrates, fish, birds, sea turtles, and marine mammals. Such surveys should be conducted at sufficient levels of effort and frequency to allow detection of changes with a high level of confidence.

Enhanced monitoring of impacted marine mammal stocks, and the integration of newly collected information with existing databases and data sets, can help to focus marine mammal restoration activities and assess their effectiveness over the long term. It also can assist in identifying unintended and potentially adverse effects of habitat restoration activities on marine mammals. Rather than developing new, stand-alone data collection programs to track the restoration and recovery of impacted marine mammals and/or monitor the effects of habitat restoration projects, the Commission recommends that the Trustees use, support, and expand existing marine mammal monitoring programs in all areas of the Gulf as the basis for an integrated, long-term approach to monitoring the restoration of marine mammals.

There are several existing marine mammal monitoring programs[1] that the Trustees should consider expanding as part of its project-specific and broad-scale restoration monitoring efforts.

- Capture-mark-recapture studies (e.g., photo-identification) from small vessels can provide information on abundance, distribution, movements, behavior, and vital rates for bottlenose dolphins and manatees. Repeated, long-term studies allow detection of population-level changes in response to environmental and human-caused perturbations. Such studies are typically conducted by non-governmental organizations, academic institutions, and state resource agencies, as well as NMFS (for bottlenose dolphins), and the U.S. Geological Survey (USGS; for manatees). Centralized large-scale, collaborative photo-identification catalogs have been established (e.g., the Gulf of Mexico Dolphin Identification System, or GoMDIS), providing a basis for tracking movements of individual animals beyond project study sites and detecting range shifts in response to environmental changes.
- Visual observations from aerial surveys are used to determine abundance and distribution of bottlenose and Atlantic spotted dolphins and manatees in nearshore and coastal waters. Aerial surveys for dolphins are conducted by NMFS and for manatees by FWRI, USGS, and other entities.
- Shipboard surveys are used to determine abundance and distribution of oceanic cetaceans. They are used also as a platform for satellite tagging to provide information on individual ranging patterns; more sophisticated satellite tags also can provide information on diving patterns and habitat use. Shipboard surveys and tagging of oceanic cetaceans are conducted primarily by NMFS due to cost and infrastructure requirements, but surveys have also been conducted independently by, or in collaboration with, academic institutions and non-governmental organizations.
- Remote biopsy samples collected as part of nearshore and offshore vessel-based surveys can provide information on stock structure, contaminants, diet (stable isotopes), and reproductive status (sex, hormones, etc.).
- Acoustic recordings of vocalizing cetaceans can be used to complement visual observations on shipboard surveys using towed arrays. Fixed acoustic arrays (i.e., acoustic buoys) can provide continuous detections of vocalizing cetaceans in a limited spatial area to determine presence and distribution; they also can be used to determine densities of animals if other species-specific information exists (such as group size and call rates). Acoustic data are

[1] Monitoring activities identified here generally involve the taking of marine mammals and therefore require permits or other authorizations under the MMPA (for bottlenose dolphins and manatees) and the ESA (for manatees).

obtained from fixed arrays deployed by academic institutions located in the Gulf and elsewhere, and also by NMFS.

- Live-capture/release health assessments of dolphins and manatees are used to investigate unusual mortality events and the effects of environmental stressors. Health assessments to investigate sub-lethal effects on bottlenose dolphins from the Deepwater Horizon oil spill were conducted at two oil-impacted sites in the Gulf (Barataria Bay and Mississippi Sound) and at a long-term reference site in Sarasota Bay. Similar manatee health assessments have been conducted in Florida waters. Health assessments are personnel- and resource-intensive and typically involve collaborators from a large number of federal and state agencies and private institutions in the Gulf and elsewhere.
- The NMFS Marine Mammal Health and Stranding Response Program oversees a national volunteer network of trained responders and veterinarians who are authorized under the MMPA to respond to, rescue, and rehabilitate live-stranded marine mammals and investigate dead-stranded marine mammals. The information collected from stranded marine mammals is used to assess marine mammal health and health trends; correlate health and trend data with biological, physical, and chemical environmental parameters; and coordinate responses to unusual mortality events. Stranding network members are located in each of the five Gulf states[2] and are typically associated with non-governmental organizations, academic institutions, and state agencies. NMFS provides administration, coordination, and data management for the program.
- The Manatee Salvage and Necropsy Program at the Florida Fish and Wildlife Research Institute (FWRI) supports efforts to salvage and necropsy Florida manatees throughout their range, including animals that strand outside the state of Florida, and to identify and track trends in manatee mortality.
- The U.S. Fish and Wildlife Service (FWS) and FWRI respond to calls about injured and distressed manatees throughout the southeastern United States. As necessary, they engage in or coordinate capture and transport to three authorized zoo and aquarium hospitals in Florida for rehabilitation and eventual release back into the wild through the Manatee Rescue and Rehabilitation Partnership.

Coordination and resources

The Trustees face a considerable challenge in implementing restoration activities for marine mammals in the face of data gaps and dispersed science capacity in the Gulf. Prioritizing data needs and meeting those needs through expanded data collection and monitoring will require strong leadership by the Trustees, Trustee Implementation Groups, and Individual Trustee Agencies. It will also require long-term, consistently maintained collaborations with Gulf marine mammal stranding network members, academics, not-for-profit organizations, educators, commercial and recreational fishermen, the oil and gas industry, wildlife tour operators, state enforcement agencies, and the public. Leadership from the agencies and organizations with prior experience collecting, analyzing, maintaining, and using biological, environmental, and socioeconomic data is central to building the collaborations needed to understand the status of, and address threats to, marine mammals.

[2] http://sero.nmfs.noaa.gov/protected_resources/marine_mammal_health_and_stranding_response_program/mmstranding_organizations/index.html

The Department of Commerce/NOAA and the Department of the Interior (DOI) are key partners for marine mammal restoration and monitoring in the Gulf. Under the MMPA, NOAA's NMFS has lead responsibility for research and management related to cetaceans and the Department of the Interior's FWS and USGS have lead responsibility for management and research (respectively) related to manatees. As demonstrated by the thoroughness of the damage assessments conducted after the oil spill, these agencies have significant expertise in designing and implementing population surveys, collecting and analyzing biological samples, conducting health assessments, and analyzing large data sets. They also have demonstrated leadership in coordinating with other public and private researchers, establishing data collection standards, training field personnel, conducting outreach and education programs, and maintaining and archiving data for broad access by other researchers and the public. NMFS and FWS have responsibility under the MMPA for reviewing and issuing marine mammal scientific research permits, stranding agreements, and incidental take authorizations, and under the Endangered Species Act (ESA) for conducting consultations with other federal agencies regarding actions that may affect endangered and threatened marine mammals and designated critical habitat (including habitat restoration projects proposed by the Trustees). NMFS and FWS also enforce the taking prohibitions of the MMPA and ESA in partnership with state natural resource agencies.

The Commission is concerned that without additional staff resources over the timeframe identified for restoration, these agencies will have limited ability to help guide and coordinate marine mammal restoration and monitoring activities in the Gulf. Without such guidance and coordination, other restoration partners in the Gulf[3] may undertake monitoring activities that are not compatible with, and do not build on, existing data collection and management programs. This would ultimately limit the Trustees' ability to evaluate the performance and long-term success of restoration activities. Additional staff are needed also to prepare and review environmental compliance documents required under NEPA and to conduct consultations and issue take authorizations as needed under the ESA and MMPA. With additional staff, these agencies also could help leverage and coordinate the broader suite of restoration resources available in the Gulf. Therefore, the Commission recommends that NOAA and DOI, as Deepwater Horizon Trustees, dedicate additional long-term staff to help guide and coordinate marine mammal restoration, monitoring, and environmental compliance activities in the Gulf.

To assist the Trustees in its planning efforts, the Commission is enclosing the summary report from the Gulf of Mexico Marine Mammal Research and Monitoring Meeting convened by the Commission and several partners in April 2015. The objectives of the meeting were to identify high priority marine mammal information needs for the next 5-15 years and to discuss existing and emerging funding opportunities in the Gulf of Mexico. The report highlights what is known (and not known) regarding marine mammal abundance, distribution, stock structure, habitat use, and causes of mortality and morbidity. It also provides information that may be useful in mitigating human impacts on marine mammals in the Gulf associated with oil and gas exploration and development, commercial and recreational fishing, shipping, tourism, military operations, and pollution.

[3] Including, but not limited to, the RESTORE Act Ecosystem Restoration Council, the RESTORE Act Centers of Excellence, the National Fish and Wildlife Foundation Gulf Environmental Benefit Fund, and the National Academy of Sciences Gulf Research Program.

The Commission hopes that information presented at the April meeting and summarized in the report will assist the Trustees in their planning efforts and also help pave the way for additional collaboration in the Gulf region. More information regarding the meeting, and PDF versions of the presentations and posters, are available at: http://www.mmc.gov/gom/gom_meeting.shtml.

The Commission understands that the Trustees will be developing their implementation strategy in more detail over the coming year. The Commission would welcome the opportunity to contribute to those efforts in any capacity that the Trustees deem appropriate.

Sincerely,

Rebecca J. Lent

Rebecca J. Lent, Ph.D.
Executive Director

Enclosure

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Gulf of Mexico Marine Mammal Research and Monitoring Meeting

7-8 April 2015
New Orleans, Louisiana

Summary Report

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An Independent Agency of the U.S. Government
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Summary Report

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November 2015

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CITATION

Suggested format for citation of this report:

Cornish, V. (ed.). 2015. Gulf of Mexico Marine Mammal Research and Monitoring Meeting: Summary Report. Marine Mammal Commission, Bethesda, MD 20910. 110 pages.

REPORT AVAILABILITY

This report, the meeting program, and a PDF version of presentations and posters from the meeting are available at www.mmc.gov.

PHOTOGRAPHS AND FIGURES

Photographs of cetaceans used on the cover and in the report were provided by Keith Mullin, National Marine Fisheries Service (NMFS) Pascagoula Laboratory, and were taken under authority of Marine Mammal Protection Act (MMPA) permit number 779-1633. The photograph of the Florida manatee on the front cover was provided by Chris Simoniello, Gulf of Mexico Coastal Ocean Observing System (GCOOS). Other photographs and figures used in the report were from presentations made at the meeting or from online sources and are credited accordingly.

EXECUTIVE SUMMARY

On April 7-8, 2015, marine mammal scientists and managers working in the Gulf of Mexico met in New Orleans, Louisiana, to discuss the state of marine mammal science in the Gulf. One hundred people attended the meeting, with presentations and posters summarizing recent and ongoing projects in the Gulf. Meeting participants also discussed existing and emerging funding opportunities, some of which could be used to expand research, monitoring, and analytical capabilities to address priority information needs for marine mammals in the Gulf.

This report is a summary of the presentations made at the meeting and ensuing discussions. The appendices provide a list of posters presented at the meeting, descriptions of 53 recent and ongoing marine mammal projects in the Gulf, as submitted by researchers themselves prior to the meeting, and a list of meeting registrants.

Some of the more general observations made at the meeting include the following—

- The economies of states bordering the Gulf contribute significantly to the nation's gross domestic product, but those economies depend to a considerable degree on a vibrant, healthy marine environment with abundant living resources.
- Marine mammals are an important component of the Gulf ecosystem.
- Research and monitoring of marine mammals in the Gulf must address the information needs arising from various legal mandates, including the Marine Mammal Protection Act, Endangered Species Act, and National Environmental Policy Act.
- Better information on marine mammal abundance, distribution, habitat use, and behavior is necessary if we are to mitigate the potential impacts of human activities in the Gulf, including those associated with oil and gas exploration and development, commercial and recreational fishing, shipping, military operations, tourism, and pollution.
- Standardized methods of collecting and archiving data, training in those methods, and improved access to data are needed to support efforts aimed at assessing the individual and cumulative impacts of human activities on marine mammals in the Gulf.
- Marine mammal models that account for environmental drivers and stressors at the individual, population, and ecosystem level are needed.
- Restoration projects that may affect marine mammals, their habitat, and prey should include a monitoring component to evaluate the effects of restoration activities on marine mammals.
- Several funding opportunities exist (or are in the planning stages) that could be used to expand marine mammal restoration, research, monitoring, and analytical capabilities in the Gulf, but each has specific focus areas and constraints.
- Recent trends in funding and publishing research require that data are made publicly available in a timely manner after the completion of the project and that data are discoverable in an easily accessible repository. This has not been a common practice for most marine mammal data and will need to be addressed.
- A coordinated and collaborative approach to developing a Gulf-wide action plan would help ensure that priority restoration, research, monitoring, and assessment needs for marine mammals are identified, and that potential funds and research capacity are leveraged for maximum benefit.

The information presented and ideas expressed at the meeting and reflected in this report are intended to help build a strong foundation for expanded marine mammal research and monitoring in the Gulf of Mexico, and to better conserve and protect marine mammals that are a part of this complex, diverse, and changing environment.

ACKNOWLEDGMENTS

The Marine Mammal Commission would like to thank the Steering Committee members (listed below) and all of the meeting presenters, session moderators, breakout group leaders, sponsors, and participants who contributed their time and efforts to make this meeting a success.

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INTRODUCTION AND MEETING OBJECTIVES

Vicki Cornish, Marine Mammal Commission

Numerous workshops and planning efforts have been conducted to review information on marine mammals and identify and address gaps in knowledge regarding their conservation status and the impacts of human activities in the northern Gulf of Mexico (Keller and James 1983, Tucker & Assoc. 1989, McKay et al. 1999, Mullin et al. 2007, NMFS 2008, MMC 2008). Those workshops and planning efforts have helped to focus resources on research and monitoring[1] studies to meet the legal mandates of the Marine Mammal Protection Act (MMPA), the Endangered Species Acton (ESA), and the National Environmental Policy Act (NEPA) to protect, conserve, and promote the recovery of marine mammal populations. Studies have included abundance and distribution surveys as well as relatively intense research on certain species (e.g., sperm whales, manatees, and bottlenose dolphins). However, federal funding for marine mammal stock assessment surveys and research has waned at the same time that human activities in the northern Gulf (e.g., oil and gas development, commercial shipping, military training, commercial and recreational fishing, and tourism) have increased.

Pantropical spotted dolphin (*Stenella attenuata*)
(*Credit: NMFS*)

The inadequacy of baseline information regarding Gulf of Mexico marine mammals became apparent during and after the 2010 Deepwater Horizon oil spill (DWHOS). The explosion on BP's Deepwater Horizon drilling platform off Venice, Louisiana, killed 11 workers and led to an oil spill of unprecedented volume, spatial extent, and duration.[2] It also involved response and clean-up efforts that may have impacted marine mammals. The Oil Pollution Act of 1990 required federal, state, and tribal authorities to conduct an assessment of injuries to natural resources affected by the spill (known as a natural resource damage assessment, or NRDA). However, the assessment of injuries to marine mammals has been hampered by the paucity of pre-spill baseline information on the status and health of marine mammals in the Gulf. Considerable research and monitoring was initiated during and after the spill. However, understanding its full impact on marine mammals and other living marine resources will continue to be challenging.

Fortunately, funding that is becoming available for restoration of the Gulf, post-DWHOS, could provide significant opportunities to increase basic scientific information on marine mammals and also obtain information needed to restore injured populations. In addition, the need to understand and minimize the effects of oil and gas exploration on marine mammals in the northern Gulf has prompted the Bureau of Ocean Energy Management (BOEM) to begin development of a long-term monitoring plan[3] to increase knowledge of marine mammals and the potential impacts related to energy exploration activities. However, it is incumbent on marine mammal scientists and managers working in the Gulf to identify research and monitoring priorities that meet pressing conservation needs for Gulf marine

[1] For the purpose of this report, research refers to the application of scientific methods to investigate, confirm, or revise theories or hypotheses regarding the relationships among various phenomena; monitoring refers to observations conducted over an extended period of time without intent to alter or affect what is being observed. In some cases, these terms may be used interchangeably.
[2] http://www.restorethegulf.gov/coast-guard-response/response
[3] http://www.gpo.gov/fdsys/pkg/FR-2014-11-07/pdf/2014-26520.pdf

mammals and also how those priorities align with funding opportunities. Many of these opportunities focus on multi-disciplinary, multi-species studies, and will require investigators to work across disciplines to better understand threats to marine mammals and promote a more resilient Gulf ecosystem.

Considering the need to expand research and monitoring efforts for Gulf marine mammals and the potential opportunities presented by increased Gulf restoration-related funding, the Marine Mammal Commission (MMC) and several other partners convened the Gulf of Mexico Marine Mammal Research and Monitoring Meeting in New Orleans, Louisiana on 7-8 April 2015, at the Astor Crowne Plaza.

The objectives of the meeting were to—

- Provide an overview of marine mammal stocks and human activities that might affect them
- Review marine mammal research and monitoring programs
- Identify potential funding sources/opportunities for marine mammal research and monitoring
- Identify high-priority information needs for the next 5-15 years, and
- Discuss options for collaborations to facilitate long-term planning, information sharing, and capacity building.

Four years ago, the MMC outlined its priorities for marine mammal research in the Gulf in the form of a Statement of Research Needs (MMC 2011). That statement was informed by input from several federal agencies working in the Gulf and was submitted to Congress as an independent MMC document. It was the MMC's expectation that its Statement of Research Needs would help drive research efforts directed at Gulf marine mammals in light of ongoing injury assessments and restoration planning associated with the NRDA process. Although we have seen increased research and monitoring efforts on marine mammals since the spill, it is clear that more can and should be done, especially across disciplines.

Meeting Participants and Research Focal Areas

One hundred people with a diverse array of affiliations (Figure 1)[4] participated in the meeting (see Appendix C for a list of all registrants). There were 28 oral presentations and 20 poster presentations. Summaries of the oral presentations are provided in the main body of this report; poster presentations are listed in Appendix A.

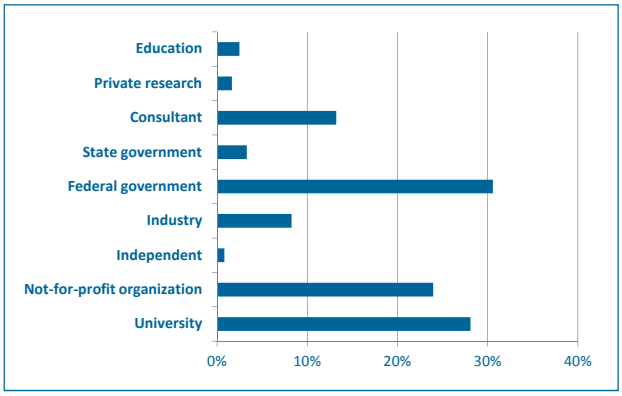


Figure 1: Meeting registrants, by affiliation (n=121)

Prior to the meeting, the Steering Committee requested that meeting participants provide descriptions of up to three marine mammal-related projects or programs for which they serve(d) as Principal Investigators (PIs). The Steering Committee received 53 project descriptions from 35 PIs. The project descriptions are provided in Appendix B of this report.

[4] The chart represents responses from 121 registrants, 98 of whom attended the meeting, 23 did not; 1 entry was a duplicate. The figure does not include responses from 3 late registrants.

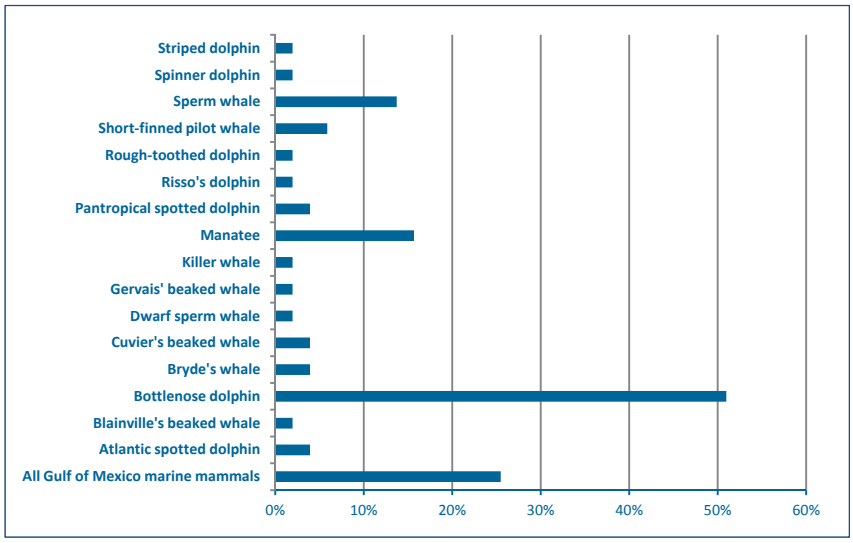


Figure 2: Focal species - Percent of responses (n=51)

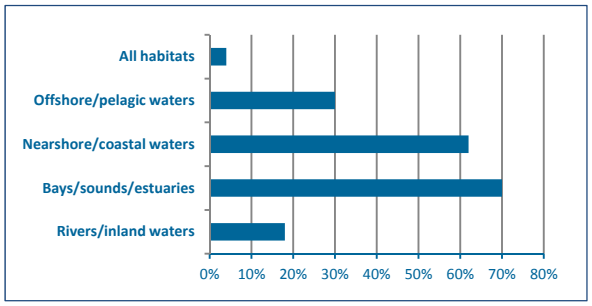


Figure 3: Focal habitats - Percent of responses (n=50)

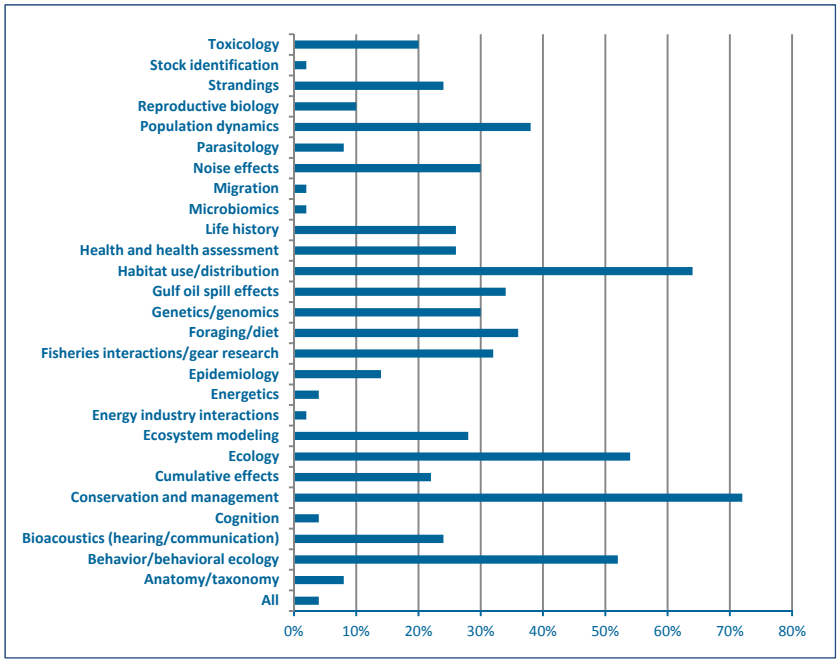


Figure 4: Research objectives - Percent of responses (n=50)

Figures 2, 3, and 4 summarize the types of information provided by the PIs on focal species, focal habitats, and research objectives.

OPENING REMARKS

Frances Gulland, Marine Mammal Commission

The Deepwater Horizon oil spill has brought some much-needed attention to the Gulf, but it is just one of many crises threatening marine mammals. Marine mammals face multiple threats, not only in the Gulf but worldwide. These include, for example, harmful algal blooms, increasing noise, and increasing ship traffic. We need to use the information gained from the Deepwater Horizon oil crisis and take a more synthetic approach to understanding the cumulative impacts of human actions and what we can do to minimize those impacts.

> *"As Winston Churchill said, never let a good crisis go to waste."*
>
> (Frances Gulland, Opening Remarks)

The 1989 Exxon Valdez oil spill taught us several things. First, we have no idea how to "restore" marine mammals injured or killed as a result of exposure to oil. Second, without adequate baseline data, we have no way of accurately assessing the full extent of injuries caused by a spill. Prevention is key, but we also need to have the right kind of information *before* a crisis arises if we are to be able to advise managers appropriately. The challenge looking forward, as a research community, is to improve both collaboration and communication—collaboration so that the science we conduct is not piecemeal, and communication with other scientists and with managers to ensure we are asking the right questions and collecting the right data.

OVERVIEW OF MARINE MAMMALS AND THREATS IN THE GULF OF MEXICO: THE BIG PICTURE

Laura Engleby, NMFS Southeast Regional Office

The Gulf of Mexico contributes significantly to the nation's overall economy. The Gulf region is comprised of 600,000 square miles of ocean in the U.S. EEZ, and the U.S. portion of the Gulf coastline extends 47,000 miles. Twenty-one million people live along the Gulf coast—more than a third of the total Gulf population—and the human population in the Gulf is increasing faster than the rest of the United States. The Gulf is one of the most heavily industrialized bodies of water in the world, and its economy is intertwined with its natural resource base—oil and gas reserves, commercial and recreational fisheries, wildlife tourism, and shipping.

There are 21 cetacean species in the Gulf, representing 56 stocks, all of which are managed by NMFS. The eastern Gulf is also home to the manatee, which is managed by the U.S. Fish and Wildlife Service (FWS). Bottlenose dolphins account for 36 of the cetacean stocks, with 31 found in bays, sounds, and estuaries, 3 in coastal waters, 1 on the Continental Shelf, and 1 in oceanic waters. Also found on the Continental Shelf are Atlantic spotted dolphins. The remaining 19 cetacean species/stocks occur in oceanic waters (Table 1).

All marine mammals in the Gulf of Mexico are protected under the Marine Mammal Protection Act (MMPA). Sperm whales and manatees are also protected under the Endangered Species Act (ESA). The goal of the MMPA is to conserve and protect marine mammals and the ecosystems upon which they depend. More specifically, the MMPA directs the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) to prevent stocks from declining to below their Optimum Sustainable Population (OSP), and to recover those that have. The goal of the ESA is to protect and recover imperiled species. Additionally, the National Environmental Policy Act (NEPA) directs federal agencies to ensure that federal agencies evaluate environmental impacts of various alternatives when making decisions. All federal agencies operating in the marine environment are users of environmental information and must

comply with the provisions of the MMPA, ESA, NEPA, and other applicable statutes. Therefore, research priorities should be linked to these legal mandates.

To comply with these mandates, managers need to understand threats to marine mammals and their individual and cumulative impacts. They must also develop ways to address those threats so as to balance healthy economies with healthy ecosystems and healthy marine mammal populations.

Table 1: Gulf of Mexico Marine Mammals
Bays/Sounds/Estuaries
Bottlenose dolphin (31 stocks)
Florida manatee (ESA-listed species)
Coastal waters (0-20 m)
Bottlenose dolphin (3 stocks)
Continental Shelf waters (20-200 m)
Atlantic spotted dolphin
Bottlenose dolphin
Oceanic waters (≥ 200 m)
Blainville's beaked whale
Bottlenose dolphin
Bryde's whale (proposed for ESA listing)
Clymene dolphin
Cuvier's beaked whale
Dwarf sperm whale
False killer whale
Fraser's dolphin
Gervais' beaked whale
Killer whale
Melon-headed whale
Pantropical spotted dolphin
Pygmy killer whale
Pygmy sperm whale
Risso's dolphin
Rough-toothed dolphin
Short-finned pilot whale
Sperm whale (ESA-listed species)
Spinner dolphin
Striped dolphin

Some of the more significant threats to Gulf marine mammals and their importance to the Gulf ecosystem—

- Oil and gas development - The Gulf offshore area (also referred to as the Outer Continental Shelf) accounts for 17% of total U.S. crude oil production[5]. Threats to marine mammals include seismic exploration, explosive platform removal, vessel and air traffic, and oil spills.
- Commercial shipping - Shipping activities are a significant contributor to the Gulf economy, with the Gulf having 13 of the 20 U.S leading ports. Shipping can result in vessel strikes, oil spills and other hazardous material discharges, habitat disruption due to dredging (to maintain shipping lanes), marine debris, sewage, and noise.
- Fisheries - Gulf commercial fisheries are some of the most productive in the world, landing $818 million in revenue in 2011 (primarily shrimp and menhaden). Recreational fishermen took more than 23 million trips in 2009, accounting for more than 44% of the U.S. recreational fishing catch (NMFS 2009). Threats include entanglement in or ingestion of fishing gear, declining prey stocks, vessel strikes, and illegal feeding by fishermen. Intentional harassment has also been observed toward dolphins that take bait or catch (depredation).
- Wildlife viewing and tourism - Annual revenues from watching wildlife are $6.5 billion, and wildlife viewing attracts more visitors than other wildlife activities (Stokes and Lowe 2013). There are no current statistics on marine mammal tourism but dolphin viewing supports a large industry in the Gulf and worldwide. In 1991, 60,000 people went on commercial dolphin tours; that number increased to over 500,000 by 2009 and is likely an underestimate (O'Connor et al. 2009). Threats from wildlife viewing include vessel strikes, illegal feeding, behavioral conditioning, and changes in distribution, all of which have implications for reproduction and health.

Information needs and approaches to enhance protections and recover marine mammals and their ecosystems include—

- Data on marine mammal abundance, habitat use, distribution, and behavior
- Data to help assess, understand, and mitigate threats from human activities (e.g., to address threats from tourism, more information is needed on viewing patterns by different tourism sectors and also on social attitudes and perceptions about marine mammals)

[5] http://www.eia.gov/special/gulf_of_mexico/

- Standardized data collection across the Gulf to facilitate comparative analyses while still allowing for innovation, and
- Ensuring that data informs management through structured decision-making, prioritization of data collection and species by managers, and the development of better metrics for determining progress and success.

There are several large-scale Gulf of Mexico initiatives in place or under development but none are focused on data needs for marine mammals. Moving forward, we need a region-wide action plan for marine mammals that will contribute to protecting and conserving marine mammal populations in the Gulf.

CURRENT MARINE MAMMAL RESEARCH AND MONITORING PROGRAMS

The objective of this session was to have invited presenters provide a brief overview of the types of research and monitoring programs being conducted in the Gulf, including information on program objectives, methods used, findings to date, how information is being used, future directions, and key data gaps.

I. ABUNDANCE, DISTRIBUTION, AND STOCK STRUCTURE

Moderator: Keith Mullin, NMFS Pascagoula Laboratory

SEFSC Research on Cetacean Abundance, Distribution & Stock Structure

Keith Mullin, NMFS Pascagoula Laboratory

NMFS's research in the Gulf of Mexico is directed at meeting the mandates of the MMPA to ensure that marine mammals remain a significant functioning of the ecosystem they inhabit. This requires information on the status of each stock relative to Optimum Sustainable Population (OSP). If a stock is below OSP, NMFS is required to take action to replenish the stock. Stocks are defined as a group of marine mammals of the same species in a common spatial arrangement that interbreed when mature. Functionally, these groups are delineated by a low rate of genetic exchange, are demographically independent, or, for management purposes, experience differential risks.

MMPA-mandated stock assessment reports require information on how each stock is defined as well as its range, population size, maximum net productivity rate, potential biological removal (PBR)[6], annual human-caused mortality and serious injury, and status. To gather this information, the NMFS Southeast Fisheries Science Center (SEFSC) conducts the following research activities (see also project descriptions by Hohn, Mullin, and Phillips in Appendix B)—

- Abundance surveys - aerial and vessel surveys to estimate and monitor abundance and distribution over time
- Stock Definition - genetics (using tissue samples), tagging, and photo-identification studies
- Habitat studies - using oceanographic and biological data from surveys and remote sensing, and
- Mortality assessments - using data collected by fisheries observers and through the stranding response program.

[6] PBR is defined in the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a stock while allowing that stock to reach or maintain OSP.

Methods used differ by habitat and, in some cases, species. Line transect surveys are used to collect data from ships and aircraft for large open habitats (e.g., oceanic and coastal shelf waters) to estimate density and abundance. Ship-based surveys are used to collect line transect data as well as biopsy samples, oceanographic data, and acoustic data. Capture-mark-recapture methods (including photo-ID) are used to estimate abundance of dolphins in bays, sounds, and estuaries, and to determine survival rates, identify residents individuals, and collect information on individual ranging patterns and habitat use (Conn et al. 2011, Melancon et al. 2011, Rosel et al. 2011). Remote biopsy sampling is used to on vessel surveys to collect samples for genetics (stock structure), contaminants, stable isotopes, and reproductive hormones (Sinclair et al. 2015).

Although some information is available on habitat partitioning in bay/sound/estuary stocks of bottlenose dolphins, more information is needed to determine whether the current stock designations (Figure 5) are accurate and realistic. In addition, very little information is available to determine whether the single stock designations for most of the oceanic cetacean species are appropriate. Genetic analyses may reveal intra-Gulf stock structure for certain species, such as the eastern and western genetic clusters found for Atlantic spotted dolphins (Viricel and Rosel 2014). The SEFSC will be examining genetic samples from pantropical spotted dolphins next.

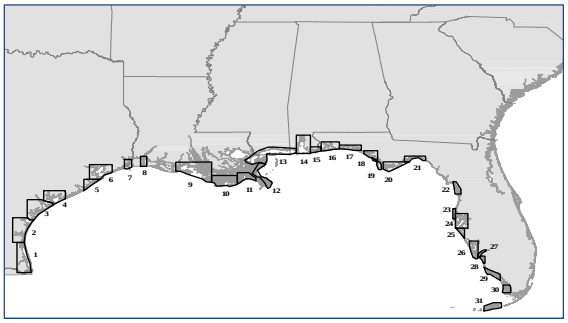


Figure 5: Map of northern Gulf of Mexico depicting the approximate boundaries of the 31 currently recognized bay, sound, and estuary stocks of bottlenose dolphins. (*Adapted from Vollmer and Rosel 2013*)

There are several challenges to estimating abundance and distribution of Gulf marine mammals. Most of the oceanic stocks are likely transboundary, occurring in waters of other countries (such as Mexico and Cuba) for which survey data are lacking. The Gulf is relatively small and so without data from the southern Gulf, abundance estimates derived from surveys conducted only in the northern Gulf are difficult to interpret. In addition, NMFS's guidelines for assessing marine mammal stocks suggest that abundance estimates and PBR be updated at least every eight years (Moore and Merrick 2011). Obtaining timely abundance estimates has been challenging for all stocks due to limited resources and infrastructure in the Gulf, but particularly for the stocks of bay/sound/estuary stocks of bottlenose dolphins.

Passive Acoustic Monitoring for Marine Mammals

John Hildebrand, Scripps Institution of Oceanography
With contributions from:
Natalia Sidorovskaia, University of Louisiana at Lafayette and Aaron Rice, Cornell University

Passive acoustic monitoring is an important complement to traditional visual surveys in the long-term monitoring of marine mammals, and an essential tool for detection of deep-diving marine mammals that is otherwise difficult using traditional surveys. Acoustic recorders can determine not only what species are present in an area but also, in some cases, how many animals are present. This kind of quantitative information can be used to determine marine mammal densities in an area, and with sufficient spatial coverage, can also be used for estimating abundance.

Towed acoustic recorders can be used to complement visual observations made during vessel surveys. Moored or "fixed" acoustic recorders may have more limited spatial coverage than towed arrays but

provide essentially continuous temporal coverage. This is particularly advantageous during an event such as an oil spill, because it allows researchers to track behavior over time in response to that event.

Mississippi Canyon, where the Deepwater Horizon spill occurred, is known as a high-use area for sperm whales (Jochens et al. 2008). In 2010, immediately after the spill, Scripps deployed a High-frequency Acoustic Recording Package (HARP) at a site near the well. That was followed by HARP deployments later in 2010 at four other sites in the Gulf to the west, east, and south of the spill site. At the same time, Cornell deployed 22 Marine Acoustic Recording Units (MARUs) in the same general areas. Some previous recordings using Ecological Acoustic Recorders (EARs) had also been made in the Mississippi Canyon area by researchers from the University of Louisiana's Littoral Acoustic Demonstration Center (LADC). (See project descriptions by Hildebrand and Sidorovskaia in Appendix B.)

Acoustic signals from the HARPs were analyzed to determine the presence of sperm whales in each area and over time. Sperm whales continued to be detected in this area after the spill, with some days having consistent sperm whale detections all day long.

To estimate densities of sperm whales and other vocalizing marine mammals around each HARP deployment, Hildebrand developed a model using best available information on the probability of sighting a group of animals, the average group size, and the probability of animals being vocal at any given time. Those estimates were then compared to NMFS-derived density estimates for the same areas based on visual survey data. The density estimates for the well site were consistently higher than other sites in which HARPs were deployed. As a next step, sightings and acoustic data can be used to test hypotheses regarding potential high-use areas and to help define overall distribution patterns. However, at present, spatial coverage is not adequate to derive abundance estimates.

Acoustic monitoring can also collect information on species that are difficult to detect visually, such as pygmy and dwarf sperm whales. The high-frequency, porpoise-like clicks made by these two *Kogia* species were detected, on average, about 1% of the time near the Mississippi Canyon and also seemed to exhibit a north-south gradient similar to sperm whales. Density estimates derived from acoustic detections were an order of magnitude higher than estimates based on visual observations.

Four species of beaked whales were detected acoustically in the Gulf. Three were known from other recordings (Gervais', Blainville's, Cuvier's), but a fourth species was detected in the Gulf with a similar "sweep" signal characteristic of beaked whales. The density of Gervais' and Cuvier's beaked whales was highest in the south, near the Dry Tortugas, which is opposite of what was seen for sperm whales. Detections also showed seasonal variations, with beaked whale presence in the northern Gulf highest during the winter months.

Gervais' beaked whale (*Mesoplodon europaeus*)
(*Credit: NMFS*)

Detecting dolphins from acoustic recordings is more difficult, as there are several closely related species. Delphinid clicks were detected near the well site in varying numbers, and clicks from at least four different *Stenella* species have been identified, with shifts in the occurrence of different species both seasonally and from year to year.

Future priorities for the Gulf include—

- Continuation of time-series data collection
- Increased effort in areas of significant human use not currently well sampled (such as deepwater non-slope areas, the western Gulf, and Mexican waters)
- Collection of acoustic (towed array) data during visual surveys to refine understanding of delphinid calls, and
- More tagging and tracking to refine density-estimation parameters.

The last two would be especially helpful in converting acoustic detections to quantitative estimates.

Sperm Whale Diving Behavior Reveals Changes in Benthic Foraging Around Macondo Spill Site

Bruce Mate, Oregon State University Marine Mammal Institute

(See also project description in Appendix B)

Sperm whale tagging has been conducted in the Gulf of Mexico for about eight years. The first five years of tagging was done from 2001-2005 under the Sperm Whale Seismic Study (Jochens et al. 2008), which was funded by the Minerals Management Service (now the Bureau of Ocean Energy Management; BOEM). Tagging of sperm whales was resumed during the spill and continued for an additional three years with funding from BP.

Sperm whale (*Physeter macrocephalus*)
(*Credit: NMFS*)

Sperm whales, like most mammals, consume approximately 4% of their body weight each day, or a ton of food daily for a 30-ton sperm whale. Sperm whales are gregarious, live in social units, and emit high-frequency clicks when foraging. Tags used for sperm whales were designed to collect information on vocalizations and dive parameters, including time of day, depth, and GPS location, with some of the more advanced tags also having accelerometers to detect feeding lunges. Tags stay on females for about six months and males about nine months. Limited volumes of data are transmitted periodically when whales are at the surface but more detailed data become available only upon release of the tag and subsequent retrieval.

Tags have provided information on more than 800 sperm whale dives. Contrary to previous belief, females that appear to be traveling together as a group at the surface dive asynchronously, to different depths and for different durations. One hypothesis that might explain this behavior is that whales spread out when food is scarce, yet keep track of one another and cluster where food is more abundant. In general, ranges of sperm whales overlap but individual whales appear to have different core areas.

Sperm whale dive behavior in the northern Gulf is highly variable, but a few patterns have emerged. Sperm whales travel on average about 35 miles per day and feed both at night and during the day, with dives reaching over a mile in depth and lasting longer than 75 minutes. Sperm whales appear to forage preferentially near the bottom, as indicated by frequent lunging and rolling. Data collected during and after the spill indicated that sperm whales appeared to be avoiding a large area centered on the spill site. This area experienced heavy amounts of oil discharge as well as dispersants and burn products that

settled at depth. Sperm whale dives in that area appear to have been primarily transitory, with limited foraging effort observed.

Biologists have difficulty determining the long-term impacts of events such as oil spills on marine mammals. But tagging represents a tool that can help us understand these impacts. For example, tagging data have shown that what was once a rich feeding area in the Mississippi Canyon for sperm whales is now experiencing limited use. The factors influencing changes in sperm whale diving and feeding behavior in that area need further investigation.

Monitoring Population Dynamics of the Florida Manatee

Leslie Ward-Geiger
Florida Fish and Wildlife Conservation Commission (FWCC), Florida Wildlife Research Institute (FWRI)

The Florida manatee monitoring program has been in place for over 30 years. The manatee monitoring plan's goal is "to effectively manage the population in perpetuity throughout Florida by securing habitat and minimizing threats." The plan strives to align research activities with key management objectives, which are to understand, describe, and monitor sustainable, healthy populations.

Florida manatee (*Trichechus manatus*)
(*Credit: FWCC/FWRI*)

The manatee research program focuses on methods to understand population dynamics, habitat needs, threats, and responses to management actions. Operationally, the program must be able to support timely, collaborative updates to the "core biological model" which is the population model used by the state to predict manatee abundance in the long term (Runge et al. 2007). From a planning perspective, it is important to understand that the various research projects conducted by the program are inter-related and require intermediate conceptual frameworks. That makes research conducted at the project level more effective and easier to manage.

Some of the methods that are used for population assessment and monitoring include carcass salvage, necropsy, and rescue; health assessments; aerial surveys; recaptures of marked individuals (photo-identification, genetics, PIT tags); and behavioral ecology (see also project descriptions by Ward in Appendix B).

Some research highlights—

- Annual mortality numbers and rescues have been tracked since 1974 and there has been a steady rise in mortality, with the current annual average (2009-2014) at 574 manatees per year (Table 2).
- Higher than average mortality years are attributed primarily to Unusual Mortality Events (UMEs). There have been nine UMEs since 1996, six due to red tide, two to cold stress, and one to a red tide repeat event.
- Health assessments provide critical baseline health information from live-captured manatees, and 263 health assessments have been conducted since 2008, in collaboration with numerous partner organizations.
- Annual aerial surveys have provided counts of manatees for both coasts as a proxy for abundance, but new aerial survey methods were initiated in recent years resulting in the first statewide abundance estimate of 6,350 manatees (Martin et al. 2015).

- Over 3,400 manatees are in the state-wide photo-identification catalog and data are used to estimate survival and reproduction rates and to study movements, habitat use, site fidelity, and behavior, and to model population dynamics (Kendall et al 2013).
- Genetics samples have been acquired for over 1,000 individual manatees.
- Loss of warm-water habitat is a significant threat to manatees, and water temperatures are monitored throughout the state during winter months.

Table 2: Manatee Deaths and their Causes, 2009-2014

Year	Water craft	Flood Gate/ Lock	Other Human	Perinatal	Cold Stress	Natural	No Necropsy or Not Recovered	Undet/ Too Decomp	Undet/ Other	Total
2014	68 (18%)	3	9	99	26	26	16	88	36	371
2013	62 (8%)	5	10	129	39	196	100	129	149	830
2012	72 (24%)	12	8	70	30	58	8	87	37	392
2011	74 (19%)	2	4	78	114	40	12	99	16	453
2010	66 (10%)	1	5	97	282	23	67	183	25	766
2009	87 (23%)	5	7	114	56	37	10	90	13	429
5-year avg.	84 (17%)	5	6	97	104	70	39	117	48	574

Future needs and goals include—

- Clarifying the objectives of the carcass recovery and necropsy program
- Focusing data collection to support timely updates of population model parameters
- Assessing sampling effort needs for projects such as photo-ID and genetics and adjusting effort as appropriate
- Evaluating the integration of inter-dependent information components and investing in data management, and
- Deriving annual estimates of abundance using an integrated population modeling approach.

The U.S. Geological Survey (USGS) Sirenia Project works closely with FWRI on manatee research. The USGS has a project funded by BOEM that is looking at manatee movements, distribution, and habitat use in the northern Gulf and how those characteristics might be affected by energy-related activities. The Sirenia Project is compiling a cooperator database for people interested in sightings and strandings in the northern Gulf and is also compiling a database of historical sightings to update a landmark 2005 paper that summarized sightings chronologically. (See also project descriptions by Slone in Appendix B.)

II. HEALTH, STRANDINGS, AND LIFE HISTORY

Moderator: Randall Wells,
Chicago Zoological Society/Sarasota Dolphin Research Program

Overview of the Gulf of Mexico Marine Mammal Stranding Network

Erin Fougeres, NMFS Southeast Regional Office

The Marine Mammal Health and Stranding Response Program (MMHSRP) was established in 1992 under Title IV of the MMPA. The objectives of the program are to collect and disseminate data on health and health trends; correlate heath and trends data with biological, physical, and chemical environmental

parameters; and coordinate effective responses to unusual mortality and morbidity events. Components of the program include stranding response, rehabilitation and release, disentanglement, disease and unusual mortality event investigations, biomonitoring and health assessments, tissue banking and associated quality assurance, data management, and administration of the Prescott Grant program.

Stranded marine mammals are those animals found sick, injured, or dead along the beach. Strandings also include animals that are entrapped or disoriented and unable to return to their natural habitat without assistance. Marine mammals may strand as single individuals, mom and calf pairs, or mass strandings involving two or more animals that are not a mom/calf pair. Under the MMPA, strandings require investigation by trained and authorized marine mammal stranding network personnel. The majority of responders are volunteers or employees of non-profit organizations (authorized through stranding agreements issued under Section 112(c) of the MMPA) or local, state, or federal agencies (authorized under Section 109(h)). Additional permits are required to respond to marine mammals listed under the ESA (such as sperm whales and manatees).

The Gulf of Mexico Marine Mammal Stranding Network (Table 3) consists of 10 stranding agreement holders, one organization whose stranding agreement is under review, and 3 designee organizations. In addition, there are two primary state agencies that have dedicated stranding response capabilities and several other state agencies that assist as needed. There are also several authorized rehabilitation facilities, one of which is not involved in stranding response. (See project descriptions by Carmichael (AL), Smith (LA), Solangi (MS), and Whitehead (TX) in Appendix B.)

Table 3: Gulf of Mexico Marine Mammal Stranding Network Members

Organization	Geographic Areas of Responsibility	Stranding Response	Rehab Facility
Texas			
Texas Marine Mammal Stranding Network (TMMSN)	Texas	√	√
Texas State Aquarium (TMMSN designee)	Texas		√
SeaWorld San Antonio (TMMSN designee)	Texas	√	
Louisiana			
Louisiana Department of Wildlife and Fisheries	Louisiana	√	
Audubon Aquarium of the Americas	Louisiana	√	√
Mississippi			
Institute for Marine Mammal Studies	Mississippi (and Alabama for live stranded animals only)	√	√
Alabama			
Dauphin Island Sea Lab	Alabama	√	
Florida (Gulf Coast)			
Emerald Coast Wildlife Refuge	Escambia, Santa Rosa, Okaloosa, and Walton counties	√	
Gulf World Marine Park	Walton, Bay, Gulf, Franklin, and Wakulla counties	√	√
University of Florida (proposal under review)	Taylor, Dixie, and Levy counties	√	
SeaWorld Orlando	Florida		√
Clearwater Marine Aquarium	Levy, Citrus, Hernando, Pasco, Hillsborough, and Pinellas counties		√
FWCC Marine Mammal Pathobiology Lab	Manatee through Citrus counties	√	
Florida Aquarium	Tampa Bay area	√	√ (manatees only)

Table 3: Gulf of Mexico Marine Mammal Stranding Network Members			
Organization	**Geographic Areas of Responsibility**	**Stranding Response**	**Rehab Facility**
Mote Marine Lab	Manatee, Sarasota, Charlotte, and northern Lee counties	√	√
Chicago Zoological Society/Sarasota Dolphin Research Program (Mote Marine Lab designee)	Manatee, Sarasota, Charlotte, and northern Lee counties	√	
FWCC Southwest Field Lab	Charlotte, Lee, and Collier counties	√	
Marine Mammal Conservancy	Southern Dade and Monroe counties through Key West	√	√

External funding for the Gulf stranding network is primarily from the Prescott Grant program, with additional funds provided since 2010 by the Deepwater Horizon oil spill response and natural resource damage assessment. Funding levels are inconsistent by year and also vary by state based on amount of coastline and number of stranded animals.

Key needs for the future include—

- Enhanced capacity for reporting, response and recovery in remote areas (e.g., southern Texas, western Louisiana, big bend Florida, southern Collier/northern Monroe Counties in Florida)
- Increased standardized data collection, diagnostic and analytical capacity Gulf-wide
- More consistent funding (e.g., through enhanced fundraising capabilities, increased funding opportunities, and greater success with private and Federal dollars)
- Increased communication and sharing of information/data across the Gulf, between network partners and with NOAA, including collaborative databases
- Integrating stranding data with other health datasets
- Increased capacity to monitor and respond to free-swimming, entangled small cetaceans
- Increased capacity to monitor animals that are rehabilitated and released or deemed appropriate for immediate release from the stranding site, and
- Increased capacity to respond to mass strandings, large whales, Unusual Mortality Events, and natural/anthropogenic disasters.

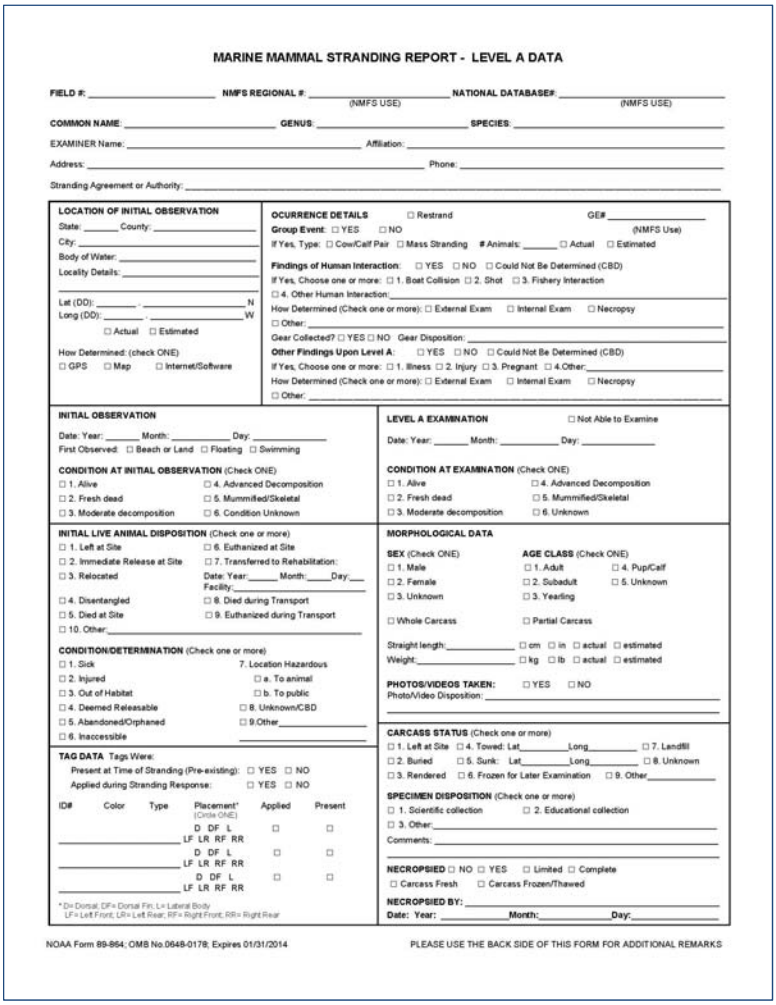
Overview of Cetacean Stranding Data from the Gulf of Mexico: 2000-2014

Jenny Litz, NMFS Southeast Fisheries Science Center
(See also project description in Appendix B)

Stranding data are important to answer a wide range of questions regarding species distribution, stock structure, health and disease, life history parameters (such as age, diet, and reproductive biology), anatomy and physiology, human interactions (such as fishery interactions or vessel strikes), and other threats to marine mammal populations. The consistent collection of stranding data over the long-term is critical for informing management decisions, identifying unusual events, and understanding changes to health and mortality trends.

Stranding network members are required to submit certain basic data to NMFS for all stranded marine mammals. Those data, termed Level A data, include the species and type of stranding, date and location of the stranding event, the condition of the animal(s), whether there was indication of human interaction, and disposition of the animal (Figure 6). NMFS provides training and instructions for completing the Level A data form and validates all data received. NMFS encourages the collection of

more detailed data on stranded animals (Level B and C data) including body measurements, gross necropsy reports, and results of tissue analyses, which may be required during investigation of certain events, such as unusual mortality events, oil spills, mass strandings, etc.



MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ NMFS REGIONAL #: _____ (NMFS USE) NATIONAL DATABASE#: _____ (NMFS USE)

COMMON NAME: _____ GENUS: _____ SPECIES: _____

EXAMINER Name: _____ Affiliation: _____

Address: _____ Phone: _____

Stranding Agreement or Authority: _____

LOCATION OF INITIAL OBSERVATION
State: _____ County: _____
City: _____
Body of Water: _____
Locality Details: _____
Lat (DD): _____ - _____ N
Long (DD): _____ - _____ W
☐ Actual ☐ Estimated
How Determined: (check ONE)
☐ GPS ☐ Map ☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE# _____ (NMFS Use)
Group Event: ☐ YES ☐ NO
If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ Actual ☐ Estimated
Findings of Human Interaction: ☐ YES ☐ NO ☐ Could Not Be Determined (CBD)
If Yes, Choose one or more: ☐ 1. Boat Collision ☐ 2. Shot ☐ 3. Fishery Interaction
☐ 4. Other Human Interaction: _____
How Determined (Check one or more): ☐ External Exam ☐ Internal Exam ☐ Necropsy
☐ Other: _____
Gear Collected? ☐ YES ☐ NO Gear Disposition: _____
Other Findings Upon Level A: ☐ YES ☐ NO ☐ Could Not Be Determined (CBD)
If Yes, Choose one or more: ☐ 1. Illness ☐ 2. Injury ☐ 3. Pregnant ☐ 4.Other: _____
How Determined (Check one or more): ☐ External Exam ☐ Internal Exam ☐ Necropsy
☐ Other: _____

INITIAL OBSERVATION
Date: Year: _____ Month: _____ Day: _____
First Observed: ☐ Beach or Land ☐ Floating ☐ Swimming
CONDITION AT INITIAL OBSERVATION (Check ONE)
☐ 1. Alive ☐ 4. Advanced Decomposition
☐ 2. Fresh dead ☐ 5. Mummified/Skeletal
☐ 3. Moderate decomposition ☐ 6. Condition Unknown

LEVEL A EXAMINATION ☐ Not Able to Examine
Date: Year: _____ Month: _____ Day: _____
CONDITION AT EXAMINATION (Check ONE)
☐ 1. Alive ☐ 4. Advanced Decomposition
☐ 2. Fresh dead ☐ 5. Mummified/Skeletal
☐ 3. Moderate decomposition ☐ 6. Unknown

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)
☐ 1. Left at Site ☐ 6. Euthanized at Site
☐ 2. Immediate Release at Site ☐ 7. Transferred to Rehabilitation:
☐ 3. Relocated Date: Year:_____ Month:____Day:___ Facility:_____
☐ 4. Disentangled ☐ 8. Died during Transport
☐ 5. Died at Site ☐ 9. Euthanized during Transport
☐ 10. Other:_____
CONDITION/DETERMINATION (Check one or more)
☐ 1. Sick 7. Location Hazardous
☐ 2. Injured ☐ a. To animal
☐ 3. Out of Habitat ☐ b. To public
☐ 4. Deemed Releasable ☐ 8. Unknown/CBD
☐ 5. Abandoned/Orphaned ☐ 9.Other_____
☐ 6. Inaccessible _____

MORPHOLOGICAL DATA
SEX (Check ONE) AGE CLASS (Check ONE)
☐ 1. Male ☐ 1. Adult ☐ 4. Pup/Calf
☐ 2. Female ☐ 2. Subadult ☐ 5. Unknown
☐ 3. Unknown ☐ 3. Yearling
☐ Whole Carcass ☐ Partial Carcass
Straight length:_____ ☐ cm ☐ in ☐ actual ☐ estimated
Weight:_____ ☐ kg ☐ lb ☐ actual ☐ estimated
PHOTOS/VIDEOS TAKEN: ☐ YES ☐ NO
Photo/Video Disposition: _____

TAG DATA Tags Were:
Present at Time of Stranding (Pre-existing): ☐ YES ☐ NO
Applied during Stranding Response: ☐ YES ☐ NO

ID#	Color	Type	Placement* (Circle ONE)	Applied	Present
_____			D DF L LF LR RF RR	☐	☐
_____			D DF L LF LR RF RR	☐	☐
_____			D DF L LF LR RF RR	☐	☐

*D= Dorsal, DF= Dorsal Fin, L= Lateral Body LF= Left Front, LR= Left Rear, RF= Right Front, RR= Right Rear

CARCASS STATUS (Check one or more)
☐ 1. Left at Site ☐ 4. Towed: Lat_____Long_____ ☐ 7. Landfill
☐ 2. Buried ☐ 5. Sunk: Lat_____Long_____ ☐ 8. Unknown
☐ 3. Rendered ☐ 6. Frozen for Later Examination ☐ 9. Other_____
SPECIMEN DISPOSITION (Check one or more)
☐ 1. Scientific collection ☐ 2. Educational collection
☐ 3. Other: _____
Comments: _____
NECROPSIED ☐ NO ☐ YES ☐ Limited ☐ Complete
☐ Carcass Fresh ☐ Carcass Frozen/Thawed
NECROPSIED BY: _____
Date: Year: _____Month:_____Day:_____

NOAA Form 89-864; OMB No.0648-0178; Expires 01/31/2014 PLEASE USE THE BACK SIDE OF THIS FORM FOR ADDITIONAL REMARKS

Figure 6: NMFS Level A data form (*Credit: NMFS*)

An analysis of Level A cetacean stranding data from the Gulf collected from 2000-2014 showed that the Gulf averages 375 strandings per year, with 85% of strandings involving bottlenose dolphins. The highest number of strandings occur from January to April, with a peak in March. Other species that typically strand include short-finned pilot whales, rough-toothed dolphins, pygmy and dwarf sperm whales, spotted dolphins, other small cetaceans, and sperm whales. Strandings of beaked and baleen whales are rare (~1%). Mass strandings of pilot whales and rough-toothed dolphins are relatively common on the west coast of Florida (especially in the southwest) but they occur throughout the northern Gulf. Less than 25% of bottlenose dolphins strand alive or freshly dead, whereas other species tend to strand alive or freshly dead more frequently. More than half of live-stranded animals either die or are euthanized on the beach or in rehab. Those that survive are either released from the site (17%) or after some amount of rehab (~6%), or remain in captivity. About 75% of freshly dead animals were necropsied.

Human interactions are a major focus of Level A investigations. However, for most stranded animals, responders are unable to determine whether signs of human interactions were present, either because the animals were too decomposed or the markings were unidentifiable. For the 8% of animals scored as positive for human interactions, 38% involved fishery interactions, 13% involved vessel strikes, 5% were shot, and 44% had signs of other types of human interaction.

The largest die-off of bottlenose dolphins ever recorded for the Gulf began in February 2010 and is still ongoing[7]. The Northern Gulf of Mexico Cetacean Unusual Mortality Event covers an area from the Florida panhandle to the Louisiana-Texas border. Approximately 1,350 cetaceans have stranded since 2010, 87% of which were bottlenose dolphins. Most animals (94%) stranded dead, and over 30,000

[7] http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm

tissue samples have been collected. Researchers have ruled out morbillivirus and biotoxins as primary causes. Analysis of samples collected through June 2013 showed that there were multiple demographic clusters of dolphin mortalities (Venn-Watson et al. 2015), and that the largest prolonged cluster was in Barataria Bay, Louisiana, in August 2010-2011. Barataria Bay was one of the most heavily oiled areas during the Deepwater Horizon oil spill.

A separate UME was declared in Texas in 2011[8], and that investigation is still ongoing. It involved 126 bottlenose dolphins, with a large number of juveniles and yearling age classes. There were concurrent harmful algal blooms and mortalities of other marine and terrestrial species, but biotoxin levels in dolphin tissues were at baseline levels except for brevetoxin. NMFS is continuing to investigate all potential contributing factors including the role of harmful algal blooms.

To maximize the information gained from stranding events, there is a continued need for—

- Enhancing the capacity of the Gulf stranding network
- Continuing long-term standardized data collection
- Increasing diagnostic and analytical capacity Gulf-wide
- Data sharing and collaborative databases among NOAA, the stranding network partners, and researchers with access to Level B and C data, and
- Integrating stranding data with other health and environmental datasets.

Bottlenose Dolphin Research on Florida's West Coast: 4+ Decades of Research, 5 Generations of Dolphins, and 3 Generations of Scientists

Randall Wells and the staff, students, and collaborators of the Chicago Zoological Society's (CZS) Sarasota Dolphin Research Program (SDRP) (see also project description in Appendix B)

Bottlenose dolphin research was initiated in Sarasota Bay, Florida, in 1970. The research started with a tagging program based out of Mote Marine Lab, working from Tampa Bay to Charlotte Harbor. Tagging showed localized movements of dolphins in the area, which set the stage for further research. Years of study have shown multi-generational, multi-decadal, year-round residency of dolphins in the Sarasota Bay area (Figure 7). The current community is comprised of about 160 dolphins spanning five concurrent generations. About 96% of dolphins that are more than 15 years old have been seen for 15 to 40 years; these are long-term residents to the area. These long-term residency findings have set the stage for longitudinal research, especially the ability to repeatedly and predictably find identifiable animals of known age, sex, and relationships in shallow, sheltered waters.

Study areas include the following—

- Movements, ranging patterns, habitat use, population definition
- Life history, genetics, and factors affecting survivorship and reproductive success
- Foraging ecology
- Behavior, social structure and communication
- Health, body condition, environmental contaminants
- Human interactions, and
- Technology development and testing.

[8] http://www.nmfs.noaa.gov/pr/health/mmume/bottlenosedolphins_texas.htm

The program also facilitates transferring technology and expertise to other populations, species, and situations around the world.

A variety of research methods and tools are used to study Sarasota Bay dolphins. Photo-identification has been used since 1977 using nicks and notches on dorsal surface to reliably identify individual animals. These data provide information on abundance, movements, and reproductive success. Photographic identification also allows for monitoring of human interactions, which is of increasing concern around much of the southeastern United States.

Figure 7: Multi-generational pod of bottlenose dolphins in Sarasota Bay: Photo taken in 2012, y.o. = years old
(*Credit: R. Wells, CZS/SDRP*)

Sarasota Bay dolphins, like other dolphin populations, face a variety of threats both concurrently and cumulatively, including disease, failure to thrive, harmful algal blooms, sharks, stingrays, hurricanes, entanglement in commercial and recreational fishing gear, human provisioning, disturbance from vessels, coastline construction, industrial activities, marine construction, pesticides, and oil spills. Population viability analyses can help to understand the individual impacts of these threats and what would happen to the population if some of the threats were removed.

Other tools used to study bottlenose dolphins in Sarasota Bay include—

- Lateral photos and unmanned aerial vehicle images to assess body condition remotely
- Health assessments to study body and health condition, contaminants, biotoxins, life history, and hearing
- Photo-identification and capture-release studies to understand population structure
- Remote biopsy sampling to collect samples for genetics, contaminants, stable isotopes, and hormones
- Focal animal observations to record and interpret behavior patterns
- Electronic tagging to track movement patterns and study diving and foraging behavior
- Prey fish sampling and analysis of stomach contents from stranded animals to understand behavior, habitat use, and population dynamics relative to prey
- Harmful algal bloom sampling to understand impacts of red tide events on dolphin abundance, reproduction, movements, and feeding
- Analysis of stranded animals to understand and minimize human-caused sources of mortality
- Intervention and rescue of stranded animals, and
- Tagging and tracking of animals that have been released after rehabilitation.

The program has been instrumental in increasing conservation capacity in the region and throughout the world. The program provides graduate students and undergraduate interns with data collection opportunities, data, samples, and guidance on research. The program also serves to educate the public and raise awareness regarding threats associated with feeding and human interactions, in coordination with the NMFS Southeast Regional Office. The program assists in research and health assessments in other areas, and the Sarasota Bay population serves as a reference population for comparative studies. The program also provides opportunities for other researchers to "piggy-back" on the work being conducted without additional risk to the dolphins.

Observations and recommendations for bay, sound, and estuary, and coastal dolphin research—

- Available information is inadequate for appropriate management of many inshore dolphin stocks.
- More effort is needed to ensure that data required for management continues to be up-to-date and does not become obsolete.
- Efforts should be scaled relative to the nature and urgency of needs, the availability of resources, and the acceptability of risks to the animals.
  - Photo-identification presents the least risk to dolphins and provides the most important, basic data on abundance, distribution, residency, habitat use, survivorship, and reproductive rates.
  - Biopsy darting is low risk but provides genetics and stable isotopes for stock assignment, contaminant loads, and hormone levels.
  - Remote assessment of body condition is potentially a viable tool prior to, or in lieu of, more complex and risky work that involves capture-release for health assessment.
  - If capture-release is used for health assessment, telemetry tags should be used to help define stock boundaries.
- Collaborations and leveraging opportunities are critical for enhancing research beyond the capacity of an individual program.

The Gulf of Mexico Dolphin Identification System (GOMDIS) is an effort to compile as many dolphin photo-identification catalogs as possible from around the Gulf and make them available in an online repository so that they can be used to track individuals around the Gulf. There is buy-in from more than 20 groups in the United States, and Mexico and Cuba are also participating (see also project description by Wells in Appendix B).

Bottlenose Dolphin Health Assessment Studies

Lori Schwacke, NOAA National Ocean Service (NOS), National Centers for Coastal Ocean Science
(See also project description in Appendix B)

Health assessments are used by NOAA to identify and understand population stressors, mitigate their effects or plan more effective conservation measures, and in response to certain management drivers (e.g., MMPA, ESA, NOAA's Ocean and Human Health initiative, and, more recently, for Natural Resource Damage Assessments - NRDAs).

NOAA has taken a tiered approach to health assessment—

- Tier 1: Hazard identification - investigations of stranded animals and environmental monitoring.
- Tier 2: Exposure (and effects) assessment - photographic monitoring and remote biopsy tissue sampling.
- Tier 3: Effects (and exposure) assessment - Capture-release health assessment, tagging, and longitudinal photographic monitoring.

Capture-release health assessments involve large teams of researchers using multiple vessels (Figure 8). A large net is used to encircle one or more dolphins in shallow water. The team then enters the water and once the dolphin is disentangled from the net and restrained, blood is collected and vital signs are assessed. The dolphin is then brought up onto a specially designed platform on a boat for further examination. This include morphometrics, swab samples of the genitals and blowhole, blubber biopsies, ultrasound, and more recently, additional assays such as dental x-rays. Samples are processed on the boat for timeliness and quality control purposes.

Figure 8: Team of researchers conducting a health assessment on a bottlenose dolphin (*Credit: NMFS/NOS*)

Diagnostics include a physical exam, ultrasound, mass:length ratio, complete blood count (CBC)/blood chemistry/blood gases, serology, pathogens, endocrinology, immunology, urinalysis, skin and oral assessment, biotoxin and contaminant measures, and blowhole swabs. Most of these diagnostics can only be obtained by capturing and restraining animals. Health assessments conducted on bottlenose dolphins in the Southeast have used standardized protocols and established laboratories for sample analysis. The pooling of available samples has resulted in the establishment of reference intervals for many health parameters, such as CBC, serum chemistry, mass:length ratio, and also baseline levels for persistent organic pollutants (POPs) including polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and a suite of organochlorine pesticides.

Health assessments have been conducted on bottlenose dolphin populations in various locations on the east coast of the United States and also in the Gulf. The first assessments to be conducted in the Gulf were in Sarasota Bay, Florida (1987-present), Mississippi Sound, Mississippi (1982-83), and Matagorda Bay, Texas (1992). More recently assessments have been conducted in St. Joseph Bay, Florida (2005-06), Barataria Bay, Louisiana (2011, 2013, 2014), and Mississippi Sound (2013), as well as continued studies in Sarasota Bay.

Notable findings published to date include—

- Florida *Tursiops* populations are exposed to multiple biotoxins (Schwacke et al. 2010, Twiner et al. 2011).
- Morbillivirus circulates in northern Gulf *Tursiops* stocks (Rowles et al. 2010).
- Highest POP concentrations in *Tursiops* are found along mid-Atlantic coast (Kucklick et al. 2011, Balmer et al. 2011)
- POP concentrations in *Tursiops* vary with sex, reproductive status, and temporally, and there is a correlation between concentration in blubber versus blood (Yordy et al. 2010).
- Lung, adrenal health effects, and poor body condition were found in *Tursiops* following oil exposure (Schwacke et al. 2013).

The future vision for health assessments is to obtain more information from remote sampling, including biopsy, breath, and tagging. This would minimize the need for capture-release health assessments because they represent higher risk to dolphins and to the team, and because of the difficult logistics and high costs. We also need coordinated data management, mapping, and spatial/temporal analysis to maximize the information gained from available samples.

Ongoing efforts that we should support across tiers include—

- Tier 1 - Coordinated surveillance through the Marine Mammal Health Monitoring and Assessment Platform (Health MAP) and NOS Coastal Intelligence.

- Tier 2 - Photo-ID through GOMDIS, the Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP), and GCOOS, and also remote biopsy through HealthMAP.
- Tier 3 - Capture-release through HealthMAP, and longitudinal monitoring through GoMDIS and GCOOS.

III. UNDERSTANDING EFFECTS OF HUMAN ACTIVITIES ON MARINE MAMMALS

Moderator: Laura Engleby, NMFS Southeast Regional Office

Epidemiological Studies on Biological and Chemical Effects on Cetaceans

Teri Rowles, NMFS Office of Protected Resources

The MMHSRP supports epidemiological studies that integrate information on marine mammal health and health trends, abundance, distribution, and life history with environmental parameters. Marine mammal health and life history data are derived from a variety of sources including strandings, live-capture health assessments, by-caught animals, and remote sampling of wild populations. Statistical modeling is then used to assess population risk and impact.

Epidemiological studies seek to understand the connection between the source of a perturbation, the exposure pathway, and its ultimate effect on an individual or population. This is achieved for wildlife populations by integrating information across data sets and populations to investigate both individual events and comparisons between events. Care must be taken to collect as much information as possible from each animal even though, in some cases, its immediate use may not be apparent. Baseline studies are key, as well as the use of standardized procedures for sample collection, handling, storage, and archival, as well as the use of common terminologies. Having archived data and samples allow researchers to conduct retrospective analyses and comparisons across geographic boundaries. These types of analyses are becoming increasingly important given increasing levels of human activities in the marine environment, and require strong collaborations between government, academic, private, and non-profit entities.

The benefits of an epidemiological approach include being able to assess status and trends in the face of change and to identify and predict possible causes of change. It also allows scientists and managers to detect emerging problems, assess the individual and cumulative impacts of human activities, evaluate the effectiveness of mitigation or restoration efforts, and recommend actions to reduce risks and promote recovery. Examples of where this approach has been used include studies on the effects of harmful algal blooms on the U.S. west coast (by the Wildlife Algal-toxin Research and Response Network; WARRN-West) and the identification of unique contaminant "signatures" associated with populations of bottlenose dolphins in the southeast and Gulf of Mexico (Kucklick et al. 2011; Figure 9). Two collaborative programs between NMFS and the National Institute of Standards and Technology (NIST) that have helped developed reference materials and analytical standards for marine mammals include the Analytical Quality Assurance program for chemical analyses (focusing on persistent organic pollutants and trace elements) and the National Marine Mammal Tissue Bank (NMMTB).

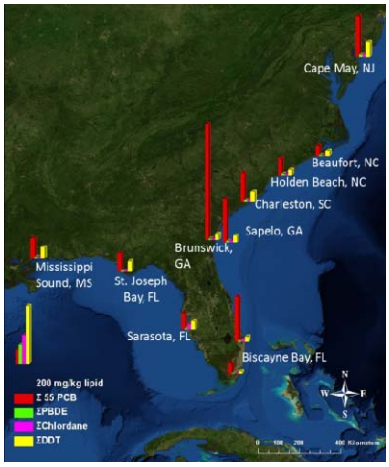


Figure 9: Contaminant signatures for bottlenose dolphin stocks
(*Credit: Kucklick et al. 2011*)

Health MAP is a new initiative being piloted on the West Coast that will integrate high quality marine mammal health data collected from stranded and wild animals to identify and track trends across regions to answer scientific, policy, and public questions. Its goal is to apply an ecosystem-based approach to provide bigger picture situational awareness and predictability based on coinciding changes in ocean conditions, prey, and marine mammal health. It also seeks to engage and educate the public regarding the relevance of marine mammal and ocean health to their interests, health, and welfare. Other efforts to develop data standards and databases to facilitate integration of ocean health and environmental data include the national and regional ocean observing systems (e.g., GCOOS, OBIS-SEAMAP, the Emergency Response Management Application (ERMA), the Wildlife Health Information Sharing Partnership Event Reporting System (WHISPers), the Marine Sample Tracking & Analytical Reporting (Marine STAR) database, and the National Environmental Public Health Tracking Network).

Future directions for expanded epidemiological analyses in the Gulf of Mexico include—

- Enhanced preparedness and response, particularly the ability to work across regions and networks to address common problems (e.g., oil spills and extreme weather events)
- Further development of the Marine Mammal HealthMAP
- Animal/sample/analytical and data standards
- Marine mammal health network of collaborators
- Training
- Interdisciplinary approach with integrated and interoperable databases
- Specimen and data archival and tracking system, and
- Research, development, validation and technology transfer of new methods.

A question was asked about whether mortalities associated with the northern Gulf of Mexico UME before and after the Deepwater Horizon oil spill could be partitioned out; Dr. Rowles referred the audience to a recent paper by Venn-Watson et al. (2015) that identified demographic clusters of bottlenose dolphins historically and within the UME. The authors identified a cluster in northern Louisiana and Mississippi during March 2010-May 2010 that had different characteristics from other clusters identified during the UME timeframe. Additional analyses are in progress.

Variability in the Gulf of Mexico's Marine Acoustic Environment

Christopher Clark, Cornell University

Human activities pose a risk in the marine environment over enormous temporal and spatial scales, and researchers and managers are working to understand the significance of these activities to both individual marine mammals and populations. Marine vertebrates rely on hearing and there is increasing evidence that there are a variety of mechanisms by which invertebrates can also sense sound. Each species of marine mammal has a different acoustic "space" defined by the range of frequencies that it can detect, the distance at which it can detect that sound, and time. This acoustic space is a component of each species' natural habitat, and marine mammals require a healthy acoustic habitat in which to live. Research is being conducted that is helping us understand the relationship of marine mammals to their acoustic habitat, and how that habitat is being affected by human activities. Two primary sources of sound that affect marine mammals are commercial ship traffic and seismic airgun surveys.

Large commercial vessels have transponders that are used to track their position and movements. The data from these transponders have been used to develop sound maps and animations that show the acoustic footprint of the low-frequency sound generated by these vessels as they move through

important marine mammal habitats. For example, the aggregate background noise in waters off Boston — important right whale feeding habitat in the Gulf of Maine — is roughly two to three orders of magnitude more noisy in the low-frequency range (the range at which baleen whales are most sensitive) than it was one hundred years ago. The sound generated by these vessels shrink the acoustic space over which whales can communicate. Low-frequency sound, in particular, can travel very effectively over a great distance in the ocean.

Figure 10: A seismic vessel shooting a 3D marine survey
(*Credit: Western Geophysical*)

Seismic airgun surveys are used in oil and gas exploration and geophysical research (Figure 10) and generate a high pulse of low-frequency energy roughly every 10 seconds. Airguns can be detected at distances much farther than the distances at which seismic operators are required to impose mitigation measures for marine mammals. Fin and humpback whales have been reported to alter their communications by reducing calls when airguns are nearby and resuming calls when the seismic survey vessel has moved away. This is evidence of a biologically significant behavioral response to airguns, but the population-level significance of these behavioral responses are unknown. Studies of ambient noise levels in Baffin Bay before and during a seismic survey indicate that in addition to the impulsive sounds generated every 10 seconds, there are reflections of low-frequency sounds detected between pulses. Seismic surveys were halted temporarily during the Deepwater Horizon event, but were resumed in November 2010. Acoustic recorders detected seismic reflections from a multi-vessel "coiled" seismic survey in the central northern Gulf of Mexico as far away as the western edge of the Gulf and the Yucatan Peninsula off Mexico.

Tracking and synthesis of cumulative noise levels over time can help determine biologically important sound levels. Tools that are used include graphical depictions, or conceptualizations, of sound that can indicate the scale of various sound sources and the mechanisms, or "recipes", used to process sound recordings that help to identify what species are present. Because of the large amounts of data being collected around the world, collaborations are critical, as are data standards and open-access data systems and databases. Sound propagation can now be modeled in real-time using high-performance computers to process large amounts of aggregate data. The technologies and automated process capabilities exist and there is a large degree of public interest in this issue. However, we must determine if people in the Gulf are truly interested in addressing sound as a component of a sustained, healthy ocean ecosystem.

Recreational Interactions - Growing Threats to Gulf Marine Mammals

Katie McHugh, Chicago Zoological Society / Sarasota Dolphin Research Program

Nearshore and coastal habitats throughout the Gulf of Mexico are adjacent to areas of high human population. The high degree of overlap with human activities results in concern for both bottlenose dolphins and manatees, both of which have documented impacts from recreational fishing, boating, and tourism, including mortalities, injuries and harassment/disturbance. Interactions occur throughout the

northern Gulf, and are increasing. Florida is a hot spot with respect to both research being conducted and known interactions. The large variety of user groups and stakeholders and multiple management jurisdictions involved in such interactions makes finding solutions challenging from a monitoring, management, and mitigation perspective.

Human activities of concern for bottlenose dolphins include—

- Recreational fisheries - Interactions stem from entanglement in or ingestion of active or discarded fishing gear, depredation on bait or catch, scavenging of released fish, habitat degradation, and provisioning of animals. They can also stem from retaliation or lethal deterrence by fishermen for depredation on bait or catch. Acute and chronic impacts include altered behavior, decreased nutritional status, injury, and mortality.
- Tourism and recreational activities - Interactions occur with recreational boaters, jet skis, dolphin and whale watching tour boats (particularly those operating irresponsibly by touching, feeding, swimming with, or harassing animals), and include boat strikes, disruption of natural behaviors, changes in group composition, association of people/boats with food if provisioning occurs, and conditioning. Long-term avoidance of high-use areas can lead to localized declines in abundance or shifts in habitat use to sub-optimal habitat. Acute and chronic impacts include altered behavior, decreased nutritional status and growth rate, injury, and mortality.

Human populations in the Gulf are increasing. There are already more than 50 million people living in the coastal belt, and the population in the Gulf is expected to increase 40% from 1995-2025 (Yoskowitz et al. 2013). This has led to a significant increase in recreational activities. For example, the number of registered boats increased 82% in Florida from 1981 to 2010, and changes in the design and increasing speed of recreational boats can increase the probability of vessel strikes of dolphins and manatees. Tourism is also on the rise in all five Gulf states as well as Mexico and Cuba, and is now the second highest economic driver in the Gulf. In some areas, tourists outnumber residents during certain seasons.

Recreational fishing and boating are extremely popular activities, and are activities engaged in by both tourists and residents. Recreationally caught fish are generally released in compliance with fishery management regulations, but this may result in dolphins associating fish (food) with recreational vessels. Wildlife viewing is also increasing, but its popularity is a double-edged sword. Although it can be an important tool to foster education and support for conservation, if viewing is not conducted responsibly, and activities are not regulated or existing laws enforced, inappropriate or illegal interactions (Figure 11) can have short and long-term impacts on individuals and populations.

Figure 11: Illegal feeding of a bottlenose dolphin (*Credit: SDRP*)

Serious injuries and mortalities to dolphins from recreational activities are at fairly low levels compared to other sources, but the added stressor on populations already facing many other threats can put local communities at risk. For example, in Sarasota Bay, 2% of the dolphin population was lost to gear entanglement and ingestion in 2006 – a rate that is not sustainable over long term. Over the long term, approximately 25% of dolphin deaths in Sarasota Bay were human-related (recreational fishing and boat strikes). Interactions with recreational hook and line gear are widespread throughout the Gulf and affect several bay/sound/estuary and coastal dolphin stocks. Depredation by dolphins on recreational fishing gear and discarded fish has been documented in Sarasota Bay, as well as the Florida Panhandle and

Alabama (see project description by Shippee in Appendix B). Reports of vessel strikes are also widespread, with the greatest number of collisions reported in Florida and Texas. Illegal feeding and swim-with programs resulting in harassment of dolphins occurs regularly in areas such as Panama City, Sarasota Bay, and Key West, Florida, and Corpus Christi, Texas. Photo-ID studies and GoMDIS are mechanisms that can be used to track sub-lethal fishing and boating-related injuries. Recovery and investigation of stranded animals also play an important role in documenting and tracking trends in fishing gear and other human interactions.

Figure 12: Snorkelers interact with a manatee at the Crystal River National Wildlife Refuge
(*Credit: Reuters*)

Manatees experience larger numbers of human-related injuries and deaths as compared to dolphins, resulting in higher impacts on this endangered species. Deaths from collisions with watercraft have been increasing over time, but there is some evidence that the rate of increase has slowed due to increased protection efforts even as the number of registered boats has increased. "Slow speed" zones have been shown to be particularly effective at reducing risk by providing additional time for both boats and manatees to react, and by reducing the severity of injuries if a collision occurs. Manatees are also subject to harassment by recreational boaters and swim-with tourism in winter warm-water refuges (such as Crystal River, Florida; Figure 12), with manatees showing clear disturbance and avoidance behavior. Provisioning manatees with freshwater occurs throughout Florida and can condition animals inappropriately to human contact, which can result in harm.

Mitigation of harmful interactions is key. Interventions and rescues of injured animals can help reduce mortality risk but are logistically complex, expensive, and not always successful. Prevention of interactions is more effective, but depends not only on enforcement of existing regulations but also a better understanding of how and why interactions occur. For example, a voluntary compliance program implemented in 2007 aimed at tour operators in Key West (i.e., the DolphinSMART program) resulted in an initial decrease in impacts, but follow-up studies have shown that the effectiveness of the program has waned over time. In Panama City, where illegal feeding and swim-with activities are pervasive, NMFS has stepped up both outreach and enforcement but neither has been completely effective at reducing impacts. Recent research on the human dimension of the feeding and harassment problem in Panama City has shown that concern for dolphins has not translated into compliance with MMPA regulations prohibiting feeding and harassment (Duda et al. 2013).

Long-term, year-round studies, such as those conducted in Sarasota Bay, coupled with data from stranded animals, can help provide a more complete picture of causes of interactions, interaction rates, and trends over time. This information can then be used to determine which mitigation options and strategies have the highest probability of success.

Priorities for the future include—

- Characterizing the true scope and nature of interactions as well as driving factors throughout Gulf
- Understanding the long-term and cumulative impacts of repeated sub-lethal interactions
- Increasing interdisciplinary human dimensions work
- Supporting enforcement and interventions
- Evaluating the effectiveness of current measures and developing improved mitigation options, and
- Taking a collaborative approach.

Commercial Fisheries and Marine Mammal Bycatch

Lance Garrison, NMFS Southeast Fisheries Science Center

Commercial fisheries are vital to the economy of the Gulf, with fishermen landing 1.8 billion pounds of fish and shellfish in 2011 and earning $818 million in landings revenue[9]. Landings revenue was dominated by shrimp ($438 million) and menhaden ($104 million). The MMPA requires NMFS to develop an annual List of Fisheries, which categorizes commercial fisheries by the frequency of incidental serious injuries and mortalities (SI/M) of marine mammals. Category I fisheries have frequent SI/M's, Category II fisheries have occasional SI/M's, and Category III fisheries have rare or no known SI/M's. The MMPA imposes requirements on Category I and II fisheries including reporting all marine mammal interactions and carrying a fisheries observer if requested by NMFS. Table 4 provides a listing of the Category I, II, and III commercial fisheries in the Gulf, as identified in the 2015 List of Fisheries (79 Fed. Reg. 77919, 29 December 2014), as well as stocks reported to interact with each fishery.

Table 4: Gulf of Mexico Commercial Fisheries, by Category

Fishery	Gulf marine mammal stocks affected
Category I	
Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline	Bottlenose dolphin (oceanic), Gervais' beaked whale, killer whale, pantropical spotted dolphin, Risso's dolphin, short-finned pilot whale, sperm whale
Category II	
Gulf of Mexico menhaden purse seine	Bottlenose dolphin (BSE and coastal)
Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl	Atlantic spotted dolphin, bottlenose dolphin (BSE, coastal, shelf), Florida manatee
Gulf of Mexico gillnet	Bottlenose dolphin (BSE and coastal)
Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot	Bottlenose dolphin (BSE and coastal)
Category III	
Gulf of Mexico butterfish trawl	Bottlenose dolphin (continental shelf and oceanic)
Gulf of Mexico mixed species trawl	None documented
FL West Coast sardine purse seine	Bottlenose dolphin (coastal)
Southeastern U.S. Atlantic, Gulf of Mexico, and Caribbean snapper- grouper and other reef fish bottom longline/ hook-and-line	Bottlenose dolphin (continental shelf)
Southeastern U.S. Atlantic, Gulf of Mexico shark bottom longline/hook-and-line	Bottlenose dolphin (coastal)
Southeastern U.S. Atlantic, Gulf of Mexico, and Caribbean pelagic hook-and-line/harpoon	None documented
U.S. Atlantic, Gulf of Mexico trotline	None documented
FL spiny lobster trap/pot	Bottlenose dolphin (BSE and coastal)
Gulf of Mexico blue crab trap/pot	Bottlenose dolphin (BSE and coastal)
Gulf of Mexico mixed species trap/pot	None documented
Southeastern U.S. Atlantic, Gulf of Mexico golden crab trap/pot	None documented
U.S. Mid-Atlantic/Gulf of Mexico oyster dredge	None documented
Gulf of Mexico haul/beach seine	None documented
Atlantic Ocean, Gulf of Mexico, Caribbean shellfish dive, hand/mechanical collection	None documented
Gulf of Mexico, Southeast Atlantic, Mid-Atlantic, and Caribbean cast net	None documented
Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel	Bottlenose dolphin (BSE and coastal)

[9] https://www.st.nmfs.noaa.gov/Assets/economics/documents/feus/2011/FEUS2011%20-%20Gulf%20of%20Mexico.pdf

Because most of the stocks affected by commercial fisheries in the Gulf are bottlenose dolphins, the rest of the presentation focused on dolphin interactions in those fisheries as opposed to all marine mammal species/stocks in the Gulf. Nearly all coastal and bay/sound/estuary (BSE) stocks of bottlenose dolphins have the potential to interact with multiple commercial fisheries. Those stocks are therefore of particular concern due to the impact that even a small number of takes can have on each stock.

Gulf of Mexico large pelagics longline

The pelagic longline fishery targets swordfish, tuna, mahi, and sharks, and operates within the US Exclusive Economic Zone (EEZ) off the continental shelf in the high seas from Florida to Texas; fishing has been prohibited in DeSoto Canyon since 2000. Observers covered 24.7% of sets in the Gulf in 2013, but in the last five years coverage has been highly variable by quarter, with 8% coverage in the first, third, and fourth quarter and 100% observer coverage of the experimental fishery for bluefin tuna in the second quarter (Garrison and Stokes 2014). This has allowed observers to document nearly all interactions in the second quarter, including rare interactions with many of the species identified in Table 4. Interactions involve hooks in the mouth and entanglement in fishing line. Most animals are released alive but many are released with a hook in the mouth, which is the primary source of serious injury.

Gulf of Mexico menhaden purse seine fishery

The purse seine fishery operates exclusively in the northern Gulf, with effort limited to inshore waters off Louisiana east and west of the Mississippi River (SEDAR 2013). The fishery experienced a significant decrease in effort from 2011 to 2012, and the fishery has been changing in recent years. Interactions are primarily with the northern and western coastal stocks of bottlenose dolphins. There are a small number of vessels (37-40) in the fleet but a fairly large number of sets. Observer coverage has been limited with only a pilot program in 2011. Three takes were observed, and all were released alive and uninjured. There have been 13 self-reported takes from 2000-2013, and previous analyses suggest as many as 57 mortalities occurred between 1992-1995.

Gulf of Mexico gillnet fishery

The gillnet fishery is relatively small and like the menhaden fishery, it targets prey species of marine mammals including Spanish mackerel, spotted seatrout, mullet, Florida pompano, and flounder. Gillnets are prohibited in Florida and Texas state waters, and effort is limited to about 200 fishermen operating off Louisiana, Mississippi, and Alabama. Since 2012 there has been a low level of observer coverage in state waters (less than 10%) and although no marine mammal takes have been observed to date, takes have occurred in gillnets used in fishery research so the potential for interactions exists.

Gulf of Mexico shrimp trawl fishery

Fishing effort in the shrimp trawl fishery (Figure 13) occurs in estuarine, near coastal, and offshore continental shelf waters. There are more than 4,000 permitted vessels, of which 1,500 are federally permitted. Despite significant bycatch of finfish and sea turtles in the shrimp fishery and associated research and management actions to reduce such bycatch, observer coverage has been extremely low and is limited to coastal waters (no coverage of estuarine waters). The program was only recently made mandatory and coverage was approximately 0.24% (± 0.21%) of total effort from 1997 to 2011. A total of 14 marine mammal mortalities

Figure 13: Bottlenose dolphin feeding alongside a shrimp trawl vessel in Galveston Bay, Texas (*Credit: Environmental Institute of Houston*)

have been observed from 1993-2013, with 6 identified as bottlenose dolphins. In addition, 10 takes were observed in relocation and research trawls from 2000-2013. Recent analyses indicate mean annual mortality estimates from 2007-2011 exceed 10% of PBR for western and northern coastal bottlenose dolphin stocks (Soldevilla et al. 2015). Mortality estimates possibly exceed PBR by a significant amount for BSE stocks in Louisiana, Alabama, and Louisiana, but further data on both abundance and bycatch rates in inshore waters are needed. Other stocks at risk are Texas and Florida BSE dolphin stocks and Atlantic spotted dolphin.

Blue and stone crab trap and lobster pot fisheries

Trap and pot fisheries are broadly distributed throughout the Gulf in estuarine and nearshore waters. There are approximately 6,800 permit holders (which includes the entire state of Florida). Interactions stem from bottlenose dolphin feeding around the gear or playing with the buoy lines. There is no observer coverage of the fishery, which underscores the importance of quality data derived from stranded animals. From 2002-2013, 18 bottlenose dolphin strandings were associated or consistent with trap/pot gear (NMFS unpublished data).

Hook-and-line fisheries

Hook-and-line fisheries have both commercial and recreational components. There are 819 permitted longline vessels in the Gulf, with 100 of those using bottom longline gear. Grouper is targeted along the northeast Gulf and snapper along the northern and western Gulf. The target level of observer coverage is 8%, and two takes of bottlenose dolphins from the continental shelf stock have been reported, in 2010 and 2012 (Gulak et al. 2013). Commercial passenger fishing vessels operate Gulfwide, with more than 800,000 charterboat trips reported in 2014.[10] There is no observer coverage on these vessels. From 2002-2013, 81 strandings associated with hook-and-line gear were reported but responders could not determine whether the gear was recreational or commercial (NMFS unpublished data).

In summary, only five of the twelve commercial fisheries in the Gulf that have reported interactions with marine mammals have systematic observer coverage and that coverage is relatively limited. Documentation of commercial fishery interactions comes from various sources (e.g. strandings, fishermen self-reports) and represent minimum counts. There is not enough information to determine total annual fishery-related impacts to stocks. Dolphins depredating on gear and scavenging discarded fish are a concern and frustrated fishermen are taking extreme action. NMFS has prosecuted cases for shooting at dolphins and throwing pipe bombs in the shrimp, longline, and charter boat fisheries.

Information needs include—

- Abundance surveys for bottlenose dolphins stocks at highest risk for fishery interactions
- Augmented observer coverage of the shrimp fishery and gillnet in inshore state waters
- Enhanced understanding of fishery distribution in inshore and nearshore waters, and
- Creative ways to observe and monitor fisheries where traditional observer coverage is challenging (e.g. menhaden and crab pot fisheries).

PRIORITY INFORMATION NEEDS AND KNOWLEDGE GAPS

Moderator: Randall Reeves, Okapi Wildlife Associates/Marine Mammal Commission

The objective of this session was to provide a brief summary of recent efforts to assess current and recent research and monitoring efforts focused on marine mammals, to assess research capabilities, and

[10] http://www.st.nmfs.noaa.gov/recreational-fisheries/index

to identify information needs and knowledge gaps. The presentations were followed by a panel discussion on alignment of research and monitoring efforts and resources to address knowledge gaps.

Gulf of Mexico Long-term Monitoring: Assessment of Marine Vertebrate Programs

Libby Fetherston, Ocean Conservancy Gulf Restoration Program

Ocean Conservancy has undertaken an assessment of long-term monitoring programs for trust resources injured by the BP oil spill in the Gulf of Mexico to better understand what is being done (or has been done) and identify gaps in monitoring coverage. This will also help to match monitoring programs with available restoration funding.

A conceptual model of the Gulf ecosystem was presented (Figure 14), but it was stressed that we know very little about each component of that model. The challenge, therefore, is to populate the model with information about species, processes, and the various stressors that affect them, and to identify actions that will help the ecosystem recover from major stressors, such as oil spills. For marine mammals, the emphasis for restoration will necessarily be on *natural recovery* (because you can't just grow new dolphins), coupled with minimizing stressors that would otherwise slow natural recovery.

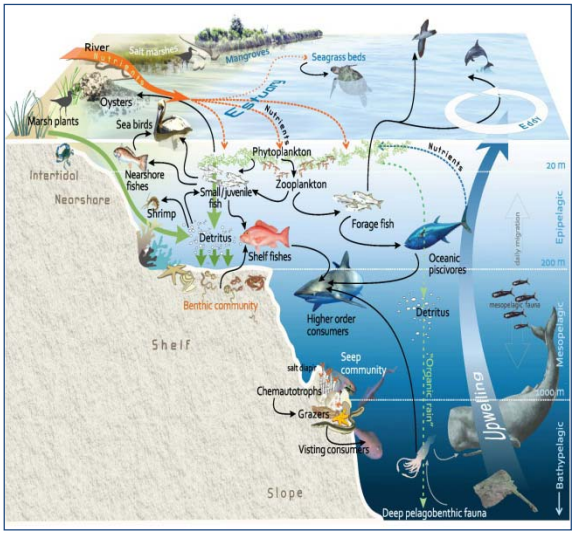


Figure 14: Conceptual model of the Gulf of Mexico ecosystem (*Credit: Ocean Conservancy*)

Ocean Conservancy is in the process of conducting an inventory of existing or past monitoring programs for each of the 13 restoration categories in the Deepwater Horizon NRDA, with a focus on publicly accessible programs that have a long-term data series (i.e., greater than five years). Those types of programs can provide the basic framework for an integrated monitoring program (referred to as "NRDA-plus"). Although several funding sources will be available for restoration of Gulf marine resources, the focus here is on NRDA because that funding source has the greatest potential to target marine mammals and sea turtles. In its assessment, Ocean Conservancy consulted with various experts to ensure that all relevant monitoring programs were included.

In its assessment, Ocean Conservancy identified a number of marine mammal monitoring efforts that had broad geographic coverage across the northern Gulf. However, several were pulsed activities, lasting only a couple of years. The Gulf stranding network was not included because it was not considered "traditional" monitoring.

Monitoring efforts that met the 5-year criterion were a smaller subset and included—

- Southeast Area Monitoring and Assessment Program (SEAMAP) plankton surveys
- Institute for Marine Mammal Studies (IMMS) health assessments
- Sarasota Dolphin Research Program, and
- IMMS dolphin surveys.

Monitoring priorities for marine mammals were developed in consultation with several marine mammal experts, and gaps in information were then identified for each priority area with respect to species, geographic area, and time (Table 5). Note that for several, the entire category was a gap.

Table 5: Ocean Conservancy Analysis of Monitoring Priorities and Gaps for Marine Mammals

Monitoring/Research Priority	General Gaps - Priority Species*	General Gaps - Geography	General Gaps - Time
Observe and assess stranded mammals	Pelagic species. This is a shore-based volunteer response network for stranded wildlife and carcasses of any species that wash ashore.	South Texas, West Louisiana, Big Bend of Florida, Southeast Florida	Volunteer response effort, so responsiveness depends on availability of resources and trained staff.
Monitor abundance and distribution of marine mammal stocks in nearshore waters (<200m), i.e., coastal and bay/sound/estuary	Low effort and lack of repeated monitoring of Atlantic spotted dolphins in majority of region outside of Mississippi Sound and Sarasota Bay; Bryde's whales.	From N extent of SEFSC aerial surveys to S extent of Sarasota Bay program. From N extent of Sarasota Bay program to E edge of Mississippi Sound. From LA/MS border to Brownsville, TX.	Entire category is a gap. No status and trends possible due to lack of sustained monitoring in coastal areas outside Mississippi Sound and Sarasota Bay, except 1992 - 2001 in SE FL.
Monitor abundance and distribution of marine mammal stocks in offshore waters (>200m)	None, there has been equal effort among species during short term surveys.	All areas are a gap. No status and trends possible without sustained monitoring, especially in oceanic waters and outside the US EEZ.	Entire category is a gap. There is no sustained monitoring programs in offshore waters.
Determine stock structure of marine mammal populations	Gap across all priority species. No status and trends possible without sustained monitoring in coastal areas outside Mississippi Sound and Sarasota Bay.	All areas are a gap. Only short-term studies have been done, there are no status and trends possible without sustained monitoring in coastal areas outside Mississippi Sound and Sarasota Bay.	Entire category is a gap. Only short-term studies have been done, there are no status and trends possible without sustained monitoring in coastal areas outside Mississippi Sound and Sarasota Bay.
Assess population demographics and reproductive rates	Gap across all priority species. No sustained monitoring beyond Mississippi Sound and Sarasota Bay.	All areas are a gap. No sustained monitoring beyond Mississippi Sound and Sarasota Bay.	Entire category is a gap. No sustained monitoring beyond Mississippi Sound and Sarasota Bay.
Assess habitat use	Gap across all priority species. No sustained monitoring beyond Mississippi Sound and Sarasota Bay.	All areas are a gap. No sustained monitoring beyond Mississippi Sound and Sarasota Bay.	Entire category is a gap. No sustained monitoring beyond Mississippi Sound and Sarasota Bay.

*Priority species identified for marine mammals: Atlantic spotted dolphins, bottlenose dolphins, Bryde's whales, sperm whales, and pelagic delphinids.

There is an opportunity to fill some of the monitoring gaps identified for marine mammals using restoration funds that will be available. Potential matches of funding sources with monitoring needs were identified, and some gaps are already being addressed in part, e.g. by the Alabama stranding network with funding from the National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund, and acoustics work by the University of Louisiana at Lafayette with funding recently provided by the Gulf of Mexico Research Initiative (GoMRI). NRDA, as mentioned, has funded a number of marine mammal injury assessment projects and should be a significant source of support for injury recovery monitoring once those funds become available.

Cooperative Conservation for Marine Mammals in the Gulf of Mexico: Developing a Plan for Action - Summary of Gulf of Mexico Regional Workshops

Laura Engleby, NMFS Southeast Regional Office

The NMFS Southeast Region, in partnership with MMC, hosted three workshops in the northern Gulf of Mexico in May 2013. Workshops were held in Baton Rouge, Louisiana, Pascagoula, Mississippi, and Galveston, Texas. The purpose of the workshops was to identify actions that would contribute to the survival of, and reduce negative impacts to, marine mammals through increased scientific knowledge, management, and public understanding.

The goals of the workshop were to—

- Provide an opportunity for exchange of information among Federal/state/local agencies, NGOs, academics, and other interested parties regarding the status and conservation of marine mammals in the Gulf
- Identify strategies and actions to address high priority needs fundamental to conserving marine mammals in the Gulf
- Stimulate and foster regional collaborations
- Identify ways to promote data integration and data sharing, and
- Identify potential sources of support and leverage.

The workshops were facilitated and the 77 participants represented a broad range of interests and affiliations. Presentations covered: (1) threats to marine mammals in the Gulf of Mexico; (2) status of ongoing NMFS research and priority needs for the future; (3) overall research needs; (4) marine mammal health and stranding response activities in the Gulf; and (5) overview of NRDA ongoing activities. After the presentations, participants were asked to identify, from a regional perspective (not just their institution) the three priority gaps that, if filled, would enhance marine mammal conservation in the Gulf.

Each workshop had nearly identical priorities, which are presented in Table 6. Each workshop group ranked stock assessments as the top priority, with second and third priorities identified as outreach and education regarding human interactions and enhancing regional coordination, communication, and collaboration. The Mississippi/Alabama and Texas groups also identified additional priorities as research on environmental and biological parameters and health of bottlenose dolphins.

Table 6: Priorities Identified by Workshop Groups in Different States

Priority	Louisiana Workshop	Mississippi/Alabama Workshop	Texas Workshop
1	Establish/maintain long term stock assessments	Conduct stock assessments	Need good stock assessments
2	Outreach and education regarding human interactions	Address human interactions (outreach, enforcement)	Better communication/networking
3	Coordination of regional efforts	Enhance collaboration	Outreach and education regarding illegal feeding/harassment of dolphins
4		Environmental parameters, biology, natural history, etc.	Health of bottlenose dolphins

With respect to stock assessments, challenges identified were the large geographic area in the Gulf, the number of marine mammal species/stocks, the logistics involved in conducting surveys, tracking

movements of highly mobile species, lack of adequate infrastructure to conduct surveys (i.e., planes and ships), inadequate funding, inadequate analytical capacity, and a lack of standardized methods. Strategies to improve stock assessments included having a clear action plan for prioritizing stock assessments (including which species/species groups and how often), leveraging restoration and other sources of funding and also public interest in marine mammals, making the most of cooperative datasets (e.g., SEAMAP).

Data sharing is critical, and participants suggested that federal agencies require that all data collected by staff or contractors be available publicly. Public access to shared data sets could be facilitated through umbrella frameworks such as NOAA's Cetacean and Sound Mapping (CetMap) that link to or synthesize data from various sources, and all researchers should follow consistent data collection standards (e.g., for photo-ID studies; see Rosel et al. 2011).

Bottlenose dolphin (*Tursiops truncatus*)
(Credit: NMFS)

For outreach and education regarding dolphin harassment, challenges included inconsistent or inadequate enforcement and a lack of resources to develop effective messaging and outreach materials and to disseminate information. In many cases, it will require user groups to overcome pre-conceived notions and take ownership of the problem. Potential strategies include using licensing to target outreach and education at the point of contact, increasing law enforcement, make dolphins a priority in the NMFS-state Joint Enforcement Agreements (JEAs), training and educating state officers, and strengthening state partnerships. It is also important to get youth involved at an early age, as kids represent a new generation and will help teach adults.

Enhanced communication and collaboration was a universal theme, as was a need to know "who's who" and also "who's doing what" in the Gulf. Each group suggested that a directory be assembled for the Gulf that includes scientists, managers, decision-makers, and non-governmental organizations. There should also be increased opportunities for exchange of information and for training on standards and common data platforms.

A question was asked regarding follow-up from the meeting. Although lack of funding has been an issue for expanding stock assessments, this meeting was identified as a logical next step to achieve greater coordination and collaboration in the Gulf and to exchange information on what types of programs exist. This meeting's program book is essentially the "who's who" directory that was called for at the workshops. Another question was asked about interest and funding for conducting research in offshore waters. Although that was recognized as an important need, most of the focus was on human interactions in coastal waters as that is more of an issue for the states. In Texas, there has been an effort to meet and collaborate among researchers as a result of the workshops. Another question was asked about who is (or should be) responsible for conducting the training on standardized methods, as that training could help build research capacity in the Gulf. This will require identifying potential trainers (like Randall Wells at the Sarasota Dolphin Research Program) and then securing the funding to conduct training.

GCOOS Build-out Plan and Marine Mammals

Barb Kirkpatrick, Gulf of Mexico Coastal Ocean Observing System (GCOOS) Regional Association, with contributions from Chris Simoniello, Stephanie Watson, and Matt Howard

GCOOS was established in 2005 under the Global Ocean Observing System (GOOS) and the U.S. Integrated Ocean Observing System (IOOS). There are 11 regional associations across the United States. GCOOS's experience with handling large data sets involving marine mammals dates back to the Sperm Whale Seismic Study (SWSS) project (see project description by Biggs in Appendix B) and managed by researchers who then went on to establish GCOOS. GCOOS has five themes, including public health and safety, healthy ecosystems and water quality, mitigation of effects of coastal hazards, safe and efficient marine operations, and long-term ocean variability and changes. These themes overlap with work being done on and the concern for marine mammals, which cross over to the kinds of societal concerns that GCOOS is trying to address. GCOOS works under a member/partnership model, with data collected by partners (e.g., data from oceanographic buoys) that then stream the data to GCOOS. The GCOOS data portal is located at http://data.gcoos.org.

Version 1 of GCOOS's Build-Out Plan was developed prior to the Deepwater Horizon spill and was more of a skeleton framework. However, the spill underscored the importance of having a comprehensive, visionary plan of what an observing system should look like for the Gulf. Version 2.1[11] of the Build-Out Plan was developed with input from workshops involving various organizations, reviews of other plans, and subject matter expert writing teams. It has several elements that would incorporate data on marine mammals. Representative types of marine mammal data that GCOOS is seeking to incorporate can be found in Table 7.

GCOOS can help with marine mammal research and monitoring needs by tracking data collected with autonomous technology (drones and autonomous vehicles), fixed and bottom-mounted hydrophones and environmental sensors, high-frequency radar, aircraft, ships, tags/receivers, and satellites. GCOOS can also be a repository for data products and modeling. Historical data are primarily focused on oceanographic parameters, but GCOOS is interested in integrating wildlife tracking and telemetry data with existing ocean observing system infrastructure. For example, it is working with fish researchers and has developed a system for identifying the origin of "orphan" fish tags detected by observing systems throughout the Gulf (i.e., Integrated Tracking of Acoustically Tagged animals; iTAG), and also for controlling the amount of data made publicly available. There is also interest in incorporating data collected by using marine animals as mobile monitoring platforms into GCOOS.

Other regional Ocean Observing Systems are also working to incorporate marine mammal data into data portal and products. The Alaska Ocean Observing System (AOOS) is working with the Animal Telemetry Network (ATN) task team, led by the Office of Naval Research and IOOS, to develop a circum-Arctic ATN. AOOS has incorporated sightings data on Cook Inlet beluga whales, photo-ID data on humpback and killer whales, acoustic data on Arctic whales, and tagging data from ice seals. The Central and Northern California Ocean Observing System (CeNCOOS) is working with NMFS and the Marine Mammal Center to incorporate marine mammal health data (the HealthMAP initiative discussed by Teri Rowles).

In summary, GCOOS is looking to marine mammal scientists and managers in the Gulf to further develop its data portal and other initiatives. With its 10-year history in the Gulf, GCOOS has considerable expertise with biological and oceanographic information. Like the other Regional Ocean Observing

[11] http://gcoos.tamu.edu/BuildOut/BuildOutPlan-V2-1.pdf

Systems, GCOOS can play a lead role in fulfilling needs for marine mammal monitoring. GCOOS is funded by IOOS, and although funding has been fairly stable, the goal is to be able to expand its services. For example, although funding limitations have limited the incorporation of effort data by AOOS, GCOOS is striving to incorporate all information made available by researchers. Some of the data sets may be very large (i.e., acoustic data) and identifying long-term repositories for such data could be a problem.

Table 7: GCOOS Build-Out Plan and Marine Mammals

Focus area	Data or analytical outputs to be incorporated
Ecosystem and habitats	o Monitoring of marine mammal movement, prey, and habitat use o Identify, characterize, protect, and monitor habitats for each protected Gulf marine mammal species; mapping of marine mammal habitats and migration corridors to identify priorities for conservation o Monitoring physical and chemical factors affecting marine mammals; coupling behavior with physical parameters o Identification of stressors
Population status and trends	o Marine mammal species and abundance; more population information needed; many classified as "unknown" o Genetics information to classify populations o Population structure, in addition to population size and trends
Information on individuals	o Physiological and health monitoring o Health status and contaminant loads of stranded or live-captured animals, necropsies of dead animals, fecundity, controlled exposure experiments, genomics o Observations of condition of stranded animals, changes in diet as determined by observations of foraging behavior, stomach content o Observations of stranded animals, analysis of tissues for evidence of toxins, monitoring of Harmful Algal Blooms (HABs) and hypoxia
Effects of marine sound	o Monitor marine sound with emphasis on marine mammal habitat o Characterize the spectrum of ambient and human-generated sound in Gulf (especially 1-200,000Hz), how it varies spatially, and effects on marine mammals o Sound propagation, physical and physiological effects and hearing, behavioral reactions and biological significant effects, mitigation and monitoring, research tools
Modeling	o Comprehensive models of the Gulf (with drivers) o Model health and sustainability of marine mammal populations o Model sound propagation
Data products and integration	o Need for a data portal and data integration o Use of data management standards (interoperability, QA/QC, etc.)

Marine Mammal Monitoring of Geological and Geophysical Activities in the Gulf of Mexico

Jennifer Bosyk, Bureau of Ocean Energy Management (BOEM)

BOEM, along with the Bureau of Safety and Environmental Enforcement (BSEE) and NMFS as cooperating agencies, is preparing a Programmatic Environmental Impact Statement (PEIS) that will consider the environmental effects of all geological and geophysical (G&G) survey activities in federal waters of the Gulf. It will also identify and analyze appropriate mitigation measures for marine mammals that may be affected by such activities. The PEIS will be used by BOEM to support ongoing G&G permit applications in the Gulf, as well as its petition to NMFS for rulemaking under section 101(a)(5) of the MMPA (incidental taking) submitted on behalf of the oil and gas industry. NMFS is a cooperating agency so that it can use the PEIS in its MMPA decision-making process on the rulemaking and the subsequent issuance of annual Letters of Authorization (LOA) to individual G&G operators for incidental taking. A draft of the PEIS is expected to be published in March 2016, with the final to be published in April 2017.

A monitoring plan is a required component of the MMPA rulemaking. The requirements of a monitoring plan include—

- Improved understanding of the distribution and abundance of marine mammals in the Gulf
- Improved understanding of how stressors affect individuals or populations
- Evaluation of the effectiveness of the mitigation or monitoring that is being conducted, and
- Improved understanding of the relationship between G&G activities and the environment (e.g., source characterization, sound propagation, and ambient sound levels).

Fraser's dolphin (*Lagenodelphis hosei*)
(*Credit: NMFS*)

Via webinars, BOEM and NMFS solicited input from a variety of stakeholder groups, including the oil and gas industry, other federal agencies, resource managers, and academics, both within and outside the Gulf region. Input was specifically solicited on—

- The nature, scope, or context of likely marine mammal exposure to potential stressors
- Interrelationships between G&G activities and the affected environment
- Ongoing or upcoming research efforts that may be appropriate to coordinate with or leverage
- Major data gaps in the Gulf related to marine mammals
- Metrics for successful monitoring
- Advice on creating an adaptive, responsive monitoring structure, and
- Major impediments to monitoring programs.

The draft monitoring plan will be submitted to NMFS later this year. The plan will be based on hypothesis-driven research addressing species/stocks most likely to be impacted, and will seek to leverage existing efforts, including BOEM's planned and ongoing environmental studies. At the outset, BOEM plans to use a phased structure as it designs and implements its monitoring program, and will include periodic review and input by an external advisory group. The first opportunity for public review of the monitoring plan will be provided when NMFS releases the draft MMPA petition.

A question was regarding how much responsibility would be placed on industry to support the monitoring plan. At this point, BOEM is still working that out with industry. Another question was asked about the programmatic approach being used by BOEM. BOEM typically conducts programmatic EIS's (e.g., for its 5-year leasing programs; it also just recently prepared a PEIS for its G&G activities in the Atlantic), and they are used as planning tools that feed into subsequent, more narrowly focused stages of environmental review.

The BOEM-funded Atlantic Marine Assessment Program for Protected Species (AMAPPS) is providing important baseline information on marine mammals in the Atlantic. A participant asked whether such a program might be implemented in the Gulf to provide much-needed baseline information on marine mammals there. BOEM responded that other work has been conducted and is ongoing in the Gulf that has provided baseline information on marine mammals, and the BOEM Environmental Studies Program provides ongoing opportunities for research in all offshore areas. BOEM also is working to make all of its data from the Environmental Studies Program publicly available, dating back to the origin of the program more than 30 years ago.

A participant asked about the difference between annual incidental take authorizations and incidental take regulations. NMFS clarified that incidental takes can be authorized through either method, but it encourages applicants to pursue rulemaking and LOAs in cases where administrative "streamlining" benefits might be achieved through a rulemaking framework. This rulemaking is a unique case (in which BOEM is petitioning on behalf of industry), but NMFS would still review the proposed activities of each individual operator to determine potential takes and how these relate to the overall take levels analyzed as part of the rulemaking.

It was noted that obtaining a MMPA research permit can take three years or longer, and that this kind of process is especially onerous for an entry-level scientist. As BOEM, NMFS, and industry develop the G&G monitoring plan, they need to bear in mind the timeframe required for permitting. Meeting participants encouraged BOEM to actively engage marine mammal scientists and managers from the outset to ensure that the plan has a strong research foundation that is achievable within the envisioned timeframe. BOEM emphasized that the monitoring plan is meant to ensure that G&G operations conducted in the Gulf are in compliance with the MMPA incidental take requirements and other mandates. This will be in addition to the requirements for mitigation monitoring that apply to individual operators.

Atlantic spotted dolphin (*Stenella frontalis*)
(*Credit: NMFS*)

The draft monitoring plan will be ready for review by industry in the next few months, and the petition to NMFS, which the monitoring plan is part of, will then be made available for public comment at the end of 2015. It is BOEM's intention to have the rulemaking and the PEIS come out at the same time. The monitoring plan will be subject to an iterative process involving BOEM, NMFS, and industry. BOEM is developing a framework for monitoring at this stage, with the monitoring goals not finalized before the PEIS has been finalized. Impacts and priorities identified in the PEIS can then be incorporated into the final monitoring plan. An external advisory group will also help to adapt the plan's goals over time.

If BOEM is pursuing a rulemaking and the process also involves the issuance of individual LOAs, the question was asked whether that is more expedient than the one-year incidental harassment authorization (IHA) process. BOEM explained that the rulemaking establishes a framework for evaluating the individual LOAs up-front, as opposed to having each operator undertake the potentially longer IHA process.

A question was asked about the availability of information on marine mammal presence and distribution in the Gulf collected by observers on seismic vessels as part of industry's mitigation and monitoring requirements. BSEE is the agency that receives and reviews those reports, and it is currently in the process of making that information available to the public.

[A summary of the input received by BOEM during the stakeholder webinars was posted shortly after the meeting on the BOEM website.[12]]

[12] http://www.boem.gov/Synthesis-Report-Stakeholder-Webinars/

Group Discussion on Assessment of Information Needs

The need to improve data access and sharing of data was an issue raised in several presentations. Recently, the federal government directed all agencies to make data collected by federally funded programs publicly accessible. Participants were asked to comment on this requirement and the challenges likely to be encountered in its implementation. The referenced document[13] requires federal agency data to be made available to the public within 12 months of collection, and this applies to both current and historical data. Processes regarding how and where those data will be available are still being developed.[14] This directive also applies to government contractors and grantees (without the provisions concerning historical data). The requirements and processes arising from the directive will be part of the framework for how the government collects data in the future.

> *"If you don't have a nerd, go get one."*
> (Libby Fetherston on analytical capabilities that will be needed for data integration)

Mining different data sets and drawing useful insights from available data will be challenging everywhere, but especially so in the Gulf where data exists in many different databases and formats. Data must be subject to rigorous QA/QC and be in a format suitable for integrated analyses using advanced analytical techniques. It will also require interdisciplinary collaborations to develop models that can integrate different types of environmental and marine mammal data. As was noted by Fetherston, "If you don't have a nerd, go get one."

Scientific journals have long been grappling with the issue of access to data. Several journals now require authors to archive and make publicly available all data supporting published findings. This is a general trend, but one not without pitfalls, especially for long-term data collections. In addition, maintaining and managing data collected on long-lived species such as marine mammals is especially challenging. Data repositories must be designed to accommodate large data sets as well as associated metadata. They must take into account advancements in technology and methodology, be maintained and updated, be searchable, and be secure and stable over the long term.

The need for data to be collected in a standardized manner and made broadly available was noted throughout the presentations. The North Atlantic Right Whale Consortium[15] was suggested as a model for marine mammal data sharing. SEAMAP, a cooperative monitoring program among academia state and federal partners to survey plankton, fish and a suite of environmental data, was also mentioned as a model that has been operating in the Gulf for many years.

DATA SHARING AS A MECHANISM FOR COLLABORATION AND CAPACITY BUILDING

Moderator: Stephanie Watson, GCOOS

As noted in previous sessions, there are many different data types that are relevant to marine mammal scientists and managers. Broader access to those different data types is one important mechanism for enhancing collaboration and capacity building in the Gulf. The objective of this session was to discuss some of the basics of data sharing, including basic terminology, benefits of data sharing, various data

[13] This requirement was formalized in a 22 February 2013 memorandum issued by the White House Office of Science and Technology "Increasing Access to the Results of Federally Funded Scientific Research," available at https://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf.
[14] The NOAA Plan for Increasing Public Access to Research Results is available at http://docs.lib.noaa.gov/noaa_documents/NOAA_Research_Council/NOAA_PARR_Plan_v5.04.pdf.
[15] http://www.narwc.org/

portals and data systems, the importance of metadata, options for data sharing, making data "discoverable," and challenges to data sharing.

Data Sharing 101: The Five W's and Some Opportunities to Share Marine Mammal Data

Samantha Simmons, Marine Mammal Commission

Data sharing means different things to different people. To some researchers, data sharing may mean sharing data with students. While that may be adequate for certain datasets, there may be utility in taking data sharing to the next level, such as making a list of publications or even datasets available on a personal website. Others will make data available if it is a requirement of funders or scientific journals. However, that data may not be widely accessible or "discoverable" by the broader research community. The proposed "gold standard" of data sharing is making data that have been collected and gone through QA/QC freely available on widely accessible and reputable websites or data portals, along with relevant metadata that adheres to the metadata standards specific to that data type.

All researchers should be looking for ways to share data. Benefits to researchers themselves include increased opportunities for multi-disciplinary collaborations, the ability to address larger scientific questions (i.e., cumulative effects), and the opportunity to leave behind a legacy of work accomplished. Benefits to society include contributions to multi-disciplinary analyses such as integrated ecosystem assessments and the ability to analyze and predict the effects of climate change. Other benefits include maximizing the value of data collected (especially in a research environment faced with shrinking budgets), the ability to assemble long-term time-series data, and minimizing impacts of invasive research on animals.

Although data should be shared promptly, concerns have been raised about sharing data that is still being analyzed or supplemented with additional data collections. GCOOS has implemented a tiered access system as part of its iTAG network to restrict how widely data may be accessed (i.e, selected colleagues, the broader research community, or the public). Including metadata from the onset increases the value and visibility of the data. Posting links to the dataset (rather than the actual data) on widely accessible data portals increases its "discoverability" and also prevents researchers from having to upload datasets multiple times or as new data are collected.

Data can be shared through a number of different mechanisms and portals, including a developing federal architecture for access and archival of marine biological data and data products (the U.S. Federal Marine Biological Data Architecture; Figure 15). Some specific examples of data mechanisms and portals by different marine mammal data type include—

- Occurrence data (species, location, and abundance) - OBIS[16], iTAG, ATN[17], Ocean Tracking Network (OTN)[18]
- Behavior and environmental data - ATN
- Acoustics - Tethys, others?
- Genetics - GenBank, Dryad[19]
- Photo-ID - GoMDIS, OBIS-SEAMAP[20]
- Health data - HealthMAP, and

[16] http://www.usgs.gov/obis-usa/
[17] http://oceanview.pfeg.noaa.gov/ATN/
[18] http://oceantrackingnetwork.org/
[19] http://datadryad.org/
[20] http://seamap.env.duke.edu/

Other data portals for oceanographic data include—

- ERMA[22]
- Marine Cadastre[23], and
- GRIIDC (GoMRI Information and Data Cooperative (GRIIDC))[24]
- NOAA's ERDDAP[25].

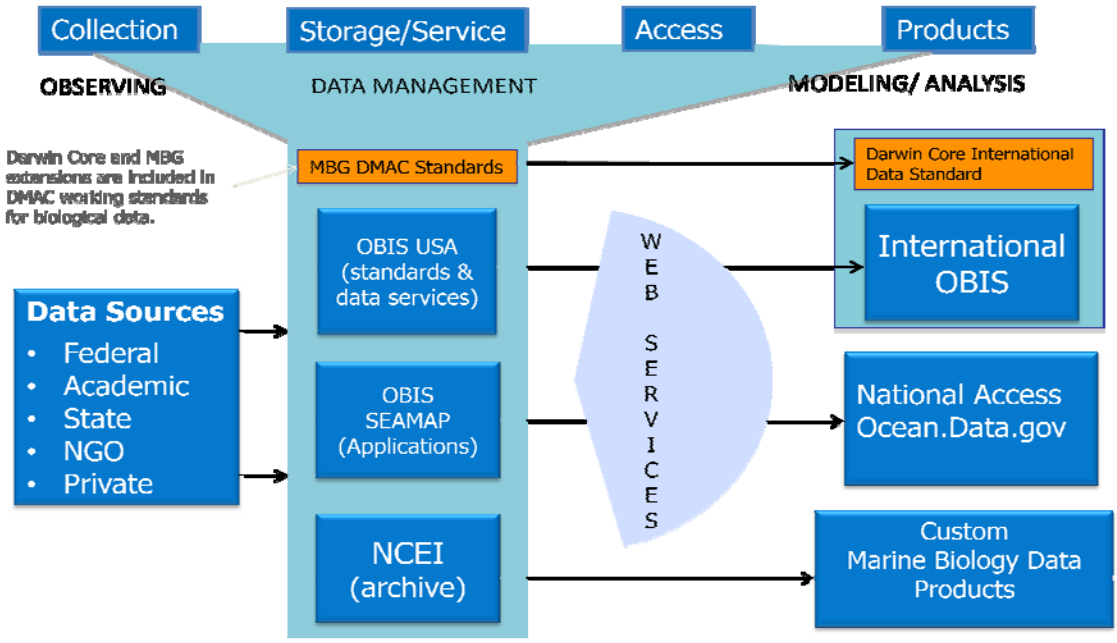


Figure 15: U.S. Federal Marine Biological Data Architecture (*Credit: S. Simmons, MMC*)

GRIIDC: Establishing a Gulf of Mexico Data Cooperative

James Gibeaut, Harte Research Institute, Texas A&M University, Corpus Christi

The mission of the GoMRI Information and Data Cooperative (GRIIDC) is to ensure a data and information legacy that promotes continual scientific discovery and public awareness of the Gulf of Mexico ecosystem. GRIIDC is managing diverse datasets from all of the 2,730 GoMRI researchers from 241 institutions. Their data holdings extend from May 2012 to February 2015 and the program is expected to continue for at least three more years.

As a condition of funding, all GoMRI researchers must make their data fully accessible to the public. Data and metadata must be submitted to GRIIDC no later than at the time of publication of results, or within 12 months of collection if no publication is expected. Users can access the data at no cost after completing a simple registration form. The benefits of data sharing include contributions to baseline data, increased efficiency, increased public trust, and more efficient planning and permitting. Data sharing also helps to inform policy, facilitate citizen science, enable new discoveries, and prevent

[21] http://www.wildme.org/wildbook/doku.php?id=start
[22] http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma
[23] http://marinecadastre.gov/data
[24] https://data.gulfresearchinitiative.org/
[25] http://coastwatch.pfeg.noaa.gov/erddap/index.html

reduced data availability over time. It is easiest to document metadata, and sharing data early allows data acquisition planning and collaboration, improved metadata, and more effective end-product review. Researchers may be reluctant to share if they get no credit (professionally) for sharing, if they have concerns about being "scooped" for their ideas, or if they have not planned in advance for the time and costs associated with sharing data. Conversely, ways to motivate researchers to share data include making it a requirement for funding or publication, using shared datasets as a metric in promotion reviews, and having data repositories create more user-friendly tools for submission, discovery, and citation (such as assigning data sets their own Digital Object Identifiers or DOI's).

GoMRI is trying to create a culture of sharing by providing—

- An efficient service (i.e., GRIIDC)
- Outreach and training
- Credit/DOIs for datasets
- Data-use statistics, and
- A public monitoring matrix that provides information on who is (and isn't) sharing data.

Establishing and maintaining all of those cultural elements will cost more money, especially in the early stages. However, this culture of data sharing will allow GRIIDC to expand beyond the current GoMRI datasets and to start developing integration products.

Group Discussion on Data Sharing

Participants indicated that the combination of "carrots" and "sticks" used by GoMRI to encourage data sharing is a good model given the value of data stemming from DWHOS-related research. However, the challenge remains of ensuring the datasets are used to generate integrated and synthetic descriptions of the Gulf ecosystem. GRIIDC is focusing initially on assembling the datasets, but it intends to address integration and synthesis challenges in the future. Funding for such products is already available, and more is anticipated in future funding rounds. For effective integration and synthesis, the repositories must be organized in such a way that all relevant datasets can be identified and accessed. This will be an important component of repositories used for housing data from restoration and monitoring efforts.

Spinner dolphin (*Stenella longirostris*)
(*Credit: NMFS*)

Carmichael noted that the Dauphin Island Sea Lab has a data management policy which has met the "gold standard" for data management and sharing. However, issues still arise because some of the data (e.g., Level A stranding data and sightings data) reside in various repositories. As new data are collected, a major challenge is to ensure data users are using updated data. To achieve this, datasets must be properly documented when updates are made, with data users directed (and enabled) to use the updated data in analyses. These issues highlight the need for carefully designed repositories with well-documented procedures for updating data and the metadata that describes it.

The 12-month "grace period" mentioned in the previous session, which gives federally-funded researchers one year to publish research before having to make their data publicly available, could be

especially problematic for students in multi-year thesis or doctoral programs, or where data need to be synthesized over a longer timeframe to analyze effects of stressors such as climate change. Participants were concerned that publishing results based on a single year of data could be misleading and is in fact contrary to scientific "best practice" in most contexts involving empirical studies of natural phenomena, where year-to-year variability is to be expected. Strict adherence to the 12-month rule could result in flawed analyses. However, it may be possible to apply tiered levels of data sharing, depending on data sensitivity, data quality, etc. Gulland mentioned that institutions like the Marine Mammal Center have developed a system for "protecting" certain data that are being used by students until they have completed their projects. GoMRI also has applied the 12-month rule, and the likely trend will be for other funders to adopt similar timeframes.

NOAA's Environmental Research Division's Data Access Program[26] (ERDDAP) was identified as a data system that should be considered for archiving marine mammal data. With the goal of "easier access to scientific data," ERDDAP can reformat user requests to conform to the format of the data as archived. It serves approximately 940 oceanographic datasets and can generate maps and other data products in the format requested by the user. It can also alert users when the datasets they are using have changed.

DEVELOPING A MONITORING FRAMEWORK FOR THE GULF

Moderator: Leslie Ward, FWCC/FWRI

Previous sessions discussed several needs that can be addressed with a clearly defined monitoring framework, including—

- Improved communication between researchers and managers so that they are focused on the same conceptual model
- Identifying management objectives and aligning those objectives with future research
- Identifying knowledge gaps and priority needs
- Integrating research components effectively to meet common objectives
- Identifying priority needs that can be addressed through partnerships, and
- Identifying where individual contributions fit into an overall monitoring framework.

This session considered a formal method — the structured decision-making (SDM) process – for analyzing a decision by breaking it into its components in order to identify the optimal way of meeting specific objectives. For example, within the FWCC manatee program, this process has been used to secure warm-water habitats into the future. A structured decision-making tool was developed that projected the consequences of management actions on parameters such as manatee abundance and population growth (Kosempa et al. 2014).

In general, failure to define objectives appropriately is one of the most common reasons for a breakdown in the SDM process. In developing priorities for marine mammal monitoring, it is important to consider the scale of objectives within an SDM framework and with a management perspective. Additionally, data management systems need to match the needs and objectives of the monitoring program, and the monitoring framework can include objectives for data management as well as specific management needs. FWCC has invested significant time and effort to ensure that its monitoring programs are matching the needs and timeframes of managers. For example, for the first time in the program's history, FWCC is providing photo-ID information within the same year of collection to inform analyses of survival rates and, in turn, population models. This allows managers to put crises in context.

[26] http://coastwatch.pfeg.noaa.gov/erddap/index.html

Toward a Gulf-Wide Bird Monitoring Network: Identifying Objectives to Prioritize Action

Randy Wilson, FWS Migratory Bird Program, with contributions from
John Tirpak, FWS Gulf Restoration Program, and Melanie Driscoll, National Audubon Society

The Gulf of Mexico bird scientists recently established an ad-hoc network of 20+ agencies and organizations working to develop a Gulf-wide bird monitoring plan, post-Deepwater Horizon. That network of scientists is dealing with many of the same issues being discussed by marine mammal scientists and likely also fish and sea turtle scientists. As a result there may be synergies in having the various groups share ideas and approaches. In common is the lack of a coordinated, objective-driven framework to guide monitoring efforts at large spatial scales across the Gulf (Bjorndal et al. 2011). Also in common are the lack of baseline data for many species and the lack of an ability to assess the effects of system drivers and management at large spatial and temporal scales.

The bird monitoring network is tackling these challenges by first defining a set of agreed-upon goals and values. Traditionally, single-loop learning solves problems by feeding the results and consequences of actions directly back into the kinds of actions that are taken. The bird network is instead taking a double-loop learning[26] approach that looks at the governing variables that influence why we do what we do and how we use new results and consequences to refine our actions. Those governing variables include our goals, values, beliefs, and conceptual frameworks. In the design of a monitoring network, we need to identify the goals, values, and key data needs that reflect the interactions and complexities of the Gulf ecosystem.

The network used a structured-decision making process based on Hammond et al. (1999), working progressively through stages as follows (Figure 16)—

- Frame the problem - under the broad vision of integrated restoration and management of the Gulf ecosystem, the goal of monitoring was to maximize the usefulness of bird monitoring data to inform and advance bird conservation. The problem statement was framed as:

  > *How do we develop a cost-effective bird monitoring strategy for the Gulf of Mexico that evaluates ongoing, chronic, and acute threats and conservation activities, maximizes learning, and is flexible and holistic enough to detect novel ecological threats with respect to management triggers and to evaluate new and emerging conservation activities?*

  The decision then becomes: What suite of monitoring projects are needed to inform and facilitate bird conservation?
- Identify objectives - This stage involved an assessment of the network's core values, which were incorporated into the program's objectives (as underlined):
  - Fundamental objective 1: Maximize Integration of monitoring projects
  - Fundamental objective 2: Maximize Rigor of monitoring projects
  - Fundamental objective 3: Maximize Relevance of monitoring projects
    - Objective 3a: Maximize understanding of Population and Habitat Status assessments (i.e., baseline information)
    - Objective 3b: Maximize understanding of Management Actions and their respective impacts on bird populations and their habitat
    - Objective 3c: Maximize understanding of Ecological Processes and their respective impacts on bird populations and their habitat.

  Each objective was then weighted as a means of setting priorities. For each objective, sub-objectives were identified that would help meet that objective and then also weighted. The idea is that actions

[26] http://www.afs.org/blog/icl/?p=2653

can then be designed to meet those sub-objectives. For example, to assess the status of a population, the network identified 1) number of priority species surveyed, 2) spatial scope, and 3) temporal scope as survey sub-objectives, with each one weighted. Different survey designs were then scored according to how well they met objective-based performance metrics. This allowed managers to select the survey (or group of surveys) that yielded the greatest contribution to the program's values (in this case the maximum number of priority species surveyed over the largest spatial and temporal scale), evaluated against some constraining factor (e.g., cost).

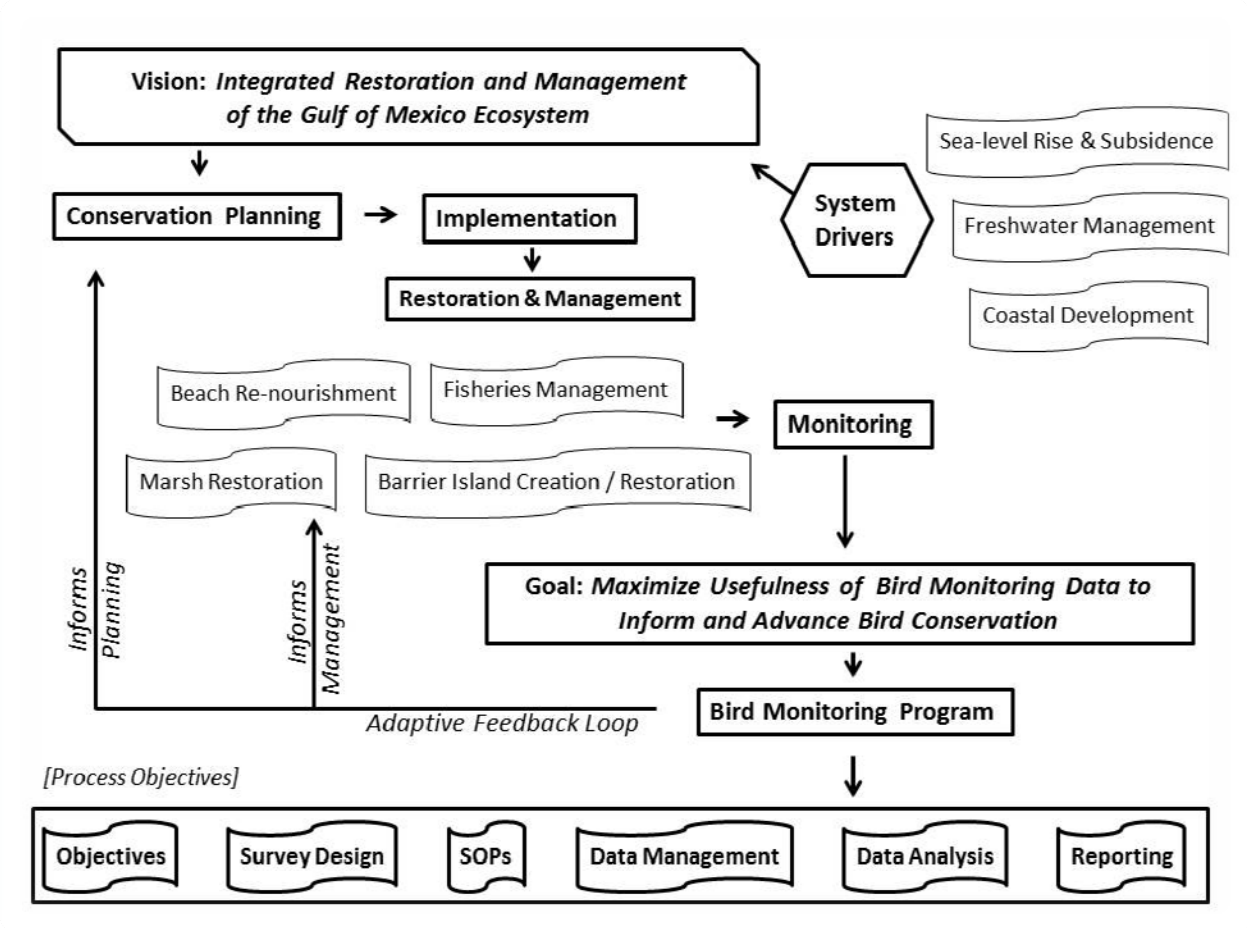


Figure 16: Framework for bird monitoring in the Gulf of Mexico (*Credit: R. Wilson, FWS*)

In summary, structured decision-making provides a pathway for moving conceptual models to reality. The model described here can help develop a monitoring framework that documents and reflects underlying decisions, assumptions, objectives, values, and priorities. Such a tool can be used to identify and rank data gaps and develop new monitoring approaches for establishing a long-term monitoring program. The process provides structure and tools to identify key program components, facilitate trade-off analyses, and coordinate with other biotic and abiotic monitoring efforts. This will increase the effectiveness of restoration expenditures, allow us to identify opportunities for pooling and leveraging resources, raise new funds to implement surveys, guide infrastructure development, and understand how important individual monitoring projects are from a regional perspective.

In response to a question, it was noted that the core bird working group is comprised of about 20 individuals and it has been working for about two years, with the last year and a half the most productive time. For now, the subject matter experts are the decision-makers, but as the process matures, agency directors and stakeholders will be consulted to ensure their values are represented and weighted appropriately. A technical report documenting the process has been drafted and Wilson offered to make the most current version of this document available upon request.

FUNDING OPPORTUNITIES IN THE GULF

Moderator: Kathryn Mengerink, Environmental Law Institute Ocean Program

The purpose of this panel was to provide an overview of potential funding sources for marine mammal research and monitoring in the Gulf, particularly those that have become available since the Deepwater Horizon oil spill. Presenters summarized the goals and objectives of each program and highlighted opportunities specific to marine mammals. The Environmental Law Institute (ELI) is a research and education organization that has been working in the Gulf since 2011. A summary of funding opportunities for recovery and restoration of the Gulf as well as other DWHOS-related synthesis materials are available on the ELI Gulf of Mexico Restoration & Recovery website[27].

Deepwater Horizon Oil Spill Natural Resource Damage Assessment Overview

Jean Cowan, NOAA Restoration Center

The Natural Resource Damage Assessment (NRDA) is a requirement of the Oil Pollution Act (15 C.F.R. §990). The Act provides guidance on how the NRDA Trustees are to resolve oil spill cases. The Trustees' specific responsibilities are to 1) determine the amount of injury to natural resources and the amount of lost services, 2) develop and oversee implementation of restoration plans to compensate the public for injuries and lost services, and 3) ensure the parties that were responsible for the damages (i.e., the polluters) pay for restoration.

The overarching goal of NRDA, as mandated by the Oil Pollution Act, is to restore, rehabilitate, replace, or acquire the equivalent of the injured natural resources and services to baseline conditions (were the spill not to have occurred) and to compensate the public for interim losses that occur during the time it takes for those resources to recover. The Trustees must implement monitoring that enables evaluation of success (i.e., meeting prescribed performance criteria) and/or the need for corrective actions. The amount and type of restoration will be dependent upon the amount and type of injury that is ultimately quantified. The NRDA is <u>not</u> a research funding opportunity, as research is explicitly not part of the Oil Pollution Act.

The Trustees for the Deepwater Horizon (DWH) are working together to conduct the injury assessments and to develop the restoration plan. There are nine Trustees: NOAA, Department of the Interior, Environmental Protection Agency, U.S. Department of Agriculture, and the states of Alabama, Florida, Louisiana, Mississippi, and Texas. Ultimately, the restoration plan developed by the DWH Trustees will balance what can be proven as injury and what can be quantified and defended as the restoration required to compensate for that injury. At the time of the meeting, the DWH Clean Water Act trial was still ongoing and the NRDA trial date had not been set. The injury assessment was also still ongoing and

[27] http://eli-ocean.org/gulf/

the amount and type of restoration that would be required had yet to be determined.[28] However, the Trustees had already identified marine mammals as one of the 13 NRDA injury categories (Figure 17).

The NRDA marine mammal team (many of whom were in attendance at the meeting) has started to identify the types of activities that may be appropriate for inclusion in the restoration plan. Those activities address many of the stressors that have been identified in the course of this meeting, and include—

- Habitat enhancement - e.g., debris removal, noise reduction, habitat restoration
- Direct resource response - e.g., stranding network, disentanglement
- Bycatch reduction - e.g., collaborative partnerships to reduce bycatch, fishery observers
- Other threat reduction - e.g., hook-and-line interactions, illegal feeding, and
- Restoration science to support restoration decision-making.

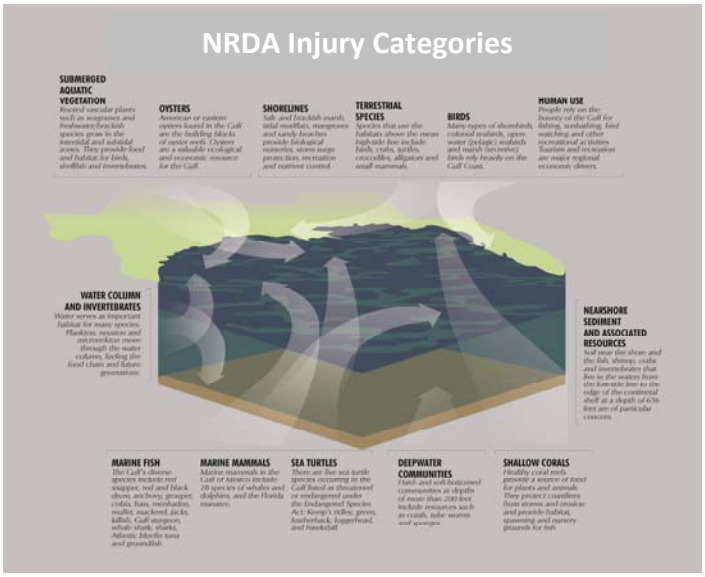


Figure 17: NRDA injury categories identified by the DWH Trustees (*Credit: NOAA*)

In terms of restoration science, it would be beneficial to approach this in the same way that the bird monitoring network is approaching the development of a bird monitoring plan. In other words, with all of the identified restoration options, what combination of activities would allow us to meet the restoration goals and what science is needed to support that decision-making? OPA is quite clear in directing the Trustees to implement monitoring to evaluate project success and/or the need for corrective actions (i.e., adaptive management). Reasonable monitoring and oversight costs cover those activities necessary to gauge the progress, performance, and success of the restoration actions. The Trustees must also be able to illustrate restoration outcomes to the public and to demonstrate regulatory compliance (e.g., NEPA and ESA). In large and complex cases like the DWHOS, it is also important that monitoring support decision-making by assessing overall restoration progress; addressing information needs to improve restoration project selection, design, and implementation; and informing a science-based adaptive management approach to reduce the risk associated with less well understood options.

The Trustees will be releasing a draft assessment and restoration plan for public comment in the near future. The plan must select and implement restoration activities that will demonstrably compensate for injuries (i.e., restore injured resources). The timing and scale of full restoration is still uncertain, but will focus on injury compensation and rely on science to support the implementation of restoration and evaluate decisions.

[28] BP has since agreed to pay $18.7 billion to settle remaining claims under the Clean Water Act and NRDA.

The Resources and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States (RESTORE) Act
Gulf Coast Ecosystem Restoration Council
John Ettinger, RESTORE Act Ecosystem Restoration Council

The RESTORE Act[29] was passed in 2012 on a bipartisan basis. It directed that 80% of the Clean Water Act civil penalties should come back to the Gulf in support of environmental and economic restoration activities, rather than having all of those penalties go to the general fund. The RESTORE Act established a new federal entity — the Gulf Coast Ecosystem Restoration Council (the RESTORE Council) — comprised of six federal agencies[30] and the five Gulf states. Similar to a Board of Directors, each state has a vote and the Chair[31], which represents the federal agencies, also has a (veto) vote. The Council will exist as long as there are funds to distribute and then it goes away under legislation. The Council has responsibility for spending 30% of the Clean Water Act penalties that comprise the Gulf Coast Restoration Trust Fund (the Fund; Figure 18).

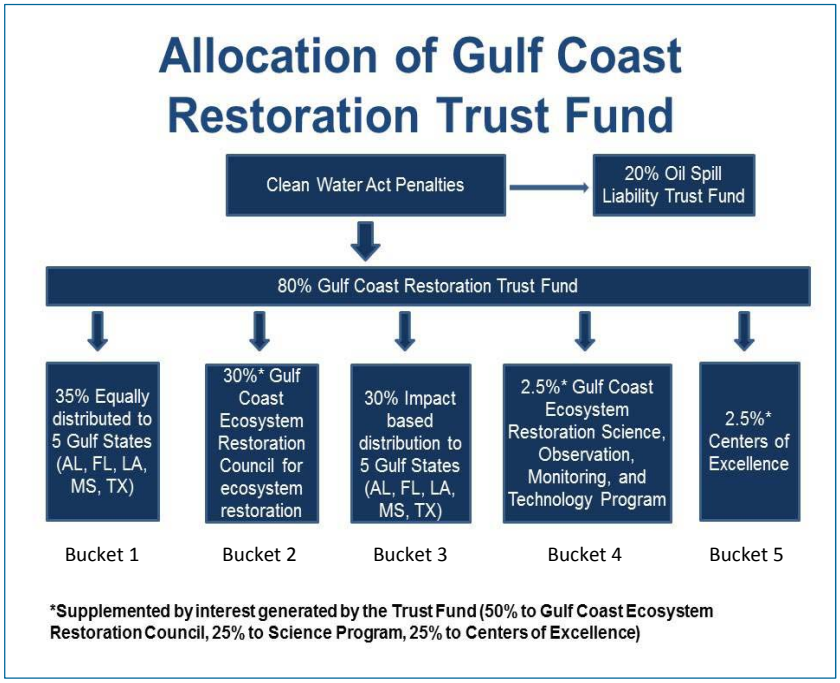


Figure 18: Allocation of funds under the five RESTORE Act "buckets"
(*Credit: The RESTORE Council*)

The five components, or "buckets," of the Trust Fund are allocated as follows—

- The Direct Component (Bucket 1) - 35% of the Fund will be equally distributed to the five Gulf states. In the case of Florida and Louisiana, the funds go directly to political subdivisions within each state. It is administered by the Treasury Department.
- The Council (Bucket 2) - 30% of the Fund is allocated to the Council. The Council selects projects and programs which it determines best address the requirements set forth in the RESTORE Act.
- The Spill Impact Component (Bucket 3) - 30% of the Fund is allocated to the states according to a formula set forth in the RESTORE Act. It is administered by the Council.
- The Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program (the Science Program; Bucket 4) - 2.5% of the Fund is to be used for research, observation, and monitoring to support long-term sustainability of Gulf ecosystems and fisheries. It is administered by NOAA (see below for more info).

[29] http://www.treasury.gov/services/restore-act/Pages/default.aspx
[30] The six federal agencies are the Department of the Interior (DOI), the Department of Commerce (DOC), the Department of Agriculture (USDA), the Department of Homeland Security (DHS), the Army, and the Environmental Protection Agency (EPA).
[31] Currently the Secretary of the Department of Commerce.

- Centers of Excellence (Bucket 5) - 2.5% of the Fund is to be used to establish Centers of Excellence in each Gulf State to further science, monitoring, and technology. It is administered by the Treasury Department (see below for more information).

Transocean has settled its Clean Water Act penalties for $1 billion, of which 80% was distributed to the five buckets per the RESTORE Act. Bucket 1 has been authorized by Treasury to distribute its funds. Bucket 2 is active also and the Council has received 50 submissions for projects and programs from Council members and federally recognized tribes. The projects vary and include marsh creation, monitoring programs, and adaptive management. At present, the only "blue water" project submitted deals with corals. All projects, as well as independent reviews of each of them, are available for viewing on the Council's website.[32] Discussions are still ongoing regarding the allocation formula for Bucket 3 funds, but all five Gulf states are eligible for planning funds (5%) so that they can develop their own expenditure plans. The funding that will be available for the Council and under the other four buckets will not be determined until after the Clean Water Act trial is over, but potentially very large sums will be available. The challenge will be the development of a decision framework to integrate all of these projects and programs with NRDA and the other funding entities so that we are not carrying out "random acts of restoration" and instead are doing something cohesive, coordinated, and big-picture.

NOAA-led RESTORE Act Science Program
Roger Helm, U.S. Fish and Wildlife Service

The mission of the RESTORE Act Science Program (Bucket 4) is to initiate and sustain an integrative, holistic understanding of the Gulf ecosystem and support, to the maximum extent practicable, restoration efforts and the long-term sustainability of the ecosystem, including its fish stocks, fishing industries, habitat, and wildlife through ecosystem research, observation, monitoring, and technology development. The program receives only a very small portion of the RESTORE Act funds (2.5%, with $20 million currently available) so these are very lofty goals.

The program is run by NOAA but the Act requires NOAA to work with FWS to develop and implement the program. The program is designed to have management application and so the science needs of resource managers are a key driver. The long-term priorities of the program will build on work already being done by other DWH-related science and restoration programs to identify science and research needs. The program has also engaged other groups and stakeholders for additional input.

The program has developed a Science Plan that establishes ten long-term research priorities. It will provide a foundation for providing good quality information that will be useful for management of the Gulf. It also aims to leverage science being done with other funding entities in the Gulf, as required by the Act. The final version of the Science Plan is due out in late April 2015.[33] The ten priorities identified in the Science Plan are as follows (with priorities particularly relevant to marine mammal scientists and managers identified in bold)—

- Comprehensive understanding of ecosystem services, resilience, and vulnerabilities of coupled social and ecological systems
- Construct management-ready and accessible ecosystem models
- Improve monitoring, modeling, and forecasting of climate change and weather effects on the sustainability and resiliency of the ecosystem

[32] https://www.restorethegulf.gov/
[33] Available at http://restoreactscienceprogram.noaa.gov/science-plan.

- Comprehensive understanding of freshwater, sediment, and nutrient flows and impacts on coastal ecology and habitats
- **Comprehensive understanding of living coastal and marine resources, food web dynamics, habitat utilization, protected areas, and carbon flow**
- **Develop long-term trend and variability information on the status and health of the ecosystem, including humans**
- Develop, identify, and validate system-wide indicators of environmental and socioeconomic conditions
- **Develop decision-support tools to assist resource managers with management decisions planned to sustain habitats, living coastal and marine resources, and wildlife**
- **Network and integrate existing and planned data and information from monitoring programs, and**
- **Develop and implement advanced technologies to improve monitoring.**

In 2015, the program designated $2-$2.5 million for a research fund to address several short-term priorities (projects that could be completed within three years) whose results would inform the future direction of the Science Program as well as the other science and restoration initiatives planned or underway. Although over 100 letters of intent were received in response to this Federal Funding Opportunity (FFO), the program expects to award about seven projects, with final decisions expected to be announced in September.[34] A second FFO is expected to be announced early in 2016.

The program has a 25-member Science Advisory Board that provides independent guidance and review of the program. Members include representatives of the Gulf States Marine Fisheries Commission, the Gulf of Mexico Fishery Management Council, and the RESTORE Act Centers of Excellence. Subject matter experts are to include those with expertise in marine mammals.

RESTORE Act Centers of Excellence / Gulf of Mexico Research Initiative (GOMRI)

Andrew Shepard, Florida Institute of Oceanography

Each of the five Gulf states has, or will have, Centers of Excellence (Bucket 5), with $4 million in funding currently available for each state. The RESTORE Act requires the Centers to award competitive grants to nongovernmental entities and consortia, including public and private institutions of higher education, with an emphasis on science, technology, and monitoring in the Gulf Coast Region relevant to at least one of the eligible disciplines identified in the Act: coastal sustainability, coastal resources, offshore energy development, sustainable economic development, and monitoring and mapping.

The Florida Center of Excellence is managed by the Florida Institute of Oceanography (FIO)[35], which also coordinates the Gulf of Mexico University Research Collaborative (GOMURC)[36]. FIO is a consortium of 29 Florida marine science research and education institutions and is hosted by the University of South Florida. FIO held public scoping meetings which identified coastal sustainability, coastal resources, and monitoring and mapping as priorities for Florida. FIO's first request for proposals (RFP) will fund competitive grants totaling up to $2.5 million. The RFP has been issued and is directed at projects focused on coastal fisheries and wildlife ecosystem research and monitoring in the Florida Gulf Coast region. FIO is also initiating a rapid response grant designed to partner with other restoration programs on ecosystem monitoring. However, as with Centers in the other Gulf states, no funds can be dispersed until authority is received from Treasury.

[34] An announcement of funded research was made 1 September 2015 (http://restoreactscienceprogram.noaa.gov/research).
[35] http://www.fio.usf.edu/research/flracep
[36] More information regarding GOMURC is available at https://prezi.com/gymvz4dmf_6g/gomurc/.

The other Gulf states are in various stages of implementation of their Centers of Excellence. The Texas Commission on Environmental Quality (TCEQ) has designated two consortia as Centers, with the University of Houston-led consortium[38] focused on offshore energy and the Texas A&M University-Corpus Christi-led consortium[39] focused on all five disciplines. Louisiana's Coastal Protection and Restoration Authority (CPRA) has designated the Water Institute of the Gulf as its state Center of Excellence. Alabama's Gulf Coast Recovery Council (GCRC) is in the process soliciting proposals for its state Center[40], as is the Mississippi Department of Environmental Quality (MDEQ)[41].

The Gulf of Mexico Research Initiative (GoMRI) has been mentioned already at this meeting as an independent research program that was funded by BP in 2010. It was designed to study the impact of the DWHOS and associated response on the environment and public health in the Gulf (Figure 19). GoMRI convenes an annual Oil Spill and Ecosystem Science Conference and this past February it hosted a special session on large marine vertebrates. It also funds the GRIIDC data management system discussed earlier. Of the original $500 million, there is still about 39% remaining. Marine mammal projects funded by GoMRI have been limited but include a block grant to study bottlenose dolphins (see project description by Worthy in Appendix B), and a recent award to the University of Louisiana-Lafayette Littoral Acoustic Demonstration Center for marine mammal acoustic studies (see project description by Sidorovskaia in Appendix B).

Figure 19: Dolphins were some of the many living marine resources impacted by the DWHOS
(*Credit: NOAA*)

National Fish and Wildlife Foundation (NFWF) Gulf Environmental Benefit Fund (GEBF)
Jon Porthouse, National Fish and Wildlife Foundation

NFWF has $2.554 billion in funding for the GEBF, which came from a plea agreement between the Justice Department and the DWHOS responsible parties (BP and Transocean) to settle criminal charges. The plea agreement directs NFWF to conduct or fund projects that remedy harm, or reduce or eliminate risk of future harm, to Gulf coast natural resources. Those projects must be directed toward situations where there has been injury to, destruction of, loss of, or loss of use of resources resulting from the DWHOS. The funding agreement does not allow for funding of routine monitoring or projects that collect baseline data. In selecting projects for funding, NFWF is to consult with state resource managers, FWS, and NOAA, and the states have the lead responsibility for identifying projects to be proposed for

[38] The University of Houston-led consortium includes Rice University, NASA Johnson Space Center, Texas Southern University, Houston Community College, and Lone Star Community College.
[39] The Texas A&M University-led consortium includes Harte Research Institute for Gulf of Mexico Studies, Center for Translational Environmental Health Research, Texas A&M University–College Station, Texas A& M University–Galveston, University of Texas at Brownsville, Texas State University, University of Houston Law Center, Gulf of Mexico Coastal Ocean Observing System Regional Association, and University of Texas Medical Branch–Galveston.
[40] http://www.restorealabama.org/
[41] MDEQ announced on 15 October 2015 that it had had designated the Mississippi Based RESTORE Act Center of Excellence (MBRACE), a consortium led by the University of Southern Mississippi and including Jackson State University, the University of Mississippi, and Mississippi State University.

funding. This allows for closer coordination with restoration efforts under NRDA and the RESTORE Act, as the states are involved in each of those processes. FWS reviews the projects for technical merit and for opportunities to leverage funds with existing projects. All projects should be designed to maximize environmental benefits. Unlike some of the other Gulf funding programs, the GEBF has a set amount of funding, with the amount of funding going to each state dictated by the plea agreement, and a 6-year schedule for when funds are to be allocated. The progressive increase in funding available each year allows NFWF and the states to prioritize and think in advance about how to spend the larger amounts once they become available.

There are opportunities to fund marine mammal research and restoration monitoring under the GEBF but relationships among the researchers, the states, and the GEBF need to be structured appropriately to take full advantage of them. Two types of projects can be funded—habitat-related and living marine resource-related. NFWF anticipates spending most of its funding on habitat conservation and restoration projects because it is reasonably confident, based on experience, that if it identifies, locates, sizes, designs, and implements habitat projects appropriately, this will result in a wider array of benefits. For marine mammals, NFWF is looking to marine mammal researchers and managers to provide input to the states regarding where to site and how to size habitat projects to provide the maximum benefit for marine mammals. Projects directed at living marine resources include management and stewardship actions intended to increase the sustainability or population size of these species. NFWF's primary focus is on bays and estuaries, with less interest in offshore environments.

The funding process follows an annual cycle. States submit pre-proposals in April with full proposals invited in June and due in July. Funding decisions are made by November, in consultation with NOAA and FWS. In general, research and monitoring are not considered plea-compliant activities unless there is a specific and measurable benefit to a resource injured by the spill. For marine mammals, the most likely linkage is improved management capability (e.g., stranding networks reporting data to a standardized Gulf-wide database), especially where a specific type of information is lacking. Regional activities are possible, but costs (and activities) must be allocated to specific states. States must also be willing to prioritize a project amongst all of the other projects it is considering, so communication and outreach to state NFWF contacts is key. More information about the GEBF can be found on the NFWF website.[41]

National Academy of Sciences (NAS) Gulf Research Program / Ad-hoc Research Funders Forum

LaDon Swann, Auburn University and NAS Gulf Research Program Advisory Board

The NAS Gulf Research Program was established by the plea agreement settling Clean Water Act criminal penalties, and is funded at $500 million, to be disbursed over 30 years. A 25-person Advisory Group solicited input from stakeholders around the Gulf, both formally and informally, and reviewed various restoration-related documents to develop the program's strategic vision and mission.[42] As part of that mission, the program aims to enhance oil system safety and the protection of human health and the environment in the Gulf of Mexico and other U.S. outer continental shelf areas by seeking to improve understanding of the region’s interconnected human, environmental, and energy systems and fostering application of that understanding to activities that will benefit Gulf communities, ecosystems, and the Nation.

[41] http://www.nfwf.org/gulf/

[42] http://www.nas.edu/gulf/vision/index.htm

The program will fund studies, projects, and other activities using three broad approaches specified in the plea agreement: research and development, education and training, and environmental monitoring. Initial activities have included exploratory grants, workshops, and the development of a science policy fellowship (for graduate students) and an early career fellowship program (for pre-tenure professionals). An RFP will be issued in April for grants that synthesize existing data that could inform efforts to restore and maintain the Gulf's ecosystem services, or that enhance understanding of the Deep Gulf or its physical and biological connectivity to coastal communities. Also being formed under the National Research Council is a committee on "Effective Approaches for Monitoring and Assessing Gulf of Mexico Restoration Activities." More information about the Gulf Research Program and funding opportunities can be found on the NAS website.[43]

The Ad-Hoc Research Funders Forum is an effort to coordinate RESTORE and non-RESTORE research funders in the Gulf, including NOAA Sea Grant, FWS, USGS, NASA, EPA, and many others. No funding is associated with the forum, but there could be opportunities for collaborative, regional research activities jointly funded by one or more of these entities.

BOEM Environmental Studies Program: Science for Informed Decisions

Rodney Cluck, BOEM Division of Environmental Sciences

The mission of the Environmental Studies Program is to provide the information needed to incorporate environmental safeguards into offshore energy and mineral exploration and development. It aims to ensure that the best available scientific information is used for making management decisions to balance environmental protection with energy development. That could include decisions regarding impact assessments, leases, permits, rules for operators, consultations, and compliance with NEPA, MMPA, ESA, state laws, and associated mitigation requirements. The program focuses not only on marine mammals but also on sea turtles, birds, bats, fish, corals, and other benthic organisms. More generally, it protects marine, coastal, and human environments, biodiversity, air and water quality, and the resources that Native people depend on.

Funding varies by discipline, but a large portion of the program's $35 million annual research budget (27%) has been dedicated to marine mammals (Figure 20). The program has been ongoing for 40 years, and every year it funds between 30 and 40 new studies. Issues related to marine mammals include—

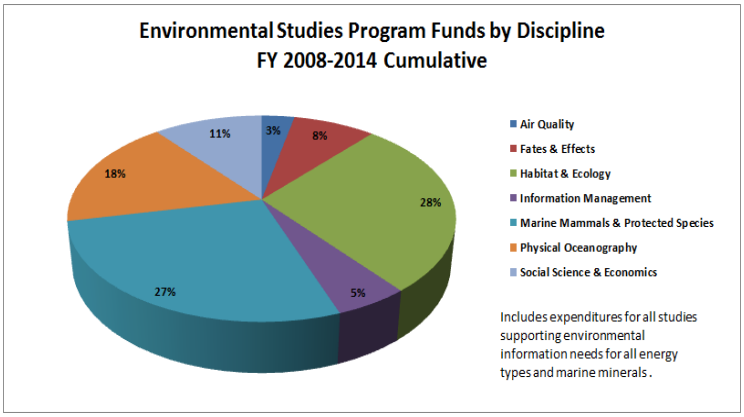


Figure 20: Allocation of BOEM Environmental Studies Program funding by discipline, FY 2008-2014 Cumulative (*Credit: BOEM*)

- Noise - acute and chronic physiological effects, behavioral effects
- Behavior - migration, diving, reproduction, calving, nursing
- Food - stocks of lower trophic level organisms, ecosystem dynamics
- Toxins - exposure to, and effects of, spilled oil and other contaminants, and
- Ship Strikes - occurrence, high risk areas, methods for avoidance.

[43] http://nas.edu/gulf/index.html

The program has spent about $1 billion since it started and PDF versions of all of the reports generated are in BOEM's Environmental Studies Program Information System (ESPIS). BOEM is now working to also make all of the data associated with those reports available through ESPIS. With all of the data available, it is BOEM's priority to re-analyze the historical data, particularly in light of other scientific information that is now available. There is also an opportunity now, given the funding available from the Environmental Studies Program, to leverage the long-term, wide-area monitoring that may be implemented under various restoration efforts in the Gulf. This will require new and expanded partnerships to share costs, data, expertise, and experience, tapping experts and resources from various federal agencies (including the Marine Mammal Commission, Office of Naval Research (ONR), Navy's Living Marine Resources Program (Navy LMR), NOAA, and NSF), the offshore energy industry, academics, and consultants. More information about the Environmental Studies Program can be found on BOEM's website.[44]

Sound and Marine Life Joint Industry Program: Research Program Update

Gary Wolinsky, Chevron

The Sound and Marine Life Joint Industry Program (SAML JIP) is an industry-led initiative focused on the effects of sound on marine life generated by oil industry exploration and production (E&P) activities globally. The international scope of the program is broader than most of the other Gulf-based programs discussed at this meeting, and the studies funded by the JIP typically have broad applicability. The program structure includes independent, external advisors, and funding is awarded through an RFP process that typically has a very high response rate. The activities of the JIP are strongly integrated into the sound and marine life research community. There are existing partnerships with a variety of organizations and JIP members have frequent interactions with the National Science Foundation (NSF), ONR, Navy LMR, NOAA and BOEM. JIP members believe that effective policy must stem from good, independent science. Advancements in understanding of the effects of E&P sound on marine life are expected to lead to better decision-making and to more effective mitigation strategies.

The JIP has had a varying number of industry members over time, and currently has 11 oil and gas E&P companies as well as the International Association of Geophysical Contractors (IAGC) and the International Association of Oil & Gas Producers (IOGP). Its total budget from 2006-2016 is $50 million. The amount available in Phase III of the program (2014-2016) is $18 million. Among the projects funded (or co-funded) to date are studies of behavioral responses of humpback whales to seismic survey activity (BOEM co-funded; Cato et al. 2012), the population consequences of (acoustic) disturbance (PCoD; Costa et al. 2012, Sills et al. 2014), controlled exposure experiments involving bottlenose dolphins (Finneran et al. 2013), modeling minke whale hearing (Tubelli et al. 2012), estimating cetacean density from passive acoustic monitoring (Marques et al. 2013), and the development of PAMGuard software for acoustic monitoring during seismic surveys (Gillespie et al. 2011). Ongoing projects include source characterization studies, a review of sound propagation models, and underwater hearing and masking studies. Phase III studies will include an update to sound exposure criteria (Southall et al. 2007), masking in seals, PCoD, an inventory of industry sound sources, equipment for use in low-visibility conditions, hearing recovery after exposure to intermittent sounds, and behavioral responses of fish to sound. More information about the SAML JIP, the proposal submittal process, ongoing projects, and project reports can be found on its newly redesigned website.[45]

[44] http://www.boem.gov/Studies/
[45] http://www.soundandmarinelife.org/

Questions Regarding Funding Opportunities

There was a question as to whether any of the funding sources could be used to address gaps in observer coverage of commercial fisheries (e.g., the shrimp trawl and menhaden purse seine fisheries). The NOAA-led RESTORE Act Science Program cannot be used to fund any of the activities that NOAA normally conducts. However, NRDA may be able to fund observer coverage as a monitoring activity as long as it is complementary to an existing observer program. The Florida Center of Excellence's current RFP includes a call to "develop innovative approaches and technologies to assess fish populations, fishing activities, ecosystem impacts of fishing activities, and pressure on resources," and expanding observer coverage could fit into that requirement.

Another question was whether the timing of RFPs and reviews are coordinated such that a project could be funded by two or more funding entities if it met the criteria for more than one program. One of the funders noted that coordination among programs was a primary goal and that measures were being taken to achieve it but more could be done. The RESTORE Act does not allow for a formal coordination process, but the program coordinators are having the relevant conversations. The various programs are just starting to issue RFPs so it is anticipated that there will be a more consistent effort by the funders to discuss projects. The Centers of Excellence have not all been designated yet and also have yet to be funded but they are all talking and sharing information and they are mandated by the RESTORE Act to cooperate and coordinate.

PRIORITY INFORMATION NEEDS AND KNOWLEDGE GAPS - BREAKOUT GROUP DISCUSSIONS

There were five breakout groups, and each was given similar questions to answer:

- What specific conservation and management needs does this address?
- What new data collection would be needed?
- What additional assets are needed (aircraft, vessels, acoustic recorders, etc)?
- What analytical capabilities are needed?
- How can data sharing be facilitated and what mechanisms might be used?
- What are some complementary data sets?
- What opportunities are there for enhanced collaboration?
- What potential funding opportunities might help to meet this need?
- Can other resources be leveraged?

I. Abundance and Stock Structure

Led by Samantha Simmons, MMC

Based on the existing gaps in the Gulf regarding species abundance and stock structure, across all habitats (bay/sound/estuary, coastal and shelf, and offshore), the first priority identified by the group was to develop a process for prioritization of stocks. Parameters that could be used in the evaluation of stocks were existing information on abundance, stock structure, habitat use or value, threats, and distinctiveness. The first step in that process would be to compile an inventory of existing data as well as the confidence in that data, in terms of coefficients of variation.

The next step would be to evaluate the best methods available for estimating abundance and stock structure, including traditional methods such as line transect surveys and genetics, but also alternative

and advanced survey technologies. We also need to evaluate the respective costs of each method to determine which survey methods would be most cost-effective.

In establishing priorities, we also need to think about the management drivers. It was noted that marine mammals do not appear to fit nicely into any of the funding "buckets" discussed earlier, so we may need a separate effort to identify appropriate funding opportunities for addressing these gaps. One of the funders clarified that much of the *current* funding available for restoration is focused on states and coastal waters and a gap exists for more pelagic species.

False killer whale (*Pseudorca crassidens*)
(*Credit: NMFS*)

There was much discussion of leadership, and where the leadership would come from to spearhead this effort. This is important not only for filling data gaps for abundance and stock structure, but for each of the breakout session topics. It was suggested that MMC could provide some of that leadership, but MMC has traditionally focused on relationships with other federal agencies and building relationships with state agencies will take more time and effort. There are several marine mammal scientists that are working at the state level, but we need to do more to identify the advocates for marine mammals and the funding decision-makers in each of the states. The states have not traditionally been involved in marine mammal research, especially in offshore waters where there are huge data gaps.

II. Distribution and Habitat Use

Led by Stephanie Watson and Chris Simoniello, GCOOS

The group identified four priority information needs, in order of priority (second and third are equal priority)—

- Site-specific analyses of habitat use
- Understand large-scale drivers of movement coupled with physical parameters
- Broad-scale seasonal data to understand temporal changes in distribution, and
- Identify prey species and their distribution for different marine mammals (food web dynamics).

For each of the priorities, the conservation/management needs include the identification of site-specific impacts, the development of marine protected areas, overlaying foraging areas with restoration areas, assessing restoration success, and understanding habitat quality and quantity. The means by which to address data needs would have to be identified for each specific site but would likely include aerial surveys, acoustics, underwater gliders, and tagging. Although NMFS has access to its large vessel for marine mammal surveys for 60 days each summer, additional assets that would be needed include large research vessels and advanced glider and drone technology (and ground-truthing these technologies with existing data sets).

Needed analytical capabilities include the development of improved methods for multi-scale habitat assessments including integration across platforms and different scales—basically an integrated analytical approach. The group discussed conducting a small-scale pilot project in an area where there

are data and compile the information from different observing or monitoring platforms (e.g., acoustics, tagging, aerial surveys) and aggregate that into an integrated data product. This could require an "inventory" of existing data sets and an evaluation of what approaches might be available to analyze data at both fine and broad scales. Sperm whales may be a good test case.

Additional resources to be leveraged could include fiber optics, GCOOS data integration, seakeepers/vessels of opportunity (e.g., Dept of Transportation or shipping industry platforms), Ocean Tracking (sharks, etc.), piggybacking on SEAMAP or LiDAR surveys (although they have a rigid survey design), and citizen-based science or shore-based data collection opportunities (such as smart phone apps to report marine mammal sightings).

III. Strandings, Health Assessments, and Life History

Led by Frances Gulland, MMC

Data from strandings and health assessments provides information on both marine mammal health and life history. However, there are significant information gaps on health data for all marine mammal stocks in the Gulf. There are also gaps in life history for all Gulf species except bottlenose dolphins and manatees.

One of the overarching needs identified was to collaborate with Mexico and Cuba on data collection, training, and data sharing. This would help in the integration of data from an animal that may have been exposed to some threat outside U.S. waters that then strands in the U.S portion of the Gulf.

Priority species for data collection efforts include bottlenose dolphins, *Kogia* spp. (dwarf and pygmy sperm whales), Bryde's whales, and sperm whales. We also need to conduct hazard/threat assessments for all non-*Tursiops* stocks, applying the method used for *Tursiops* in Texas waters by Phillips and Rosel (2014). To facilitate data sharing and collaboration, we need to inventory samples and data so that information collected could be accessed by different researchers or managers in the Gulf and elsewhere. That would help ensure maximum use of existing data and resources. That inventory needs to be a living data set.

Bryde's whale (*Balaenoptera edeni*)
(*Credit: NMFS*)

The group also discussed the challenge of convincing managers at the state level why they should care about the health of a marine mammal stock that occurs in offshore waters. We need to find compelling ways to communicate the need to address information gaps to others outside the marine mammal research community.

IV. Human Activities: Sound

Led by Tiff Brookens, MMC

The top three priorities for research and monitoring to assess the effects of human-generated sound were as follows—

- Characterization of human-generated sounds

  - Seismic as well as vessel traffic and other sources
  - Seasonality and inter-annual trends in the Gulf/soundscape
- Behavioral response to sound at individual/population/species level
  - Short term, acute impacts and longer term, chronic and cumulative impacts
  - Effects on prey and ecosystem approaches to analyzing impacts
- Hearing capabilities and audiograms, particularly for non-*Tursiops* delphinids and low-frequency cetaceans (i.e., Bryde's whales)—audio-evoked potential (AEP) data can be collected from stranded animals and finite element modeling can be used to determine potential hearing capabilities.

Passive acoustic data can provide information not only on the sound sources but also on the distribution and (depending on the devices used and how they were used) the densities of animals. This has implications for leveraging the data collected. More generally, baseline data on the abundance, density, and distribution of marine mammals (whether gleaned from line-transect surveys, acoustic monitoring, or both) is necessary to inform analyses of exposures, behavioral responses, and cumulative impacts.

Additional priorities identified—
- Better spatial resolution of abundance/density/distribution data (a priority identified by this group but addressed by other breakout groups)
- Life cycle and source characteristics of a sound field
- Further development of methods to assess effects of sound (e.g., behavioral response, opportunistic studies), and
- Assessment of soundscape as a habitat feature for marine mammals.

Conservation and management needs were to—
- Support incidental take authorization permit applications and analyses
- Characterize sound-generating activities and conduct sound source verifications and modeling
- Address impacts of shipping-related sound (especially in light of the expansion of the Panama Canal), and
- Understand behavioral responses, especially for deep-water species.

Data collection needs for sound characterizations include more spatio-temporal monitoring of anthropogenic sound and an inventory of sound-generating activities, with a focus on areas with species of concern. For behavioral response studies, short-term data collections are more feasible, but data collection methods need to be improved. Better information also is needed to understand population-level impacts. To collect audiograms, AEP data, technology development and standardization, and training for stranding network members is needed.

Analytical capabilities needed to characterize the Gulf soundscape include more "computer nerds" and the ability to handle big data sets using qualified staff and enhanced storage capabilities. Behavioral response studies will require analysis of the effects of sound on individual animals, new and improved analytical technologies and methods, and a more comprehensive analysis of existing data.

For all of the priorities identified, more funding is needed for data collection and analysis, but there may be opportunities to collaborate on funding with BOEM or other entities (perhaps an AMAPPS[46] for the

[46] AMAPPS, or the Atlantic Marine Assessment Program for Protected Species, is a joint BOEM/NOAA/Navy/FWS initiative to collect broad-scale, multiple year, year-round sightings and vocalizations to determine abundance, density, and distribution of

Gulf?). Also needed are opportunistically collected baseline data (i.e., when hurricanes or other events create a lull in anthropogenic activities) and an evaluation of existing sound data. Behavioral response studies should leverage studies being conducted elsewhere (i.e., response to Navy sonar in the Pacific, humpback whale response to seismic activity off Australia).

V. Human Activities: Fishing and Tourism

Led by Randall Reeves, MMC

The top priorities identified for research and monitoring to assess impacts of fishing and tourism were—

- Better geo-referenced information on the nature, frequency, and scale of human activities in the marine environment (boating, shipping, fishing, wildlife tourism[47], etc.) and overlay that with known distributions of marine mammals to develop a risk assessment matrix. Information would include—
  - Inventory of manatee- and dolphin-focused tourism (dolphin and manatee watching, tour operators) in Gulf and metrics to gauge effort (number of vessels, trips, operators, etc.)
  - Nature and levels of fishery interactions (depredation and bycatch) for swordfish/tuna/shark longline, reef fish longline, hook-and-line, purse seine, and recreational fisheries
- Information on "human dimensions" aspects, such as—
  - Characteristics of people who interact with marine mammals (e.g., what circumstances may cause people to shoot at a dolphin?)
  - The motivations of people who want to swim with dolphins, and things that might motivate them to change their behavior.

The big-picture need is to identify the scope and nature of human interactions with marine mammals and understand how any threats resulting from those interactions relate to the larger suite of threats in the Gulf (pollution, habitat loss, noise, etc.). What are the most relevant and significant problems associated with fishing and tourism (e.g., derelict gear, feeding dolphins, entanglement, hooking), and how can these be addressed in order to target limited funds for mitigation? It was noted that some problem areas for tourism interactions have not responded to outreach or enforcement efforts to date, and this led to the suggestion that attention should focus elsewhere. However, there was concern that if one community is “getting away with” something and profiting from the activity (e.g., feeding dolphins), this would have a "wildfire effect," with other communities more likely to engage in the same activity.

The group identified marine mammal interactions with commercial fisheries as a priority for which more information is needed, including improved understanding of the impacts of lost or abandoned fishing gear. The importance of knowing more about the impacts on marine mammals of recreation, fishing, and tourism in the southern Gulf of Mexico (Cuba and Mexico) was also emphasized.

Much of the human dimension boils down to understanding and preventing the activities of individuals or particular communities of individuals that are harmful to marine mammals. A risk assessment approach would be helpful. For example, with regard to recreational fishing and tourism, overlays of various types and locations of human recreational activity on top of information on marine mammal population abundance and behavior could enable managers to do a better job of tailoring mitigation

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marine mammals, sea turtles, and seabirds in the Mid- and North Atlantic OCS planning areas (http://www.nefsc.noaa.gov/psb/AMAPPS/).

[47] Members of the group generally agreed that wildlife-centered tourism was beneficial for both the economy and the environment, and therefore it should be encouraged, albeit with appropriate safeguards in place to ensure that such tourism does not jeopardize the health of the target animal populations and is safe for people.

efforts to specific needs. Also, predicting where problems are likely to occur should help address the "wildfire effect" issue.

ALIGNMENT OF FUNDING OPPORTUNITIES WITH INFORMATION NEEDS AND KNOWLEDGE GAPS - GROUP DISCUSSION

Moderated by Kathryn Mengerink, Environmental Law Institute

Some of the issues we heard from the funders that are relevant for marine mammals—

- NRDA is focused on restoration rather than research, but restoration includes implementation of the restoration plans and monitoring their effectiveness. Restoration of marine mammals is a little different than restoration of other resources, and the challenge is to fit that into the monitoring priorities identified at this meeting. How can marine mammal restoration link to long-term monitoring needs? Can restoration monitoring address those broader monitoring needs?
- The RESTORE Council has had one call for proposals to date, but that process is largely driven by state Council representatives. How can marine mammal scientists and managers work within this process to ensure that the Council is considering marine mammals appropriately?
- The RESTORE Act Spill Impact Component is a state program overseen by the RESTORE Council and there are planning grants being made available to the states to address spill impacts. This also gets at the question of what the role the states play in marine mammal research and how the marine mammal research community can engage with states in that process.
- The RESTORE Act Science Program has already issued an RFP and more are expected in the future. Although there is only $20 million currently available under that program, additional funds will be available in the future. Several of the Science Program's objectives align with marine mammal research needs, including living marine resources, food webs, long-term trends, monitoring, and habitat management, as well as coupled social-ecological systems.
- The RESTORE Act Centers of Excellence programs still have a lot of unknowns so it's unclear at present where there could be alignment with marine mammal needs.
- GoMRI has about 40% of its available funding remaining to be allocated over roughly the next five years.
- The NFWF GEBF is focused on resources harmed by the spill, primarily in bays, sounds, estuaries, and coastal waters. The funds are going to the states and we need to engage with the states regarding priorities for marine mammals.
- The NAS Gulf Research Program's focus is on environmental monitoring, which has been a major area of discussion at this meeting, but questions remain as to how to develop effective monitoring systems. The upcoming National Academy study will look at effective approaches for monitoring restoration activities and there may be marine mammal researchers and managers that can inform that process.[48] There is also funding for leadership and policy fellows.
- There are a lot more funding opportunities in the Gulf and the Ad-Hoc Research Funders Forum is looking at how those programs can link to each other and encourage collaboration.

Risso's dolphins (*Grampus griseus*)
(*Credit: NMFS*)

[48] Frances Gulland was appointed to the NRC panel, which had four meetings scheduled for 2015 (http://www8.nationalacademies.org/cp/projectview.aspx?key=49695).

- The BOEM Environmental Studies Program has allocated, on average, 27% of its annual $35 million budget to marine mammals and other protected species. BOEM is particularly interested in data systems, reanalysis of existing data, and long-term monitoring.
- The SAML JIP is an internationally-focused program focused on research of broad applicability, but there are many focal areas relevant to the Gulf, including acoustic monitoring and the effects of sound on marine mammals.

Clymene dolphin (*Stenella clymene*)
(*Credit: NMFS*)

A suggestion was made to highlight the economics of wildlife viewing and the importance of those activities to state economies as one way of engaging state resource managers and associated funding entities. As a first step, we need to identify who the appropriate representatives are within each state. Perhaps a working group could be formed to figure this out and develop a strategy for engagement.

There were also several funding entities that expressed interested in data synthesis and integration projects (e.g., NAS Gulf Research Program), so there may be marine mammal projects that fit that need.

Having different marine mammal researchers all proposing separate projects is probably not as effective as collaborating on projects that might fit one of more of these buckets. Therefore, we might consider developing one or more overarching marine mammal projects that address the priorities outlined by the funders and which include a variety of tools, technologies, and strategies for addressing research and monitoring needs. If we had a group that could bring this plan together for the marine mammal research community, we may be more competitive for funds that are not necessarily focused on marine mammals.

The NAS Gulf Research Program is looking at ways to better integrate existing monitoring systems. One of the groups discussed the ability to integrate new technologies, like additional acoustic moorings, to supplement ship-based surveys. That is especially important for expensive and hard-to-reach areas, like the deep pelagic waters of the Gulf. There were several examples presented here regarding how to better use existing resources by having a more integrated monitoring approach.
We also need to find ways to communicate to the public the importance of marine mammals to the Gulf, the role they play, and the impact of human activities on marine mammals. This would provide support not only at the agency level but also within the public for additional research and monitoring of marine mammals.

Another point was raised regarding BOEM's interest in analyzing historical data. Several researchers have samples or data that they have collected over the years but don't have the capacity to evaluate or archive in a data system. Could the available funding opportunities be used to provide a mechanism to support the development of those data systems or an inventory of those samples?

Having marine mammal scientists and managers working in the Gulf identify their highest priorities for research and having the funders hear the same priorities from everyone is very powerful and would make the funders feel more comfortable allocating funds to marine mammal projects. This is especially true for the states that are not familiar with research on marine mammals. They will be looking to the

experts to bring that information forward, especially if the experts come forward as a community with a set of shared priorities. There may even be opportunity for scientists working on marine mammals and other large marine vertebrates to come together on common approaches to prioritizing research. This is a good time, as funders are just starting to sort things out and plan, but once the funds start to flow they will need to allocate those funds rather quickly. We need to be ready for that.

One of the funders noted that all of the funders are feeling the pressure to coordinate and use the correct instruments for doing that. However, we shouldn't wait for the funders to work through the appropriate conceptual ecological model to drive a coordinated Gulf restoration plan. Marine mammals are one of the 13 NRDA injury categories and there is tremendous interest in marine mammals, so there are opportunities to address marine mammal research and monitoring needs. Having a plan will help the funders include specific examples of marine mammal projects in their RFPs. The funders talk amongst themselves, and what comes from the marine mammal research community is one of the most important considerations they take into account. When multiple communities come together with a similar message, that provides a strong rationale for funders to follow a course of action. When the funders or the states hear different or competing objectives, or when proposed activities do not link well with what the states want, it will be difficult for those activities to be selected. This is also a very different funding model, with funds being allocated by the states rather than from Congress or the federal agencies. And once the Clean Water case settles, the funding will remain available over a long timeframe. The funds have certain restrictions, but the vision for the funds is expansive, long-term, and holistic. Even having one or two things that marine mammal scientists and managers agree on as their priorities will increase the probability of funding exponentially.

One of the other funders agreed that the marine mammal research community can help drive the funding process, but it will require leadership to get on the funders' radar. The MMC was invited to come to the next meeting of the National Ocean Partnership Program (NOPP) to engage other federal agencies and have the outcome of this meeting communicated to the Subcommittee on Ocean Science and Technology (SOST)[49]. The major interest of the NOPP is to look across a broader ecosystem perspective. For marine mammals, we should be thinking about how that fits in with other ecosystem variables (physical, social, and economic). The MMC could carry that voice for marine mammal scientists and managers working in the Gulf.

A number of the states and federal agencies have developed a vision and list of priorities for Gulf restoration (e.g., Louisiana's Master Plan, FWS's Vision for a Healthy Gulf of Mexico Watershed[50]), as have several NGOs (Ocean Conservancy[51], The Nature Conservancy[52], and the National Wildlife Federation[53]). NOAA has yet to release its restoration vision for the Gulf,[54] nor has the NMFS Office of Protected Resources. The MMC's organization of the marine mammal research community is timely, and putting forward our collective vision for the next 5-15 years would be a powerful statement in this vacuum. It would also be useful to have a "Marine Mammal Action Plan" for the Gulf that integrates the management drivers and the science to get at a structured decision-making model. That plan requires

[49] The SOST is the lead interagency entity for Federal coordination on ocean science and technology (see https://www.whitehouse.gov/administration/eop/ostp/nstc/oceans).
[50] http://www.fws.gov/gulfrestoration/pdf/VisionDocument.pdf
[51] http://www.oceanconservancy.org/places/gulf-of-mexico/gulf-restoration.html
[52] http://www.nature.org/ourinitiatives/regions/northamerica/areas/gulfofmexico/restoration/index.htm
[53] http://www.nwf.org/News-and-Magazines/Media-Center/News-by-Topic/Wildlife/2014/12-09-14-A-Vision-For-Comprehensive-Gulf-Restoration.aspx
[54] NOAA's Strategy for a Healthy Gulf of Mexico was released in late April 2015 (http://www.habitat.noaa.gov/pdf/healthy_gulf_of_mexico_april2015.pdf).

that management clearly articulates its objectives and then illustrate how the science can help meet those objectives.

OPTIONS FOR DEVELOPING A GULF-WIDE MARINE MAMMAL RESEARCH AND MONITORING PLAN

Moderated by Vicki Cornish and Michael Tillman, MMC

The MMC was prompted to hold this meeting to understand oil spill impacts and explore restoration opportunities associated with the Deepwater Horizon oil spill. Moreover, the Commission was concerned that discussions at such meetings had generally not recognized and reflected the importance of marine mammals in the Gulf ecosystem and the threats they face from various human activities. One potential model of the kind of thing needed in the Gulf is the Alaska Marine Science Symposium (AMSS), which emphasizes an integrated approach to understanding ecosystem-wide impacts of various stressors. The AMSS consistently includes explicit consideration of marine mammals and the roles they play in both the ecosystem and the Alaskan regional economy. The MMC envisions a similarly integrative and regular forum for the Gulf region, and believes the time is ripe to establish such a forum (or equivalent mechanism). With its present composition, the MMC is strongly committed to ensuring a resilient Gulf ecosystem that includes marine mammals, but the Commissioners and staff are all based at a considerable distance from the Gulf and want to make sure that they have heard the voices and priorities directly from people living and working in the region. The priorities outlined in the Commission's 2011 Statement of Research Needs (MMC 2011) may not be sufficiently up to date or detailed, and it was expected that the present meeting would rectify that by facilitating the collaborative development of an action plan for building research capacity and information exchange in the Gulf.

Melon-headed whale (*Peponocephala electra*)
(*Credit: NMFS*)

The funding that has become available as a result of the DWHOS is almost entirely directed to the states, which have a large stake in the outcome. However, if allocation of those funds is driven solely by the states, marine mammals, especially the outer shelf and deepwater species, are likely to lose because the states' interests tend to be parochial and coast-oriented. Without strong, forceful leadership within the marine mammal research community to identify and communicate priorities, there is a risk that a great deal of money will be spent on restoration but little of it to the direct benefit of marine mammals. One way to address this would be through the development of a regional coalition aimed at regular meetings with state decision-makers on the importance of marine mammal research and monitoring. This coalition could, among other tasks, educate state decision-makers about the economic benefits of marine mammals to their economies (Stokes and Lowe 2013).

One of the needs expressed by the funders was to monitor the recovery of certain species, which would involve many of the activities discussed at the meeting. In addition, oil and gas development in the Gulf is bound to continue, and BOEM will therefore continue to be attentive to the potential impacts of exploration and development on offshore species. Sharing data and coordinating activities were identified as overarching needs, as well as collaborative planning. One successful model for doing so, the AMSS, grew out of the Exxon Valdez oil spill, with the purpose of furthering outreach and education regarding the ecosystem impacts of the spill and other stressors. The annual AMSS meetings provide the

opportunity for researchers to exchange information on results and plans, develop collaborations, and share resources, which collectively are directed at meeting the objectives of various funders. The agendas of AMSS meetings are organized according to different ecosystem components, ensuring multi-disciplinary thinking and a focus on ecological linkages.

The MMC would like, as a result of this meeting, to see scientists and managers in the Gulf take full advantage of the information presented and develop their own collaborative strategic vision or plan for marine mammal science and conservation. It will be essential for funding sources and state recipients of funds to participate as full partners in this endeavor. Ocean Conservancy offered to help with the effort of forging the documentation and discussions from this meeting (and other sources) into a draft action plan, and the MMC is eager to play a supporting role. Even though the responsibility for marine mammal conservation and management rests primarily with the federal government, the coastal states have their own clear stake in a healthy, productive, and diverse ecosystem and in profitable, environmentally responsible fisheries, offshore energy development, and tourism.

The MMC thanked the sponsors, the steering committee, the moderators, the presenters, and participants and adjourned the meeting.

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Appendix A: List of Poster Presentations

PDF versions of the posters presented at the meeting are available at www.mmc.gov.

Baker, Scott, Oregon State University
- Archiving and Accessing a 'DNA Register' for Individual Identification and Stock Structure of Sperm Whales in the Gulf of Mexico

Carmichael, Ruth and Noel Wingers, Dauphin Island Sea Lab — Three posters:
- Sighting Demographics of the West Indian manatee (*Trichechus manatus*) in Alabama and Mississippi waters
- Modeling West Indian Manatee Movements Informs Space Use Patterns and Phenology in the Northern Gulf of Mexico
- Distribution of Stranded Bottlenose Dolphins (*Tursiops truncatus*) in Alabama Waters from 2004 – 2013

Cush, Carolyn, Chicago Zoological Society
- Gulf of Mexico Dolphin Identification System (GoMDIS) - A Collaborative Tool for Bottlenose Dolphin Conservation & Monitoring

Fazioli, Kristi, University of Houston-Clear Lake Environmental Institute of Houston
- An Apparent Increase in Bottlenose Dolphins in Upper Galveston Bay: City Slickers or Tourists?

Frasier, Kaitlin, Scripps Institution of Oceanography
- Long-term Passive Acoustic Monitoring of Dolphins in the Gulf of Mexico

Hohn, Aleta, NMFS Beaufort Laboratory
- Assigning *Tursiops* Strandings to Stock Using Stable Isotope Ratios

Kerr, Iain, Ocean Alliance
- Marine Mammal Toxicological Research and Education: Five summers in the Gulf of Mexico in Response to the Deepwater Horizon Disaster

Martinez-Serrano, Ibiza, Universidad Veracruzano — Two posters:
- Biological Monitoring Program Based on Indicator Species of Ecological Integrity in the National Park "Sistema Arrecifal Veracruzano" (Veracruz Reef System)
- Use and Characterization of Habitat by the Antillean Manatee (*Trichechus manatus manatus*) in the South of Veracruz, Mexico

Moreno, Paula, USM Gulf Coast Research Laboratory — Two posters:
- Independent Advisory Team for Marine Mammal Assessment
- Gulf Coast Research Laboratory: Marine Mammal Research

Norris, Thomas, Bio-Waves, Inc.
- Passive Listening, Active Mitigation: Passive Acoustic Monitoring and Mitigation of Oceanic Delphinids During Mid-Water Net Trawl Sampling on NOAA's R/V Pisces

Phillips, Nicole, University of Miami / NMFS Lafayette Laboratory
- A Method for Prioritizing Research on Common Bottlenose Dolphin Stocks through Evaluating Threats and Data Availability: Development and Application to Bay, Sound and Estuary Stocks in Texas

Pitchford, Jonathan, Institute for Marine Mammal Studies

Predictive Spatial Modeling of Seasonal Bottlenose Dolphin (*Tursiops truncatus*) Distributions in the Mississippi Sound

Shippee, Steve, Marine Wildlife Response

Can Simple Tackle Modifications and Use of Fish Descenders Decrease Harmful Fishery Interactions with Bottlenose Dolphins?

Slone, Dan, US Geological Survey

USGS Manatee Research in the Gulf of Mexico: Movement and Habitat Use in the Northern GOM to Assist BOEM with Management of Coastal Resources

Solangi, Moby, Institute for Marine Mammal Studies

Bottlenose Dolphin (*Tursiops truncatus*) Stranding Response and Research

Stimmelmayer, Raphaela, North Slope Borough (in absentia)

Bile Collection Technique in Subsistence Harvested Beluga Whales (*Delphinapterus leucas*): Proof of Concept Study

Appendix B. Project Descriptions

The following section contains descriptions of 53 recent or current marine mammal research and monitoring projects in the Gulf. The information was compiled from information provided by meeting registrants, as well as others that were not able to attend the meeting.

Archiving and accessing a 'DNA register' for sperm whales in the Gulf of Mexico

Baker, C. Scott, Oregon State University, Marine Mammal Institute, 2030 SE Marine Science Dr, Newport, OR 97365, 541-272-0560, scott.baker@oregonstate.edu
Co-investigators: Bruce Mate, Oregon State University; Dan Engelhaupt, HDR, Inc.; Alana Alexander, University of Kansas
Duration of Project: 06/2015 – 06/2017
Websites: mmi.oregonstate.edu/c-scott-baker, www.splashcatalog.org/mmuwildbook

Focal species
Sperm whale

Focal habitats
Offshore/pelagic waters

Objectives
Behavior/behavioral ecology
Conservation and management
Genetics/genomics
Gulf oil spill effects
Habitat use/distribution
Life history
Population dynamics

Project Description
A growing number of long-term studies of marine mammals and other marine megafauna (e.g., sharks, and turtles) are collecting spatially explicit records linked through individual identification to genetic samples, photo-identification and telemetry. These spatio-temporal records have been used to track the migration and life history parameters of individuals, to estimate the abundance and trends of populations by capture-recapture and, in the case of genetic markers, to infer close kinship (e.g., parent/offspring relationships) and define management units, or Distinct Population Segments. Here we describe progress with developing a 'register' of DNA profiles for sperm whales in the Gulf of Mexico, using biopsy samples and a standard set of genetic markers (e.g., mtDNA haplotypes, microsatellite genotypes, and sex). These DNA profiles have now been used for individual identification and matching between investigators and across projects extending from the Sperm Whale Seismic Study (SWSS) and the Voyage of the Odyssey, to more recent project resulting from the Deepwater Horizon spill. We also describe progress with developing a cloud-based program, with distributed management, for archiving and accessing the spatially explicit records associated with DNA profiles. The database structure and tools provide for visual exploration of individual encounters and group occurrences of individual whales identified by DNA profiles, by photographs of natural marking (photo-ID), or from both sources of identity.

Keywords: DNA profiling, biopsy samples, computation, photo-identification

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Pressure Wave Acoustic Study for Well Decommissioning in the Gulf of Mexico

Barkaszi, Mary Jo, CSA Ocean Sciences, 8502 SW Kansas Ave, Stuart, FL 33701, 772-219-3000, mbarkaszi@conshelf.com
Co-investigators: Adam Frankle, MAI; Billy Poe, Explosive Services International; Tre Glen, (COR) BOEM
Duration of Project: 10/1/2014 - 11/1/2015
Website: www.csaocean.com

Focal species
All Gulf of Mexico marine mammals and marine turtles

Focal habitats
Offshore/pelagic waters

Objectives
Conservation and management
Noise effects

Project Description
Pressure wave measurements were taken at explosive well decommissioning events for data comparisons and enhancement of the ARA Underwater Calculator (UWC), which provides regulators with information for establishing safety zones for marine species during these events.

Keywords: Pressure wave, acoustic, Underwater Calculator, Explosive Removal of Offshore Structures (EROS)

Sperm Whale Seismic Studies

Biggs, Douglas, Texas A&M University, 979-219-4163, d-biggs@tamu.edu
Co-investigators: Peter Tyack, WHOI; Bruce Mate, OSU; Aaron Thode, SIO
Duration of Project: 2001 - 2007

Project Description
I was Chief Scientist for SWSS fieldwork (2001-2005).

Keywords: Sperm whales, habitat, controlled exposure experiments, partnership, government, academia, industry

Focal species
Sperm whale

Focal habitats
Offshore/pelagic waters

Objectives
Behavior/behavioral ecology
Foraging/diet
Genetics/genomics
Habitat use/distribution
Noise effects
Population dynamics

Mapping and conservation of marine migratory species in the Gulf of Mexico

Brenner, Jorge, The Nature Conservancy, 205 N. Carrizo St, Corpus Christi, TX 78401, 361-687-2209, jbrenner@tnc.org
Co-investigators: Carly Voight, TNC; David Mehlman, TNC
Duration of Project: 02/01/2014 - 03/01/2015

Project Description
The Nature Conservancy is working on synthesizing existing scientific information into a report and series of maps (incl. GIS products) to increase the Conservancy and its network of partners' understanding of marine migratory species in the Gulf of Mexico, their ecological migration strategies, migratory corridors and stepping-stones used to migrate. Additionally the study will provide a series of research and conservation recommendations for future projects, including needs for coastal and marine habitat restoration. This project focuses in marine species of fish, sea turtles, marine mammals and birds, including estuarine, commercial, recreational, and highly migratory species. This project will be conducted at the Gulf of Mexico whole system scale. It will support the integration of a comprehensive view of the features, processes and areas used to migrate along the Gulf and into/outside the Gulf. This project intends to support a broad audience in the decision-making processes ranging from research needs, to commercial and recreational fishing industry to non-profit organizations and agencies working to conserve coastal and marine areas.

Keywords: Gulf of Mexico, migratory species, migrations, corridors, conservation

Focal species
Manatee
Sperm whale

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters
Offshore/pelagic waters

Objectives
Conservation and management
Ecosystem modeling
Fisheries interactions/gear research
Habitat use/distribution
Migration

Proposed data collection plan to assess injury to West Indian manatees from the Deepwater Horizon Oil Spill outside of Florida

Carmichael, Ruth H., Dauphin Island Sea Lab, 101 Bienville Blvd., Dauphin Island, AL 36528, 251-861-2141, rcarmichael@disl.org
Co-investigators: James Powell, Monica Ross, Nicole Adimey
Duration of Project: 05/01/2010 - 11/01/2010

Project Description
Aerial surveys from western Florida through eastern Louisiana to document locations of manatees and surface oil; collaboration with Sea to Shore Alliance and Florida Fish and Wildlife Conservation Commission.

Keywords: Aerial survey, *Trichechus manatus*, NRDA, oil spill

Focal species
Manatee

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Conservation and management
Ecology
Gulf oil spill effects
Habitat use/distribution
Life history

Effects of oil contaminants on sentinel benthic and pelagic species in Mobile Bay

Carmichael, Ruth H., Dauphin Island Sea Lab, 101 Bienville Blvd., Dauphin Island, AL 36528, 251-861-2141, rcarmichael@disl.org
Co-investigators: Anne Boettcher, Kyeong Park, Kristie Willett
Duration of Project: 07/01/2010 - 12/01/2010

Project Description
Effects of oil-derived substances on oysters and manatees; monitoring of tagged manatee distribution, movements, condition.

Keywords: *Trichechus manatus*, oil spill, telemetry

Focal species
Manatee (and eastern oysters)

Focal habitats
River/inland waters
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Conservation and management
Ecology
Foraging/diet
Habitat use/distribution
Health and health assessment
Life history

A cooperative marine mammal stranding network for Alabama

Carmichael, Ruth H., Dauphin Island Sea Lab, 101 Bienville Blvd., Dauphin Island, AL 36528, 251-861-2141, rcarmichael@disl.org
Co-investigators: Kelly Brinkman
Duration of Project: 05/01/2011 - 03/01/2012

Project Description
Established equipment infrastructure for development of the AL Marine Mammal Stranding Network at DISL.

Keywords: Stranding, bottlenose dolphin, manatee

Focal species
All Gulf of Mexico species

Focal habitats
River/inland waters
Bays/sounds/estuaries
Nearshore/coastal waters
Offshore/pelagic waters

Objectives
Anatomy/taxonomy
Conservation and management
Cumulative effects
Ecology
Epidemiology
Fisheries interactions/gear research
Foraging/diet
Genetics/genomics
Gulf oil spill effects
Health and health assessment
Life history
Strandings
Toxicology

Phylogeography, Kinship, and Molecular Ecology of Sperm Whales

Engelhaupt, Dan, HDR, 1209 Independence Blvd, Suite 108, Virginia Beach, VA 23455, 757-354-6735, Daniel.Engelhaupt@hdrinc.com
Co-investigators: A. Rus Hoelzel, University of Durham, England
Duration of Project: 06/01/2000 - 04/01/2008
Website: http://seawater.tamu.edu/SWSS/

Project Description
The molecular ecology for sperm whales (*Physeter macrocephalus*) in the northern Gulf of Mexico was investigated in detail using a suite of molecular markers. In addition, several genetic related aspects for the Mediterranean Sea, North Sea and the North Atlantic Ocean putative sperm whale populations were described. These analyses have provided new insights requiring proper management to ensure the survival of the northern Gulf of Mexico sperm whale stock in an area of increasing industrial activity.

Keywords: Sperm Whale Seismic Study, sperm Whale, cetacean, microsatellite DNA, mitochondrial DNA

Focal species
Sperm whale

Focal habitats
Offshore/pelagic waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Genetics/genomics

Naval Surface Warfare Center Panama City Division - Training Range Marine Mammal Monitoring

Engelhaupt, Dan, HDR, 1209 Independence Blvd, Suite 108, Virginia Beach, VA 23455, 757-354-6735, Daniel.Engelhaupt@hdrinc.com
Co-investigators: Jennifer Latusek-Nabholz
Duration of Project: 04/01/2011 - 11/01/2014

Focal species
All Gulf of Mexico species

Focal habitats
Nearshore/coastal waters
Offshore/pelagic waters

Objectives
Behavior/behavioral ecology
Habitat use/distribution
Noise effects

Project Description
HDR working as a subcontractor to ARINC provided marine and biological resources monitoring and management services for the NSWC PCD. Marine species monitoring, evaluations, and/or assessments were conducted at various locations within the NSWC PCD's testing areas in the Gulf of Mexico as part of the Navy's requirements under their existing Letter of Authorizations. Specific tasks conducted under this contract included aerial and shipboard surveys; passive acoustic monitoring; behavioral studies; and management and coordination of complex projects during Navy training and testing exercises.

Keywords: Monitoring, dolphins, Navy, aerial surveys

Ecology and Conservation of the Common Bottlenose Dolphin (*Tursiops truncatus*) in the Bay, Sound, Estuary and Near-shore Coastal Waters of Texas

Fazioli, Kristi, UHCL Environmental Institute of Houston, 2700 Bay Area Blvd., Box 540, Houston, TX 77058, 281-283-3792, fazioli@uhcl.edu
Contributing Researchers: George Guillen, UHCL Environmental Institute of Houston; Bernd Würsig, Chris Marshall, Sarah Piwetz, Dara Orbach, Texas A&M University at Galveston; Tim Tristan, Will McGlaun, Texas Sealife Center; Andreas Fahlman, Danielle Kleinhenz, Linda Price-May, Texas A&M University Corpus Christi
Duration of Project: 05/01/2015 - Long-Term Monitoring

Focal species
Bottlenose dolphins

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Cumulative effects
Ecology
Fisheries interactions/gear research
Foraging/diet
Genetics/genomics
Habitat use/distribution
Life history
Population dynamics
Toxicology

Project Description
Recent stock assessment reports, publications and workshops have called for increased collaborative research and the use of a multidisciplinary approach to elucidate fine-scale stock delineation in Gulf of Mexico (GoM) bay, sound and estuarine (BSE), and coastal environments. In response to these recommendations, the Texas Dolphin Research Collaborative aims to establish a long-term monitoring program that will provide population distribution and abundance estimates, identify natural and human-generated risks and establish baseline health and life history parameters for Texas BSE and near-coastal bottlenose dolphins. By coordinating the efforts of a network of institutions and researchers, we can facilitate the use of a multidisciplinary approach to provide thorough analyses, efficient use of resources, and a reduction of duplicative efforts. Data compiled by participating institutions will be published and presented in a variety of scientific and popular venues to disseminate results and aid in management decisions. In the event of an environmental disturbance, such as an oil spill, the underlying logistical structure and availability of baseline data will improve response efforts and allow us to characterize effects on Texas populations. Long-term collaborative efforts, such as those led by the Sarasota Dolphin Research Program on the west coast of Florida, and those used to elucidate stock structure on the Atlantic Coast have yielded invaluable data on the life history of bottlenose dolphin communities, supporting the validity of this approach and providing a blueprint for success.

Keywords: *Tursiops truncatus*, Texas, stock structure

Galveston Bay Dolphin Research and Conservation Program

Fazioli, Kristi, University of Houston-Clear Lake (UHCL), Environmental Institute of Houston, 2700 Bay Area Blvd., Box 540, Houston, TX 77058, 281-283-3792, fazioli@uhcl.edu
Co-investigators: Vanessa Mintzer, Galveston Bay Foundation
Duration of Project: 08/01/2013 - Long-term monitoring

Focal species
Bottlenose dolphins

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Cumulative effects
Ecology
Ecosystem modeling
Fisheries interactions/gear research
Foraging/diet
Genetics/genomics
Habitat use/distribution
Health and health assessment
Life history
Population dynamics
Toxicology

Project Description
Galveston Bay, Texas is one of the most industrialized estuaries in the United States. An urban watershed supporting over 4 million people and the second largest petro-chemical complex in the world concentrates its effects in the western portion of upper Galveston Bay. Heavy maritime traffic traverses the Houston Ship Channel and port facilities are undergoing significant expansions in concurrence with the deepening of the Panama Canal. Water quality in this region prior to 1970 was severely impaired and Galveston Bay was named one of the EPA's top 10 most polluted water bodies. Corrective measures have improved water quality and the region now shows declining trends for ammonia, phosphorus, and chlorophyll a. However, while these trends have created a better environment for biological life in the bay, concerns over elevated concentrations of pathogenic bacteria and chlorinated organic compounds persist. The Department of State Health Services (DSHS) has issued seafood consumption advisories throughout the Galveston Bay system and initiated total maximum daily load (TMDL) projects for PCBs and Dioxins in the Houston Ship Channel and upper Galveston Bay. Evidence from recent surveys suggests that a bottlenose dolphin (*Tursiops truncatus*) population regularly utilizes upper Galveston Bay and the Houston Ship Channel, an area previously thought to have very little dolphin activity following surveys conducted in 1990 by Texas A&M University at Galveston (TAMUG). Increased activity in this area may reflect the success of efforts to protect Galveston Bay and improve water quality over the past 30 years, however little is known about their habitat use, site fidelity or stock structure in the region. In fact, critical data gaps exist for all Texas bay, sound and estuary bottlenose dolphin stocks and managers consider Galveston Bay a high priority for research. Elevated exposure to contaminants in upper Galveston bay, combined with additional anthropogenic stressors such as habitat loss, harmful algal blooms, noise pollution and human and fisheries interactions, place these dolphins at high risk. The Galveston Bay Foundation (GBF) is partnering with the Environmental Institute of Houston at the University of Houston, Clear Lake (EIH-UHCL) to conduct research on this understudied population and is establishing the Galveston Bay Dolphin Research and Conservation Program (GDRCP). Through long-term photo-id monitoring, mark-recapture techniques and remote biopsy darting, this program aims to tackle fundamental questions pertaining to the population's ecology, health and behavior. Fin catalogs will be compared to historical sightings in the TAMUG fin database and other programs along the Texas coast and will be entered into the Gulf of Mexico Dolphin Identification System (GoMDIS). Analysis of skin and tissue samples will be completed in collaboration with management agencies and contribute to conservation goals for the region. Corresponding education and outreach programs will increase public awareness by promoting bottlenose dolphins as sentinels for Galveston Bay ecosystem health and sustainability.

Keywords: Galveston Bay, stock structure, monitoring, contaminants, *Tursiops truncatus*

Eckerd College Dolphin Project

Gowans, Shannon, Eckerd College, 4200 54th Avenue South, St. Petersburg, FL 33711, 727-864-8388, gowanss@eckerd.edu
Co-investigators: John Reynolds III, Mote Marine Laboratory
Duration of Project: 12/01/1993 - present
Website: www.eckerd.edu/academics/marinescience/research/dolphin.php

Project Description
The Eckerd College Dolphin Project has been collecting distribution and photo-identification data on bottlenose dolphins in the Tampa Bay region since 1993. The photo-id database has been integrated with the Sarasota Dolphin Research Program and is in the process of integration with GoMDIS. The project was lead by John Reynolds III until 2004 and I have been in charge since then. The focus of the project has been to conduct long term monitoring of the population using sighting surveys and photo-identification. Our study area includes the inshore waters of Boca Ciegay Bay (the northern side of the mouth of Tampa Bay), the southwestern waters of Tampa Bay and Nearshore waters from Johns Pass to Egmont Key till about 5 nautical miles offshore. In recent years we have included both passive acoustic monitoring from moored hydrophones and towed hydrophones while following dolphin groups.

Focal species
Bottlenose dolphins

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Bioacoustics (hearing/communication)
Conservation and management
Ecology
Ecosystem modeling
Foraging/diet
Habitat use/distribution
Life history
Noise effects
Population dynamics

A Bottlenose Dolphin Surveillance Team for Mississippi Sound

Grimes, D. Jay, University of Southern Mississippi, Gulf Coast Research Laboratory, 300 Laurel Oak Drive, Ocean Springs, MS 39564, 228-818-8009, jay.grimes@usm.edu
Duration of Project: 08/25/2010 - 12/31/2014 (no cost ext to 12/15)
Website: www.usm.edu/gcrl/cv/grimes.jay/cv.grimes.jay.php

Project Description
Culture-based and non-culture-based microbiomic surveys of bottlenose dolphin samples from Barataria and Sarasota Bays (samples collected by NOAA and provided to us for microbiomics).

Keywords: Microbiomics, bottlenose dolphins, viruses, bacteria

Focal species
Bottlenose dolphins

Focal habitats
Bays/sounds/estuaries

Objectives
Microbiomics

Passive Acoustic Monitoring for Marine Mammals in the Gulf of Mexico

Hildebrand, John, Scripps Institution of Oceanography, UCSD – 0205, La Jolla, CA 92037, 858-534-4069, jhildebrand@ucsd.edu

Duration of Project: 05/01/2010 - present

Website: www.cetus.ucsd.edu

Focal species
All Gulf of Mexico marine mammals

Focal habitats
Offshore/pelagic waters

Objectives
Bioacoustics (hearing/communication)
Conservation and management
Ecology
Ecosystem modeling
Gulf oil spill effects
Habitat use/distribution
Noise effects

Project Description

Deep-diving cetaceans are an important component of the Gulf of Mexico ecosystem. These long-lived animals, including sperm whales, dwarf and pygmy sperm whales, and at least three species of beaked whales, forage in offshore and deepwater habitat, with presence in the region of the Deepwater Horizon Oil Spill. Due to their extended and deep foraging dives, these species are difficult to study with visual surveys but are readily detected by passive acoustic monitoring. Long-term passive acoustic monitoring at three sites along the continental slope, provides records of cetacean presence during and following the oil spill. High-frequency Acoustic Recording Packages (HARPS) recorded wideband (10 Hz - 100 kHz) acoustic data beginning in May 2010. One recording site was located near the Deepwater Horizon site, one was located to the west of the spill near Green Canyon, and one was located to the south of the spill off the Florida Escarpment. Acoustic data was scanned for echolocation clicks and classified for deep-diving cetacean species. Using parameters for cetacean sound production and acoustic detection range, estimates were made of population density by species. Time-series are presented for deep-diving cetacean presence in the Gulf of Mexico from May 2010 to September 2013. Higher rates of sperm whale detections were found in the northern Gulf of Mexico than in the southern Gulf of Mexico, whereas, beaked whales were found at their highest densities in the southern Gulf of Mexico. Gervais' beaked whale was the dominant beaked whale species detected at the northern Gulf of Mexico sites whereas Cuvier's beaked whale was the most detected species at the southern site. The relationship between cetacean presence and environmental parameters help provide an understanding of the ecology of these species as well as potential impact of the oil spill. This work was supported by BP and NOAA and any opinions, findings, and conclusions or other recommendations expressed are those of the authors and do not necessarily reflect the views of BP and/or any State or Federal Natural Resource Trustee.

Keywords: Passive acoustics, cetaceans

Assigning *Tursiops* strandings to stock using stable isotope ratios

Hohn, Aleta, NOAA, 101 Pivers Island Rd, Beaufort, NC 28516, 252-728-8797, aleta.hohn@noaa.gov
Co-investigators: Len Thomas, The Centre for Research into Ecological and Environmental Modeling, St Andrews, UK; Todd Speakman and Eric Zolman, NOAA, NOS, NCCOS, Hollings Marine Laboratory; Jenny Litz, NOAA, NMFS, SEFSC, Miami Laboratory; Carrie Sinclair, NOAA, NMFS, SEFSC, Mississippi Laboratories

Duration of Project: 01/01/2013 - 12/01/2015

Focal species
Bottlenose dolphins

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Conservation and management
Habitat use/distribution
Strandings
Stock identification

Project Description

Stable isotopes ratios have demonstrated value for assigning dolphins to different habitats. This technique is being explored for discriminating between common bottlenose dolphins that primarily inhabit coastal vs. estuarine waters.

Keywords: Stable isotope ratios, stock identification

Gulf of Mexico Odyssey Expeditions 2010 - 2014

Kerr, Iain, Ocean Alliance, 32 Horton Street, Gloucester, MA 01930, 978-281-2814 ext 15, Kerr@whale.org
Co-investigators: John Wise - University of Southern Maine
Duration of Project: Summer 2010 - Fall 2014
Website: www.whale.org

Project Description
The goal of these expeditions was to try to monitor the toxicological effects of the Deepwater Horizon disaster on offshore populations of marine mammals. Over five summers, we collected 349 biopsy samples from 4 species of cetaceans and a considerable amount of accompanying meta data. We grew 182 whale cell lines at sea. We focused our efforts primarily in the deep water off the continental shelf logging over 20,000 miles at sea. As far east as St Petersburg Florida, as far west as Galveston Texas, and as far south as Key West Florida.

Keywords: Sperm whales, Brydes whales, cell cultures, benign research techniques

Focal species
Bryde's whale
Cuvier's beaked whale
Short-finned pilot whale
Sperm whale

Focal habitats
Offshore/pelagic waters

Objectives
Behavior/behavioral ecology
Bioacoustics (hearing/communication)
Conservation and management
Cumulative effects
Genetics/genomics
Gulf oil spill effects
Health and health assessment
Noise effects
Population dynamics
Toxicology

Gulf of Mexico Marine Mammal Stranding Network - data collection and important uses

Jenny Litz, NOAA Fisheries, SEFSC, 75 Virginia Beach Dr, Miami, FL, 33149, 305-361-4224, jenny.litz@noaa.gov
Co-investigators: NOAA, NMFS, Gulf of Mexico stranding network

Project Description
The marine mammal stranding network responds to an average of 375 cetacean strandings a year in the Gulf of Mexico (defined here as Monroe County through Texas, 15 year average 2000 - 2014). While 85% of those are bottlenose dolphins, at least 23 other species are represented in the data. Standardized stranding data collected by the SEUS marine mammal stranding network is critical for understanding long-term stranding trends and identifying unusual mortality events. In addition, data from marine mammal strandings provide valuable data that can be used to monitor human impacts on marine mammals, as well as, marine mammal health, distribution, and life history.

Keywords: Strandings, marine mammal health

Focal species
All Gulf of Mexico marine mammals

Focal habitats
All

Objectives
All

Biological Monitoring Program based on indicator species of ecological integrity in the National Park "Sistema Arrecifal Veracruzano" (Veracruz Reef System)

Martinez-Serrano, Ibiza, Universidad Veracruzana, Circ. Gonzalo Aguirre Beltran s/n, Zona Universitaria, Xalapa, Veracruz, Mexico 91090, 52-228-842-1748, ibimartinez@uv.mx
Co-investigators: Emilio A. Suárez-Dominguez, Universidad Veracruzana; Mauricio Hoyos-Padilla, Pelagios-Kakunjá, A.C.

Duration of Project: 04/01/2015 - 03/01/2018
Website: www.uv.mx/personal/ibimartinez

Project Description
Currently, the port of Veracruz, Mexico is under development to achieve an extension both in capacities and operations territory. Under these circumstances, the Mexican environmental authorities recommended an Environmental judge to watch that all construction operations will be developed under laws and with minimum impact to the environment. Furthermore, recommended an integral monitoring project. This project involves the study of three great marine vertebrates (sharks, sea turtles, and cetaceans) bioindicators and their ecology. We will address aspects such as distribution, density, use of area, migration patterns, and contaminants concentrations in order to know how the port operations will impact them and consequently to the entire environment, a very important reef such as the Veracruzan Reef System.

Focal species
Bottlenose dolphin
Rough-toothed dolphin
(Sea turtles and sharks)

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Ecosystem modeling
Habitat use/distribution
Health and health assessment
Population dynamics
Toxicology

Keywords: Elasmobranchs, Cetartiodactyles, sea turtles, port operations, behavioral ecology

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Use and characterization of habitat by the Antillean Manatee (*Trichechus manatus manatus*) in the south of Veracruz, Mexico

Martinez-Serrano, Ibiza, Universidad Veracruzana, Circ. Gonzalo Aguirre Beltran s/n, Zona Universitaria, Xalapa, Veracruz, Mexico 91090, 52-228-842-1748, ibimartinez@uv.mx
Website: www.uv.mx/personal/ibimartinez

Project Description
In Mexico, the Antillean manatee (*Trichechus manatus manatus*) distribution is restricted to the south of the country. In the central coast of the Gulf of Mexico, during the 90's decade, the species was declared extinct in the south of the Veracruz state, specifically in the Coatzacoalcos River, due to pollution, ships traffic and habitat loss. Since then, no systematic surveys were developed. This region is important because of the oil exploration and production, but also because still bears well conserved patches of habitat and clean tributaries. The main goal of this study was to assess systematically the distribution, density, and use of habitat and its characterization of the manatee in the Coatzacoalcos River.

Focal species
Manatee

Focal habitats
Rivers/inland waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Ecosystem modeling
Fisheries interactions/gear research
Habitat use/distribution

Keywords: Habitat use, Antillean manatee, behavioral ecology

Sperm Whale Seismic Study - satellite-monitored tagging project

Mate, Bruce R., Oregon State University Marine Mammal Institute, 2030 SE Marine Science Drive, Newport, OR 97365, 541-867-0202, bruce.mate@oregonstate.edu
Co-investigators: Doug Biggs, Texas A&M; Ann Jochens, Texas A&M; Dan Englehaupt, HDR
Duration of Project: 04/01/2001 - 08/01/2005
Website: mmi.oregonstate.edu

Project Description
We tagged and tracked 58 sperm whales in the GoM to identify their seasonal presence, distribution, home ranges and genetic relationships.

Keywords: Argos, tracking, tagging, distribution

Focal species
Sperm whale

Focal habitats
Offshore/pelagic waters

Objectives
Ecology
Habitat use/distribution

Sperm whale assessment during and after the DWH oil spill

Mate, Bruce R., Oregon State University Marine Mammal Institute, 2030 SE Marine Science Drive, Newport, OR 97365, 541- 867-0202, bruce.mate@oregonstate.edu
Co-investigators: Ladd Irvine, Oregon State University
Duration of Project: 05/01/2010 - 12/01/2013
Website: mmi.oregonstate.edu

Project Description
Sperm whales were tagged during the spill and annually for 3 years after the spill to look for possible effects from the spill.

Keywords: Sperm whale, foraging, distribution, tagging, tracking

Focal species
Sperm whale

Focal habitats
Offshore/pelagic waters

Objectives
Cumulative effects
Ecology
Foraging/diet
Gulf oil spill effects
Habitat use/distribution

Independent Advisory Team (IAT) for Marine Mammal Assessment and Development/Testing of a Tier System for Application to Potential Biological Removal

Moreno, Paula, Gulf Coast Research Laboratory, University of Southern Mississippi,703 East Beach Drive, Ocean Springs, MS 39564, 228-818-8013, Paula.Moreno@usm.edu
Co-investigators: André Punt, University of Washington; Randall Reeves, Okapi Wildlife Associates; John Brandon, Greeneridge Sciences
Duration of Project: 08/01/2013 - Ongoing
Website: scemfis.org/research.html

Focal species
Applicable to several stocks

Focal habitats
Applicable to several habitats

Objectives
Conservation and management
Population dynamics

Project Description
The primary focus of the IAT is to examine sources of uncertainty (e.g., bias and precision) associated with estimates used for assessment of marine mammals (MM) in U.S. waters. Based on its review of literature, reports, data, and meetings with scientists and managers from NMFS and other entities, the IAT identifies research priorities and produces scientific recommendations to the Science Center for Marine Fisheries (SCeMFiS), a NSF Industry/University Cooperative Research Center. In addition, the IAT conducts research on issues related to MM assessment. In 2014 the IAT initiated a project entitled “Development and Testing of a Tier System for Application to Potential Biological Removal (PBR)”. PBR is defined in the Marine Mammal Protection Act as “the maximum number of animals, not including natural mortalities that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.” PBR is calculated stock-by-stock, and is the basis for assessment and management of MM interactions in the U.S. To calculate PBR, three parameters are required: a minimum abundance estimate, a maximum theoretical or estimated net productivity rate, and a recovery factor. Data availability and level of uncertainty associated with some of these parameters, in particular abundance, may vary among stocks. The goal of this project is to develop a tier PBR system and test it using a Management Strategy Evaluation (MSE). A tier system would make better use of existing information by incorporating the best available information for each stock, which could mean drawing on more data than are currently used to set PBR for data-rich cases, and exploiting novel data sources and analytical approaches to set PBR for data-poor stocks. The MSE approach is widely used within the U.S. and elsewhere to evaluate the robustness of management strategies given scientific uncertainties. MSE involves three key steps: (a) development of a model, which represents the system being managed, (b) identification of candidate management strategies (in this case features of the proposed tier system such as how historical abundance estimates are weighted, how trends are estimated, and whether abundance data older than 8 years are used, and (c) evaluation, using simulation of the candidate management strategies. The PBR project is funded by the Western Pacific Fisheries Management Council.

Keywords: Marine mammal, stock assessment, Potential Biological Removal, Management Strategy Evaluation

Ecology, population dynamics and shrimp fishery interaction of Bottlenose dolphins in the Galveston Bay, Texas

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Website: scemfis.org/research.html

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Fisheries interactions/gear research
Foraging/diet
Gulf oil spill effects
Habitat use/distribution
Population dynamics

Project Description
Systematic vessel surveys were conducted over nearly a decade in the Galveston Bay (GB) to collect data on abundance, distribution, residency patterns and behavior of bottlenose dolphins. Environmental (e.g., depth, turbidity, dissolved oxygen) and vessel traffic data were collected on fixed stations along transects and after dolphin sightings. Noteworthy findings include identification of sub-areas of the GB with high relative abundance of dolphins and foraging hotspots. In addition, we quantified the relative importance of feeding in association with shrimp vessels. Next, we plan to estimate abundance and residence patterns in the GB using mark-recapture techniques on dorsal fin images collected during these surveys. We also plan to use this photo-ID data to determine whether feeding in association with shrimpers in the GB is a widespread foraging behavior exhibited by resident and transient dolphins or restricted to certain individuals or social units. This multi-year study offers a unique opportunity to characterize population dynamics and foraging patterns of bottlenose dolphins in a large Gulf of Mexico estuary. In addition, this study provides a baseline of pre-oil spill conditions against which the results of post oil spill studies can be compared. Assuming no major change in the Galveston Bay environment, and considering that GB is located more than 500 km from the DWH wellhead, major changes in this bottlenose dolphin population would not be anticipated. However, noting that the GB is a very productive estuary supporting resident and transient dolphins, it might offer alternative habitat to those populations that may have been adversely impacted by the DWH event.

Keywords: Abundance, shrimp fishery interactions, photo-identification, habitat use, pre-oil spill conditions

Trophic ecology of bottlenose dolphin-artisanal fisheries interactions in the coastal waters of Veracruz

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Co-investigators: Fernando Elorriaga, CICIMAR/IPN; Ibiza Martinez, Fac.Biol./UV; Luis Abarca, IIB/UV
Duration of Project: 08/01/2014 - 12/01/2018
Website: www.uv.mx/personal/emorteo/investigacion/

Project Description
Determination of diet is necessary to understand the response of species to the ecosystem variability, but also their contribution as a source of mortality for they prey. Feeding is a fundamental aspect in dolphin ecology but one of the most difficult to study in wild populations; thus little is known regarding this issue across the distribution of such species, including the Mexican coasts of the Gulf of Mexico. Coastal bottlenose dolphins (Tursiops truncatus) are known to feed upon fishing gear, and although this may be true for only a fraction of the populations, it may also be very frequent. The extent of these interactions as a source of food for such individuals is unknown, thus this project aims to determine temporal variations in the composition, trophic level, and quality of the diet in bottlenose dolphins within the central coast of the State of Veracruz, emphasizing the differences in individuals that regularly interact with artisanal fisheries.

Keywords: Trophic dynamics, feeding ecology, artisanal fisheries, human-dolphin interactions, Gulf of Mexico

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Ecosystem modeling
Energetics
Epidemiology
Fisheries interactions/gear research
Foraging/diet
Genetics/genomics
Habitat use/distribution
Health and health assessment
Life history
Population dynamics

Abundance and distribution of cetaceans in the Gulf of Mexico

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Co-investigators: Lance Garrison, NOAA NMFS; Patricia Rosel, NOAA NMFS
Duration of Project: 1990 - 2015

Project Description
Large-scale line-transect surveys are conducted to estimate abundance and define the spatial distribution of cetacean species in continental shelf (2 species) and oceanic (20 species) waters in the U.S. Gulf of Mexico. Generally ships are used to survey oceanic habitat and aircraft are used for coastal and outer continental shelf habitats. To meet the mandates of the Marine Mammal Protection Act, a series of surveys is conducted at a minimum every 8 years. Additional objectives of the surveys are to define the habitat of each species and to collect biopsy samples to define stock structure.

Keywords: Abundance, density, spatial distribution, cetaceans

Focal species
All Gulf of Mexico marine mammals

Focal habitats
Nearshore/coastal waters
Offshore/pelagic waters

Objectives
Conservation and management
Ecosystem modeling
Genetics/genomics
Gulf oil spill effects
Habitat use/distribution

Developing Updated Abundance Estimates for Texas Bays using Photo ID Mark-Recapture

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Co-investigators: Heidi Whitehead, Texas Marine Mammal Stranding Network; Errol Ronje, NOAA

Project Description

Abundance estimates for bottlenose dolphins in the Gulf of Mexico, including the Texas coast, are more than eight years old and considered insufficient for conservation management by NMFS. For example, recently the Texas Marine Mammal Stranding Network investigated a number of bottlenose dolphin Unusual Mortality Events and due to a lack of baseline information, potential impacts to the population were difficult to assess. Updated abundance estimates are important for understanding potential impacts of future mortalities and for conservation measures. Therefore, we initiated a multi-phase project to estimate abundance for central Texas coastal bays using photo-ID mark-recapture techniques that will provide updated baseline data for dolphins inhabiting these areas. The first phase completed was Galveston West Bay. The photo-ID data can also provide information on spatial and temporal patterns such as movement patterns, site fidelity, and seasonality of individual dolphins.

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries

Objectives
Conservation and management
Habitat use/distribution
Strandings

Key Words: Photo-ID, abundance, management, Texas

Passive acoustic monitoring and mitigation of mid and deep water net tows to prevent dolphin entanglements

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Co-investigators: Ken Deslarzes, Geo-Marine
Duration of Project: Summer 2011- Fall 2011
Websites: www.biowaves.net; www.biowaves.net/research/pisces-dolphin-mitigation

Project Description

In 2011 NOAA deployed their research vessel, Pisces, to sample mid-and deep-water species of marine life (i.e. fish and crustaceans). Net trawls were conducted to examine the meso and bathypelagic fauna. The net tows were conducted both during the day and night, at stations located both inside and outside of the oil spill zone. Unfortunately during one of the earlier research cruises, three spotted dolphins (*Stenella attenuata*) were incidentally caught and drowned in one of the net deployments. At night, a potentially hazardous situation existed for delphinid species (which often were attracted to nets because of concentration of prey inside), but could not be seen by the tow operators because of light conditions. Because of this, NOAA requested Bio-Waves to provide a passive acoustic system to mitigate the possibility of catching dolphins both during the day and night while net tows where being conducted. During the night, when visual observations were not possible, passive acoustic monitoring was the only effective method to detect dolphins in the area. During this research cruises, Bio-Waves acousticians monitored a towed hydrophone array for 30 minutes prior to deployment of nets, and if any dolphins were detected, the deployment of the net was delayed. If dolphins were not detected, the array was retrieved and the trawl net was deployed. During four 10-day cruises in which Bio-Waves conducted passive acoustic monitoring and mitigation, no additional dolphins were incidentally caught in nets. This demonstrated the success of passive acoustic monitoring and mitigation for this activity, with limited impact on the success of the overall research objective.

Focal species
Pantropical spotted dolphin

Focal habitats
Offshore/pelagic waters

Objectives
Behavior/behavioral Ecology
Bioacoustics (hearing/communication)
Conservation and management
Fisheries interactions/gear research

Keywords: Acoustics, monitoring, mitigation, dolphins, PAM

A method for prioritizing research on common bottlenose dolphin stocks through evaluating threats and data availability: development and application to bay, sound and estuary stocks in Texas

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Co-investigators: Patricia Rosel, NOAA/SEFSC
Duration of Project: 09/01/2012 - 12/01/2015

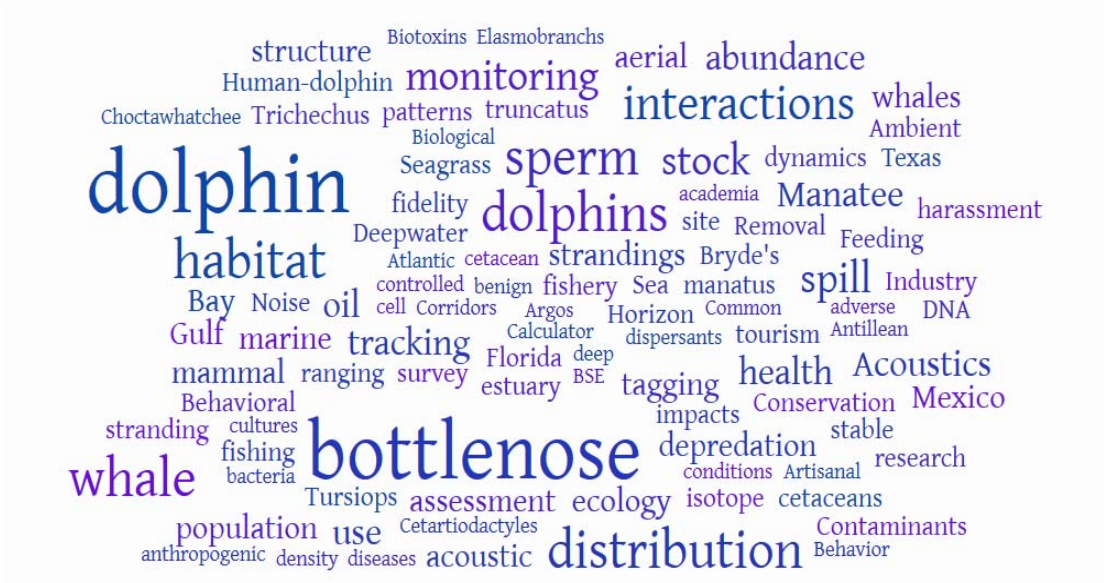
Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries

Objectives
Conservation and management

Project Description
Thirty-one stocks of common bottlenose dolphins have been delimited in the bay, sound and estuary (BSE) environments in the Gulf of Mexico from the Florida Keys to the Texas-Mexico border. For many of the stocks, up-to-date information necessary for accurate assessment of their status is limited. We have developed a scoring system to objectively prioritize these stocks relative to one another for basic stock assessment research to aid the decision making process and allow resources to be directed where they would be the most effective for meeting research and management objectives. This Threat Assessment Priority Scoring System incorporates a Cumulative Threat Score from an assessment of the presence, severity and impact of 19 potential threats impacting a given stock area and a Data Assessment Score from an evaluation of the quality of available stock assessment data for a stock. Together, the Cumulative Threat Score and Data Assessment Score are used to determine whether a particular stock should be given low, medium or high priority for research. When this method was applied to the Texas common bottlenose dolphin BSE stocks, they all scored as a 'high priority' with medium levels of threats and virtually no data assessment available for each stock. Galveston Bay, Laguna Madre and Corpus Christi Bay had the highest cumulative threat scores while Sabine Lake had the lowest, although this low score is partially attributed to a lack of comprehensive information on the threats in this area. It is expected that future work will provide the scores and priority rankings for the remaining common bottlenose dolphin BSE stocks in the Gulf of Mexico.

Keywords: Common bottlenose dolphin, threat, bay sound estuary (BSE), prioritize, Texas



Word cloud generated from key words for project descriptions

Predictive spatial modeling of seasonal bottlenose dolphin (*Tursiops truncatus*) distributions in the Mississippi Sound

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Co-investigators: Victoria Howard, Jamie Shelley, Moby Solangi
Duration of Project: 2011 - 2013

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries

Objectives
Habitat use/distribution

Project Description
Spatial distribution models (SDMs) have been useful for improving management of species of concern in many areas. This study was designed to model the spatial distribution of bottlenose dolphins among seasons of the year in the Mississippi Sound (MS) within the northern Gulf of Mexico. Models were constructed by integrating presence locations of dolphins acquired from line-transect sampling from 2011–2013 with maps of environmental conditions for the region to generate a likelihood of dolphin occurrence for winter (Jan–Mar), spring (Apr–Jun), summer (Jul–Sep), and autumn (Oct–Dec) using maximum entropy. Models were successfully generated using the program MaxEnt and had high predictive capacity for all seasons (AUC > 0.8). Distinct seasonal shifts in spatial distribution were evident including increased predicted occurrence in deepwater habitats during the winter, limited predicted occurrence in the western MS Sound in winter and spring, widespread predicted occurrence over the entire region during summer, and a distinct westward shift of predicted occurrence in the autumn. The most important environmental predictors used in SDMs were distance to shore, salinity, and nitrates, but variable importance differed considerably among seasons. Geographic shifts in predicted occurrence likely reflect both direct effects of changing environmental conditions and subsequent changes in prey availability and foraging efficiency. Overall, seasonal models helped to identify preferred habitats for dolphins among seasons of the year that can be used to inform management of this protected species in the northern Gulf of Mexico.

Keywords: Bottlenose dolphin, distribution, GIS, estuary, habitat mapping

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Fifteen years later: An updated evaluation of the impacts and evolution of marine mammal tourism with a focus on human-dolphin interactions in Panama City, Florida

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Co-investigators: Laura Engleby, Trevor Spradlin
Duration of Project: 06/01/2014 - 07/01/2015

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management

Project Description
Marine mammal tourism has grown dramatically over the past 20 years resulting in exploitive tourism throughout U.S. waters and intensifying concerns about sustainability and health of marine mammal populations and individuals. This is particularly true in Panama City, where boat operators illegally feed wild bottlenose dolphins in order to condition them to approach vessels and swimmers. Our study repeats and updates previous work sponsored by the Marine Mammal Commission (MMC) conducted by Samuels et al. (2000 and 2003) and Samuels and Bejder (1998 and 2004) to (1) provide an updated literature review on the impacts of human activities on marine mammals, and (2) replicate the Panama City field study to evaluate the current status of “swim-with-dolphin” and other dolphin-human interactions. An updated literature review will be useful to MMC and NMFS to help evaluate future management needs. In addition, a re-evaluation of the Panama City case study will provide an assessment of the long-term effects of tourism and provide important insights to managers and law enforcement officials who need to develop new strategies to address this hot-spot area where chronic feeding and harassment of wild dolphins takes place.

Keywords: Swim with dolphins, tourism impacts, feeding, harassment

Evaluating the Effectiveness of a Voluntary Program in Reducing Vessel Based Harassment in Key West, Florida

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Co-investigators: Laura Engleby, Nick Farmer
Duration of Project: 05/01/2005 - 09/01/2011

Focal species
Bottlenose dolphin

Focal habitats
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management

Project Description

A resident population of common bottlenose dolphins (*Tursiops truncatus truncatus*) inhabits the coastal waters near Key West, Florida. During the summer, dolphins are routinely sighted in a 16 km2 sand bottom area with clear, shallow water (1-6 m). This area is sheltered from wind and located less than 10 km northwest of several major harbors. The number of vessels conducting daily dolphin tours in this area increased from one operator in 1986 to 37 operators in 2004. To mitigate this potential increase for vessel-based harassment, a voluntary education program, Dolphin SMART, was developed with substantial tour operator involvement and was implemented in 2007. This program continues today. To evaluate the effectiveness of this program, behavioral studies were conducted prior to, during, and following implementation. Focal dolphin behavior was monitored and recorded across age and sex classes in three areas ('Tourism', 'Transit', and 'Remote') containing different levels of vessel traffic and tourism pressure. Results suggest that despite Dolphin SMART implementation, vessel interactions continue to significantly impact dolphin behavior. Dolphins observed within the 'Tourism' area traveled significantly more than animals observed in other areas ($p=0.02$). In the 'Tourism' area, there was a time-lagged (6 minute) impact of vessel presence on the number of dolphin groups ($p<0.05$), with the magnitude of vessel disturbance predicting group fission ($p<0.001$). There was also a time-lagged (9 minute) impact of the magnitude of vessel disturbance on group cohesion ($p<0.05$). In the 'Transit' area, a time-lagged (6 minute) effect of the magnitude of vessel disturbance was a significant predictor of changes in travel activity ($p<0.01$). No impacts of vessel disturbance were observed in the 'Remote' area. Harassment to dolphins still occurs near Key West despite the Dolphin SMART program, suggesting other mitigation measures are necessary to prevent further population or individual level impacts to the dolphins from tourism.

Keywords: Bottlenose dolphins, harassment, dolphin tours, tourism

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Insights from Whaling Logbooks on Cetaceans in the Gulf of Mexico

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Co-investigators: Judy Lund, Tim Smith, Beth Josephson
Duration of Project: 2009 - 2011

Focal species
Bryde's whale
Short-finned pilot whale
Sperm whale

Focal habitats
Offshore/pelagic waters

Objectives
Conservation and management
Ecology

Project Description

Extracted data from 18th and 19th C. American whaling logbooks, tabulated and mapped catches and sightings of all species. See paper in Gulf of Mexico Science 29(1) (2011).

Keywords: Sperm whale, Bryde's whale, pilot whale, whaling

DWH Natural Resource Damage Assessment Studies for Bay, Sound and Estuary Bottlenose Dolphins Following the Deepwater Horizon Oil Spill

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Website: response.restoration.noaa.gov/about/media/study-shows-gulf-dolphins-poor-health-following-deepwater-horizon-oil-spill.html
Co-investigators: Teri Rowles, NMFS; Keith Mullin, NMFS; Patricia Rosel, NMFS; Mandy Tumlin, LDWF; Willie McKercher, MS DEQ
Duration of Project: 05/01/2010 - 08/01/2015

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Conservation and management
Cumulative effects
Ecosystem modeling
Epidemiology
Genetics/genomics
Gulf oil spill effects
Health and health assessment
Life history
Population dynamics
Reproductive biology
Strandings
Toxicology

Project Description
As part of the Natural Resource Damage Assessment (NRDA) following the Deepwater Horizon (DWH) oil spill, a series of studies including longitudinal photo-identification surveys, remote biopsy sampling, and capture-release health assessments, have been conducted for bottlenose dolphins in multiple Gulf of Mexico sites. While the most intensive efforts have been in Barataria Bay, Louisiana, a site which received some of the heaviest and most prolonged oiling, studies have also been conducted in Chandeleur Sound, Mississippi Sound, and St. Joseph Bay. In addition, Sarasota Bay has served as a reference site for the health assessment studies. The objective of the studies has been to investigate potential sub-lethal effects from the DWH oil spill and to estimate associated impacts on the dolphin stocks that were exposed to DWH oil. The studies have been conducted by a collaborative team including investigators from both NOAA offices (NOS and NMFS), as well as State agencies (Louisiana Department of Wildlife and Fisheries, Mississippi Department of Environmental Quality) and non-governmental organizations (National Marine Mammal Foundation, Chicago Zoological Society).

Keywords: Deepwater Horizon, oil spill, dolphin-health, toxicity

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Testing Tackle Modifications and Fish Descender Tools for reducing dolphin depredation and scavenging of sport fish

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Co-investigators: Randall Wells, Chicago Zoological Society; Katie McHugh, Chicago Zoological Society
Duration of Project: 08/01/2014 - 02/01/2016

Focal species
Bottlenose dolphin

Focal habitats
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Fisheries interactions/gear research

Project Description
Several depredation mitigation devices (DMDs) designed for attachment to terminal fishing tackle have been suggested as deterrents to discourage dolphins from taking hooked fish. Descender tools may offer a means to reduce dolphins' scavenging on discarded fish that are being returned to the seafloor. We are conducting in-situ tests of the applicability and effectiveness of using these devices aboard recreational fishing vessels as a means to reduce dolphin interactions that might have long-term effectiveness if accepted by the sport angler.

Keywords: Depredation, scavenging, recreational fishing, dolphin interactions

Can simple tackle modifications and use of fish descenders decrease harmful fishery interactions with bottlenose dolphins?

Steve Shippee[1], Hannah Roth[1], Christina Toms[1,2], Chris Verlinde[3], Tim Doran[1], Randy Wells[4], and Katherine McHugh[4]

[1]Marine Wildlife Response, Mary Esther, FL
[2]University of Central Florida, Orlando, FL
[3]Florida Sea Grant, IFAS/University of Florida, Milton, FL
[4]Sarasota Dolphin Research Project of Chicago Zoological Society, Sarasota, FL

Poster abstract
Bottlenose dolphins interact frequently with recreational fishing at offshore reefs in the northern Gulf of Mexico resulting in potential harm to the animals and to fish stocks. Anglers complain that dolphins frequently depredate fish off hooks being reeled up from depth and scavenge on discarded fish that suffer from barotrauma and disorientation. Modified terminal tackle intended for bottom fishing rigs has been suggested as a method to reduce depredation, and fish descender tools are being promoted as a means to successfully return embolized reef fish to depth. We are conducting a study to measure the effectiveness of using these techniques to reduce dolphin interactions with recreational fishing and will evaluate: 1) tackle modifications (wires, shrouds, etc.) to deter depredation; 2) effectiveness of commercially available descender devices to mitigate dolphin scavenging of released fish; 3) applicability of using such devices in inshore fishing to alleviate dolphin interactions; and 4) acceptability of using these tools by sport anglers. The results of this study will benefit outreach efforts to encourage use of mitigation techniques that reduce dolphin interactions and enhance conservation of both dolphins and reef fish stocks.

Assessment of depredation by bottlenose dolphins (*Tursiops truncatus*) in the Northwest Florida and Alabama sport fishery

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Co-investigators: Randall Wells, Chicago Zoological Society
Duration of Project: 04/01/2008 - 09/01/2010

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Fisheries interactions/gear research
Foraging/diet
Habitat use/distribution
Strandings

Project Description
We recognized the need to gain an understanding of the dolphin community in this part of the Gulf Coast associated with fishery interactions (FI) and to answer questions about habitat use and foraging patterns. This study focused on observations of dolphins and FI on deep-sea trips and at fishing piers to define and characterize the extent of the problem. We were also interested in exploring potential mitigation strategies. Developing a partnership with the local stranding networks led to better monitoring for FI in stranded animals. The objectives were to: provide a general assessment of the scope of the FI problem with sport fishing (at deep-sea reefs and shoreline fishing piers) in the North Central Gulf Coast; determine the frequency of dolphin FI with sport fishing; differentiate between depredation and other forms of interactions; investigate possible relationships between FI and other variables; gauge economic impacts; seek mitigation techniques and solutions; and provide new tools and data for use by fisheries managers.

Keywords: Fishing interactions (FI), deep sea reefs, strandings, bottlenose dolphin, depredation

Littoral Acoustic Demonstration Center - Gulf Ecological Monitoring and Modeling (LADC-GEMM)

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Co-investigators: George E. Ioup, University of New Orleans; Dave Mellinger, Oregon State University; ASV & Seiche Measurements
Duration of Project: 01/2015 – 12/2017
Websites: www.physics-louisiana.org/natalia-sidorovskaia-bio; www.ladcgemm.org

Focal species
Atlantic spotted dolphin
Blainville's beaked whale
Cuvier's beaked whale
Dwarf sperm whale
Gervais' beaked whale
Killer whale
Pantropical spotted dolphin
Risso's dolphin
Short-finned pilot whale
Sperm whale
Spinner dolphin
Striped dolphin

Focal habitats
Offshore/pelagic waters

Objectives
Bioacoustics (hearing/communication)
Ecology
Ecosystem modeling
Gulf oil spill effects
Habitat use/distribution
Noise effects
Population dynamics

Project Description
The three year BP/GOMRI sponsored LADC-GEMM consortium (2015-2017) will continue passive acoustic monitoring of changes in regional distribution and abundance of several strategic species of marine mammals (endangered sperm whales, beaked whales, and dolphins). The operational area of interest will cover a 50 mi radius around the Gulf of Mexico (GoM) 2010 oil spill site. The LADC-GEMM consortium members include the University of Louisiana at Lafayette, the University of New Orleans, the University of Southern Mississippi, and Oregon State University. The consortium's expertise and experimental capabilities are extended through collaboration with Proteus Technologies LLC, R2Sonic LLC, ASV Ltd., and Seiche Measurements Ltd. The regional abundance estimates obtained from the newly collected acoustic data will be compared to ones derived from baseline data collected by LADC before and right after the spill. The LADC-GEMM consortium is in a unique position among those conducting passive acoustic studies in the GoM given its access to data unavailable elsewhere. Prior to the 2010 oil spill, LADC had conducted six broadband passive acoustic surveys in the GoM. In 2007 LADC conducted a two-week visual and acoustic survey of marine mammal activity just 9 miles and 23 miles from the spill site, giving LADC a unique pre-spill baseline dataset of marine mammal activity and anthropogenic soundscapes near the oil spill site. Earlier surveys had also been conducted at sites 50 miles from the incident site. In September 2010, LADC returned to those same survey sites to repeat underwater acoustic recordings, gathering data to support the first and possibly only comparisons of pre- and post-spill estimates of the marine mammal populations in the vicinity of the event based on their acoustic activity. The overall new project objectives are three-fold:
1) Establish a precedent of long-term ecosystem-centered passive acoustic monitoring (E-PAM) of the marine mammal recovery after the oil spill, based on previously collected baseline data, continued data collection utilizing advanced PAM technology, and development of population dynamics prediction models;
2) Design and test a new cost-effective PAM approach for near real-time detection, characterization, and monitoring of the impact of environmental changes of different magnitude and duration on deep diving GoM marine mammals by utilizing the integrated experimental capabilities of the consortium, which will include bottom-moored listening buoys, deep-diving Seagliders, and autonomous surface vehicles;
3) Develop an integrated acoustic data processing technique, which will allow in-depth understanding of the relations between observed/predicted abundance variations and underlying reasons decipherable from collected acoustic data, such as anthropogenic noise soundscapes, food supply, stock composition (adults versus calves, females versus males, etc.), and seasonal migrations.
The research outcomes will provide data on regional stock population health for several strategic species of marine mammals (endangered sperm whales, beaked whales, and dolphins) and will stipulate recommendations for needed mitigation efforts to improve various stock recoveries. The outcomes of the research will also aid in improving regulations, monitoring, and mitigation efforts for everyday industrial operations in the northern GoM.

Keywords: ecosystem passive acoustic monitoring, sperm whales, beaked whales, dolphins, marine mammal abundance, population model, population growth rate

Dolphin acoustic and visual surveys on the West Florida Shelf

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Co-investigators: David Mann, Loggerhead Instruments; Shannon Gowans, Eckerd College; Chris Stallings, University of South Florida
Duration of Project: 06/01/2008 - 12/01/2020

Project Description
I use both boat-based visual surveys and autonomous acoustic recorders to determine spatial and temporal patterns of dolphins on the West Florida Shelf. Species mainly limited to bottlenose dolphins and Atlantic spotted dolphins. Study area has changed over the duration of the study (since 2008) but is currently from Tampa Bay to Clearwater, out to the 30m isobath. I also use autonomous acoustic recorders to monitor bottlenose dolphins in an adjacent inshore location (Boca Ciega, Tampa Bay) in collaboration with the Eckerd College Dolphin Project (Shannon Gowans). Finally, my research also involves acoustic recordings using a boat-based towed hydrophone during focal group follows of dolphins.

Keywords: Acoustic, distribution, bottlenose dolphin, Atlantic spotted dolphin, West Florida Shelf

Focal species
All Gulf of Mexico marine mammals
Atlantic spotted dolphin
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters
Offshore/pelagic waters

Objectives
Behavior/behavioral ecology
Bioacoustics (hearing/communication)
Ecology
Habitat use/distribution
Noise effects

Analysis of existing USGS manatee telemetry data for the northern Gulf of Mexico

Slone, Daniel, USGS Southeast Ecological Science Center, 7920 NW 71st St, Gainesville, FL 32653, 352-264-3551, dslone@usgs.gov
Co-investigators: James Reid, USGS; Susan Butler, USGS; Ruth Carmichael, DISL
Duration of Project: 3/2011 - 9/2012

Project Description
We propose to compile and analyze existing manatee telemetry data to produce habitat use and travel corridor maps for Apalachicola Bay, Wakulla, and other panhandle areas. Maps will feature low-speed use of habitat features, such as resting and feeding, and higher-speed use of travel corridors. We will compare maps of manatee use patterns with those of Florida Wildlife Research Institute aerial survey distribution data to ascertain correlations. Discrepancies between data types would point to areas to focus on in future aerial survey work, or tagging operations for more detailed telemetry studies. With all data types, correlate manatee use with measured oil spill coverage on SAV and emergent (marsh) vegetation, to indicate possible areas of forage impact, or manatee exposure to oil contamination.

Keywords: Manatee, seagrass, Deepwater Horizon, Gulf of Mexico

Focal species
Manatee

Focal habitats
Rivers/inland waters
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Ecology
Ecosystem modeling
Gulf oil spill effects
Habitat use/distribution

Florida Manatee Movement and Habitat Use in the Northern Gulf of Mexico

Slone, Daniel, USGS Southeast Ecological Science Center, 7920 NW 71st St, Gainesville, FL 32653, 352-264-3551, dslone@usgs.gov
Co-investigators: James Reid, Susan Butler, Robert Bonde
Duration of Project: 6/2013 - 9/2017

Focal species
Manatee

Focal habitats
Rivers/inland waters
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Ecology
Ecosystem modeling
Energy Industry interactions
Foraging/diet
Habitat use/distribution
Health and health assessment

Project Description
The overall goal of the project is to describe manatee movements and habitat use through the northern Gulf of Mexico to determine and aid in the management of manatee interactions with energy industry shipping and operations in the region. The area of interest for this study extends from the Suwannee River, Florida, west along the Gulf coast through Texas. Manatee distribution and habitat will be assessed through a comprehensive set of complementary research activities that together will provide information on spatial and temporal manatee use of the northern Gulf of Mexico, the health and disposition of individual manatees traversing the study area, and the extent and quality of the habitat that they may use. Several potential research actions involving multiple agencies and partners will be considered. Habitat characterization will begin with a survey of available data, especially from recent work that supported research following the 2010 Deepwater Horizon incident (REF). Areas of interest within the study area that do not have adequate data coverage will be targeted for aerial imagery interpretation, and field characterization. Temperature and salinity probes (Onset, Inc.) will be used to provide continuous logging of environmental parameters at selected sites to determine seasonal water temperature and salinity regimes across the study area. Photographs of manatees in the northern GOM will be compiled and matched to the Manatee Individual Photo-identification System (MIPS) database to document individual animal movements and fidelity, as well as prior sighting histories. Individual manatees will be captured for health assessments and radio tagging. Manatee captures typically involve nylon nets deployed by either land-based or open-water techniques on targeted manatees. Individual manatee health will be monitored, including temperature, respiration and pulse rate, and handling time will be kept to a minimum (less than one hour if possible). Assessed individuals will be released at or close to their original capture location. Additional data recorded upon capture will include morphometrics (total length and girths), sex and complete photographs consisting of scars or natural markings. During capture complete out-of-water monitoring and biological sampling will be performed by trained personnel under veterinary supervision. Captured manatees in the northern GOM will be tagged with GPS to record location, transmitter temperature, activity and dive periods, and other sensor data. Specific findings will include identification of habitat hotspots, site fidelity, characterization of large-scale moves or movement highways and characterization of foraging movements. With the addition of on-board readings from Time-Depth Recorders, or salinity and temperature sensors, the activity of manatees can be categorized into behavior types such as foraging, travelling, resting, drinking, or other types. Once a part of the underlying habitat has been described, the manatees' use of similar habitat can be used to predict locations of other similar habitat, which can then be verified through field sampling. This form of GIS interpretation, integrated with field sampling, will be used throughout the period of performance to create maps of functional habitat types, along with detailed assessments of the underlying habitat components (salinity, temperature, seagrass, wave activity, etc.) that contributes to manatee use (or lack of) the study area.

Keywords: Manatee, habitat use, energy industry, movement, seagrass

Louisiana Marine Mammal and Sea Turtle Rescue Program

Smith, Suzanne, Audubon Nature Institute, 14001 River Rd, New Orleans, LA 70131, 504-235-3005, ssmith@audubon· institute.org
Co-investigators: Dr. Elsburgh "Tres" Clarke; Dr. Robert MacLean
Website: www.audubonoinstitute.com

Project Description
We are a rehabilitation facility, and also provide infrastructure and personnel for marine mammal necropsies.

Focal species
All Gulf of Mexico marine mammals

Abundance and site fidelity of dolphins in Mississippi Sound and adjacent waters

Solangi, Moby, Ph.D., IMMS, 10801 Dolphin Lane, Gulfport, MS 39503, 228-896-9182, solangim@aol.com
Co-investigators: Dr. Jonathon Pitchford, Dr. Eric Pulis, Dr. Andy Coleman
Duration of Project: 2002 - continuing
Website: www.imms.org

Project Description
The project is a multiyear study in the Mississippi Sound and adjacent waters to study population trends and site fidelity of bottlenose dolphins. This involves boat transect surveys and photo ID work.

Keywords: Population dynamics, site fidelity, stock assessment

Focal species
All Gulf of Mexico marine mammals

Focal habitats
Bays/sounds/estuaries

Objectives
Anatomy/taxonomy
Behavior/behavioral ecology
Bioacoustics (hearing/communication)
Cognition
Conservation and management
Cumulative effects
Ecology
Epidemiology
Fisheries interactions/gear research
Foraging/diet
Genetics/genomics
Gulf oil spill effects
Habitat use/distribution
Health and health assessment
Life history
Noise effects
Parasitology
Population dynamics
Reproductive biology
Strandings
Toxicology

Bottlenose stranding response and research

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Co-investigators: Dr. Eric Pulis; Dr. Jonathon Pitchford; Dr. Delphine Shannon
Duration of Project: 1984 - continuing
Website: www.imms.org

Project Description
Respond to sick, injured, and dead bottlenose dolphins. Conduct necropsies. Rehabilitate and release sick injured dolphins, evaluate cause and effect relationships for mortality .

Keywords: Strandings, bottlenose dolphin, research, conservation, rehabilitation

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries

Objectives
Anatomy/taxonomy
Behavior/behavioral ecology
Bioacoustics (hearing/communication)
Cognition
Conservation and management
Cumulative effects
Ecology
Epidemiology
Fisheries interactions/gear research
Foraging/diet
Genetics/genomics
Gulf oil spill effects
Habitat use/distribution
Health and health assessment
Life history
Noise effects
Parasitology
Population dynamics
Reproductive biology
Strandings
Toxicology

Correlation of the Broadband Spectral Characteristics of Bottlenose Dolphin Signatures with Dolphin Behavior in the Mississippi Sound

Stanic, Steve, USM / Southern Acoustics, stanic@cableone.net
Co-investigators: Bob Brown; Mobashir Solangi; Ted Kennedy
Duration of Project: 06/01/2008 - 06/01/2009

Project Description
A series of acoustic measurements and visual observations were made of Bottlenose dolphins in the Mississippi Sound. A portable acoustic monitoring system recorded dolphin echolocation clicks, wideband burst pulses and narrowband frequency modulated whistles. The signal spectra were correlated with observations of dolphin behavior. The results showed that when these dolphins are diving and traveling, the primary signals are short echolocation clicks. During what appeared to be social interactions, the signals were more complex broadband amplitude modulated whistles. MTS/IEEE Proceedings of Oceans'09. Oct 2009.

Keywords: Acoustics, spectral signatures, behavior

Focal species
All Gulf of Mexico marine mammals
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Bioacoustics (hearing/communication)
Noise effects

Ambient Noise Measurements in the Mississippi Sound

Stanic, Steve, USM / Southern Acoustics, stanic@cableone.net
Co-investigators: L. Newcomb; M. Solangi; D. Vanderpool
Duration of Project: 06/01/2007 - 07/01/2008

Focal species
All Gulf of Mexico marine mammals

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Bioacoustics (hearing/communication)
Noise effects

Project Description
During the spring, summer, and fall of 2004, underwater ambient noise measurements were conducted in the Mississippi Sound. The Naval Research Laboratory, Stennis Space Center (NRL–Stennis) and the Institute for Marine Mammal Studies (IMMS) collaborated in acquiring acoustic ambient noise data at eight (8) sites in the Mississippi Sound. The sites were chosen to represent sites of expected high anthropomorphic noise sources and a control site with few or no expected anthropomorphic noise sources. (Research supported by IMMS) J. Newconb, S. Stanic, A. Cranford, D. Vanderpool, and M. Solangi, "Ambient Noise Measurements in the Mississippi Sound," NRL/MR/7185-08-9117, 2008.

Keywords: Acoustics, ambient noise

Ambient noise measurements in and around the Gulfport Mississippi harbor and its potential influence on marine mammals

Stanic, Steve, USM / Southern Acoustics, stanic@cableone.net
Co-investigators: Bob Brown, Ted Kennedy, Mobashir Solangi
Duration of Project: 06/01/2007 - 07/01/2008

Focal species
All Gulf of Mexico marine mammals

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Bioacoustics (hearing/communication)
Noise effects

Project Description
This report documents the results of a pilot study designed to determine the feasibility of monitoring bottlenose dolphin 24 hours a day, 7 days a week at the entrance to the Gulfport harbor. The primary task concentrated on the measurement, and analysis, of noise recorded in this area. These measurements also have the potential to correlate changes in ambient noise levels, with dolphin population numbers in these areas. It also documents the activity of dolphins during the evening and early morning hours. S. Stanic, R. Brown, E. Kennedy, D. Malley, and M, Solangi, "Ambient noise Measurements in and around the Gulfport Harbor and it Potential Influence on Marine Mammals," NRL/MR/ 184-07-9049, (2007).

Keywords: Acoustics, ambient noise

Florida Marine Mammal Rescue, Carcass Salvage, Necropsy

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Co-investigators: Martine de Wit, FWC; Andy Garrett, FWC; Kat Frisch, FWC
Duration of Project: 1985 - ongoing
Website: myfwc.com/research/manatee/

Project Description
The purposes of the FWC marine mammal (primarily manatees) carcass salvage and necropsy program are to characterize and record information to determine cause(s) of death and obtain information on morphology, life-history, and health. The statewide Florida program is a source of information used to determine and mitigate human-related causes of death and to investigate Unusual Mortality Events. FWC also receives calls from the public reporting marine mammals in distress. Field staff members respond to these calls and coordinate a network of personnel from various agencies and organizations to collaborate in conducting rescues and when necessary transport to rehabilitation facilities. FWC manages the Oceanaria Reimbursement Assistance Program for rescued, rehabilitated, and released Florida manatees. The Florida Legislature recently increased this program appropriation that helps support contracted and federally permitted manatee rehabilitation facilities in Florida in the care and treatment of sick, injured or orphaned Florida manatees.

Focal species
All Gulf of Mexico marine mammals
Manatee
Stranded marine mammals along Florida coast

Focal habitats
Rivers/inland waters
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Anatomy/taxonomy
Conservation and management
Foraging/diet
Genetics/genomics
Health and health assessment
Life history
Strandings

Keywords: Stranding, necropsy, and rescue

Manatee Aerial Surveys

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Co-investigators: Julien Martin, USGS; Holly Edwards, FWC
Duration of Project: 1985 - ongoing
Website: myfwc.com/research/manatee/projects/population-monitoring/

Project Description
FWC uses various survey designs to acquire information on manatee abundance, distribution, and habitat use.

Keywords: Aerial, survey, abundance, distribution, habitat

Focal species
Manatee

Focal habitats
Rivers/inland waters
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Gulf oil spill effects

Photo-Identification and Genetic Monitoring of Florida Manatees

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Co-investigator: Cathy Beck, USGS; Kari Rood, FWC; Mike Tringali, FWC
Duration of Project: 1980s - ongoing
Website: myfwc.com/research/manatee/projects/photo-identification/

Project Description
Manatee photo-identification in the Southeast U.S. is a multi-agency effort that includes USGS, FWC, and Mote Marine Lab (MML). A concerted photo-identification effort has been in place for decades. More recently, efforts from various institutions including USGS, UF, FWC, and MML were made to expand and refine the array of genetic tools for the Florida manatee. Individual identification allows monitoring of survival rates in capture-recapture and capture-recapture-recovery studies.

Keywords: Photo-identification, population, monitoring, genetics, survival rate

Focal species
Manatee

Focal habitats
Rivers/inland waters
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Conservation and management
Genetics/genomics
Life history
Population dynamics

Sarasota Dolphin Research Program

Wells, Randall, Chicago Zoological Society, c/o Mote Marine Lab, 1600 Ken Thompson Pkwy, Sarasota, FL 34242, 941-388-2705, rwells@mote.org
Co-investigators: Katherine McHugh; Jason Allen; Aaron Barleycorn
Duration of Project: 10/01/1970 - ongoing
Website: www.sarasotadolphin.org

Project Description
Long-term research on a resident population of bottlenose dolphins near Sarasota, Florida, initiated in 1970. Research examines biology, ecology, health and body condition, environmental contaminant concentrations, behavior and communication, natural history, life history, reproductive success, and human interactions. Research methods include photographic identification, health assessment, tagging and tracking, biopsy sampling, fish surveys, and focal animal behavioral observations. We also engage in the development and refinement of research techniques, such as telemetry. Research is focused in the multi-decadal, multi-generational, year-round resident Sarasota Bay dolphin community, which includes up to 5 concurrent generations of individuals up to 64 years of age, but also extends into surrounding bay, sound and estuary waters, as well as offshore in the Gulf of Mexico. The program also provides training opportunities in field and analytical techniques.

Keywords: Bottlenose dolphin, health assessment, tagging and tracking, photo-identification, environmental contaminants

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Bioacoustics (hearing/communication)
Conservation and management
Cumulative effects
Ecology
Ecosystem modeling
Energetics
Epidemiology
Fisheries interactions/gear research
Foraging/diet
Genetics/genomics
Gulf oil spill effects
Habitat use/distribution
Health and health assessment
Life history
Noise effects
Parasitology
Population dynamics
Reproductive biology
Strandings
Toxicology

Gulf of Mexico Dolphin Identification System (GoMDIS)

Wells, Randall, Chicago Zoological Society, c/o Mote Marine Lab, 1600 Ken Thompson Pkwy, Sarasota, FL 34242, 941-388-2705, rwells@mote.org
Co-investigators: Carolyn Cush, Chicago Zoological Society; Allison Honaker, Chicago Zoological Society; Jason Allen, Chicago Zoological Society
Duration of Project: 2011 - Ongoing
Website: www.sarasotadolphin.org

Project Description
We manage the collaborative Gulf-wide bottlenose dolphin photo-identification catalog. PIs of photo-ID projects around the Gulf use GoMDIS as a repository for ID catalog images and accompanying metadata. Through an online interface, catalogs are accessible to all researchers who contribute images, to facilitate across-site matches, and ensure that data are archived for future research.

Keywords: Bottlenose dolphin, photographic identification, ranging patterns, site fidelity

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Gulf oil spill effects
Habitat use/distribution
Population dynamics

Tagging and tracking of bottlenose dolphins in the Northern Gulf of Mexico

Wells, Randall, Chicago Zoological Society, c/o Mote Marine Lab, 1600 Ken Thompson Pkwy, Sarasota, FL 34242, 941-388-2705, rwells@mote.org
Co-investigators: Lori Schwacke, National Ocean Service; Teri Rowles, National Marine Fisheries Service; Eric Zolman, National Ocean Service
Duration of Project: 08/01/2011 - 04/01/2015
Website: www.sarasotadolphin.org

Project Description
As part of the NRDA investigation of the potential impacts of the Deepwater Horizon oil spill, the Sarasota Dolphin Research Program provided tagging and tracking services. Satellite-linked tags were attached to bottlenose dolphins in Barataria Bay in 2011, 2013, and 2014, and in the Mississippi Sound in 2013. Dolphins were tracked for up to 260 days each.

Keywords: Bottlenose dolphins, satellite-linked tags, tracking, ranging patterns, distribution and habitat use

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Gulf oil spill effects
Habitat use/distribution
Population dynamics

Enhancement of response, treatment and data collection from living and dead marine mammals stranded along the Texas coast

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Co-investigators: Sarah Piwetz and Dr. Richard Henderson, Texas Marine Mammal Stranding Network
Website: www.tmmsn.org

Project Description
The Texas Marine Mammal Stranding Network responds to an average of 150 stranded or injured marine mammal reports and conducts surveys for stranded marine mammals. Live stranded cetaceans are either euthanized or returned to designated rehabilitation facilities for assessment, treatment and release or placement. With enhanced diagnostic capabilities, live strandings receive targeted treatment and aid in determining initial cause of stranding. Using techniques of necropsy and clinical laboratory testing samples are collected and evaluated for use in assessing the incidence or prevalence of human induced injury or mortality and detection of emerging diseases.

Keywords: Stranding, rehabilitation, necropsy, disease

Focal species
All Gulf of Mexico marine mammals

Focal habitats
Texascoastal waters

Objectives
Conservation and management
Fisheries interaction/gear research
Gulf oil spill effects
Life history
Strandings

Towards a Gulf-wide Bird Monitoring Network: Identifying Objectives to Prioritize Action

Randy Wilson[1], John Tirpak[2], and Melanie Driscoll[3]
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Project Description
Birds are a conspicuous and remarkable natural resource of the Gulf of Mexico. Hundreds of species and millions of individual birds are supported by barrier islands, beaches, marshes, near-shore and offshore waters and coastal forests. Although many avian monitoring projects have been implemented, scientist and conservationist lack a comprehensive and coordinated approach to monitoring avian resources across the northern Gulf of Mexico. To address this need, an ambitious plan is being developed by a small consortium of researchers, managers, coordinators, and administrators representing a subset of state and federal agencies, NGOs, universities, and partnerships across the northern Gulf of Mexico. This group has been working to define a vision and process for developing the role of bird monitoring in achieving integrated, efficient, and effective Gulf of Mexico management and recovery. To date we have identified the goals, objectives, and metrics of success for the program through a Structured Decision Making approach, and now have a mostly completed SDM decision tool by which we can judge the appropriateness of proposed monitoring packages. Specifically, this integrated monitoring program will serve multiple goals, including monitoring long term responses to anthropogenic and natural drivers, detecting unpredicted changes in status and trends, and detecting response to conservation and management actions. The monitoring plan is expected to be long term in nature, taxonomically diverse in scope, and to cover the Gulf of Mexico from freshwater to pelagic zones. The team anticipates using identified objectives to (1) facilitate communication regarding avian monitoring needs; (2) guide develop of a comprehensive, coordinated monitoring strategy; and (3) utilize the objectives and value models to develop a prioritization tool to assist funding agencies.

Impacts of the 2010 Deep Water Horizon Oil Spill on Estuarine Bottlenose Dolphin Populations in the West Florida Panhandle

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Co-investigators: Randall Wells, Chicago Zoological Society; Steve Shippee, Marine Wildlife Rescue
Duration of Project: 09/01/2010 - 12/31/2011

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Behavior/behavioral ecology
Conservation and management
Ecology
Ecosystem modeling
Foraging/diet
Habitat use/distribution
Strandings

Project Description
Our UCF team in partnership with staff of the Florida Fish and Wildlife Research Institute (FWRI) and the Sarasota Dolphin Research Program (SDRP) at Mote Marine Laboratory provided a rapid response study to evaluate the local bottlenose dolphin status in this region. We expanded on previous research that had been conducted in Choctawhatchee Bay to incorporate the Pensacola Bay segment of the area, and conducted a comprehensive Mark-Recapture effort over an 18 month period to create a photo-id catalog of individual dolphins for estimating dolphin abundance, habitat use, site fidelity, grand scale movement, and foraging patterns. In addition, we collected remote dart-biopsy samples from free-swimming dolphins inhabiting discrete segments of the habitat in order to elucidate foraging dynamics and genetic structure. Collections of putative prey species allowed analyses to be made of nutritional characteristics that would lead to a predictive model of diet composition of the apex predators (e.g. dolphins) and therefore potential food chain effects on their health.

Keywords: Dolphin abundance, northwestern Florida Panhandle, stable isotope, putative prey, Choctawhatchee Bay

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Filling the gaps: Bottlenose dolphin population dynamics, structure, and connectivity in the Florida Panhandle

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Co-investigators: Christina Toms, University of Central Florida
Duration of Project: June 2013 - August 2016
Website: oceans4generations.wix.com/oceans4generations

Focal species
Bottlenose dolphin

Focal habitats
Bays/sounds/estuaries
Nearshore/coastal waters

Objectives
Conservation and management
Ecology
Foraging/diet
Genetics/genomics
Population dynamics

Project Description
The Florida Panhandle coastline has been exposed to numerous anthropogenic and ecological threats in the past few decades (e.g., chemical spills, pollution, infectious disease, and red tide events), including the Deep Water Horizon oil spill. This dissertation research focuses on the historically disturbed yet understudied Pensacola Bay area and neighboring systems. Project goals include (1) estimating survival, seasonal abundance, site-fidelity and residency patterns of bottlenose dolphin in the Pensacola Bay system using photo-ID mark-recapture methods over three years; and (2) evaluating fine-scale population structure, genetic diversity, and connectivity of dolphins between inshore and coastal waters in the Florida Panhandle (i.e., between Pensacola Bay, Choctawhatchee Bay, and a coastal zone); We are also evaluating and preparing to report on an outbreak of skin lesions associated with a record-breaking flood event in 2014.

Keywords: Abundance, residency, population genetics, population dynamics

Appendix C: Meeting Registrants

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